The Environmental Impact Assessment Report on the Baltica Offshore Wind Farm

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PRINCIPAL:

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Gdańsk, November 2017

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Contractor	**Maritime Institute in Gdańsk**
	MEWO S.A.
Subcontractors	**National Marine Fisheries Research Institute**
	DHI Polska Sp. z o.o.
	EKO-KONSULT Sp. z o.o.
	ENVIA Sp. z o.o.

Declaration

I, the Head of the Team, hereby certify that I comply with all the requirements stated in the Act of 3 October 2008 on the Provision of Information on the Environment and its Protection, Public Participation in Environmental Protection and Environmental Impact Assessments (Official Journal of the Laws of 2017, Item 1405, consolidated text) art. 74a § 2, and that I am aware of the of criminal liability for making a false statement.

Head of the Team

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Contents

Abbreviations and definitions

AIS	Automatic Identification System; all ships with gross tonnage of over 300 Mg are equipped with AIS. It provides automatic exchange of data, which helps to avoid collisions between ships and to identify ships for the coastal marine vessel traffic service
Applicant	The Baltica-2 Wind Farm LLC and Baltica-3 Wind Farm LLC
BACC II	Assessment of Climate Change for the Baltic Sea Basin II BALTEX
BBC	Big Bubble Curtain – underwater noise reduction system
Benthophagous diving birds	The species of waterbirds diving to the bottom of water bodies to feed on benthic organisms
BHD	Backhoe dredger – type of a dredger
BIAS or IBAS	Baltic International Acoustic Survey/International Baltic Acoustic Survey
BirdLife International	An international non-governmental organization working to protect birds and their habitats
BITS	Baltic International Trawl Surveys
BOD_5	Five-day biochemical oxygen demand
BSAP	Baltic Sea Action Plan a programme to restore the good ecological status of the Baltic Sea marine environment implemented by the States Parties to the Helsinki Convention
BŚII, BŚIII	Offshore wind farm “Polenergia Bałtyk II”, previously “Bałtyk Środkowy II”, Offshore wind farm “Polenergia Bałtyk III”, previously “Bałtyk Środkowy III”
CFCs	Chlorofluorocarbons
CIEP (Polish: *GIOŚ*)	Chief Inspectorate of Environmental Protection (Polish: *Główny Inspektorat Ochrony Środowiska*)
C-POD	Continuous Porpoise Detector
CSD	Cutter suction dredger – type of a dredger
Decision on environmental conditions	Decision on environmental conditions in accordance with the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (Journal of Laws of 2008, no. 199, item 1227 as amended)
DIN	Dissolved inorganic nitrogen
DIP	Phosphate phosphorus
DW	Dry weight

EC	European Commission
EEZ	Exclusive Economic Zone in accordance with the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws 1991 No. 32, item 131 as amended) (*Ustawa z dnia 21 marca 1991 r. o obszarach morskich Rzeczypospolitej Polskiej i administracji morskiej [Dz.U. 1991 Nr 32, poz. 131 z późn. zm.]*)
EGIA	Electricity grid installation area – the area on which electricity grid and teletechnical networks are allowed to be laid
EGMMIA	Electricity grid and measurement masts installation area – the area on which electricity grid and teletechnical networks as well as measurement masts are allowed to be installed
EIA	Environmental Impact Assessment
EIA Report	Environmental Impact Assessment Report in accordance with the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (Journal of Laws of 2008 no. 199, item 1227 as amended)
EMF	Electromagnetic field
EQR	Ecological Quality Ratio (non-quantified index that takes values in the range 0–1)
EU	European Union
FMC	Fisheries Monitoring Centre
GBS	Gravity-based structure
GD	Grab dredger – type of a dredger
GDEP	General Directorate of Environmental Protection
GES	Good Environmental Status, in accordance with MSFD
GMDSS	Global Maritime Distress and Safety System
Habituation	Getting used to the permanent occurrence of a given factor that does not pose a direct threat
HELCOM	Baltic Marine Environment Protection Commission – Helsinki Commission
HF	High frequency
HFCs	Hydrofluorocarbons
ICES	International Council for the Exploration of the Sea
ICES 25-26	ICES Subdivision 25-26

ICES 32 Ex GoR	ICES subdivision 32 excluding Gulf of Riga
Ichthyophagous birds	Species of birds feeding on fish
ICM UW	Interdisciplinary Centre for Mathematical and Computational Modelling University of Warsaw
IMO	International Maritime Organisation
IMWM-NRI	Institute of Meteorology and Water Management – National Research Institute
indiv.	individual/individuals
IUCN	International Union for Conservation of Nature
IUCN threat category	LC (least concern) – the least concern species (the species that do not meet the eligibility criteria for one of the threat or near threat categories, they include common, widespread species); NT (near threatened) – species close to being threatened (species close to the VU category, but not yet eligible); VU (vulnerable) – species likely to become endangered (species that may become extinct relatively soon, though not as soon as endangered)
LFI1	Large fish indicator – index of fish size in open waters
LUA	Limited use area
MARPOL 73/78	The International Convention for the Prevention of Pollution from Ships
Monitoring of Marine Habitats and Species	Monitoring of Marine Habitats and Species
Monitoring of Wintering Seabirds	Monitoring of Wintering Seabirds carried out by the Polish Society for the Protection of Birds on behalf of the Chief Inspector of Environmental Protection within the framework of the State Environment Monitoring Program
Moulting areas	Areas where birds gather (usually *Anseriformes*) to exchange feathers, including remiges
MSFD	Marine Strategy Framework Directive (Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (O.J. L 164, 25.6.2008 p.19 as amended)
MW	Megawatt
NM	Nautical mile
NMSS (Polish: *KSBM*)	National Maritime Security System (Polish: *Krajowy System Bezpieczeństwa Morskiego*)
NOAA	National Oceanic and Atmospheric Administration
NPS (Polish: *KSE*)	National Power System (Polish: *Krajowy System Elektroenergetyczny*)

NSDC	National Spatial Development Concept
Omnivores	Omnivorous bird species which prefer fish when at open sea, most often they pick discards produced during pre-treatment of fish on fishing boats
OSH (Polish: *BHP*)	Occupational Safety and Health (Polish: *Bezpieczeństwo i higiena pracy*)
OSPAR	The OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic or Oslo and Paris Commission
OWF	Offshore Wind Farm
OWF Area	The Baltica OWF Area
OWF Area (1 NM)	The Baltica Offshore Wind Farm Area together with the surrounding zone of at least 1 nautical mile width
OWF Area (2 NM)	The Baltica Offshore Wind Farm Area together with the surrounding zone of at least 2 nautical miles width
OWF's built-up area	The built-up area of the Offshore Wind Farm – an area where the construction of offshore wind power stations, power substations, residential and service platforms, measurement and research platforms (including measurement masts) as well as the installation of electricity grid and teletechnical networks is planned
PAHs	Polycyclic aromatic hydrocarbons
PAS (Polish: *PAN*)	Polish Academy of Sciences (Polish: *Polska Akademia Nauk*)
PCBs	Polychlorinated biphenyls
Phytobenthos	The communities of aquatic plants, including vascular plants and macroalgae
PMA (Polish: *POM*)	Polish Marine Areas (Polish: *Polskie Obszary Morskie*)
PMASMP	Polish Marine Areas Spatial Management Plan
POPs	Persistent organic pollutants
PORP (Polish: *PBPR*)	Pomeranian Office for Regional Planning (Polish: *Pomorskie Biuro Planowania Regionalnego*)
Project	The investment involving the construction of an offshore wind farm, in accordance with the permits for the construction and use of artificial islands, structures and devices issued by decisions no. MFW/4/12 and MFW/5/12 on 16 April 2012
PSE S.A.	Polskie Sieci Elektroenergetyczne Joint Stock Company
PSU	Practical salinity unit

PSZW	The permit for the construction and use of the artificial islands, installations and devices in the Polish maritime areas under the Act of 21 March 1991 on the Polish sea areas and the Maritime Administration (Journal of Laws of 1991 no. 32, item. 131, as amended) (Polish: *Pozwolenie na wznoszenie sztucznych wysp*)
PTS	Permanent Threshold Shift
PUWG 1992	State Geodesic Coordinate System 1992 (abbreviation from Polish: *Państwowy Układ Współrzędnych Geodezyjnych 1992*)
RCS	Radar Cross Section – the effective surface reflection of radar waves
RES	Renewable energy sources
ROV	Remotely Operated Vehicle
RP	The Republic of Poland (Polish: *Rzeczpospolita Polska*)
SAR	Search and Rescue (Maritime Search and Rescue Service; Polish: *Morska Służba Poszukiwania i Ratownictwa*)
SDF	Standard Data Form for the Natura 2000 sites
Seaducks	Ducks of the *Mergini* tribe
SEL	Sound exposure level
SEL_{cum}	Sound exposure level cumulated – the level of sound exposure accumulated over a period of one hour, e.g. from multiple blows of a pile driver
SM2M	An underwater sound recorder
SMP of the Pomeranian Voivodeship	Spatial Management Plan for the Pomeranian Voivodeship
SPEC	Species of European Conservation Concern – the rank of special concern, considering the category of threat and the species occurrence in Europe and in the world, given to bird species by BirdLife International
SPEC 2	Elevated Rank SPEC 2 (species whose global populations are concentrated in Europe with unfavourable conservation status in Europe)
SPEC 3	Elevated Rank SPEC 3 (species whose global populations are not concentrated in Europe but whose conservation status in Europe is unfavourable)
SPL	Sound Pressure Level
SSI	Species sensitivity index – an indicator of a given bird species' sensitivity to the impact of an offshore wind farm
STC	Sensitivity Time Control

subGES	The environment status is below good, according to MSFD
TBT	Tributyltin – organotin compound
Territorial sea	The maritime area of 12 nautical miles width (22,224 m) measured from the baseline of a sea
The Baltica 2 Area	Area covered by the decision of 16 April 2012 No. MFW/4/12 issued for Baltica 2 Offshore Wind Farm LCC with headquarters in Warsaw
The Baltica 3 Area	Area covered by the decision of 16 April 2012 No. MFW/5/12 issued for Baltica 3 Offshore Wind Farm LCC with headquarters in Warsaw
The EU Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (O.J. L 20, 21.1.2010, pp. 7–25)
The Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (O.J. L 206, 22.7.1992, pp. 7–50)
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TSHD	Trailing Suction Hopper Dredger – type of a dredging craft
TSP	"Typical species' presence" index
TTS	Temporary Threshold Shift
UMPL	Unified Model PL – numerical atmospheric model for Poland
UNCLOS	United Nations Conventions on the Law of the Sea
UTM33	Universal Transverse Mercator
VIEP (Polish: *WIOŚ*)	Voivodeship Inspectorate of Environmental Protection (Polish: *Wojewódzki Inspektorat Ochrony Środowiska*)
WFD	Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 23.10.2000, p. 1 as amended)
WGS 84	World Geodetic System 1984
Zoobenthos	Invertebrates that live both on the surface and inside seabed sediments

1 Preface

1.1 Introduction

This document is an Environmental Impact Assessment Report on the Baltica Offshore Wind Farm. The Applicants, who are planning the implementation of the Baltica OWF, are: Baltica-2 Wind Farm LLC and Baltica-3 Wind Farm LLC – special purpose entities of PGE Energia Odnawialna S.A. which is a subsidiary of the PGE Capital Group.

The planned undertaking is the Baltica Offshore Wind Farm with a maximum capacity of 2550 MW located in the maritime areas of the Republic of Poland, in the area of 268.2 km^2, at a distance of about 26 km from the sea shore (hereinafter: the Baltica OWF). The location of the planned undertaking has been presented in the figure (Figure 1). The planned project includes the construction, exploitation and decommissioning of the OWF, constituting the infrastructure for the production of electricity; it will consist of a maximum of 209 wind power stations, 418 km of cable routes, 21 power substations, 2 measurement and research platforms, and 2 residential and service platforms.

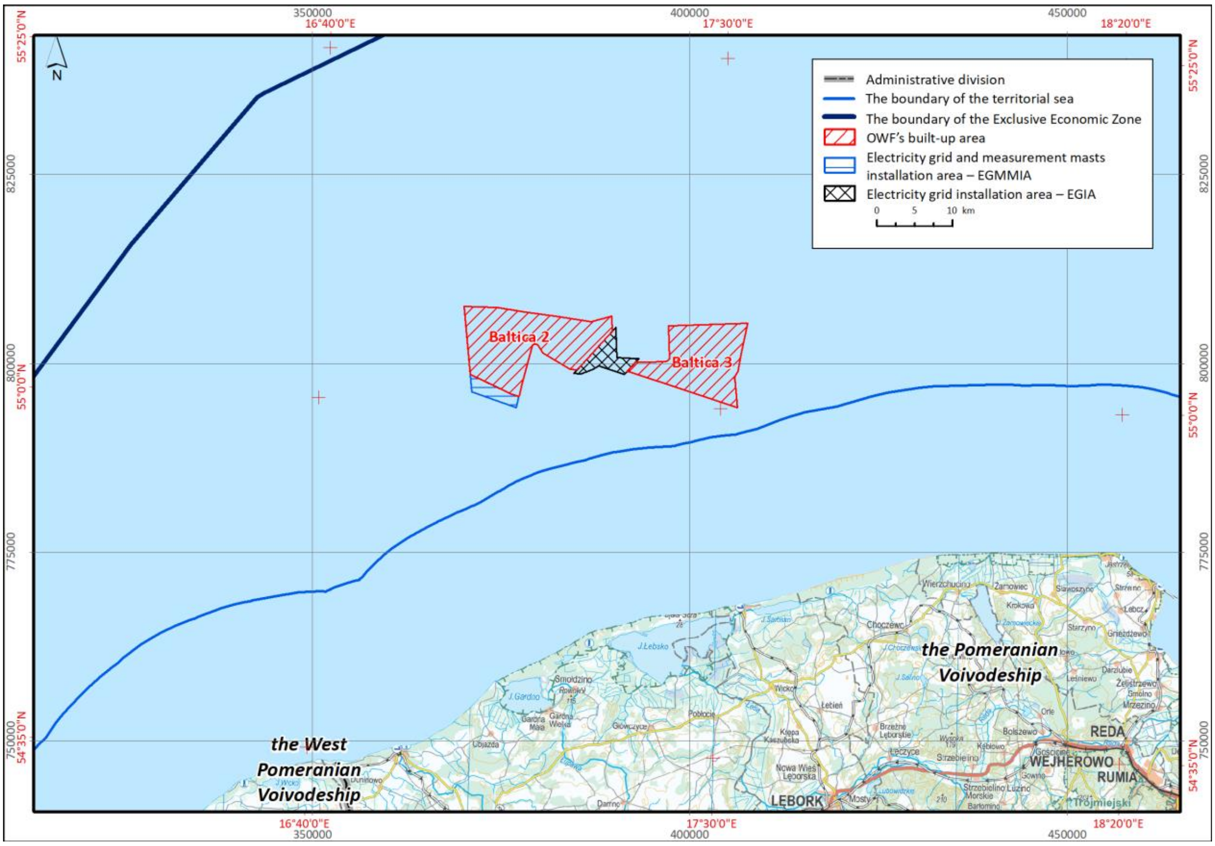


Figure 1. The location of the planned undertaking the Baltica Offshore Wind Farm

Source: internal data

Baltica-2 Wind Farm LLC and Baltica-3 Wind Farm LLC, have been issued with permits No. MFW/4/12 and No. MFW/5/12 of the Minister of Maritime Economy and Inland Navigation for construction and use of artificial islands, structures and devices in the Polish maritime areas for the complex of offshore wind farms with the maximum capacity of 2550 MW including their technical, measuring and research, and service infrastructure related to the preparation, implementation and exploitation stages. This Report on the environmental impact assessment applies to the Baltica Offshore Wind Farm, planned in the Baltica 2 Area and the Baltica 3 Area.

The investment, the Baltica OWF, is planned in three types of areas presented in the figure above (Figure 1):

1. The built-up area of the OWF – an area where the construction of offshore wind power stations, power substations, residential and service platforms, measurement and research platforms (including measurement masts) as well as the installation of electricity grid and teletechnical networks is planned (237.63 km^2);
2. The electricity grid installation area – EGIA – the area on which electricity grid and teletechnical networks are allowed to be laid (19.02 km^2);
3. The electricity grid and measurement masts installation area – EGMMIA – the area on which electricity grid and teletechnical networks as well as measurement masts are allowed to be installed (11.55 km^2).

Basic parameters of the planned Baltica OWF in the variant proposed by the Applicant have been summarised in the table below (Table 1).

Table 1. Basic parameters describing the Baltica OWF in the variant proposed by the Applicant

Name of the construction or parameter	The parameter's value
Maximum number of wind power stations [items]	209
Maximum number of offshore measurement and research stations [items]	2
Maximum number of offshore power substations (transformer, collective and/or conversion stations) [items]	21
Maximum number of offshore residential and service stations [items]	2
Maximum total number of foundations [items]	234
Maximum length of cable installation routes within the OWF [km]	418

Source: internal data

The Baltica OWF will be linked to the National Power System (NPS) by the connection line from the Baltica OWF to the Main Power Supply Point "Żarnowiec" in accordance with the terms of connection to the National Power System of 1045.5 MW obtained by the Applicant. The connection will be covered by a separate application for the decision on environmental conditions. The current conditions for connection to the National Power System in the amount of 1045.5 MW define the first stage of the OWF construction. The remaining capacity will be implemented in subsequent stages based on the connection conditions obtained.

The aim of the planned project is the generation of electricity using the renewable energy source – wind.

This Environmental Impact Assessment Report is an Appendix to the application for a decision on environmental conditions [in accordance with the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (consolidated text: Journal of Laws of 2016, item 353 as amended)]. According to Art. 75 paragraph 1 point c) the authority competent to issue a decision on environmental conditions for the planned project is the Regional Director for Environmental Protection in Gdańsk

The area of the planned project is not covered by the provisions of the spatial development plans.

The Director of the Maritime Office in Gdynia, the Director of the Maritime Office in Słupsk and the Director of the Maritime Office in Szczecin on 15 November 2013 made public the information about joining the planning process, the purpose of which is to draft a "Spatial Development Plan for Polish Marine Areas". The planning process includes the development of the "Study of conditions for the plan" and the "Spatial Development Plan for Polish Marine Areas". The plan's draft is currently under development.

This "Environmental Impact Assessment Report of the Baltica Offshore Wind Farm" has been elaborated by the Consortium of the Maritime Institute in Gdańsk and MEWO S.A. in cooperation with subcontractors (NMFRI, ENVIA Ltd., DHI Polska Ltd., EKO-KONSULT Ltd.).

1.2 The undertaking classification

According to the Regulation of the Council of Ministers of 9 November 2010 on types of projects likely to have significant effects on the environment (consolidated text: Journal of Laws of 2016, item 71), the planned project is classified as:

- able to always significantly affect the environment, in accordance with the paragraph 2 section 1 point:

  5) installations using wind energy for the production of electricity with a total nominal power capacity of the power station not smaller than 100 MW and located in the maritime areas of the Republic of Poland,
  6) power substations or overhead power lines with voltage rating not less than 220 kV, and lengths not shorter than 15 km;

- potentially able to significantly affect the environment, in accordance with the paragraph 3 section 1 point:

  7) power substations or overhead power lines with voltage rating not less than 110 kV, other than those mentioned in paragraph 2 section 1 point 6,
  59) airports other than those mentioned in paragraph 2 section 1 point 30 or landing pads, excluding landing pads of trauma centres, referred to in the Act of 8 September 2006 on State Emergency Medical Services (Journal of Laws of 2013, item 757, as amended), intended solely for the rescue helicopters.

Being classified as a project that may always significantly affect the environment means the obligation to obtain a decision on environmental conditions after an obligatory conduct of proceedings regarding the assessment of the project's environmental impact.

The environmental impact assessment of the planned project includes:

- verification of the Environmental Impact Assessment Report;
- obtaining opinions and agreements required by law;
- providing opportunities for public participation in proceedings.

The proceedings regarding the project's environmental impact assessment require the Regional Director for Environmental Protection in Gdańsk to provide the opportunity for public participation, including, among others:

- providing information to the public on, among others, the initiation of proceedings and proceeding to carry out an environmental impact assessment, as well as the possibility to study the documentation and the place of its presentation for inspection and the date, manner and place of submitting comments and requests, indicating the 30-day deadline for their submittance;

- consideration of the submitted comments and requests;
- providing in the justification of the decision the information on public participation and the manner and extent to which the comments and requests made in relation to public participation were taken into account;
- providing information to the public on the issued decision on environmental conditions and the possibility of studying its content and the documentation of the case.

Everyone has the right to submit comments and requests in proceedings requiring public participation; this applies also to environmental impact assessment procedures. Comments and requests may be submitted in writing, orally for the record or by means of electronic communication without the need to sign them with a qualified electronic signature.

1.3 Reasons for the implementation of the undertaking

The planned undertaking, the Baltica OWF, is an investment of the companies: The Baltica-2 Wind Farm LLC and Baltica-3 Wind Farm LLC – special purpose entities of PGE Energia Odnawialna S.A. which is a subsidiary of the PGE Capital Group and is one of the strategic options for the development of the PGE Capital Group after 2020.

In the first stage of the investment, the implementation of an OWF of 1045.5 MW is planned in accordance with the agreement for connection to the National Power System, signed with PSE S.A. in 2014. The next stage of the project, covering approximately 1500 MW, will depend on the possibility of connecting generation capacities to the National Power System.

An important premise for the investment is the ability to avoid emission of pollution into the atmosphere. With a conservative assumption of 40% capacity utilization and 25 years of exploitation an OWF with a capacity of 2550 MW can produce 223.38 TWh/804.168 PJ of electricity, which would avoid the emission of over 80 million tons of CO_2, over 1 million tons of SO_2, about 150,000 tons of nitrogen oxides and over 2 million tons of dust in lignite-fired power stations.

The above indicators for investment may be an element of Poland's compliance with international regulations at the global and regional level.

At the global level, the provisions of the **United Nations Framework Convention on Climate Change**, signed in 1992 in Rio de Janeiro (UNFCCC) (ratified by Poland in 1994), which aim to stabilize the concentration of greenhouse gases in the atmosphere at a level that does not cause dangerous interferences with the climate system, apply. In 1997, the regulatory mechanism of the Convention was adopted, so-called **Kyoto Protocol**, establishing a time frame for the reduction of greenhouse gas emissions. The protocol came into effect in 2005 and was ratified in Poland in 2002. In 2015, the **Paris Agreement** was established (UNFCCC, Paris Agreement), defining the goal of maintaining the global temperature increase to 2°C by the end of the 21st century. The agreement was adopted in October 2016, also in Poland.

Poland is obliged to fulfil the assumptions of the **European Union Climate and Energy Package** (European Commission, Climate Action) adopted in 2008, which introduces mechanisms leading to the achievement of the European Union goals in 2020 in the scope of the reduction of the greenhouse gas emissions:

- in the part concerning the share of renewable energy – 20% share;

- in the part concerning improvement of energy efficiency – 20%;
- in the part concerning the reduction of carbon dioxide emissions – by 20%.

The planned project involving the implementation of a renewable source of offshore electricity generation is part of the energy policy of Poland, contributing to the reduction of the negative impact on the environment and reducing greenhouse gas emissions from the energy sector. It is consistent with the EU climate and energy framework with forecasts until 2030 (the climate and energy package), whose main objectives are:

- reduction, in relation to the 1990 level, of greenhouse gas emissions by at least 40%;
- ensuring at least a 27% share of energy produced by renewable sources;
- improving energy efficiency by at least 27%.

The planned investment, through the production of energy from a renewable source and the simultaneous reduction of carbon dioxide emissions fits directly in two of the three objectives of the European Union in this respect.

These goals are also mentioned in the **EUROPE 2020 Strategy** (European Commission, Europe 2020 strategy) for employment and economic growth in the current decade.

1.4 Report's aim and scope

The Report on the Environmental Impact Assessment of the project has been prepared for the purpose of assessing the impact of the planned project on the environment with an aim of issuing a decision on environmental conditions.

The purpose of the report is to specify:

- the nature and scale of the project;
- possible variants of the project;
- environmental conditions, resources and values of abiotic, natural, cultural and landscape environments;
- the existing and planned use and development of marine areas;
- other conditions resulting, among other, from specific provisions, e.g. concerning the prevention of construction accidents or disasters;
- the nature, extent and significance of the expected environmental, spatial and social impacts related to the construction and exploitation of the Baltica OWF;
- the possibility of avoiding, preventing, limiting and possibly compensating for identified adverse project impacts or threats, including potential emergency situations;
- the need to formulate the recommendations to be applied in the design and preparation phase of the investment, its implementation and exploitation as well as decommissioning;
- the need to protect people and people's health and living conditions from negative impacts;
- proposals for environmental monitoring in all phases of the project.

The subject of the study is to analyse the impact of the planned Baltica OWF on the environment, compare the analysed variants of the planned project in terms of environmental protection and indicate the most favourable option for the environment.

The scope of the report results from the requirements set out in Art. 66 and contains information enabling the analysis of the criteria listed in Art. 62 of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (Table 2).

Table 2. The compliance of the report content with the provisions of Art. 62 paragraph 1 and Art. 66 of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment

Provision of the Act	Section in the report
Art. 62 paragraph 1	
Identification, analysis and assessment of the direct and indirect impact of the undertaking on the environment	6
Identification, analysis and assessment of the direct and indirect impact of the undertaking on the population, including people's health and living conditions	6.1.1.8; 6.1.2.9; 6.1.4.9; 6.2.1.8; 6.2.2.9; 6.2.4.8
Identification, analysis and assessment of the direct and indirect impact of the undertaking on material assets	6.1.1.6; 6.1.2.7; 6.1.4.7; 6.2.1.6; 6.2.2.7; 6.2.4.6
Identification, analysis and assessment of the direct and indirect impact of the undertaking on historical monuments	6.1.1.5; 6.1.2.6; 6.1.4.6; 6.2.1.5; 6.2.2.6; 6.2.4.5
Identification, analysis and assessment of the direct and indirect impact of the undertaking on landscape including cultural landscape	6.1.1.7; 6.1.2.8; 6.1.4.8; 6.2.1.7; 6.2.2.8; 6.2.4.7
Identification, analysis and assessment of the direct and indirect impact of the undertaking on the mutual interactions between the elements referred to above	6
Identification, analysis and assessment of the direct and indirect impact of the undertaking on accessibility of mineral deposits	6.1.1.1; 6.1.2.1; 6.1.4.1; 6.2.1.1; 6.2.2.1; 6.2.4.1
Identification, analysis and assessment of the risk of natural and construction disasters and major accidents	2.5.8
Identification, analysis and assessment of the possibilities and ways of preventing and reducing the negative impact of the project on the environment	11
Identification, analysis and assessment of the required monitoring range	12
Art. 66 paragraph 1	
The description of the planned project, including:	2
a) the characteristics of the entire undertaking and the conditions of the land use during the construction and exploitation or use phases	2.4
b) the main characteristics of production processes	2.2
c) predicted types and quantities of emissions, including waste, resulting from the operation of the planned project	2.4
d) information on biodiversity, the use of natural resources, including soil, water and the earth's surface	3.2.3; 3.7.4;
e) the information on energy demand and its consumption	2.4.6
f) the information on demolition work concerning projects that may significantly affect the environment	2.4.5
g) the risk of major natural or constructional accidents and disasters, evaluated on the basis of scientific knowledge, taking into account the substances and technologies used, including risk related to climate change	2.5.8
The description of the natural elements of the environment falling within the scope of the anticipated impact of the planned project on the environment, including:	3
a) the elements of the environment protected under the Act of 16 April 2004 on nature protection and the ecological corridors within the meaning of this Act	3.7.2; 3.7.3
b) hydromorphological, physico-chemical, biological and chemical properties of water	3.3; 3.7.1
The results of the environmental inventory, which is understood as a set of field studies	Appendix 1

Provision of the Act	Section in the report
carried out for the purposes of characterising the elements of the natural environment, if it has been carried out, along with the description of the applied methodology	
The description of monuments protected under the provisions on the protection and care of historical monuments existing in the vicinity or in the immediate range of the planned project's impact	3.8
The description of the landscape in which the project is to be located	3.10
Information on connections with other projects, in particular the cumulative impact of projects being implemented, completed or planned, for which the decision on environmental conditions has been issued, located in the area where the project is planned, and in the area of the project's impact or whose impact falls within the area of impact of the planned project – to the extent to which their impact may lead to the cumulative impacts of the planned venture	7.2
The description of the envisaged environmental effects in the event of a failure to undertake the project, taking into account available environmental information and scientific knowledge	5
The description of variants taking into account the specific characteristics of the project or its impact, including:	2.3
a) variant proposed by the Applicant and the rational alternative variant	2.3.2; 9
b) rational variant most favourable for the environment – along with the justification for its choice	2.3.2; 9
The determination of the expected impact of the analysed variants on the environment, including the event of a serious industrial accident and natural and construction disaster, on the climate, including greenhouse gas emissions and impacts relevant to the adaptation to climate change, as well as the possible transboundary environmental impact	2.5; 8
The comparison of the impacts of the analysed variants on:	6.1; 6.2
a) people, plants, animals, fungi and natural habitats, water and air	6.1.1.8; 6.1.1.4.1; 6.1.1.2; 6.1.1.3; 6.2.1.4.1; 6.2.1.8; 6.2.1.2; 6.2.1.3
b) the earth's surface, including mass movements of the earth and landscape	6.1.1.1; 6.2.1.1
c) material assets	6.1.1.6; 6.2.1.6
d) historical monuments and cultural landscape, covered by the existing documentation, in particular a register or inventory of monuments	6.1.1.5; 6.2.1.5
e) forms of nature protection, referred to in Art. 6 paragraph 1 of the Nature Conservation Act of 16 April 2004, including the aims and the subject of protection in the Natura 2000 sites as well as the continuity of the ecological corridors connecting them	6.1.1.4.2; 6.1.1.4.2.1; 6.1.1.4.3; 6.2.1.4.2; 6.2.1.4.3; 6.2.1.4.4
f) elements listed in Art. 68 paragraph 2 point 2 b if they has been included in the environmental impact assessment report or if they are required by the competent authority	Not applicable
g) the interaction between the elements referred to in point a–f	6.1; 6.2
Justification of the variant proposed by the Applicant, including the information referred to in points 6 and 6a	2.3.2
The description of forecasting methods used by the Applicant and the description of the planned project's expected significant impacts on the environment, including direct, indirect, secondary, cumulative, short-, medium- and long-term, permanent and temporary environmental impact, resulting from:	1.8; 6
a) the project's existence	6.1; 6.2
b) the use of environmental resources	6.1; 6.2

Provision of the Act	Section in the report
c) emissions	6.1; 6.2
The description of the envisaged actions to avoid, prevent, limit or compensate environmentally for the negative impacts on the environment, in particular on the forms of nature protection, referred to in Art. 6 paragraph 1 of the Nature Conservation Act of 16 April 2004, including the aims and the subject of protection in the Natura 2000 site, as well as the continuity of the ecological corridors connecting them, together with an assessment of their effectiveness at the implementation, exploitation and decommissioning stages of the project respectively	11
If the planned project is related to the use of the installations, a comparison of the proposed technology with the technology meeting the requirements referred to in Art. 143 of the Act of 27 April 2001 – Environmental Protection Law	10
The reference to the environmental objectives resulting from strategic documents relevant to the implementation of the undertaking	1.6
The indication whether it is necessary, for the planned project, to establish a limited use area, referred to in the Act of 27 April 2001 – Environmental Protection Law, and to define the boundaries of such an area, the restrictions on the use of land, the technical requirements for buildings and ways of their employment; this does not apply to undertakings consisting in the construction or reconstruction of a road and projects consisting in the construction or reconstruction of a railway line or public use airport	13
The analysis of possible social conflicts related to the planned undertaking	14
Proposal for monitoring the impact of the planned project at the stage of is construction and exploitation or use, in particular on forms of nature protection, referred to in the Art. 6, paragraph 1 of the Act of 16 April 2004 on the nature conservation, including the objectives and the subject of protection of the Natura 2000 site, and the continuity of the wildlife corridors connecting them, as well as the information on the available results of other monitoring, which may be important for establishing responsibilities in this area.	12
Indication of difficulties resulting from technical shortcomings or gaps in contemporary knowledge encountered in the preparation of the report	15
Non-technical summary of the information contained in the report, for each element of the report	In the elaboration attached to the EIA Report
Signature of the author, and in the case when the report is written by the team of authors – the head of the team, including the name and surname as well as the date of the report	Before the list of Abbreviations and definitions
The author's statement, and in the case when the report is written by the team of authors – the head of the team, on meeting the requirements referred to in Art. 74a paragraph 2	Before the list of Abbreviations and definitions
Sources of information providing the basis for the report	17

Source: internal materials based on the Act (Journal of Laws of 2008, No. 199, item 1227)

1.5 The basis for the report

The basis for the report was:

- Applicant's documentation:
  - Permission for the construction and use of artificial islands, installations and structures in Polish marine areas for the project entitled "The Complex of Offshore Wind Farms with the maximum total power of 1500 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and exploitation stages" and for the project entitled "The Complex of Offshore Wind Farms with the maximum capacity of 1050 MW

together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and exploitation stages",
- Contract No. DS/MFW/2012/Baltica-3 for connection to the transmission network of the Baltica Offshore Wind Farm of 24 October 2014 together with Annex No. 1, concluded on 3 November 2015,
- Expertise – The Action Plan on Counteracting Threats and Contamination from Oil Spills, Maritime Institute in Gdańsk, MEWO S.A., Gdańsk 2017,
- Navigational Expertise, Maritime Institute in Gdańsk, MEWO S.A., Gdańsk 2017,
- Expert study on safety impact of surveys aimed at prospecting and extraction of seabed mineral resources, Maritime Institute in Gdańsk, MEWO S.A., Gdańsk 2017,
- Documentation containing the results of environmental surveys and environmental inventories carried out in the period from March 2016 to April 2017 for the purposes of this EIA Report (Appendix no. 1);

- strategic documents, programming and planning documents at the international, national, regional and local levels;
- applicable legal regulations, including:
  - The Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (henceforth: the EIA Act),
  - Directive 2009/147/EC of the European Parliament and of the Council of 13 December 20011 on the assessment of the effects of certain public and private projects on the environment (as amended by the Directive of 16 April 2014),
  - other international, EU and national regulations.

In addition, when preparing this EIA Report, the sources of information specified in the section 17 have been used, in particular reports on environmental impact or other documentation for projects being implemented, completed or planned, closest to the planned project, such as:

- Report on Environmental Impact Assessment of the Offshore Wind Farm Bałtyk Środkowy III (now Polenergia Bałtyk III);
- Report on Environmental Impact Assessment of the Offshore Wind Farm Bałtyk Środkowy II (now Polenergia Bałtyk II).

1.6 The findings of the strategic and planning documents

The main premises for the project's implementation have been presented in the section 1.3. They include increasing the share of energy from renewable sources and reducing the emission of harmful gases to the atmosphere. The following are other international and national documents whose provisions have an impact on the planned investment or whose provisions the planned investment implements.

1.6.1 International and EU documents

Baltic documents and initiatives

The Baltic region is characterized by long-term cooperation at the international level in such areas as development and spatial planning (VASAB), protection of the marine environment (HELCOM) or energy (BASREC). In 2009, the European Union Strategy for the Baltic Sea Region (EUSBSR) was adopted, being the first EU strategy at the intra-EU macro-regional level.

VASAB – an intergovernmental cooperation of the ministers of the Baltic Sea Region countries responsible for development and spatial planning. In their strategic document VASAB Long-Term Perspective for the Territorial Development of the Baltic Sea Region (2009) defines the development directions for the region in the 2030 perspective. One of them is to strengthen internal and external accessibility, and the development of offshore wind energy is indicated as a way to achieve the region's energy independence. No. 18 of the LTP points directly to the need to use the potential in PMA in the short time perspective (up to 2015). The planned investment is in line with the development directions of the Baltic Sea region suggested by VASAB.

Poland is a signatory to the **Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992** (Helsinki Convention). As part of the Helsinki Convention, the activities for the protection of the Baltic Sea are focused on the implementation of the Baltic Sea Action Plan (BSAP), adopted at the HELCOM ministerial meeting in 2007. BSAP assumes the achievement of good ecological status of the Baltic Sea by 2021 and sets the fields of action to achieve this. The overriding strategic goal of segment IV – Offshore activities is that maritime transport and economic activity are conducted in the Baltic Sea in a manner that is environmentally friendly. One of the priorities is the minimum risk from offshore constructions. The countries have agreed within the BSAP that they will follow appropriate procedures and make efforts to eliminate, reduce or redress the potential negative environmental impacts that may be caused by offshore constructions. At the ministerial conference in 2013 in Copenhagen, the **Recommendation 34E/1** concerning the conservation of important bird habitats and migratory routes in the Baltic Sea against negative effects of wind and wind waves energy production was adopted. The positive aspect of wind energy development in the context of climate change is emphasized in this document, recommending specific steps that may help to reduce the negative impact of investments on the environment. It should be emphasized that the planned investment will be implemented in accordance with the Recommendation 34E/1 HELCOM. The provisions of this recommendation concern mainly the actions of the States Parties to the Helsinki Convention and as such do not concern the planned investment, but the Applicant assumes the conducting of the investment in such a way as to avoid or minimize the impact of investments on the environment, in particular on important bird habitats and migration routes.

1.6.2 Documents at the national and regional level

The planned investment directly pursues the objectives described in the national and regional documents listed below. These objectives relate mainly to avoiding the emission of harmful gases, increasing the share of energy from RES in energy production and increasing the level of energy security.

National documents

The National Spatial Management Concept 2030 adopted by the Resolution No. 239 of the Council of Ministers on 13 December 2011 (M.P.2012.252). It is the main document regarding spatial development in the long-term perspective; it defines the objectives and directions of spatial development policy of the country. It takes into account the need to develop offshore wind farms to solve the problem of underinvesting in energy infrastructure and improve the country's energy security. The development of offshore wind energy will contribute to reducing CO_2 emissions in line with the European Union's agreements. The concept defines that wind energy will account for 45% of energy obtained from RES. The necessity to build new transmission lines together with the accompanying infrastructure, the necessity to take into account air corridors of bird migration and landscape protection as well as weather variability have been considered as the barriers to the development of renewable energy in Poland. According to the findings of NSDC 2030, the planned project is located in the development zone of dispersed renewable wind energy. At NSDC 2030, 6 goals have been set out to achieve the strategic goal. The planned project is part of the implementation of objective 5: "*Increasing the resilience of the spatial structure to natural hazards and loss of energy security and shaping spatial structures supporting the country's defensive capabilities".* One of the directions of the actions implementing this objective is "*increasing the use of renewable energy sources by building new capacities that will reduce losses related to energy transmission and increase energy security at the levels: national, regional and local.*" "*One of the elements of support for the diversification of energy sources, which also has positive effects on reducing CO_2 emissions, is increasing the production of energy from renewable sources. In Polish conditions, this type of sources with the greatest economic potential should include wind energy (…)". "It is planned that by 2020 at least 15% of final gross energy consumption will come from renewable energy sources".*

In the **Maritime Policy of the Republic of Poland until 2020** (with forecasts until 2030), adopted by the Council of Ministers on17 March 2015, it was specified that the real potential of offshore wind energy development in Poland, which may bring the greatest benefits for the Polish energy balance and the Polish economy, is 6 GW of installed capacity in offshore wind farms until 2030, of which 1 GW in 2020, and another 2 GW by 2025. The creation of conditions for the construction of offshore wind farms was defined as an action to improve energy security.

Polish Energy Policy until 2030, adopted by the Council of Ministers on 10 November 2009, is a binding government document defining the directions of the power system development, including the indication of sources of electricity supply. In the *Forecast of Fuel and Electricity Demand until 2030*, which constitutes Appendix 2 to the "Polish Energy Policy until 2030", the economic potential of wind energy resources in PMA has been estimated at 19 TWh a year.

In the **Polish Energy Policy until 2050** project (presented in August 2015) (version 0.6), offshore wind energy was mentioned in the "gas + RES" scenario as a desired direction for the development of RES technologies, but without indicating specific quantitative objectives. The necessity of developing smart power grids, enabling the integration of significant amounts of energy from renewable sources, including those located at sea has been indicated in the document as well as the actions related to offshore wind energy. The analysis of the conditions for the offshore wind energy development with an indication of economic benefits for the country and coastal regions, as well as the analysis of legal and systemic needs and solutions for generating energy from offshore wind farms has been accepted in it. A proposal for legislative changes and the development of a research and development program for connection infrastructure necessary for the development of offshore wind energy technology have also been proposed.

The **Strategy for Responsible Growth until 2020 (with forecasts until 2030)** also responds to the provisions of the Europe 2020 Strategy of EU. It has been specified there that the modernization of production sources and innovative solutions in the economy sector, together with the development of available capacity from renewable energy sources, will contribute to the reduction of greenhouse gas emissions. It has been concluded in the Strategy that RES are for the most part uncontrollable sources. Continuous subsidization of RES causes serious disturbances in the functioning of energy markets – leading to an increase in energy prices. Therefore, it has been identified as necessary, among others:

- to ensure the possibility of balancing and interoperability of RES with other sources (not subject to limitations from the forces of nature);
- the evolutionary change process.

The development of offshore wind energy is also included in the **Development Plan for Satisfying The Current and Future Electricity Demand for 2016–2025**, agreed by PSE with the President of Energy Regulatory Office on 15 January 2016. In the section on potential directions of the development of transmission networks ensuring reliability of the power system it has been indicated that analytical works in the field of the construction of offshore transmission networks and energy storage were being conducted.

The **National Program for the Development of Low-emission Economy** determines the need for greater diversification of the energy mix. The coast region has been defined as the main place for wind farms location. It has also been determined that modernization and extension of the national power system is required to meet the requirements of the RES market. It has been stated in the document that the maximum productivity of offshore wind farms in PMA is estimated at 12 GW of installed capacity and 48–56 TWh of energy per year. The real investment plans until 2030 are 6 GW. For the development of the offshore wind energy in Poland, as it has been defined in the document, it is necessary to:

- conduct analyses regarding the legitimacy of the development of the OWF in Poland;
- develop the offshore power networks.

The Polish Marine Areas Spatial Management Plan (PMASMP) is being prepared. The document, which is expected to be adopted by the end of 2021, should take into account the PSZW decisions issued before the commencement of works on PMASMP and other decisions (for example permits for laying cables or pipelines) in accordance with the assumptions for the preparation of this document presented by the maritime administration during the public consultation. Therefore, it should be stated that the planned investment will be part of the PMASMP's findings.

Regional documents

The **2020 Pomeranian Voivodeship Development Strategy** adopted by the Regional Council of the Pomeranian Voivodeship in Resolution No. 458/XXII/12 of 24 September 2012 is the basic strategic document setting out the directions of development of the Pomeranian Voivodeship. The Strategy sets three strategic goals: Modern Economy, Active Citizens and Attractive Space. They are specified within 10 operational objectives and 35 directions of activities. The planned project contributes to the implementation of the operational objective 3.2. Safety and energy efficiency through the use of the marine areas' potential for the development of renewable energy. The Pomeranian Voivodeship has been presented as strongly dependent on external energy supplies. The development of this sector may result in the creation of numerous jobs. Regional Strategic Program for energy and environment **Eco-efficient Pomerania** (2013) recognizes the development of low-emission energy sources as one of the priorities.

The **Spatial Management Plan for the Pomeranian Voivodeship 2030** was adopted by resolution No. 318/XXX/16 of the Regional Council of the Pomeranian Voivodeship of 29 December 2016. In the field of spatial policy, the focus is, among others, on the growth of electricity production and transformation of the region into the national leader in renewable energy production. Among the activities and undertakings of spatial policy listed in the 2030 SMP of the Pomeranian Voivodeship are among others: "…the construction of transmission and distribution systems as well as power stations for power evacuation from the new and renewable energy sources systems (wind farms, including offshore…) (…) the extension of 400/110 kV substation Żarnowiec for the possibility of connecting the offshore wind farms to the NPS…". The vision of spatial transformation of the region is outlined in the 2030 SMP of the Pomeranian Voivodeship. One of the elements of the vision is an assumption that as a result of the installation within the voivodeship large capacity nuclear and coal power station as well as offshore wind farms and due to the development of distributed energy, the energy security of Northern Poland will improve, and the voivodeship will become self-sufficient in energy. It has been pointed out that in ports in Łeba, Ustka and Władysławowo, shipbuilding areas should be activated for projects related to the development of marine areas (e.g. logistics centre, service and maintenance of offshore wind farms).

1.6.3 Summary of the findings of the strategic and planning documents

The planned project is in line with the expectations of many policies and strategies, in particular regarding environmental protection (reduction of pollution emissions), balanced development (the use of renewable energy sources) and energy security (independence from external energy sources). **In no case does the planned investment contradicts the environmental objectives of the analysed strategic and planning documents.**

1.7 Information on the links between the Baltica OWF and other projects

In the immediate vicinity of the investment, there are other offshore wind farms planned to be launched. Currently, three decisions on the construction and use of artificial islands, structures and equipment in PMA adjoining the Baltica OWF remain in force (Figure 2):

- BŚII – decision no. MFW/2a/13 (west of the Baltica 2 Area);
- BŚIII – decision no. MFW/2a/12 (south of the Baltica 3 Area);
- Baltic Power – decision no. MFW/6/12 (east of the Baltica 3 Area).

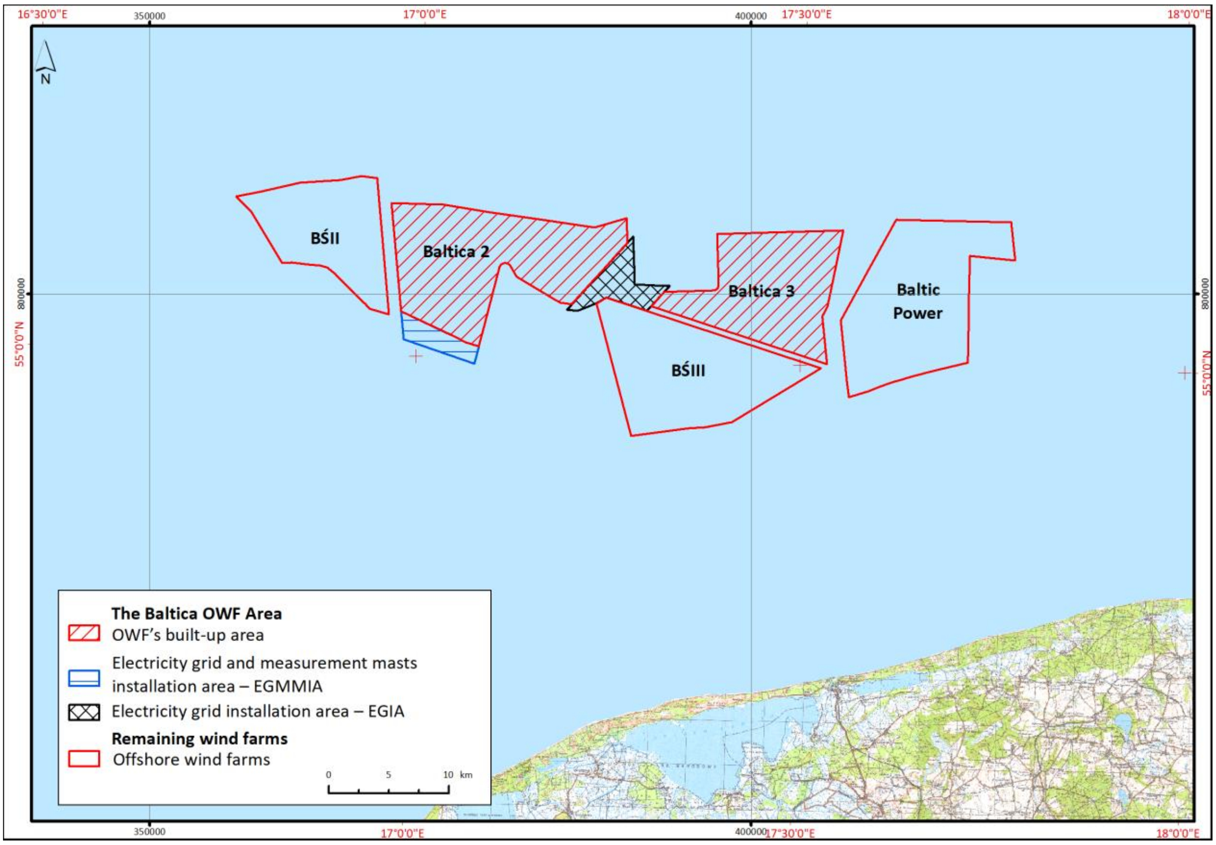


Figure 2. The location of other planned OWFs in the direct vicinity of the Baltica OWF

Source: internal data

In 2016, the Ministry of Maritime Economy and Inland Navigation suspended further issuance of permits until the adoption of the PMASMP. One more area located in the immediate vicinity of the Baltica 2 Area (south of it) has been presented in an application to the PMASMP.

The establishment of wind farms results in the development of linear infrastructure. The construction of offshore connection infrastructure is planned in the immediate vicinity of the investment site, thanks to which it will be possible to transfer electricity generated by offshore wind farms to the National Power System (mainly power cables but also telecommunication and teletechnical cables). For the purposes of the Baltica OWF, the construction of off- and onshore infrastructure for connection to the Żarnowiec substation is planned south of the farm area. In 2014, PSE S.A. concluded an agreement with the Baltica-3 Wind Farm LLC for connection to the transmission network. Still in force are also the permits for laying and maintaining subsea cables and pipelines for:

- the external connection infrastructure of the BŚII and BŚIII OWFs (decisions: MFWK/1/13–19.07.2013 – Ministry of Transport, Construction and Maritime Economy; no. 4/14 – DUM Słupsk);
- the external connection infrastructure of the FEW Baltic II (decisions: MFWK/1/15 – Ministry of Transport, Construction and Maritime Economy; no. 1/15 – DUM Słupsk);
- offshore electricity transmission infrastructure – eastern part – (MIP-E) (DUM 4/14).

1.8 Methodology for the planned project's impact assessment

In preparing this EIA Report, the results of the environmental surveys and inventories carried out for the Baltica OWF in the years 2016–2017 have been used. The scope of work also included the results of information meetings, which served to specify the issues of public interest and to prepare a part of the report devoted to the analysis of possible social conflicts.

The works have been carried out in accordance with the scheme for the preparation of the report on the project's environmental impact assessment taking into account:

- the use of information from environmental surveys and inventories;
- the basic findings of the program and planning documents of the international, national and regional level, as well as the results of environmental impact forecasts for these documents related to the planned project;
- the investment's concept, including the definition of activities at the stages of construction, overlapping construction and exploitation, exploitation and decommissioning, together with the identification of threats to the environment and their potential effects;
- the results of information meetings.

When preparing the EIA Report, the following have been used mainly:

- guidelines, textbooks and other materials on the preparation of the EIA Report;
- the authors' experiences and good practices.

The EIA Report includes four stages of the planned project:

- construction;
- exploitation;
- construction and exploitation (overlapping for a few years);
- decommissioning.

The purpose of the elaboration of the EIA Report is to determine the potential impacts of the planned project on the environment. The assessment is analytical and study work carried out by a team of specialists. While preparing the EIA Report, the analyses of descriptive and cartographic materials, general assessment methodology and expert assessment methods as well as the interpretation of the results of the conducted surveys and inventories have been used.

When preparing the Report, the following have been analysed mainly:

- technical and technological aspects of the planned project affecting the impact’s size;
- environmental, spatial and social determinants of the planned project;
- options for variants (location, technical, technological, organizational and logistics);
- the size and significance of potential environmental impacts;
- the possibility to avoid and reduce adverse environmental impacts;
- the scope of monitoring.

In the EIA Report, the planned project has been analysed in terms of the techniques and technologies used as well as the operating conditions. Among other things, information contained in the documentation of the planned project has been used and the potential impact of similar activities that could accumulate has been analysed.

On the basis of available data as well as environmental surveys and inventories, the significant environmental, spatial and social determinants have been defined. On this basis, the potential impacts and threats related to the planned project have been identified. The scope and range of the anticipated environmental impact have also been determined. Comparisons have been made with similar cases, in terms of environmental conditions and the size and nature of impacts.

The approach used to assess the scale and significance of impacts has arisen from the authors’ experience gained during the environmental impact assessments of projects planned for implementation in marine areas, including offshore wind farms.

The adopted approach makes it possible to indicate comprehensive actions aimed at avoiding, preventing, limiting or compensating the negative impacts associated with the planned undertaking.

A diagram of the EIA Report elaboration method in relation to the data on the planned project and the conducted environmental surveys and inventories has been presented in the figure (Figure 3).

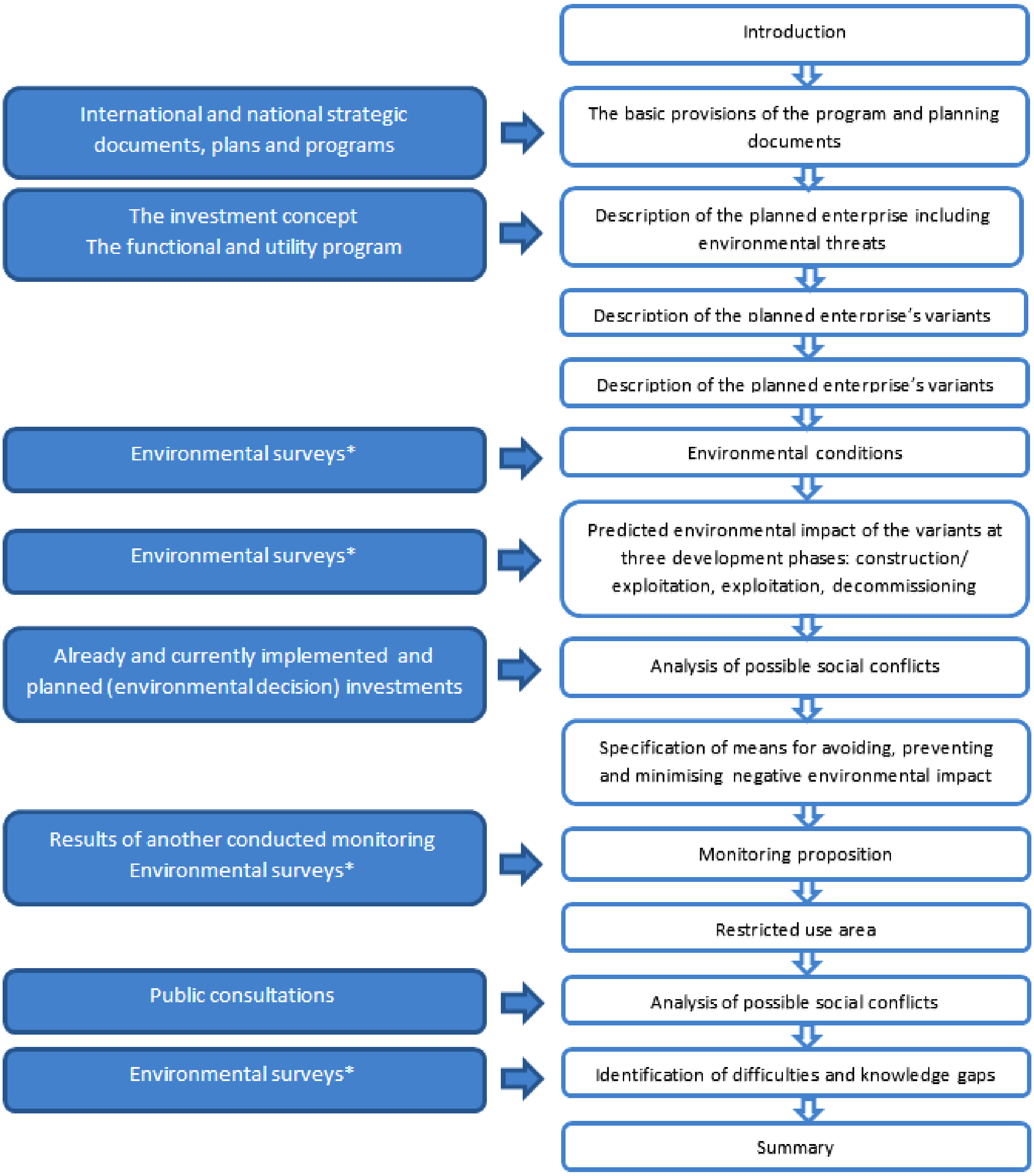


Figure 3. Overall scheme for the Environmental Impact Assessment Report elaboration

**Environmental surveys mean that in the Environmental Impact Assessment Report for the planned project both environmental surveys and inventories carried out for the purposes of this study have been used, as well as the results of other surveys, e.g. for projects closest to the planned project, in connection with the preparation of documents such as protection plans for conservation areas resulting from environmental monitoring or monitoring/surveys carried out in connection with other activities or projects, available to the public or in the literature*

Source: internal data

The methods of the marine environment surveys that have been carried out for the purposes of the EIA Report preparation have been presented in the table (Table 3).

Table 3. Methods of marine environment elements/components surveying

Type of surveys	Time of field studies	Range	Methods
Geophysical	04.2016 – 05.2017	OWF Area (1 NM)	The measurements have been carried out along the same profiles, spaced every 90 m: • bathymetric measurements have been carried out using a multi-beam echosounder; • sonar measurements have been carried out with side-scan sonar; digital data has been stored in the Coda GeoSurvey data acquisition and processing system; • magnetometric measurements (measurements of magnetic anomalies) have been carried out with caesium magnetometer; • seismoacoustic and seismic measurements have been carried out using two sediment profilers operating at different frequencies (high and low). Later the analysis of the material collected during magnetometric, bathymetric and sonar measurements as well as video inspections of selected objects (using a remotely controlled ROV vehicle) have been carried out. Also, the core sample collection has been conducted in an evenly distributed measuring grid with an average density of 1 core sample per 3 km^2. The points of the core sample collection have been determined on the basis of the data obtained from shallow seismoacoustic surveys and based on the analysis of the bathymetric map and the sonar mosaic.
Hydrometeorological (including sea currents)	03.2016 – 04.2017	OWF Area	The measurements have been carried out using two sets of measurement buoys for measuring meteorological conditions and four sets for demersal measurements of physical parameters (two directly under the buoys and two in places of the shallowest areas of the OWF). Measuring sets recorded the following elements: wind (velocities and directions), atmospheric pressure, temperature and humidity of air, wave motion (heights, periods and directions), sea levels and sea currents (velocities and directions, recorded in the following layers: surface, central and bottom). Measurements have been carried out at hourly intervals. Meteorological stations have been located about 4 m above the free surface of the sea.
Hydrological	04.2016 – 01.2017 water samples collection;03. 2016 – 04.2017 measurement s using measuring sets	OWF Area (1 NM)	Samples of surface water, bottom water and vertical profiles have been collected on 101 survey stations, and afterwards subjected to laboratory analysis. Physico-chemical analyses of the tested indicators have been conducted in accordance with the reference methods (or equivalent) specified in Appendix 7 to the Regulation of the Minister of the Environment of 19 July 2016 regarding the forms and methods of executing the monitoring of uniform parts of surface and underground waters (Journal of Laws of 2016, item 1178) The turbidity, salinity and water temperature have been recorded using the measuring sets. The measurements

Type of surveys	Time of field studies	Range	Methods
			have been carried out for a year, at hourly intervals. The measuring sensors have been placed at the depth of: 1 m, 4 m, 8 m, 16 m and above the seabed. In addition, the measurements of turbidity, salinity and temperature have been carried out in entire vertical profiles during water and sediment sampling as well as during the maintenance work of measuring sets.
Geochemical	06–10.2016; 01–05. 2017	OWF Area (1 NM)	At 488 survey stations distributed in a uniform grid, samples of seabed sediments have been collected, which have been subjected to laboratory analyses, carried out on the basis of PN-EN-ISO standards or, in the absence thereof, in accordance with survey procedures developed by the accredited laboratory of the Maritime Institute in Gdańsk Environmental Protection Department.
Biological (phytobenthos)	06–08.2016	OWF Area (1 NM)	The surveys have been carried out in a rocky bottom area. The tests included underwater video inspection on 25 transects (medium length 111 m) and sampling using a stone grab mounted on a ROV vehicle. Film documentation analysis and laboratory analysis of samples have been carried out.
Biological (zoobenthos)	05–07.2016	OWF Area (1 NM)	The surveys included sampling at 501 stations, including 402 on the soft seabed and 99 on the hard seabed, with the help of specialist equipment suitable for both soft and hard seabed. Afterwards, laboratory analyses have been carried out.
Biological (ichthyofauna)	03.2016 – 01.2017	OWF Area (1 NM)	Acoustic survey – scientific echo sounder. Pelagic fish catch – pelagic trawl. Ichthyoplankton catch – Bongo net. Demersal fish catch – sets of survey nets.
Biological (marine mammals)	03.2016 – 04.2017	OWF Area (1 NM)	Passive acoustic monitoring of porpoises using 10 C-POD devices spaced evenly within the OWF Area. Background noise measured using 2 (3) acoustic recorders. Aerial surveys have been carried out by qualified observers along 10 transects (altogether 7 aerial surveys have been conducted).
Biological (migratory birds)	03–05.2016; 07–11.2016; 03.2017	OWF Area (2 NM)	Visual observations, acoustic recordings, vertical and horizontal radar measurements have been carried out. The tests have been performed at 3 stations simultaneously for over 40 days. The stations were ships always anchored at the same position, evenly distributed within the OWF Area. Acoustic recordings and radar measurements have been recorded in a continuous mode. Flight route tracking and visual observations have only been carried out during the day.
Biological (seabirds)	03.2016 – 03.2017	OWF Area (2 NM) and the Słupsk Bank area	Examinations along the delineated transects have been performed 23 times. Counting all birds on the water and birds sitting on the water only within the transect zone (300 m from one side of the ship). Counting birds in flight – all birds and birds within the transect belt at a given moment, using the so-called “snap shot” technique.
Biological (bats)	05.2016 08–09.2016 04–05.2017	OWF Area (2 NM)	The surveys on bats’ activity in the OWF Area have been carried out during the spring and autumn migrations for over 50 nights, in accordance with the adopted

Type of surveys	Time of field studies	Range	Methods
			methodology based on the project called "Guidelines for the assessment of impact of wind turbines on bats" developed by Polish specialists and practitioners commissioned by the GDEP in 2011 (Kepel et al. 2011). Bats' activity surveys have been carried out by a direct survey method recording acoustic signals during cruises with two ships along the delineated transect covering the entire OWF Area and at six monitoring points visited on rotation during the given migration season.

Source: internal data

A diagram of the methodology for the environmental impact assessment of the project has been presented in the figure (Figure 4).

The actions resulting from the implementation of the planned project in its particular phases, i.e. construction, exploitation and decommissioning, including the overlapping construction and exploitation phase, have been defined in the first stage of the assessment. On the basis of the environmental and inventory surveys, carried out for the purposes of the EIA Report, the environmental elements on which these activities may have an impact have also been specified. In the second stage of the assessment, based on the literature and experts' experience, the links between the sources of potential interactions and individual receptors have been identified.

The specified impacts have been assigned features in four categories:

- nature of impact (positive or negative);
- type of impact (direct, indirect, secondary/primary, cumulative, reversible, permanent);
- range of impact (local, regional) and determining if it is a transboundary impact;
- time range of impact (short-term, medium-term, long-term, permanent, temporary).

At the same time, the receptors' resistance to particular impacts in the cases of possible interaction between the action and the receptor has been established. Considering the assigned characteristics of impacts and the established resistance of receptors, the scale (magnitude) of impact, specific for particular relation between the impact and the receptor has been determined. The impacts have been described in a four-level scale (impact scale):

- negligible impact;
- low impact;
- medium impact;
- high impact.

Considering the prevalence or rarity of a given receptor, its importance and role in the environment, and especially its conservation status, individual receptors, considered an environmental resource, have been assigned a value (significance), specified in a three-point scale: low, medium or high.

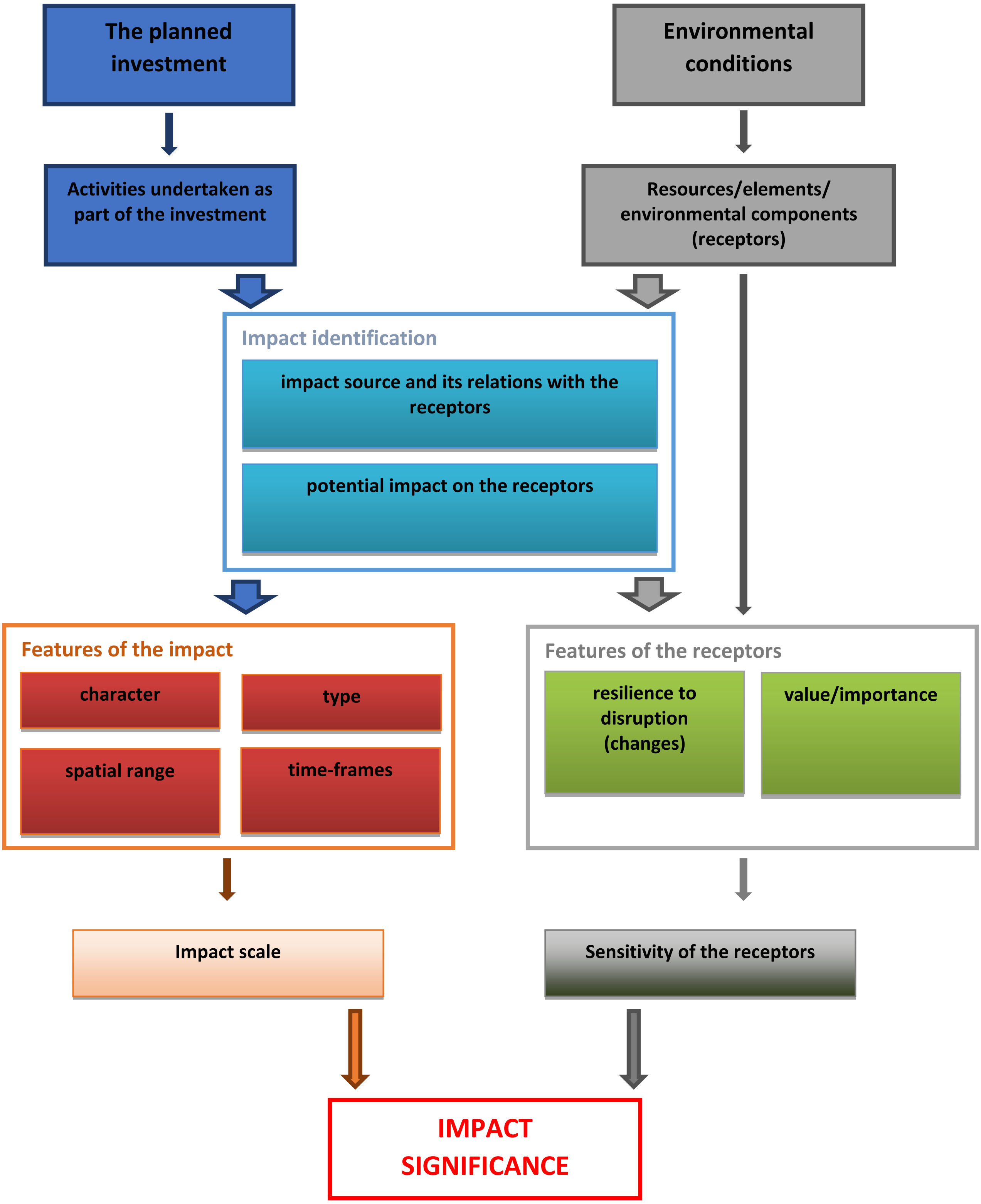


Figure 4. The diagram of the environmental impact identification and assessment together with the determination of the impact's significance

Source: internal data based on ESPOO REPORT (2017)

In the following stage of the assessment, taking into account the assigned impact scale and the value (significance) of the receptor, the significance of the impact has been determined also on the four-level scale (Table 4):

- irrelevant impact;
- insignificant impact;
- moderate impact;
- significant impact.

Table 4. The matrix defining the impact's significance in relation to the impact's scale and the value of the resource

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

In accordance with the environmental impact assessment methodology described above, a significant impact may occur when the scale of impact has been determined as medium and the value of the resource as high or in the case of a high impact and the medium or high value of the resource.

The definitions of concepts used in the process of the planned project's environmental impact assessment have been included in the table (Table 5). Due to their general nature, in some cases, particular concepts have been clarified in the detailed assessments in section 6, taking into account the specificity of both impacts, receptors and the relations between them. If good practices or generally accepted and applied methodologies indicate the need for other assessment and/or definition methodologies, they have been quoted directly in the place of their use. For elements for which there was more than one impact, the highest value of impact has been assumed, unless a different value of the impact's significance has been obtained from the analysis of the impacts' interactions.

Table 5. Definitions of terms used in the environmental impact assessment

Concept	**Definition**
Positive impact	The impact which improves the initial situation or introduces a new desired factor
Negative impact	The impact which causes an adverse change in relation to the initial situation or introduces a new undesirable factor
Direct impact	The impact resulting from a direct interaction between actions related to the planned project's implementation and the elements of environment
Indirect impact	The impact resulting from an indirect interaction between actions related to the planned project's implementation and the elements of environment
Secondary impact	The impact resulting from the interaction between the planned project's implementation and the elements of the environment, postponed in time, which may occur as a result of direct or indirect impact
Primary impact	The impact resulting from the implementation, exploitation or decommissioning of the planned project
Cumulative impact	The impact occurring in connection with impacts resulting from the current

Concept	Definition
	and/or planned other projects, concerning the same objects of influence
Short-term impact	The impact which is limited in time and its effects are noticeable for a relatively short period after the completion of the activity related to the planned undertaking; it lasts no longer than one year or one vegetative cycle after the end of the activity
Medium-term impact	The impact which is limited in time and its effects are noticeable either constantly or periodically for a specified period of time after the completion of the activity related to the planned undertaking; it lasts from over 1 year or one vegetative cycle up to 3 years or 3 vegetative cycles after the end of the activity
Long-term impact	The impact, the effects of which are noticeable either constantly or periodically for a long period of time after the completion of the activity related to the planned undertaking; it lasts for over 3 years or 3 vegetative cycles after the end of the activity; or an impact related to the exploitation phase, which will disappear with the end of the exploitation phase
Constant impact	The impact which will not subside after the conclusion of the activities related to the planned undertaking
Temporary impact	The impact which is limited in time (for example, for as long as specific activities related to the planned project are being carried out)
Reversible impact	The impact that ceases to be noticeable (measurable) when the activities related to the planned undertaking have been finished
Permanent impact	The impact, the effects of which will not disappear after the cessation of activities related to the planned undertaking, resources do not return to the initial state
Local impact	The impact that takes place in the close proximity of the activities related to the planned project
Regional impact	The impact that occurs on a regional scale extending beyond the immediate proximity of the activities related to the planned project, not extending beyond Polish maritime areas
Transboundary impact	The impact, the effects of which are felt outside Poland on the territory of other countries
High value of a resource	A resource of high importance for the functioning of the ecosystem, rare, covered by any conservation status
Medium value of a resource	A resource of medium importance for the functioning of the ecosystem, regardless of the conservation status
Low value of a resource	A resource of low importance for the functioning of the ecosystem, common, regardless of the conservation status

Source: internal data

2 Description of the planned project

2.1 General characteristics of the planned project

2.1.1 Subject and scope of the project

The subject of the proposed project is the construction of the Baltica Offshore Wind Farm with a total installed capacity not exceeding 2550 MW. Baltica-2 Offshore Wind Farm LLC and Baltica-3 Offshore Wind Farm LLC have been issued with permits (No. MFW/4/12 and No. MFW/5/12) of the Minister of Maritime Economy and Inland Navigation for construction and use of artificial islands, structures and devices in the PMA with the maximum capacity of 2550 MW including their technical, measuring and research, and service infrastructure related to the preparation, implementation and exploitation stages.

The entire investment will consist of the following elements:

- offshore wind power stations consisting of nacelles with rotors and towers anchored or set on foundations on the seabed or embedded in the seabed;
- cable installations of internal electricity grid and teletechnical networks;
- power substations;
- optionally, research and measurement platforms as well as residential and service platforms.

The detailed scope of the project's parameters for the Applicant's variant has been presented in the table (Table 6). The description of the variants considered in this document can be found in the section 2.3.

Table 6. List of the most important parameters in the Applicant's variant of the project

Parameter	Applicant's variant
Maximum installed capacity [MW]	2550
Maximum number of wind power stations [items]	209
The maximum diameter of the rotor [m]	220
Minimum clearance between the working area of the rotor and the water surface [m]	20
Maximum height [m]	250
Maximum number of additional constructions [items]	25
The maximum diameter of the gravity based structure [m]	40
Maximum area of the seabed occupied by the gravity based structure [m^2]	1257
Maximum area of the seabed occupied by the foundations [m^2]	262,713
Maximum length of cable installation routes within the OWF [km]	418

Source: internal data

The off- and onshore transmission infrastructure, which will be covered by a separate application for a decision on the environmental conditions of the project is not the subject of the application for issuing the decision on the environmental conditions of the project. It is connected with the lack of the location for the transmission infrastructure route to the substation in Żarnowiec and the fact that currently the Applicant has a connection agreement for only 1045.5 MW and there is a need to search for the possibility of connecting the rest of the power planned to be installed.

This EIA Report is based on the concept of an envelope description of the project. This is the result of the significant extension in time of the investment in offshore wind energy – the investment processes in the case of offshore wind farms last many years, often exceeding 10 years from the decision to begin preparations for the investment to the beginning of construction. During this time, the technologies used in offshore wind farms undergo significant changes, whose main direction is to reduce the environmental impact, by increasing the efficiency of a single wind power station in electricity generation and reducing their total number necessary to achieve the assumed power of the farm. The existing and currently used wind power stations (with capacity from 3.6 MW to 9.5 MW) in the perspective of the Baltica OWF's implementation and the commencement of the first construction phase after 2021 may not be available in production and for use. Thus, the parameters of the investment had to be described in such a way that it would allow in the future for taking advantage of technological progress and application of the solutions not worse than the ones existing at present.

The enveloping concept means that in the case of the evaluation of the chosen parameter and the possibility of applying different technical solutions, the environmental impact assessment has been carried out for the potentially most burdensome to the environment solution. It has been assumed that if the most burdensome solution would not have a significantly negative impact on the environment, the remaining solutions, which are less burdensome, would also be acceptable. An example of the enveloping approach to the assessment can be the assessment of the foundation laying impact. The gravity based structure installation requires great effort related to the transferring of the sediment and it is the most burdensome solution in this respect. The piling of a monopile will generate the greatest noise. In the enveloping concept of the assessment, it has been assumed that the assessment will take into account the amount of sediment moved in the case of using a gravity based structure and the underwater noise generated in the case of piling a monopile. This means that the environmental impact assessment of the technology most burdensome for the given environmental element has been carried out. It is unlikely that such impacts will occur simultaneously – if a gravity based structure is selected, the underwater noise will be much smaller, and if a monopile is selected, the sediment will be practically unmoved. This means that each applied foundation selection will lead to smaller impacts than the ones assumed in the EIA Report.

The main assumption of the applied envelope concept has been to determine what OWF's parameters are significant for the scale of its impact, and based on this determine the conditions for the implementation of the undertaking in decision on the environmental conditions as well as to ensure that its implementation will not cause significant environmental impact, regardless of the technology chosen ultimately, among the ones considered in this Report.

2.1.2 The location of the project and the occupied sea area

The Baltica-2 Offshore Wind Farm LLC and Baltica-3 Offshore Wind Farm LLC have been issued with PSZW for offshore wind farms with the maximum total capacity of 2550 MW including technical and research and measurement infrastructure. PSZW is a permit that grants the Applicant the right to use the Polish maritime area for the purposes specified in the permit, but is not a permit for the implementation of the investment. The Applicant will be required to obtain the necessary permits before the beginning of the implementation of the planned investment. The area covered by the PSZW has been shown in the figure (Figure 5). The figure also presents the area of the planned Baltica OWF investment consisting of:

1) the OWF's built-up area, where the construction of offshore wind power stations together with the infrastructure is planned – a total area of 237.63 km^2, the coordinates of which are presented in the table (Table 7);
2) Electricity grid and measurement masts installation area – EGMMIA – 11.55 km^2, the coordinates of which have been presented in the table (Table 8);
3) Electricity grid installation area – EGIA – 19.02 km^2, the coordinates of which have been presented in the table (Table 9).

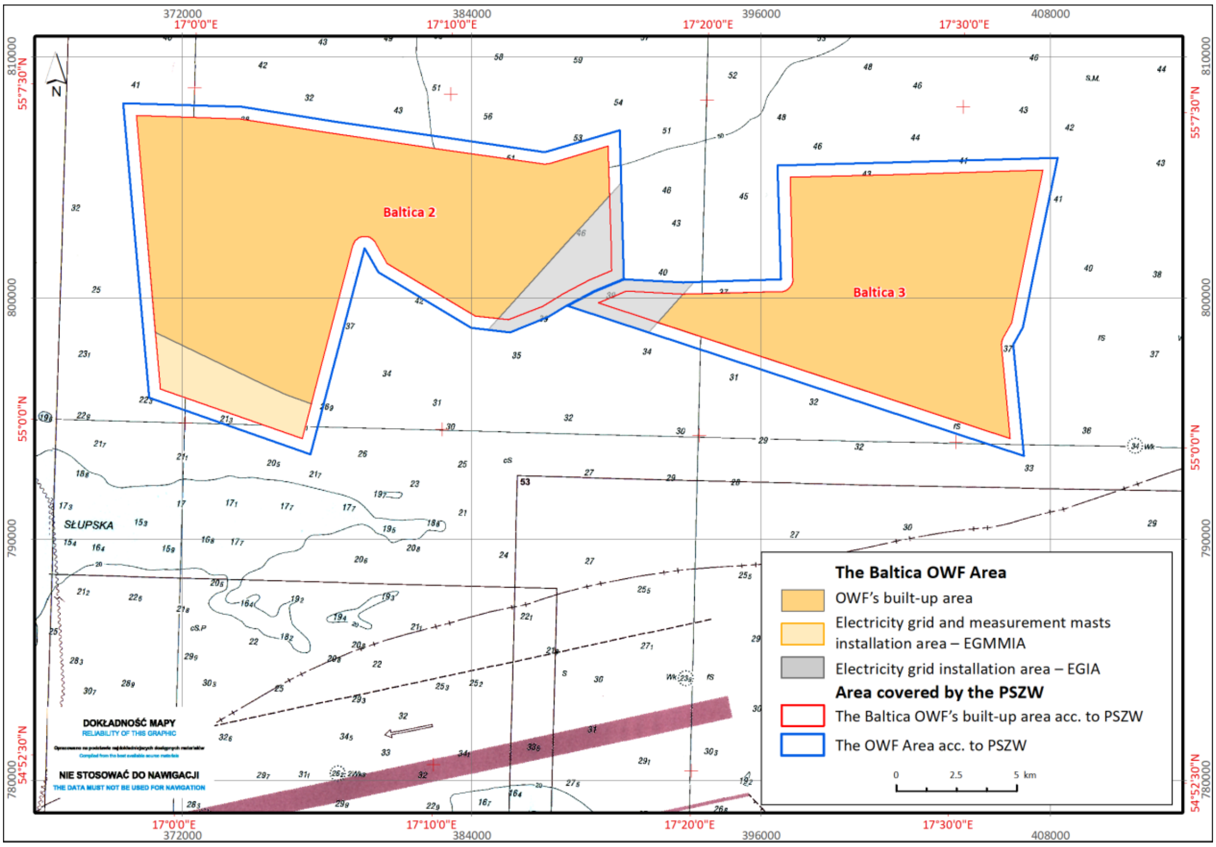


Figure 5. The location of the project in relation to the issued PSZW's decisions

Source: internal data

Table 7. OWF's built-up area coordinates

Point's no.	**PUWG 1992 [m]**		**UTM33 [m]**		**WGS 84 [DD°MM'SS.SSS"]**	
	X	**Y**	**X**		**Longitude**	**Latitude**
1	391975.93	798902.95	647533.40	6101863.74	17°18'32.221" E	55°02'29.961" N
2	391716.25	798988.48	647269.14	6101934.30	17°18'17.476" E	55°02'32.524" N
3	392774.12	800157.23	648258.85	6103162.18	17°19'15.484" E	55°03'11.155"N
4	393939.98	800190.48	649421.40	6103262.10	17°20'21.130" E	55°03'13.132" N
5	393946.37	800194.67	649427.55	6103266.65	17°20'21.485" E	55°03'13.272" N
6	396833.27	800272.98	652306.52	6103510.09	17°23'04.052" E	55°03'17.995" N
7	396851.72	800273.85	652324.90	6103512.01	17°23'05.090" E	55°03'18.036" N
8	396884.28	800277.06	652357.24	6103517.07	17°23'06.921" E	55°03'18.164" N
9	396916.57	800282.39	652389.18	6103524.24	17°23'08.733" E	55°03'18.361" N
10	396948.43	800289.82	652420.58	6103533.49	17°23'10.519" E	55°03'18.625" N
11	396979.74	800299.32	652451.31	6103544.77	17°23'12.271" E	55°03'18.956" N
12	397010.36	800310.84	652481.23	6103558.03	17°23'13.981" E	55°03'19.351" N
13	397040.17	800324.34	652510.23	6103573.23	17°23'15.643" E	55°03'19.811" N
14	397069.02	800339.77	652538.17	6103590.28	17°23'17.249" E	55°03'20.331" N
15	397096.81	800357.05	652564.93	6103609.13	17°23'18.792" E	55°03'20.911" N
16	397123.40	800376.10	652590.40	6103629.69	17°23'20.266" E	55°03'21.547" N
17	397148.69	800396.86	652614.48	6103651.87	17°23'21.665" E	55°03'22.237" N

Point's no.	PUWG 1992 [m]		UTM33 [m]		WGS 84 [DD°MM'SS.SSS"]	
	X	Y	X		Longitude	Latitude
18	397172.57	800419.23	652637.05	6103675.57	17°23'22.981" E	55°03'22.979" N
19	397194.94	800443.11	652658.02	6103700.71	17°23'24.211" E	55°03'23.768" N
20	397215.70	800468.40	652677.31	6103727.16	17°23'25.347" E	55°03'24.601" N
21	397234.76	800495.00	652694.82	6103754.81	17°23'26.387" E	55°03'25.476" N
22	397252.03	800522.78	652710.49	6103783.55	17°23'27.324" E	55°03'26.387" N
23	397267.46	800551.64	652724.24	6103813.26	17°23'28.156" E	55°03'27.332" N
24	397280.96	800581.44	652736.03	6103843.80	17°23'28.878" E	55°03'28.306" N
25	397292.49	800612.06	652745.78	6103875.04	17°23'29.488" E	55°03'29.306" N
26	397301.98	800643.37	652753.48	6103906.86	17°23'29.983" E	55°03'30.325" N
27	397309.41	800675.24	652759.08	6103939.11	17°23'30.360" E	55°03'31.362" N
28	397314.74	800707.52	652762.55	6103971.66	17°23'30.619" E	55°03'32.410" N
29	397317.95	800740.08	652763.89	6104004.37	17°23'30.757" E	55°03'33.466" N
30	397318.82	800786.98	652762.08	6104051.27	17°23'30.745" E	55°03'34.984" N
31	397198.99	805003.60	652401.01	6108256.03	17°23'18.511" E	55°05'51.292" N
32	401486.76	805126.47	656676.72	6108624.28	17°27'20.234" E	55°05'58.400" N
33	401487.06	805126.48	656677.01	6108624.31	17°27'20.251" E	55°05'58.401" N
34	407684.37	805307.79	662856.89	6109160.30	17°33'09.666" E	55°06'08.559" N
35	406836.02	801190.47	662245.23	6104999.02	17°32'26.655" E	55°03'54.793" N
36	406835.71	801188.93	662245.00	6104997.46	17°32'26.639" E	55°03'54.743" N
37	406386.25	798972.28	661922.91	6102757.58	17°32'03.924" E	55°02'42.731" N
38	406021.14	798306.59	661596.31	6102071.74	17°31'44.144" E	55°02'20.947" N
39	406011.10	798287.29	661587.38	6102051.89	17°31'43.601" E	55°02'20.316" N
40	405997.59	798257.48	661575.60	6102021.35	17°31'42.875" E	55°02'19.343" N
41	405986.07	798226.86	661565.83	6101990.10	17°31'42.262" E	55°02'18.344" N
42	405976.57	798195.55	661558.14	6101958.28	17°31'41.765" E	55°02'17.325" N
43	405969.14	798163.69	661552.54	6101926.03	17°31'41.384" E	55°02'16.289" N
44	405963.81	798131.41	661549.06	6101893.48	17°31'41.122" E	55°02'15.241" N
45	405960.60	798098.84	661547.72	6101860.77	17°31'40.980" E	55°02'14.186" N
46	405959.53	798066.14	661548.53	6101828.04	17°31'40.958" E	55°02'13.127" N
47	405960.60	798033.44	661551.47	6101795.44	17°31'41.057" E	55°02'12.070" N
48	405961.82	798018.33	661553.55	6101780.42	17°31'41.144" E	55°02'11.582" N
49	406330.98	794175.25	662142.15	6097962.77	17°32'06.473" E	55°00'07.509" N
50	392251.86	798812.04	647814.19	6101788.73	17°18'47.887" E	55°02'27.236" N
51	391975.89	798902.93	647533.36	6101863.71	17°18'32.218" E	55°02'29.960" N
52	375285.00	796471.48	631002.68	6098480.53	17°02'55.981" E	55°00'57.251" N
53	370885.36	798572.23	626488.74	6100326.83	16°58'44.941" E	55°02'01.149" N
54	370090.20	807566.56	625179.88	6109263.51	16°57'45.397" E	55°06'51.280" N
55	374424.11	807434.69	629515.53	6109379.97	17˚01'50.132" E	55°06'51.037" N
56	378234.23	806828.89	633355.32	6108993.15	17°05'26.046" E	55°06'34.867" N
57	378240.29	806827.97	633361.43	6108992.57	17°05'26.390" E	55°06'34.843" N
58	382653.03	806181.71	637805.48	6108599.81	17°09'36.313" E	55°06'17.772" N

Point's no.	PUWG 1992 [m]		UTM33 [m]		WGS 84 [DD°MM'SS.SSS"]	
	X	Y	X		Longitude	Latitude
59	382653.52	806181.64	637805.98	6108599.77	17°09'36.341" E	55°06'17.770" N
60	386956.25	805555.87	642139.11	6108221.15	17°13'39.974" E	55°06'01.130" N
61	386962.95	805554.94	642145.85	6108220.61	17°13'40.353" E	55°06'01.105" N
62	386995.51	805551.73	642178.55	6108219.27	17°13'42.195" E	55°06'01.028" N
63	387028.22	805550.66	642211.28	6108220.08	17°13'44.041" E	55°06'01.020" N
64	387060.92	805551.73	642243.88	6108223.02	17°13'45.884" E	55°06'01.082" N
65	387093.48	805554.94	642276.21	6108228.09	17°13'47.716" E	55°06'01.212" N
66	387125.76	805560.27	642308.15	6108235.26	17°13'49.530" E	55°06'01.411" N
67	387157.62	805567.70	642339.55	6108244.50	17°13'51.316" E	55°06'01.677" N
68	387168.44	805570.73	642350.18	6108248.15	17°13'51.922" E	55°06'01.784" N
69	389659.48	806298.55	644796.46	6109117.71	17°16'11.424" E	55°06'27.344" N
70	389717.65	804252.59	644971.69	6107077.59	17°16'17.563" E	55°05'21.213" N
71	388766.59	803201.84	644081.96	6105973.69	17°15'25.407" E	55°04'46.462" N
72	387906.23	802251.30	643277.07	6104975.08	17°14'38.247" E	55°04'15.019" N
73	386816.43	801047.27	642257.54	6103710.18	17°13'38.541" E	55°03'35.185" N
74	385097.24	799147.88	640649.18	6101714.78	17°12'04.418" E	55°02'32.328" N
75	384155.54	799255.83	639702.50	6101768.72	17°11'11.218" E	55°02'35.032" N
76	383687.74	799533.78	639219.39	6102019.56	17°10'44.461"E	55°02'43.629" N
77	383687.74	799533.78	639219.39	6102019.55	17°10'44.461"E	55°02'43.629" N
78	380494.20	801431.28	635921.35	6103731.90	17°07'41.711" E	55°03'42.272" N
79	379997.18	802310.45	635374.65	6104581.49	17°07'12.370" E	55°04'10.276" N
80	379994.94	802314.39	635372.18	6104585.29	17°07'12.238" E	55°04'10.401" N
81	379977.66	802342.17	635353.34	6104612.05	17°07'11.222" E	55°04'11.285" N
82	379958.60	802368.77	635332.78	6104637.52	17°07'10.107" E	55°04'12.128" N
83	379937.84	802394.06	635310.60	6104661.59	17°07'08.899" E	55°04'12.928" N
84	379915.48	802417.94	635286.90	6104684.16	17°07'07.602" E	55°04'13.681" N
85	379891.60	802440.31	635261.77	6104705.13	17°07'06.222" E	55°04'14.384" N
86	379866.30	802461.07	635235.32	6104724.42	17°07'04.765" E	55°04'15.033" N
87	379839.71	802480.12	635207.67	6104741.93	17°07'03.237" E	55°04'15.626" N
88	379811.92	802497.40	635178.93	6104757.59	17°07'01.645" E	55°04'16.161" N
89	379783.07	802512.82	635149.23	6104771.35	17°07'00.000" E	55°04'16.634" N
90	379753.26	802526.33	635118.69	6104783.13	17°06'58.294" E	55°04'17.045" N
91	379722.64	802537.85	635087.45	6104792.88	17°06'56.551" E	55°04'17.391" N
92	379691.33	802547.35	635055.64	6104800.58	17°06'54.772" E	55°04'17.671" N
93	379659.47	802554.78	635023.39	6104806.17	17°06'52.964" E	55°04'17.884" N
94	379627.19	802560.11	634990.84	6104809.65	17°06'51.137" E	55°04'18.028" N
95	379594.62	802563.32	634958.14	6104810.99	17°06'49.297" E	55°04'18.103" N
96	379561.92	802564.39	634925.42	6104810.19	17°06'47.452" E	55°04'18.109" N
97	379529.22	802563.32	634892.82	6104807.24	17°06'45.610" E	55°04'18.046" N
98	379496.66	802560.11	634860.49	6104802.18	17°06'43.780" E	55°04'17.914" N
99	379464.38	802554.78	634828.55	6104795.01	17°06'41.968" E	55°04'17.713" N

Point's no.	PUWG 1992 [m]		UTM33 [m]		WGS 84 [DD°MM'SS.SSS"]	
	X	Y	X		Longitude	Latitude
100	379432.51	802547.35	634797.15	6104785.76	17°06'40.184" E	55°04'17.445" N
101	379401.20	802537.85	634766.43	6104774.49	17°06'38.433" E	55°04'17.110" N
102	379370.58	802526.33	634736.50	6104761.22	17°06'36.725" E	55°04'16.711" N
103	379340.78	802512.82	634707.51	6104746.03	17°06'35.066" E	55°04'16.248" N
104	379311.92	802497.40	634679.58	6104728.98	17°06'33.463" E	55°04'15.724" N
105	379284.14	802480.12	634652.82	6104710.13	17°06'31.923" E	55°04'15.141" N
106	379257.54	802461.07	634627.35	6104689.57	17°06'30.453" E	55°04'14.501" N
107	379232.25	802440.31	634603.28	6104667.40	17°06'29.059" E	55°04'13.808" N
108	379208.37	802417.94	634580.71	6104643.69	17°06'27.747" E	55°04'13.063" N
109	379186.00	802394.06	634559.73	6104618.56	17°06'26.523" E	55°04'12.271" N
110	379165.25	802368.77	634540.45	6104592.12	17°06'25.392" E	55°04'11.435" N
111	379146.19	802342.17	634522.94	6104564.46	17°06'24.359" E	55°04'10.558" N
112	379128.91	802314.39	634507.28	6104535.73	17°06'23.427" E	55°04'09.645" N
113	379113.49	802285.53	634493.52	6104506.03	17°06'22.602" E	55°04'08.698" N
114	379099.98	802255.73	634481.74	6104475.49	17°06'21.886" E	55°04'07.722" N
115	379088.46	802225.11	634471.99	6104444.25	17°06'21.284" E	55°04'06.721" N
116	379078.96	802193.80	634464.29	6104412.43	17°06'20.796" E	55°04'05.701" N
117	379078.27	802191.19	634463.75	6104409.78	17°06'20.761" E	55°04'05.615" N
118	377832.99	797441.19	633491.87	6099594.70	17°05'17.902" E	55°01'30.891" N
119	377383.22	795725.59	633140.81	6097855.61	17°04'55.231" E	55°00'35.005" N
120	377355.50	795619.84	633119.17	6097748.41	17°04'53.834" E	55°00'31.560" N
121	376292.29	795990.52	632036.15	6098057.81	17°03'53.425" E	55°00'42.602" N
122	375285.00	796471.48	631002.68	6098480.53	17°02'55.981" E	55°00'57.251" N

Source: internal data

Table 8. EGMMIA coordinates

Point's no.	PUWG 1992 [m]		UTM33 [m]		WGS 84 [DD°MM'SS.SSS"]	
	X	Y	X		Longitude	Latitude
1	371092.85	796226.30	626830.12	6097995.91	16°59'00.435" E	55°00'45.474" N
2	370885.36	798572.23	626488.74	6100326.83	16°58'44.941" E	55°02'01.149" N
3	374606.33	796795.54	630306.37	6098765.34	17°02'17.271" E	55°01'07.117" N
4	375285.00	796471.48	631002.68	6098480.53	17°02'55.981" E	55°00'57.251" N
5	376292.29	795990.52	632036.15	6098057.81	17°03'53.425" E	55°00'42.602" N
6	377355.50	795619.84	633119.17	6097748.41	17°04'53.834" E	55°00'31.560" N
7	376977.20	794176.81	632823.89	6096285.64	17°04'34.780" E	54°59'44.553" N

Source: internal data

Table 9. EGIA coordinates

Point's no.	PUWG 1992 [m]		UTM33 [m]		WGS 84 [DD°MM'SS.SSS"]	
	X	Y	X		Longitude	Latitude
1	392759.49	800657.02	648215.63	6103660.52	17°19'13.983" E	55°03'27.310"N
2	393238.86	800670.69	648693.64	6103701.61	17°19'40.978" E	55°03'28.124"N
3	391349.19	798582.95	646925.73	6101508.26	17°17'57.356" E	55°02'19.118" N
4	388115.05	799648.08	643634.61	6102387.04	17°14'53.697" E	55°02'50.987" N
5	388113.48	799648.60	643633.01	6102387.47	17°14'53.608" E	55°02'51.002" N
6	387988.56	799689.74	643505.89	6102421.41	17°14'46.512" E	55°02'52.232" N
7	387961.27	799698.20	643478.16	6102428.30	17°14'44.963" E	55°02'52.483" N
8	387960.42	799697.75	643477.34	6102427.79	17°14'44.916" E	55°02'52.468" N
9	387160.62	799213.28	642706.25	6101898.16	17°14'00.549" E	55°02'36.146" N
10	385584.95	798588.69	641168.28	6101184.21	17°12'32.696" E	55°02'14.646" N
11	384684.53	798691.91	640263.09	6101235.78	17°11'41.835" E	55°02'17.236" N
12	390202.62	804788.40	645425.40	6107640.50	17°16'44.168" E	55°05'38.932" N
13	390271.52	802365.22	645632.93	6105224.25	17°16'51.417" E	55°04'20.607" N
14	390319.63	800809.52	645770.02	6103673.20	17°16'56.285" E	55°03'30.324" N
15	390326.78	800789.74	645778.29	6103653.86	17°16'56.715" E	55°03'29.691" N

Source: internal data

The planned undertaking covers the areas listed above – OWF's built-up area, EGMMIA and EGIA, with the construction of offshore wind power stations planned only within the OWF's built-up area. This is due to the need to move the boundary of the Baltica OWF's wind power stations built-up area away from the border of the Natura 2000 site Słupsk Bank (PLC990001) by about 2 km and to leave a space free from offshore wind power stations between the Baltica 2 Area and the Baltica 3 Area. Both restrictions are connected with the necessity to avoid deterioration of the conditions of staying in the area of the Słupsk Bank (PLC990001) of the subject of protection and the most common seabird in this area during the winter – the long-tailed duck (*Clangula hyemalis*).

The first of the restrictions concerns the potential displacement of long-tailed ducks from the Słupsk Bank site (PLC990001) – current studies on the behaviour of these birds in the vicinity of offshore wind farms indicate statistically significant avoidance of wind power stations up to a distance of 2 km (Petersen et al., 2006).

Petersen and his team (Petersen et al., 2006) conducted surveys on the impact of the OWF on bird populations in the years 1999–2005, among others on the Nysted farm, where the occurrence of the long-tailed duck has been recorded. In his report, he has presented the dependence of displacement from 3 groups of areas for all bird species observed, i.e. from the OWF area, from the area 0 to 2 km from the external wind turbines and the area 2 to 4 km from the external wind turbines.

During these surveys, 16 observations were made before and 15 after the construction of the Nysted farm. The following results of the displacement indicators have been recorded:

- in the OWF area, the displacement amounted to 72.83% of the long-tailed duck's population, taking into account the fluctuations in the total number of the long-tailed duck's individuals observed. This dependence was classified as statistically significant;
- in the area from 0 to 2 km from the external wind power stations, the displacement amounted to 57.76% of the long-tailed duck's population, taking into account the

fluctuations in the total number of the long-tailed duck's individuals observed. This dependence was classified as statistically significant;

- in the area from 2 to 4 km from the external wind power stations, the displacement amounted to 25.06% of the population, taking into account the fluctuations in the total number of the long-tailed duck's individuals observed. This dependence was not classified as statistically significant.

In accordance with the above surveys' results and in line with the adopted for the BŚII OWF for which a decision on environmental conditions has been issued, relocation of the wind power stations' development area, the Applicant has decided to move it away from the Natura 2000 site PLC9900001 (the Słupsk Bank) by 2 to 2.5 km.

The second restriction concerns the creation of free access to the Słupsk Bank from the north-east direction, from which the long-tailed ducks arrive in the Słupsk Bank in the winter and in which they depart from this wintering ground. There is a possibility of viewing the uninterrupted construction of a number of wind power stations on the north-eastern part of the Słupsk Bank (including by other investors – BŚII and BŚIII OWFs) as an impact on the coherence of the Natura 2000 network through the barrier effect, especially in the direction from which the birds reach the wintering ground at the Słupsk Bank during the autumn migration or depart from during the spring migration. This position has been confirmed in the environmental decisions for the BŚII and BŚIII OWFs, in which the Regional Director for Environmental Protection in Gdańsk who issuing decisions explicitly draws attention to the need to designate corridors for bird migration. The Regulator introduces the need to delineate the corridors between neighbouring OWFs along the axis between the OWFs or in a different way if scientific reasons determine it.

The Applicant has decided to leave an area of the 5 km wide migration corridor free from offshore wind power stations between the Baltica 2 Area and the Baltica 3 and BŚIII OWF Areas. The delineation of a migration corridor in this location will result in the section of the migration corridor in which the distance between external wind turbines of the particular projects is the smallest and equals 5 km, to be optimal for birds, i.e. ensuring the shortest possible proximity to wind turbines, and thus, the shortest period of stress for birds during flights. This is because the migration corridor crosses the narrowest part of the Baltica OWF Area, for which the PSZW permit has been obtained, and the entry zones from the north and south, free of wind turbines, will thus be wider. The direction of the migration corridor has been established in accordance with the main axis of birds' migration determined on the basis of the results of surveys conducted for both the Baltica OWF project and the BŚII and BŚIII OWFs. Thanks to the division, more or less in the middle, of the barrier potentially provided in the form of the Baltica OWF, the effect of extending the journey in relation to flying directly over the OWF Area (if it had not been built-up with turbines) is insignificant and equalised regardless of the avoidance scenario chosen by the birds (through the corridor, north or south of the Baltica OWF). The migration corridor planned in this way together with the bird-entry zones expanding from the north-east direction (between the Baltica 2 Area and the Baltica 3 Area) and from the south-west direction (between the Baltica 2 and BŚIII Areas) will allow unconstrained access to the PLC990001 site from the directions of the prevailing migrations.

Most bird species (including in particular the long-tailed duck – the subject of protection in the PLC990001 site) bypass offshore wind power stations by up to 2 km from the construction line of the offshore wind power stations (Petersen et al., 2006, Masden et al., 2009). Therefore, the adoption of a 5 km wide migration corridor is sufficient to ensure free passage of birds between the Baltica 2 Area and the Baltica 3 Area.

On the basis of the surveys conducted, it can be concluded that it is unnecessary to delineate other corridors for bird migration in the area of the Baltica OWF, considering an investment in the Baltica OWF and in the BŚII and BŚIII OWFs for which the decisions on environmental conditions have been issued. This applies in particular to the migration corridor between the Baltica OWF and the BŚII OWF. The results of the bird surveys (Appendix 1) indicate that the designation of such a migration corridor is not justified because of the direction of the long-tailed ducks' passage during migration.

Due to the reduction in the area of offshore wind power stations development, the Baltica OWF's impact on the environment has been reduced. As shown in the subsequent parts of the Report, the investment in this form has at most a moderate impact on the environment, including no significant negative impact on the Natura 2000 site Słupsk Bank (PLC990001), neither separately nor in conjunction with other projects.

In the proposed areas of the OWF's built-up area and the EGMMIA it is planned to use the areas in accordance with the decisions MWF/4/12 and MWF/5/12, while in the EGIA it is assumed that an application will be made for permission to lay cables in maritime areas issued as a separate decision after the needs within this field such as the designation of specific locations of the electricity grid and teletechnical network have been determined.

2.1.3 Staging of the project's implementation

According to the obtained permits for the construction of artificial islands, structures and devices, the Applicant has obtained the permission to use the OWF Area to build an OWF with a maximum capacity not exceeding 2550 MW.

The construction of an OWF of this power, beside the location conditions (such as wind, geotechnical parameters of the ground, environmental conditions), also depends on the possibility of connecting the OWF to the National Power System. Currently, the Applicant has a connection agreement for 1045.5 MW and this document determines the possibility of constructing in the first stage the OWF with a maximum installed capacity of 1045.5 MW.

The construction of the OWF with the remaining capacity of 1504.5 MW, which will constitute the second stage of the project, will depend on a number of different factors, the most important being the possibility of obtaining an agreement to connect the remaining capacity to the NPS.

2.2 Technology description

2.2.1 Description of the production process

Offshore wind power stations, just like their onshore counterparts, are devices for converting kinetic energy of wind into electricity by propelling the electricity generator with a rotor driven by wind. The mechanical energy of the spinning rotor is transformed in the generator into low voltage alternating current, which is usually transformed to medium voltage for further transmission to collecting stations via internal power infrastructure to power substations, collective and/or converter stations, depending on the technical solution, this is the level and type of voltage transmitted to land.

Wind power stations do not need to use fuels and other raw materials to generate electricity. Properly used, they do not cause environmental pollution. A demand for electricity in small amounts is made only in the case of windless weather. The limited demand for raw materials is due to the construction (materials used to produce as well as fuels and other materials necessary during the construction process), operation of service units (fuels and materials) and decommissioning (fuels and materials).

2.2.2 Description of the technology of individual elements of the project

Offshore wind power stations consist of several main elements (Figure 6), which include:

- nacelle with electric generator and rotor, usually consisting of three blades;
- the tower on which the nacelle is mounted;
- support structure;
- foundation (or anchoring system).

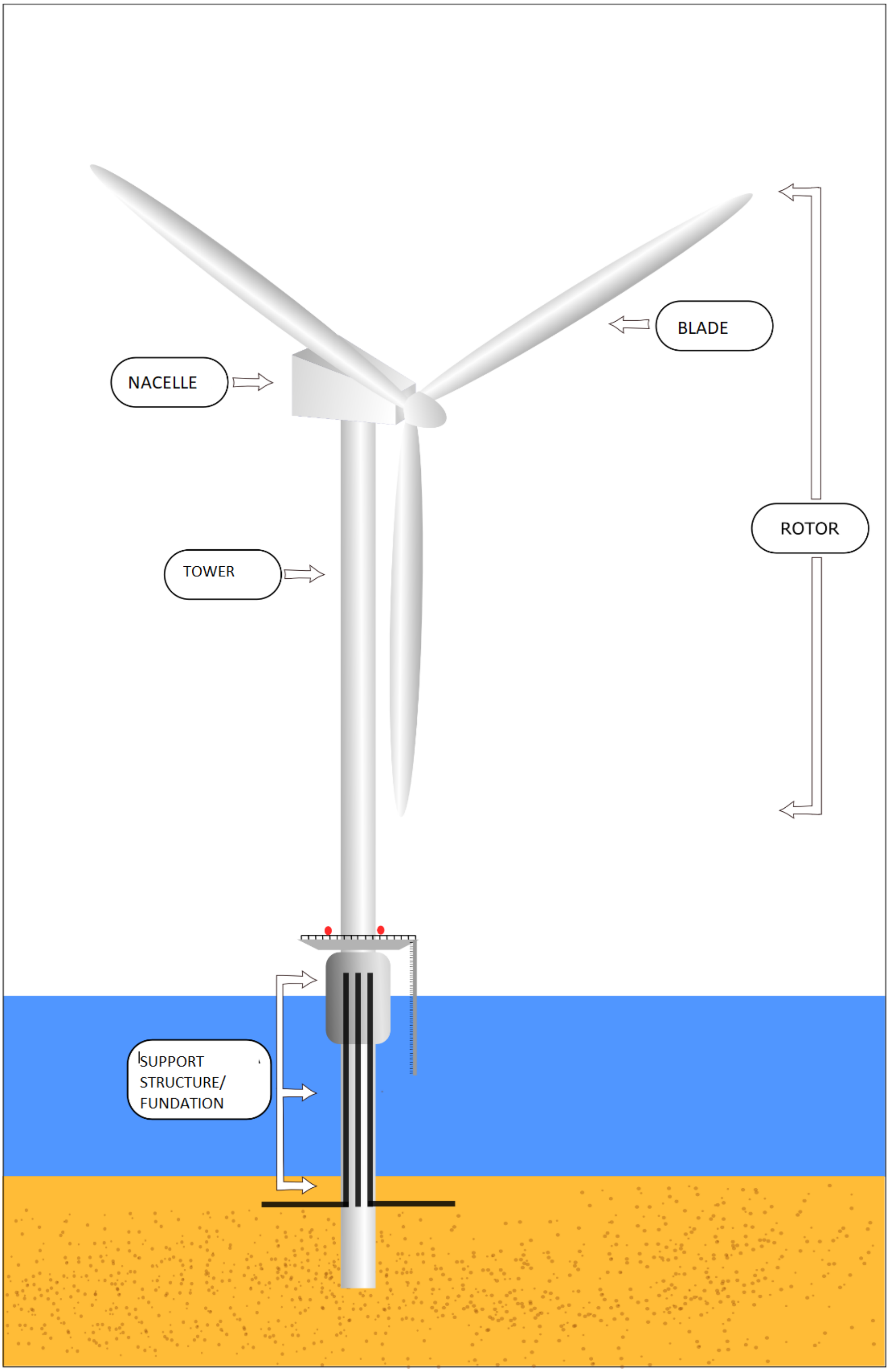


Figure 6. Main elements of an offshore wind power stations

Source: internal data

Offshore wind farms consist of offshore wind power stations, electricity grids and teletechnical networks connecting the elements of offshore wind farms and offshore power substations, where the current parameters generated in offshore wind power stations are adjusted for transmission within the offshore wind farm and outside to the NPS.

The basic elements of offshore wind power stations and offshore wind farms have been described in the following sections.

2.2.2.1 Nacelles with rotors

Nacelles with rotors are the basic element of the offshore wind power station responsible for the fundamental technological process – the conversion of kinetic energy of wind into electricity by forcing the movement of a wind power station's rotor and transferring the drive to an electric generator.

Electricity generation systems used in offshore wind power stations in most cases consist of rotors with three blades that rotate on a hub connected to an electric generator either directly to the shaft or indirectly by means of a gearbox that adjusts the rotor speed to the speed required for the stable operation of a generator. After transforming the kinetic energy into electric energy, the voltage is adjusted to the voltage in the internal electricity grid of the OWF with the use of a transformer. The whole equipment of the electricity generation system outside the rotor is built in the form of a nacelle mounted on the tower. There is a possibility of placing a helicopter landing pad on a nacelle.

Currently, wind power stations of up to 9.5 MW are used offshore. In the future, wind power stations of higher capacities are expected to be used. An example of technological progress in the field of generating electricity from wind is wind power station V164 produced by MHI-Vestas. In 2014, the first such wind power station with a 164 m rotor diameter and capacity of 7 MW was launched. By constantly improving the various elements of the wind power station from the motion control software and the rake angle of the blades, by improving the efficiency of the gearbox, to optimise the generator cooling system, in June 2017 the first wind turbine V164 with a capacity of 9.5 MW was installed on the same rotor. It should be expected that at the time of the Baltica OWF's implementation, wind power stations of greater capacity will be available. In 2017, there have been prototypes of 10 MW wind power stations using generators based on superconducting technologies (e.g. 10 MW Sea Titan), which are characterised by even a twofold reduction in the weight of the nacelle with the rotor compared to the classic generation. This may allow, in the near future, for the construction of wind power stations with potentially twice as large capacity on the same foundations and towers, with only slightly larger rotors.

2.2.2.2 Towers

Nacelles with rotors are mounted on towers of different types, depending on the height (reaching up to 175 m above sea level) and the size (and hence the weight) of the nacelle. The most common are steel and reinforced concrete constructions, prefabricated and connected on land or directly at sea.

2.2.2.3 Support structures

Five different wind turbine support structures and other permanent structures can be used for the analysed offshore wind farm, including all optional structures:

a) gravity based structure;
b) jacket structure;
c) monopile;

d) tripod;
e) floating structure.

The above constructional solutions have been presented schematically in the figure (Figure 7).

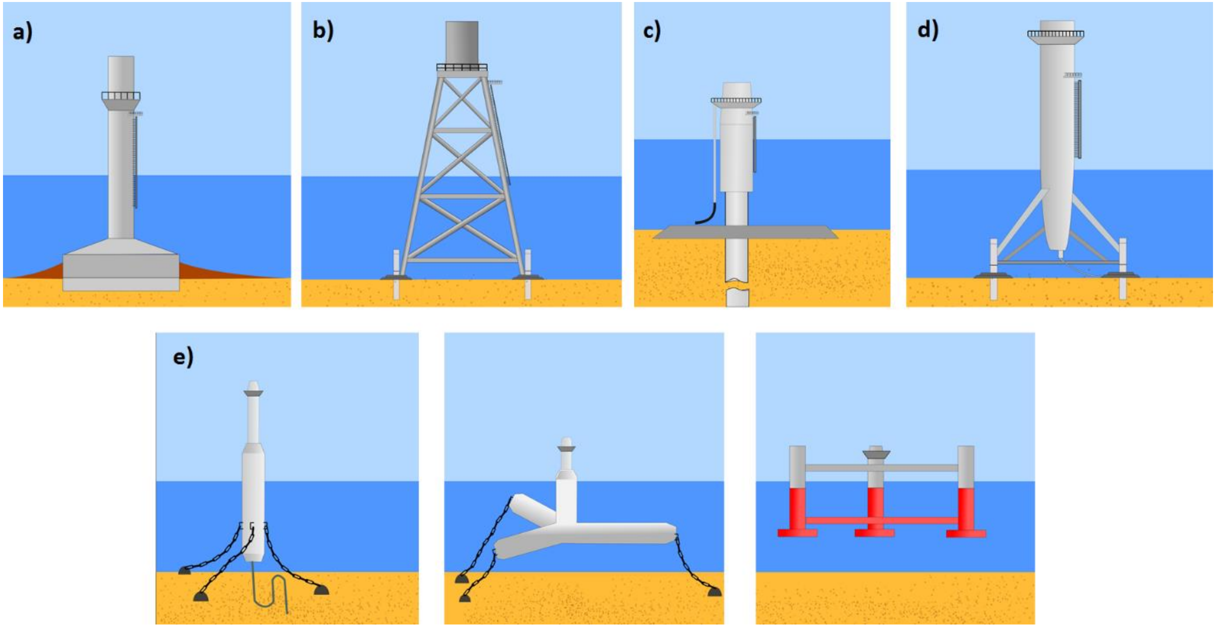


Figure 7. The draft of supporting structures: a) gravity based, b) jacket, c) monopile, d) tripod, e) floating (various types)

Source: internal data

The stability of the gravity based structure (GBS) is ensured by the low placed gravity centre and the weight of the structure itself. This type of construction is placed directly on the seabed. For this construction, an initial preparation of the seabed by levelling it and possibly replacing the ground is often required. This is connected with the conduction of dredging works, which cause the disturbance of the seabed sediments' structure along with the short-term suspension of the finest fractions in the water. Moreover, in the immediate vicinity of the GBS foundation, sea currents are subject to modification – the effects of potential sediment leaching are eliminated by the shape of the foundation footing and, if needed, anti-erosion protections.

The jacket structure consists of a series of tubular elements connected to each other in K, X or Y knots. The most loaded, and thus the main load-bearing elements of the jacket are legs, deviating from the vertical by several degrees. Such solution allows for better transmission of horizontal forces affecting the wind power station. The whole structure is tied with tubular elements, the diameters of which are about 1 m, and the jacket itself is placed indirectly on the seabed. The clamps located at the bottom of the main girders are connected in a rigid way to the embedded in the ground piles. The survey of the environmental impact of this type of construction requires first of all an assessment of the noise level during its installation.

A monopile can be simply defined as a large-scale, prefabricated steel pipe with a mass of up to 1000 Mg, driven to a maximum of half its length into the seabed. The interior of the structure remains empty until its erection and its bottom and head open. The dimensions of a large-diameter pile are determined by the magnitudes of horizontal and vertical loads as well as the bending moment generated by them. The influence of the horizontal and vertical loads is transmitted directly into the total length of piles, which in currently implemented constructions can reach as much as

80 m. Safe transmission of very large loads to the substrate requires ensuring an adequate rigidity of the structure. To achieve this, piles with the diameter over 6 m and wall thickness exceeding 100 mm in some segments, are used. Driving this type of pile into the ground causes the generation and propagation of sound waves in the marine environment. In the immediate vicinity of large diameter piles, sea currents are modified, causing the seabed sediments to move on the bottom of the sea basin. This results in the intensification of local erosion at the point of piles driving – small grains and soil particles are washed out and displaced.

The way of transferring loads to the substrate via the tripod construction is completely different than in the case of large diameter piles. By dividing the force within the support structure into 3 independent pillar supports, a better working characteristic is obtained. Such a system is much more stable and less susceptible to the effect of the overturning moment, generated by horizontal forces. The support surface that provides the technological load-bearing capacity of the structure through the connection with the piles is also greater in this case. In situations where the ground conditions do not allow the large-diameter pile to be embedded (too much resistance to piling in or vibrating, etc.), a replacement solution may be the support structure with a tripod geometry. As in the case of a jacket structure, primarily assessed is the noise during installation.

The analyses of the impact on the marine environment caused by suspended matter resulting from anthropogenic factors demonstrate that among the types of support structures presented above, the greatest disturbance will be caused by the installation of a gravity based structure. Whereas, the monopile construction is characterised by the highest noise level during installation.

Industrial surveys on floating wind power stations date back to the mid-1990s. Although they are advanced, so far only the prototype or pilot solutions have been tested under real world conditions. Floating structures are intended for deeper sea and ocean areas, and current economic estimates allow concluding that such solutions in offshore wind energy are competitive in comparison with supporting structures installed on the seabed for depths exceeding 50 m.

Currently, the use of the following three types of deep sea foundations in the offshore wind energy industry, adapted from the oil and gas extraction industry, is considered:

- spar buoys – constructed as large-sized, cylindrical buoys with considerable stability provided by a low placed gravity centre (ballast placed in the lower part of the buoy) in relation to the buoyancy centre. About 90% of the structure is below the surface of the water. These platforms are anchored to the bottom with conventional anchor ropes, while maintaining the vertical position of the structure depends only to a small extent on anchoring. They are applicable at depths exceeding 120 m;

- tension leg platforms – they consist of a floating hull anchored by ties (each “leg” consists of a set of tendons), cables or pipes with a vertical or almost vertical course. Ties or cables are always under the influence of significant tensile forces, which cause additional buoyancy of the hull. If the hull is tilted from the basic position due to the hydrodynamic and aerodynamic forces, the horizontal component of the anchor ties’ stretching tends to move the platform to its original position. They are applicable at depths exceeding 50 m;

- semi-submersible structures – they owe their buoyancy, and above all stability, to the lower, submerged hull, which is connected by columns with the proper deck (frame). Generally, structures of this type are anchored by a conventional mooring system. They are applicable at depths exceeding 70–80 m.

In terms of the negative impact on the marine environment, all the above floating structures solutions will have a minimal impact on the lifting and dissemination of suspended matter both during the construction phase and in the exploitation phase. In some technological solutions (the use of pile heads for fixing vertical anchor tendons of platforms), the impact will be the noise during the installation process. However, it is estimated that it will be decidedly lower than for the installation of monopiles.

2.2.2.4 Noise reduction system

The placing of the above described elements of the project in or on the seabed is often accompanied by the generation of significant underwater noise. In the case of piling, vibrating or driving in monopiles, underwater noise can at source reach temporary SPL values above 230 dB re 1 µPa at a distance of 1 m. The experiences of other offshore wind farms show that the implementation of piling without the use of noise reduction measures usually means significant negative impact on marine mammals and fish. Therefore, the Applicant has made a decision that in view of the underwater noise and to avoid significant negative impact of vibrations and noise on underwater organisms a noise reduction system that will be characterised by the effectiveness of achieving the underwater noise levels that do not cause significant negative impacts at the boundaries of selected conservation areas, will be applied.

The area for which the need to maintain an appropriate level of underwater noise has been established is the boundary of the Natura 2000 site the *Ostoja Słowińska* (PLH220023), where due to the presence of fish and marine mammals, which are the subject of protection of this area, the permissible level of underwater noise cannot exceed: for fish 186 dB re 1 μPa^2s SEL_{cum}, for porpoise 140 dB re 1 μPa^2s SEL_{cum} and weighted by the HF function [HF weighting function for marine mammals with high sensitivity to high frequency sounds (NMFS, 2016)], for seals 170 dB re 1 μPa^2s SEL_{cum} and weighted by the PW function [PW weighting function for pinniped marine mammals (NMFS, 2016)].

In the case of foundations installation in the period from the beginning of November to the end of April, in accordance with the provisions adopted for activities aimed at avoiding, preventing and limiting negative impacts on the environment, the value of the underwater noise level at the boundary of the Słupsk Bank site (PLC990001) may not exceed 117 dB re 1 μPa^2s SELcum, due to the necessity to protect the wintering population of the long-tailed duck, the subject of protection of this area, from being scared away. The proposed value is a precautionary estimate based on existing knowledge and it is assumed that if new survey results regarding the impact of underwater noise on long-tailed ducks are obtained, the Applicant will inform the Regional Directorate for Environmental Protection about this fact in order to agree on a different noise level limit.

Currently, there are few ways to reduce underwater noise, mainly due to the acoustic impedance of water and its excellent sound transmission parameters. The commonly used methods are big bubble curtains, which are created by pumping air through the diffusers installed on the seabed (Figure 8). The air bubble "walls" created in this way, thanks to the change of acoustic impedance parameters between the mediums (water–air), remain the most effective means of noise reduction. Typically used big bubble curtains obtain in the frequency range above 63 Hz sound suppression effect from 5 to 30 dB re 1 μPa^2s depending on the frequency (Diederichs et al., 2014). Other methods of reducing the nuisance of the underwater noise for marine organisms may be the use of the "soft start" procedure – a successive increase of piling energy in order to allow mobile marine organisms to leave the direct impact zone and/or the use of devices to deter marine organisms before starting the processes of installing foundations. The "soft start" procedure and deterrence do not lower the noise level but allow effective reduction of the number of marine organisms exposed to the impact of the underwater noise. It should be expected that before the commencement of the Baltica OWF construction other effective noise reduction measures may appear, thus, the Applicant assumes the use of a noise reduction system, without prejudging the way it is implemented, so as to be able to use the most appropriate underwater noise reduction methods at the time of construction, enabling adherence to the noise levels specified above.

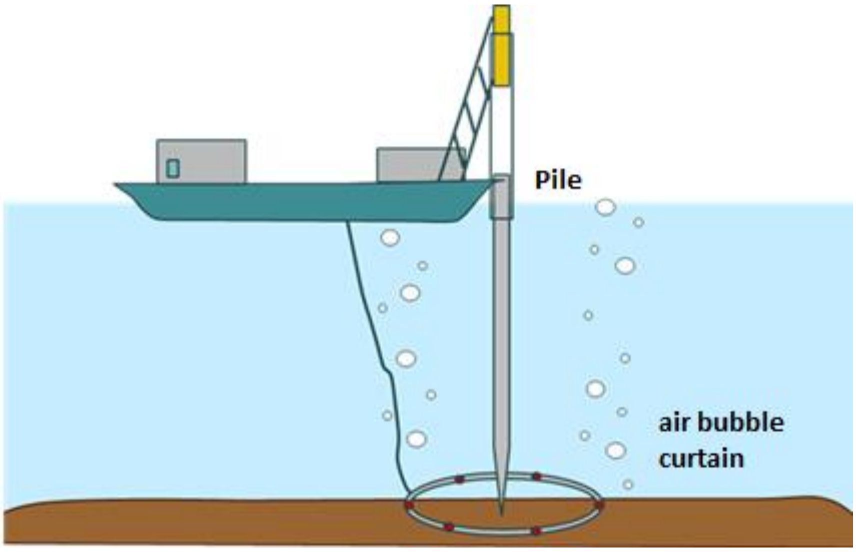


Figure 8. An outline of the big bubble curtain application

Source: DHI materials

2.2.2.5 Internal power and teletechnical network

The internal wind farms' connection system includes offshore electricity grid joining individual offshore wind power stations into groups connected to offshore power substations as well as the necessary teletechnical network in the form of optic fiber lines integrated in multi-core power cables or in separate cables laid together with power cables. The internal electricity grid in the Baltica OWF does not have yet agreed parameters (type and level of voltage), as these parameters will depend on the farm's electric concept, the distribution of offshore wind power stations and the number of power substations.

At the current stage it is not possible to specify detailed cable parameters, due to among others the unknown eventual power rating of the planned wind power stations. Depending on the wind turbines employed, their location and the accepted power take-off solutions, alternating current multi core submarine power cables with cross sections depending on the designed load, operating at a rated voltage of 20–66 kV or other, can be used.

Due to the conceptual work on the possibilities of a direct power output from wind farms, the use of appropriate direct current cables is also not excluded.

Cable networks (electricity and teletechnical) included in the internal wind power stations and power substations connection system will be laid embedded in the seabed to a depth of about 2 m or on the seabed in the case of unfavourable for embedding in the seabed geological conditions.

The generators of offshore wind power stations generate electricity usually with a voltage ranging from 0.6–6.6 kV, which is then raised to a value of 20 kV or 33 kV, maximum 66 kV in a transformer located inside the power station's nacelle. From the power station, electricity is discharged through the MV cable system, which combines the individual power stations into sections, and discharges it to the power substation in order to raise the voltage to a value that ensures relatively low loss transmission over longer distances.

2.2.2.6 Power substations

Fundamentally, it is assumed that the OWF will have a group of power substations located in the OWF Area. In order to optimise the costs and rationalise the use of the area, the possibility of implementing multiple power substations placed on a common platform is not excluded.

In addition to the standard equipment of power substations in devices and installations necessary for the transformation of MV/HV voltage (transformers, switchgear and control equipment, control and communication devices, emergency power systems including fuel) and for service and supervision of the station (helicopter landing pad and crane as well as others depending on the needs), the possibility of installing rooms and structures allowing short or long-term stay of service teams at selected stations is accepted.

The determination of the offshore power substations' location will be possible after specifying the location of the individual elements of the OWF.

Due to the possibility of a direct power output from a wind power station, the construction of power substations in a direct current system is also not excluded.

The possibility of converting alternating current MW/HW to direct current and exporting direct current to land is not excluded. In this case, it will be necessary to install appropriate devices for the conversion of AC into DC at the export station.

Offshore power substations will be placed on foundations adapted to their construction parameters, the seabed's geological conditions and hydrotechnical conditions (depth, sea currents, wave motion parameters, ice conditions, etc.).

2.2.2.7 Research and measurement as well as residential and service platforms

In order to conduct measurements of meteorological parameters necessary to determine the working conditions of the designed offshore wind power stations, the construction of a maximum of 2 stationary offshore research and measurement stations located within the limits of OWF's built-up area and/or EGMMIA has been assumed, however in the second above mentioned area the station may be implemented within the limited to the construction of a measurement mast scope due to the proximity of the Natura 2000 site Słupsk Bank PLC 990001.

The key element of the planned research and measurement stations will be a meteorological mast with the maximum height of 150 m, together with the necessary measuring equipment, able to record and transmit data.

The most advanced variant of the research and measurement platform assumes the construction of the station in the form of an extensive work platform, which will house both the mast with a height of up to 150 m, as well as the additional installations and equipment as well as rooms for conducting other scientific and research works, including temporary stay of survey teams.

The Applicant informs about the withdrawal from the implementation of a part of the investment if there is no need to erect a research and measurement station to ensure the proper functioning of the planned complex of offshore wind farms. This applies in particular to the situation in which the Applicant will be able to obtain appropriate and considered as representative meteorological data from external sources or through the use of alternative methods of meteorological parameters measurement (e.g. lidar or sodar) that do not require the construction of station or require the use of simplified construction solutions.

The Applicant also informs about the possibility of constructing the measurement station in a different form, e.g. as a temporary facility based on a support structure used after the completion of measurements for the wind turbine foundation or on a structure temporarily set on the seabed (e.g. on a caisson or a jack-up type foundation) or as a temporarily anchored structure. The implementation of a measuring and research station in the form of a solid measurement mast is also accepted. This applies in particular to the station installed within the EGMMIA.

In order to reduce the transport costs of specialist maintenance and repair teams, in the case where it is not possible to locate suitable facilities, e.g. on power substation platforms, the Applicant considers locating a maximum of 2 autonomous residential and service stations within the OWF's built-up area, as an additional infrastructure of the planned project.

The most advanced variant of the residential and service platform assumes the construction of a station in the form of an extensive work platform, where accommodation and storage facilities as well as additional installations and devices for the preparation and conduction of maintenance and renovation works will be located, including the facilities allowing people to stay either permanently or temporarily. The detailed design and location of the station will be determined in the later stages of the design work.

The Applicant also informs about the possibility of resignation from the construction of a residential and service station or its implementation in a different form, e.g. as a temporary facility based on a support structure used after the completion of the implementation phase for the wind turbine foundation or on a structure temporarily set on the seabed (e.g. on a caisson or a jack-up type foundation) or as a temporarily anchored structure (e.g. the use of a hotelship).

2.3 The considered variants of the project

2.3.1 An approach to the designation of the project's variants

The particular variants of the undertaking have been described using parameters that are possible to be envelope specified for the investment of such nature as an offshore wind farm, i.e. a long investment process with a significant development in technology.

The undertaking was characterised by specifying for each of the variants:

- **the maximum installed capacity** of the OWF – this parameter is determined by the decisions of the PSZW, on the basis of which the Applicant prepares the investment process. Ultimately, the amount of the installed capacity will be the derivative of the possibility of connecting to the NPS and the result of optimisation of the planned farm from the point of view of environmental parameters. Under no circumstances will this value be exceeded;
- **the maximum number of wind turbines** – a parameter resulting from the maximum installed capacity of the OWF and the forecasted size of the wind turbines installed in the OWF. The use of wind turbines of various sizes is accepted, but no more than the maximum number declared;
- **the maximum rotor diameter** – a parameter defining the size of the rotor, affecting, among others, the scale of the impact on birds and bats in the OWF Area;
- **the minimal clearance between the working area of the rotor and the water surface** – a parameter affecting the scale of the impact on birds and bats in the OWF Area – the lower the rotor blades reach, the greater the effect is;

- **the maximum height of wind turbines** – the maximum height of wind power stations resulting from the height of the tower and radius of the rotor; a parameter affecting the scale of the impact on birds and bats in the OWF Area and the aerial use of the OWF Area;
- **the maximum diameter of the gravity based structure** – a parameter defining the diameter of the largest permissible foundation constituting the maximum occupation of the seabed;
- **the maximum seabed surface covered by the gravity based structure** – the maximum surface covered by a single gravity based structure without anti-erosion protection (e.g. rip-rap);
- **the maximum seabed area occupied by foundations** – the limit value of the total area occupied by the foundations (for the gravity based structures as covering the largest seabed surface); a parameter directly affecting benthic organisms through the interference in the seabed;
- **the maximum length of cable installation routes inside the OWF** – a parameter defining the length of cable connections inside OWF's built-up area, EGIA and EGMMIA, necessary to determine the scale of the suspended solids dispersion during the burial of cables.

2.3.2 The considered variants of the project along with the justification for their choice

In accordance with the requirements for the preparation of the project's environmental impact assessment report, the proposed variants are reasonable, i.e. possible to implement in the current legal status (including as part of the issued PSZW decisions) and with the current knowledge about the environment.

2.3.2.1 Variant proposed by the Applicant

The variant proposed by the Applicant (interchangeably: the Applicant's variant) is an option which assumes the use, to the greatest possible extent, of the latest technologies available at the time of the preparation of the construction project for the particular stages of the investment implementation, including, in particular, the wind power stations larger than those available on the market at the time of application for a decision on environmental conditions for the undertaking. The employment of wind power stations of various types, capacities and foundations has been permitted. In the case of the implementation of the construction program of the OWF with a total capacity specified in the PSZW, i.e. 2550 MW, the employment of no more than 209 wind power stations on different types of foundations with a maximum diameter of 40 m has been assumed.

The variant proposed by the Applicant takes into account the fact that a constant development of the offshore wind power stations technologies should be expected, not only in the direction of the increasing size of rotors, generators and towers, but also in terms of efficiency of the applied engineering solutions. This is illustrated by the example of a single wind power station Vestas – V164 development (164 in this case is the rotor diameter in meters), which in 2014 was implemented in the 7 MW version, in subsequent years received the versions of 8 MW and 9 MW and in June 2017 reached 9.5 MW, and yet it was implemented with exactly the same external parameters (tower height, rotor and blades size). This means that for the assumed maximum rotor diameter of 220 m, by analogy to the wind power station V164 (proportionally to the rotor's working surface), it can be assumed that the employment of the wind power stations with a capacity of 12 to 16 MW will be possible during the construction phase. This will allow the project to be implemented in better environmental parameters, in particular with:

- fewer wind power stations;
- smaller total rotor working area;
- smaller coverage of the seabed surface;

- shorter length of cable routes for the OWF's built-up area, EGIA and EGMMIA.

This way, the project will be implemented in a shorter time and with smaller raw materials and fuels' consumption.

The chosen option proposed by the Applicant will allow reducing the impact of the investment on the environment and according to further analyses is the most favourable variant for the environment.

2.3.2.2 Rational alternative variant

The rational alternative variant has been chosen as a variant based on the existing technologies, currently used and available on the market on an industrial scale. Therefore, the capacity of wind power stations has been assumed at about 8 MW, which means a maximum of 319 wind turbines with a maximum foundation diameter of 35 m. This applies to the same OWF's built-up area as in the case of the Applicant's variant, but due to a larger number of the planned wind power stations it will require a different layout within the area. This variant allows the implementation of the project in the assumed maximum installed capacity of the OWF, although in accordance with the further analyses, this variant has a greater negative impact on the environment than the Applicant's variant. Similarly as in the case of the variant proposed by the Applicant, the employment of wind power stations of various types, capacities and foundations has been allowed. The development of EGIA and EGMMIA will be the same for both the rational alternative and the Applicant's variants.

2.3.2.3 The compilation of technical parameters of the considered variants of the project

The most important parameters of the project for both variants analysed in this Report, i.e. the variant proposed by the Applicant and the rational alternative has been presented in the table (Table 10). For some parameters, variants (e.g. minimum clearance) have not been differentiated, as their selection is related to the environmental parameters (height of birds' flights) or to the legal context (maximum installed capacity resulting from the PSZW or staging related to the NPS connection contract).

Table 10. List of the most important parameters of the project for the variant proposed by the Applicant and the rational alternative variant

Parameter	**Variant proposed by the Applicant**	**Rational alternative variant**
Maximum installed capacity [MW]	2550	2550
Maximum number of wind power stations [items]	209	319
The maximum diameter of the rotor [m]	220	180
Minimum clearance between the working area of the rotor and the water surface [m]	20	20
Maximum height [m]	250	230
Maximum number of additional constructions [items]	25	25
The maximum diameter of the gravity based structure [m]	40	35
Maximum area of the seabed occupied by the gravity based structure [m^2]	1257	962
Maximum area of the seabed occupied by the foundations [m^2]	262,713	306,913
Maximum length of cable installation routes within the OWF [km]	418	638

Source: internal data

2.4 Description of particular phases of the project

2.4.1 General information relating to all phases of the project

The main activities related to all phases of the offshore wind farm, i.e. the construction, overlapping construction and exploitation, exploitation and decommissioning phases, will be the following:

- the transport of construction elements, including large-scale ones, during the construction phase, occasionally during exploitation and again in the decommissioning phase of the undertaking;
- the transport of supplies and materials in all phases of the undertaking;
- carrying out construction works (e.g. construction of foundations) and installation works (e.g. laying cables);
- the transport of service teams and service works;
- carrying out dismantling works in the decommissioning phase.

The following vessels will be used during the works:

- construction vessels, usually large, specialized vessels with a high level of security (e.g. equipped in dynamic positioning systems with multi-level security); often such units are supported on the lowered onto the seabed supports and stabilized under their own weight by elevating itself above the water surface;
- transportation vessels, universal or adapted to perform specific tasks, often equipped with dynamic positioning systems;
- tug supply vessels, usually small, fast watercraft for transporting service teams or current consumables, adapted to be moored/docked to a wind power station and to transfer people and materials to offshore wind power stations;
- in some situations – helicopters for transporting service teams and consumables.

All operations related to the activities in the OWF's built-up area, EGIA and EGMMIA will require the establishment of temporary or permanent exclusion zones for navigation (permitting the movement of ships servicing the OWF) of various sizes depending on the type of operation. The largest safety zones will be established for the operations of construction and transportation vessels during the construction and decommissioning of wind power stations or during major repairs in exploitation phase. Such areas will be agreed with the appropriate maritime administration bodies and announced in the relevant publications. During exploitation, the maritime administration will have the right to set permanent navigation exclusion zones around individual offshore wind turbines and these zones will be sufficient as safety zones for service traffic in the OWF Area.

All navigational activity related to servicing the OWF outside the standard supervision of maritime administration will be coordinated and monitored by traffic control.

All activities within the OWF Area will include noise generated by ships during normal operation – the characteristics of this noise are presented in section 3.5.1. Navigational and communication devices installed on ships and operated in accordance with the relevant regulations will emit electromagnetic fields. Ship equipment is regularly checked for EMF emissions because of people working on the vessels. Vessels employed currently, by burning fossil fuels, emit pollutants (gases and dust) into the atmosphere. In this case, it can be expected that this impact will be reduced by increasing the share of clean light fuels (for example compressed natural gas/liquified natural gas) or introducing new standards for the quality of heavy fuels, especially regarding the fuels' sulphur content.

The operations of construction and transportation vessels must be carried out from the ports with appropriate parameters (the size and draft of the approved vessels and increased quay capacity). The ports suitable for these vessels are, for example, Gdańsk, Gdynia, Szczecin and Świnoujście. Tug supply vessels can use ports of lower requirements. The ports closest to the planned investment meeting such requirements are the ports of Ustka and Łeba.

The number of sea operations related to the construction, exploitation and decommissioning phases of the Baltica OWF project is proportional to the number of facilities installed and constructed in the OWF Area. Therefore, the number of operations and their effects (for example fuel consumption, emissions related to transport) for the Applicant's variant will be smaller than in the case of the rational alternative variant.

Solid waste and wastewater management during all phases of the OWF's life

The Applicant will require from the contractors of all works related to the construction, exploitation and decommissioning of the Baltica OWF the application of legal requirements and good practices regarding waste and sewage treatment, in particular noting the possibilities resulting from sorting of waste and the possible recycling of some of them.

Various hazardous materials will be used during the different phases of the Baltica OWF's life, including lubricating oils, diesel and hydraulic oils. All units used for the construction, exploitation and decommissioning of the Baltica OWF and all the Baltica OWF's constructions will be equipped with appropriate safeguard measures to prevent the spillage of these substances (e.g. trays for any transformer oil spills) and measures to eliminate the effects of these substances' spills (e.g. sorbents). The oil-polluted water produced during the works (e.g. washing of equipment, decks) will be collected and separated to obtain oil-derivative concentrations below 15 p.p.m. and the oil obtained from the separation process will be stored and transferred in appropriate containers to specialized waste disposal companies.

The same will be done in the case of other waste, including other hazardous waste – they will be sorted, collected in specially marked and secured containers, transported ashore and transferred to specialized companies for utilisation.

Domestic sewage generated during the construction, exploitation and decommissioning of the Baltica OWF on vessels and residential and service platforms as well as other installations of the Baltica OWF will be stored, pre-treated and discharged to the sea or transferred onshore to be utilised in accordance with the MARPOL 73/78 Convention and secondary regulations related to limiting the dumping of pollutants by ships. It is assumed that the generation of domestic sewage will be carried out in an amount not greater than in the case of dirty work – up to 100 l per person per day.

In the descriptions of individual OWF's life stages, the estimated quantities of waste expected to be generated in these phases have been given.

Transfer of sediments as a result of construction works

One of the important problems occurring during underwater works is the method of managing the transferred seabed sediments. It is assumed that the transferred sediment will be managed within the Baltica OWF, i.e. it will not be transferred outside the Baltica OWF Area, but only moved out of the direct foundation placement area (this applies to gravity based structures or other types for which the preparation and/or replacement of the substrate may be necessary). This is in line with the Art. 2, section 3 of the Act on Waste of 14 December 2012 (Journal of Laws of 2013, item 21), according to which the provisions of the Act do not apply to "*[…] uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purpose of construction in its natural state on the site from which it was excavated […]*". No pollution has been found within the sediments in the OWF Area, therefore it is not planned to be transferred to offshore dump site or landfills. The maximum amount of the transferred sediments can occur in the case of gravity based structures, but these deposits can be used to fill and weight the foundation structures or to shape the seabed around the foundation.

Noise emissions connected to the underwater works

For the majority of offshore wind farms, the construction site must be prepared using the dredging process, which generates noise and suspended matter (Carstensen et al., 2006, Reach et al., 2012). As with many other activities, dredging generates underwater noise. The four basic types of dredgers are suction dredgers (CSD), trailing suction hopper dredgers (TSHD), grab dredgers (GD) and backhoe dredgers (BHD). TSHD is used on many occasions. The noise emitted by TSHD comes from various sources, mainly from the ship's propulsion and the suction head of the dredger (CEDA, 2011) (Figure 9).

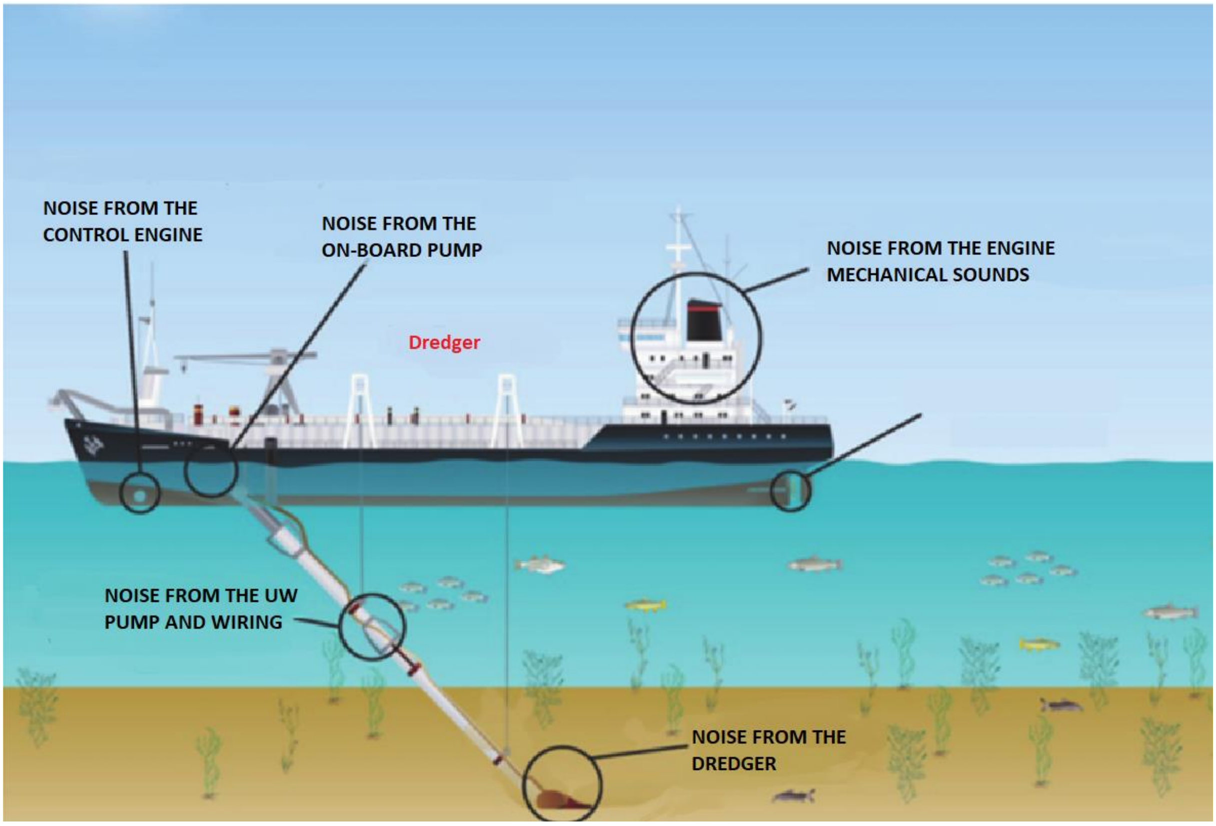


Figure 9. Schematic illustration of the TSHD dredger's operation

Source: CEDA, 2011

Robinson et al. (2011) tested that TSHD emits noise at frequencies below 500 Hz. It has also been found that noise originating from TSHD may have a frequency above 1 kHz depending on the composition of the substrate excavated during dredging. It is believed that the highest noise level is generated by larger grains of sand and gravel when pumped through a pipe. However, even if the dredged substrate is sandy, acoustic energy is still produced which can affect porpoises and seals. Reported noise levels range from 186–188 dB re 1 µPa rms at 1 m (Thomsen et al., 2009, Robinson et al., 2011). These levels are much lower than in the case of a pile driver's operation, but because the dredging noise is more or less continuous, and the piling noise intermittent (pulse length = 50 ms) they cannot be compared.

The underwater works using dredging systems can occur with the greatest intensity during construction and decommissioning. During the exploitation phase, such operations can only take place in case of emergency service works (e.g. the repair of buried, broken cables).

2.4.2 Construction phase

Depending on the adopted variant, this phase will include the installation of a maximum of 209 (Applicant's variant) or 319 (a reasonable alternative variant) wind turbines, internal wiring and up to 25 other types of structures or installations within the Baltica OWF Area. The construction phase will require a very large number of transport and reloading operations and the related to it slightly increased traffic of large vessels, as well as the presence of a large number of vessels in the OWF Area. The construction is accompanied by significantly increased traffic of smaller supply and service vessels. It should be remembered that the relatively large undertaking will be extended over time – the assumed construction cycle is 8 years. Since most structures are prefabricated on land, it should be emphasized that the inconvenience of building processes is in practice directly proportional to the number of construction elements. This implies that the rational alternative variant will have a more significant impact on the marine environment.

Construction site facilities

Prior to the OWF construction, it will be necessary to organize construction site facilities, assuming that each of the logistics solutions including the following will be possible:

- direct transport from the producer to the OWF Area;
- indirect transport through the main supply ports – the nearest ports are in Gdańsk and Gdynia;
- indirect transport through temporary supply ports – the nearest port is in Ustka;
- transports from service ports – the nearest ports are located in Łeba and Ustka.

The direct transport will not require changes in the operation of Polish ports. Similarly, the transport from major supply ports will change the organization of these ports to a small extent. The creation of a temporary supply port in Ustka and the location of service ports in Ustka and Łeba will be associated with changes in the organization of work of these ports, as they will require adaptation to greater ship traffic and its efficient service.

Transport routes (off- and onshore)

Maritime transportation will be of main significance and the impact of land transportation should be minimal. Land transportation will take place within existing transportation solutions. It is possible that the assembly or production of large-scale elements will take place in port or shipyard areas. Traffic in maritime transportation will take place in places where it has been small or insignificant so far. Depending on the choice of supply concept, supply and service ports, the transportation system will include reloading work and vessel traffic on routes port – OWF – port or between ports.

The number of offshore operations related to the construction phase of the Baltica OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the installed electricity grid. Therefore, the number of operations and their effects (for example fuel consumption, emissions related to transport) for the Applicant's variant will be smaller than in the case of the rational alternative variant.

Waste

The expected types and quantities of waste generated during the construction phase of the Baltica OWF divided in accordance with the Regulation of the Minister of the Environment of 9 December 2014 on Waste Catalogue (Journal of Laws of 2014, item 1923) have been presented in the table (Table 11). In this case, the generation of waste connected to the operation of ships carrying out the Baltica OWF construction as well as the generation of waste during cement or sediment filling of the installations, joining construction elements (e.g. welding), piling and driving piles (e.g. drill cuttings), assembly of anti-corrosion protection elements and possible abrasion of the protective coatings (e.g. during piling) is expected.

Table 11. The compilation of waste generated during the construction phase of the Baltica OWF on an annual basis

Expected types and quantities of waste in the construction phase		**Applicant's variant**	**Rational alternative variant**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
08	Waste from production, preparation, circulation and the use of protective coatings (paints, varnishes, ceramic enamels), putty, adhesives, sealants and printing inks		
08 01	Waste from production, preparation, circulation and the use and removal of paints and varnishes		
08 01 11*	Waste paints and varnishes containing organic solvents or other dangerous substances	0.04	0.07
08 01 12	Waste paints and varnishes other than those listed in 08 01 11	0.04	0.07
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics		
12 01	Wastes from shaping and physical and mechanical surface treatment of metals and plastics		
12 01 13	Welding waste	0.09	0.13
13	Oils and liquid fuel waste (excluding edible oils and groups 05, 12 and 19)		
13 01	Hydraulic oil waste		
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.04	0.07
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.04	0.07
13 01 11*	Synthetic hydraulic oils	0.04	0.07
13 02	Engine, gear and lubricating oils waste		
13 02 04*	Mineral engine, gear and lubricating oils containing halogenated organic compounds	0.04	0.07
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.04	0.07
13 02 06*	Synthetic engine, gear and lubricating oils	0.04	0.07
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.04	0.07
13 02 08*	Other engine, gear and lubricating oils	0.04	0.07
13 03	Waste oils and liquids used as electroisolators and heat carriers		
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	0.17	0.27
13 04	Bilge oils		
13 04 03*	Bilge oils from sea ships	0.09	0.13
13 05	Wastes from dewatering oil in separators		

Expected types and quantities of waste in the construction phase		Applicant's variant	Rational alternative variant
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
13 05 02*	Sludge from dewatering oil in separators	0.44	0.66
13 05 06*	Oil from dewatering oil in separators	0.44	0.66
13 05 07*	Oily water from dewatering oil in separators	0.44	0.66
13 07	Liquid fuel waste		
13 07 01*	Furnace oil and diesel oil	0.04	0.07
13 07 02*	Petrol	0.04	0.07
13 08	Oil waste not included in other subgroups		
13 08 80	Oily solid waste from ships	0.09	0.13
14	Waste from organic solvents, coolants and propellants (excluding groups 07 and 08)		
14 06	Waste from organic solvents, coolants and propellants in foams or aerosols		
14 06 01*	Freons, HCFC, HFC	0.04	0.07
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.04	0.07
14 06 03*	Other solvents and solvent mixtures	0.04	0.07
15	Packaging waste; sorbents, wiping cloths, filter materials and protective clothing not included in other groups		
15 01	Packaging waste (including selectively collected municipal packaging waste)		
15 01 01	Paper and cardboard packaging	1.74	2.66
15 01 02	Plastic packaging	1.74	2.66
15 01 03	Wooden packaging	1.74	2.66
15 01 04	Metal packaging	1.74	2.66
15 01 05	Multi-material packaging	1.74	2.66
15 01 06	Mixed packaging waste	1.74	2.66
15 01 07	Glass packaging	0.09	0.13
15 01 09	Textile packaging	0.09	0.13
15 02	Sorbents, filter materials, wiping cloths and protective clothing		
15 02 02*	Sorbents, filter materials (including oil filters not included in other groups), wiping cloths (e.g. rags, dishcloths) and protective clothing contaminated with dangerous substances (e.g. PCBs)	0.87	1.33
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	0.87	1.33
16	Waste not included in other subgroups		
16 06	Batteries and accumulators		
16 06 01*	Lead batteries and accumulators	0.09	0.13
16 06 02*	Nickel-cadmium batteries and accumulators	0.09	0.13
16 06 03*	Batteries containing mercury	0.01	0.01
16 06 04	Alkaline batteries (excluding 16 06 03)	0.01	0.01
16 06 05	Other batteries and accumulators	0.01	0.01
16 81	Waste created as a result of accidents and unexpected random incidents		
16 81 01*	Wastes of hazardous properties	0.87	1.33
16 81 02	Waste other than those listed in 16 81 01	0.87	1.33
17	Wastes from construction, renovation and dismantling of construction works and road infrastructure (including soil and ground from contaminated areas)		

Expected types and quantities of waste in the construction phase		**Applicant's variant**	**Rational alternative variant**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
17 01	Waste materials and building elements as well as road infrastructure (e.g. concrete, bricks, boards, ceramics)		
17 01 01	Concrete waste and debris from demolition and renovation	43.54	66.46
17 01 03	Wastes of other ceramic materials and equipment items	8.71	13.29
17 01 82	Other not mentioned waste	43.54	66.46
17 02	Wood, glass and plastic waste		
17 02 01	Wood	1.74	2.66
17 02 02	Glass	0.09	0.13
17 02 03	Plastics	4.35	6.65
17 04	Scrap metal and metal alloys waste		
17 04 01	Copper, bronze, brass	0.04	0.07
17 04 02	Aluminium	0.04	0.07
17 04 04	Zinc	0.04	0.07
17 04 05	Iron and steel	0.87	1.33
17 04 07	Metal alloys	0.04	0.07
17 04 11	Cables other than those listed in 17 04 10	4.35	6.65
17 09	Other waste from construction, renovation and dismantling		
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	17.42	26.58
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	17.42	26.58
19	Waste from installations and devices for waste management, wastewater treatment plants and water treatment for drinking and for industrial purposes		
19 08	Waste from wastewater treatment plants not included in other subgroups		
19 08 05	Stabilized municipal sewage sludge	0.87	1.33
20	Municipal waste including selectively collected fractions		
20 01	Municipal waste segregated and collected separately (excluding 15 01)		
20 01 01	Paper and cardboard	0.87	1.33
20 01 02	Glass	0.87	1.33
20 01 08	Biodegradable kitchen waste	0.87	1.33
20 01 10	Clothing	0.87	1.33
20 01 21*	Fluorescent lamps and other waste containing mercury	0.04	0.07
20 01 23*	Devices containing freons	0.04	0.07
20 01 29*	Detergents containing dangerous substances	0.04	0.07
20 01 30	Detergents other than those listed in 20 01 29	0.04	0.07
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.04	0.07
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.04	0.07
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.04	0.07
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.04	0.07

Expected types and quantities of waste in the construction phase		Applicant's variant	Rational alternative variant
Code	Groups, subgroups and types of waste	Estimated quantity [Mg per year]	Estimated quantity [Mg per year]
20 03	Other municipal waste		
20 03 01	Unsorted (mixed) municipal waste	17.42	26.58

Source: modification of the EIA Report for BŚII (SMDI, 2015)

2.4.3 Construction and exploitation phase

The OWF construction concept assumes the possibility of simultaneous construction and exploitation of offshore wind power stations. In the impact assessment category, this phenomenon will be the sum of the simultaneous impact of the OWF construction in one place and exploitation elsewhere. Due to the different location and different technical requirements, conflicts and collisions should not be expected, provided that the exploitation and further development of the OWF will be covered by a coordinated ship traffic plan in the OWF Area.

2.4.4 Exploitation phase

In contrast to the construction phase, this stage will be characterised by the increased traffic of small and medium sized vessels related to the exploitation and service of the OWF. Three variants of exploitation are possible:

- the use of offshore residential and service stations – the movement of small vessels within the farm will take place between the station and individual wind power stations. To secure the functioning of the residential and service station, cyclical supply transport and periodic exchange of the station crew and service personnel will be necessary. The estimated number of trips will minimally increase the intensity of navigation for the main navigation routes and will only slightly increase the intensity of navigation in the service port;
- the use of medium sized vessels – service bases that will perform periodic service duty in the OWF area and make cyclical trips to service ports to replenish the supplies and exchange service personnel or crew. Changes in the intensity of navigation will occur in the same way as in the case above;
- the use of small vessels travelling between the service port(s) and the OWF area in the daily work cycle. The estimated number of trips will significantly increase the intensity of navigation on navigation routes and in ports.

The number of offshore operations related to the exploitation phase of the Baltica OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the installed electricity grid. Therefore, the number of operations and their effects (for example fuel consumption, emissions related to transport) for the Applicant's variant will be smaller than in the case of the rational alternative variant.

EMF

The exploitation of the offshore wind farm will be a long-term project. Offshore wind power stations will be connected by electricity grid and teletechnical networks with power substations. The length of the cables laid inside the OWF will depend on the number of installed wind turbines (up to 209 power stations) and on: 2 offshore research and measurement stations, 21 offshore power substations. It is assumed that the length of cable routes along which the cables will be laid in the

OWF Area will not be greater than 418 km. Cables buried in the seabed are optimized to emit a residual electric field. The possible magnetic component of the EMF is minimized by the conduct of the individual wires in the greatest proximity to each other (for individual phases for the alternating current or the flow directions of the direct current). In the case of the DC cables, the range of EMF influence is the smaller the closer the individual conductors of the line are run (there are practically no interactions in the composite cable). In the case of alternating current, the use of a composite cable reduces the magnetic field, but it may remain at the level generating the electric field in seawater (OSPAR, 2012). The remedy for this is the burial of the cable in the sediment, which does not reduce the effects of EMF by itself, but separating the cables from seawater reduces the impact considerably.

Heat emission through power cables

Electric current, flowing through a cable, causes it to heat up, as a result of power losses on the resistance, in accordance with Joule's law. As the temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment. An accurate quantification of the given heat is difficult because of the following phenomena: conduction, lifting and radiation of the heat, subject to different physical laws (Stiller et al., 2006). The heating of sediments may lead to a change in the taxonomic composition of the benthos living on and in the seabed in the immediate vicinity of the cables (OSPAR, 2009). According to the OSPAR's guide on the best environmental practices in the laying and use of subsea cables (OSPAR, 2012) the burial of the cable at a depth of 1 to 3 m under the seabed is sufficient to allow within 0.2 m below the seabed surface the rise of the sediment temperature associated with heat emission through the power cables under load to be not greater than the recommended 2°C. The minimum burial depth should be determined on the basis of the type of sediments (their thermal conductivity) and the type of electricity grid (size and type of loads, thermal characteristics).

Waste

The expected types and quantities of waste generated during the exploitation phase of the Baltica OWF divided in accordance with the Regulation of the Minister of the Environment of 9 December 2014 on Waste Catalogue (Journal of Laws of 2014, item 1923) have been presented in the table (Table 12). The amounts of waste shown refer to a single offshore wind power station or offshore power substation. Therefore, it should be assumed that the amount of solid waste and wastewater will be significantly higher in the case of the rational alternative variant than in the Applicant's variant.

The main factors causing the generation of waste and wastewater at the Baltica OWF's exploitation stage is the employment of ships and conduction of repairs.

Table 12. The compilation of waste generated during the exploitation phase of the Baltica OWF on an annual basis

Expected types and quantities of waste in the exploitation phase		**Applicant's variant**	**Rational alternative variant**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
08	Waste from production, preparation, circulation and the use of protective coatings (paints, varnishes, ceramic enamels), putty, adhesives, sealants and printing inks		
08 01	Waste from production, preparation, circulation and the use and removal of paints and varnishes		

Expected types and quantities of waste in the exploitation phase		Applicant's variant	Rational alternative variant
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
08 01 11*	Waste paints and varnishes containing organic solvents or other dangerous substances	0.87	1.33
08 01 12	Waste paints and varnishes other than those listed in 08 01 11	0.87	1.33
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics		
12 01	Wastes from shaping and physical and mechanical surface treatment of metals and plastics		
12 01 13	Welding waste	0.17	0.27
13	Oils and liquid fuel waste (excluding edible oils and groups 05, 12 and 19)		
13 01	Hydraulic oil waste		
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.05	0.08
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.05	0.08
13 01 11*	Synthetic hydraulic oils	0.05	0.08
13 01 12*	Hydraulic oils that are easily biodegradable	0.05	0.08
13 01 13*	Other hydraulic oils	0.05	0.08
13 02	Engine, gear and lubricating oils waste		
13 02 04*	Mineral engine, gear and lubricating oils containing halogenated organic compounds	0.05	0.08
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.05	0.08
13 02 06*	Synthetic engine, gear and lubricating oils	0.05	0.08
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.05	0.08
13 02 08*	Other engine, gear and lubricating oils	0.05	0.08
13 03	Waste oils and liquids used as electroisolators and heat carriers		
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	1.74	2.66
13 04	Bilge oils		
13 04 03*	Bilge oils from sea ships	0.17	0.27
13 05	Wastes from dewatering oil in separators		
13 05 02*	Sludge from dewatering oil in separators	0.87	1.33
13 05 06*	Oil from dewatering oil in separators	0.87	1.33
13 05 07*	Oily water from dewatering oil in separators	0.87	1.33
13 07	Liquid fuel waste		
13 07 01*	Furnace oil and diesel oil	0.17	0.27
13 07 02*	Petrol	0.09	0.13
13 08	Oil waste not included in other subgroups		
13 08 80	Oily solid waste from ships	0.17	0.27
14	Waste from organic solvents, coolants and propellants (excluding groups 07 and 08)		
14 06	Waste from organic solvents, coolants and propellants in foams or aerosols		

Expected types and quantities of waste in the exploitation phase		Applicant's variant	Rational alternative variant
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
14 06 01*	Freons, HCFC, HFC	0.09	0.13
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.09	0.13
14 06 03*	Other solvents and solvent mixtures	0.09	0.13
15	Packaging waste; sorbents, wiping cloths, filter materials and protective clothing not included in other groups		
15 01	Packaging waste (including selectively collected municipal packaging waste)		
15 01 01	Paper and cardboard packaging	0.17	0.27
15 01 02	Plastic packaging	0.17	0.27
15 01 03	Wooden packaging	0.17	0.27
15 01 04	Metal packaging	0.17	0.27
15 01 05	Multi-material packaging	0.17	0.27
15 01 06	Mixed packaging waste	0.17	0.27
15 01 07	Glass packaging	0.17	0.27
15 01 09	Textile packaging	0.17	0.27
15 02	Sorbents, filter materials, wiping cloths and protective clothing		
15 02 02*	Sorbents, filter materials (including oil filters not included in other groups), wiping cloths (e.g. rags, dishcloths) and protective clothing contaminated with dangerous substances (e.g. PCBs)	0.52	0.80
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	0.52	0.80
16	Waste not included in other subgroups		
16 06	Batteries and accumulators		
16 06 01*	Lead batteries and accumulators	0.17	0.27
16 06 02*	Nickel-cadmium batteries and accumulators	0.17	0.27
16 06 03*	Batteries containing mercury	0.02	0.03
16 06 04	Alkaline batteries (excluding 16 06 03)	0.02	0.03
16 06 05	Other batteries and accumulators	0.02	0.03
16 81	Waste created as a result of accidents and unexpected random incidents		
16 81 01*	Wastes of hazardous properties	0.52	0.80
16 81 02	Waste other than those listed in 16 81 01	0.52	0.80
17	Wastes from construction, renovation and dismantling of construction works and road infrastructure (including soil and ground from contaminated areas)		
17 01	Waste materials and building elements as well as road infrastructure (e.g. concrete, bricks, boards, ceramics)		
17 01 01	Concrete waste and debris from demolition and renovation	8.71	13.29
17 01 03	Wastes of other ceramic materials and equipment items	1.74	2.66
17 01 82	Other not mentioned waste	8.71	13.29
17 02	Wood, glass and plastic waste		
17 02 01	Wood	0.35	0.53
17 02 02	Glass	0.17	0.27
17 02 03	Plastics	0.87	1.33

Expected types and quantities of waste in the exploitation phase		**Applicant's variant**	**Rational alternative variant**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per year]**	**Estimated quantity [Mg per year]**
17 04	Scrap metal and metal alloys waste		
17 04 01	Copper, bronze, brass	0.09	0.13
17 04 02	Aluminium	0.09	0.13
17 04 04	Zinc	0.09	0.13
17 04 05	Iron and steel	1.74	2.66
17 04 07	Metal alloys	0.09	0.13
17 04 11	Cables other than those listed in 17 04 10	8.71	13.29
17 09	Other waste from construction, renovation and dismantling		
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	3.48	5.32
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	3.48	5.32
19	Waste from installations and devices for waste management, wastewater treatment plants and water treatment for drinking and for industrial purposes		
19 08	Waste from wastewater treatment plants not included in other subgroups		
19 08 05	Stabilized municipal sewage sludge	5.23	7.98
20	Municipal waste including selectively collected fractions		
20 01	Municipal waste segregated and collected separately (excluding 15 01)		
20 01 01	Paper and cardboard	3.48	5.32
20 01 02	Glass	3.48	5.32
20 01 08	Biodegradable kitchen waste	3.48	5.32
20 01 10	Clothing	3.48	5.32
20 01 21*	Fluorescent lamps and other waste containing mercury	0.17	0.27
20 01 23*	Devices containing freons	0.17	0.27
20 01 29*	Detergents containing dangerous substances	0.17	0.27
20 01 30	Detergents other than those listed in 20 01 29	0.17	0.27
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.17	0.27
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.17	0.27
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.17	0.27
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.17	0.27
20 03	Other municipal waste		
20 03 01	Unsorted (mixed) municipal waste	52.25	79.75

Source: modification of the EIA Report for BŚII (SMDI, 2015)

2.4.5 Decommissioning phase

In technical terms, the decommissioning phase is a reversal of the OWF construction phase. In the reverse order of the construction phase, the individual components of offshore wind power stations will be removed and transported to utilization sites.

The number of offshore operations related to the decommissioning phase of the Baltica OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the installed electricity grid. Therefore, the number of operations and their effects (e.g. fuel consumption, emissions related to transport) for the Applicant's variant will be smaller than in the case of the rational alternative variant.

Waste

The expected types and quantities of waste generated during the decommissioning phase of the Baltica OWF divided in accordance with the Regulation of the Minister of the Environment of 9 December 2014 on Waste Catalogue (Journal of Laws of 2014, item 1923) have been presented in the table (Table 13). The amounts of waste presented refer to a single offshore wind power station or offshore power substation – the maximum values for these two types of structures have been adopted. Therefore, it should be assumed that the amount of solid waste and wastewater will be significantly higher in the case of the rational alternative variant than in the Applicant's variant.

It is expected that decommissioning of the structures in the Baltica OWF Area will take place to the level of the seabed (embedded piles will be left in the seabed, because they do not cause environmental impact, whereas their removal may cause environmental impact – e.g. when applying disposal methods employing explosives). In the case of the decommissioning of the Baltica OWF, the generation of waste is mainly related to the physical removal of the worn out Baltica OWF's components and the exploitation of ships used during the decommissioning.

Table 13. The compilation of waste generated during the decommissioning phase of the Baltica OWF for a single structure

Expected types and quantities of waste in the decommissioning phase		**Single wind power station or offshore power substation**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per structure]**
13	Oils and liquid fuel waste (excluding edible oils and groups 05, 12 and 19)	
13 01	Hydraulic oil waste	
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.05
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 01 12*	Hydraulic oils that are easily biodegradable	0.05
13 01 13*	Other hydraulic oils	0.05
13 02	Engine, gear and lubricating oils waste	
13 02 04*	Mineral engine, gear and lubricating oils containing halogenated organic compounds	0.1
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.1
13 02 06*	Synthetic engine, gear and lubricating oils	0.1
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.1

Expected types and quantities of waste in the decommissioning phase		**Single wind power station or offshore power substation**
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per structure]**
13 02 08*	Other engine, gear and lubricating oils	0.1
13 03	Waste oils and liquids used as electroisolators and heat carriers	
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	82.5
13 04	Bilge oils	
13 04 03*	Bilge oils from sea ships	0.1
13 08	Oil waste not included in other subgroups	
13 08 80	Oily solid waste from ships	0.1
14	Waste from organic solvents, coolants and propellants (excluding groups 07 and 08)	
14 06	Waste from organic solvents, coolants and propellants in foams or aerosols	
14 06 01*	Freons, HCFC, HFC	0.1
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.1
14 06 03*	Other solvents and solvent mixtures	0.1
15	Packaging waste; sorbents, wiping cloths, filter materials and protective clothing not included in other groups	
15 01	Packaging waste (including selectively collected municipal packaging waste)	
15 01 01	Paper and cardboard packaging	0.1
15 01 02	Plastic packaging	0.1
15 01 03	Wooden packaging	0.1
15 01 04	Metal packaging	0.1
15 01 05	Multi-material packaging	0.1
15 01 06	Mixed packaging waste	0.1
15 01 07	Glass packaging	0.1
15 01 09	Textile packaging	0.1
15 02	Sorbents, filter materials, wiping cloths and protective clothing	
15 02 02*	Sorbents, filter materials (including oil filters not included in other groups), wiping cloths (e.g. rags, dishcloths) and protective clothing contaminated with dangerous substances (e.g. PCBs)	1
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	1
16	Waste not included in other subgroups	
16 06	Batteries and accumulators	
16 06 01*	Lead batteries and accumulators	0.1
16 06 02*	Nickel-cadmium batteries and accumulators	0.1
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (excluding 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81	Waste created as a result of accidents and unexpected random incidents	
16 81 01*	Wastes of hazardous properties	1
16 81 02	Waste other than those listed in 16 81 01	1
17	Wastes from construction, renovation and dismantling of construction works and road infrastructure (including soil and ground from contaminated areas)	
17 01	Waste materials and building elements as well as road infrastructure (e.g. concrete, bricks, boards, ceramics)	
17 01 01	Concrete waste and debris from demolition and renovation	7000

Expected types and quantities of waste in the decommissioning phase		Single wind power station or offshore power substation
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per structure]**
17 01 03	Wastes of other ceramic materials and equipment items	50
17 01 07	Mixed waste from concrete, brick rubble, ceramic materials and elements of equipment other than those listed in 17 01 06	50
17 01 82	Other not mentioned waste	50
17 02	Wood, glass and plastic waste	
17 02 01	Wood	0.1
17 02 02	Glass	2
17 02 03	Plastics	1000
17 04	Scrap metal and metal alloys waste	
17 04 01	Copper, bronze, brass	1
17 04 02	Aluminium	1
17 04 04	Zinc	1
17 04 05	Iron and steel	4000
17 04 07	Metal alloys	1
17 04 11	Cables other than those listed in 17 04 10	71
17 09	Other waste from construction, renovation and dismantling	
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	50
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	50
19	Waste from installations and devices for waste management, wastewater treatment plants and water treatment for drinking and for industrial purposes	
19 08	Waste from wastewater treatment plants not included in other subgroups	
19 08 05	Stabilized municipal sewage sludge	1
20	Municipal waste including selectively collected fractions	
20 01	Municipal waste segregated and collected separately (excluding 15 01)	
20 01 01	Paper and cardboard	1
20 01 02	Glass	1
20 01 08	Biodegradable kitchen waste	1
20 01 10	Clothing	1
20 01 21*	Fluorescent lamps and other waste containing mercury	0.05
20 01 23*	Devices containing freons	0.05
20 01 29*	Detergents containing dangerous substances	0.05
20 01 30	Detergents other than those listed in 20 01 29	0.05
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.05
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.05
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.05
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03	Other municipal waste	

Expected types and quantities of waste in the decommissioning phase		Single wind power station or offshore power substation
Code	**Groups, subgroups and types of waste**	**Estimated quantity [Mg per structure]**
20 03 01	Unsorted (mixed) municipal waste	20

Source: modification of the EIA Report for BŚII (SMDI, 2015)

2.4.6 The information on energy demand and its consumption

The most important factor shaping the energy demand and its consumption is the choice of the structure types built in the OWF Area and the organisation of building work, and then the choice of one of the OWF exploitation methods presented in the section 2.4.4. The energy needed and consumed for the construction of the OWF is almost 100% fuel used for transportation, transhipment and installation of components of wind power stations and other OWF's facilities.

In contrast to commercial shipping, the specialist vessels adapted to work in the construction and maintenance of offshore industrial structures have a different exploitation profile. This is primarily related to the need to perform complex marine operations (transhipments, working in dynamic positioning mode), which are not related to the distance travelled, but determined by the number of working hours. Therefore, the estimation of the planned fuel consumption depends on a very large number of variable factors and is virtually always subject to a significant error.

Average fuel consumption values for different types of vessels have been presented in the table (Table 14).

Table 14. Average fuel consumption for various types of ships

Vessel size	Designation	Average fuel consumption (diesel) [$kg \cdot h^{-1}$]	Nominal daily working time [h]
Small vessels	Small supplies, personnel transport, one-day service, emergency operations – for each stage	50–200	8–10
Medium size vessels	Supplies, support for construction works, towing work, multi-day stationary service – for each stage	500–2000	12–18
Large vessels	Supplies, storage, construction work – mainly for the construction and demolition phase	2500–5000	12–24

Source: own elaboration based on Borkowski, 2017

The number of offshore operations related to the construction, exploitation and decommissioning phase of the Baltica OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the installed electricity grid. Therefore, the fuel consumption and emissions resulting from transportation will be smaller for the Applicant's variant than in the case of the rational alternative variant.

2.5 The risk of major accidents or natural and construction disasters

2.5.1 Types of breakdowns resulting in environmental contamination

The project related to the construction, exploitation and decommissioning of offshore wind farms is an undertaking involving several decades of complex activities carried out on land and at sea.

The project which is the subject of this report is not the place of storage of substances determining the project's classification as a plant with an increased or high risk of a serious industrial accident pursuant to the Regulation of the Minister of Development of 29 January 2016 on the types and quantities of hazardous substances present in the industrial plants, which determine the plant's classification as a plant with an increased or high risk of a serious industrial accident (Journal of Laws of 2016, item 138).

All elements for the OWF construction and its operation are manufactured on land. Construction, installation, service, renovation and subsequent demolition work are carried out at sea. All these activities depend on vessels: transportation, service and construction.

Ports and ships are of key importance during the implementation of the project. Large-scale components of wind power stations, foundations and towers, residential and service platforms and research and measuring platforms as well as power substations are manufactured in ports or their immediate vicinity. The technologies and production processes related to their production do not create a risk of emergency situations. Possible emergencies will not cause significant emissions of pollutants threatening the environment. Also during the decommissioning of the disassembled components of wind power stations in port areas no events will occur that pose a threat to the environment.

The main threats that may occur during the construction and decommissioning of offshore wind power stations are the spillages of oil derivative substances, mainly diesel, hydraulic, transformer and lubricating oils. To a lesser extent, the marine environment may incidentally be endangered with materials containing hazardous substances, if they were used. During the exploitation phase, the main cause of marine pollution can be oil spills. Both within the open sea waters (e.g. the OWF) and near the coast, they can be a problem with long-lasting effects on fauna, flora, fishery and beaches affected by the contamination.

The size of oil contamination can be classified in the following way:

- **I degree (small spillage)** – small leakages of oil derivative substances which do not require the intervention of external forces and resources, and are possible to be removed with own resources. These spills have a local character, their removal does not present particular technical difficulties and they do not pose a great threat to the marine environment;
- **II degree (medium-sized spillage)** – spills of oil derivative substances, the scale of which requires a coordinated counteraction within the maritime area under the authority of the Director of the Maritime Office, who decides on the required scale of the counteraction;
- **III degree (catastrophic spillage)** – oil derivatives spill that is extremely dangerous to the environment the neutralisation of which involves the forces and resources subordinate to more than one Director of the Maritime Office.

2.5.2 Accident description with a potential impact assessment

2.5.2.1 Oil derivatives leak (in the course of the normal operation of vessels)

Various oil derivative substances' (lubricating and diesel oils, petrol) leaks may occur during normal vessels' operation. It should be assumed that these will be small (I degree) spills, up to 20 m^3.

From an environmental point of view, the places most vulnerable to any spillages are: the Słupsk Bank and the coast area approximately between the towns of Ustka in the west and Dębki in the east. Taking into account the prevailing western wind and the coastal currents, the endangered area is the coast with tourist destinations (Jarosławiec, Rowy) and small ports from Ustka and Łeba in the west to the town and port of Władysławowo.

The areas particularly vulnerable to potential pollution are the conservation areas including the areas belonging to the Natura 2000 network (Reszko, 2017).

It should be emphasized that the key issue here is not so much the size of the spillage as the place where it has occurred. There are known cases of high birds' mortality due to small oil spills into the sea. Extensive oil spills drifting away from the coasts, on waters with very low numbers of birds do not cause as much losses in populations as smaller spills in the place of high concentration of seabirds (Meissner, 2005). In the area of the planned Baltica OWF, the density of birds was relatively small, reaching 50 indiv.$\cdot$km^{-2}. In the area of the Słupsk Bank, the density of birds reached 500 indiv.$\cdot$km^{-2}, and up to 1000 indiv.$\cdot$km^{-2} in the winter. It should be emphasized, however, that in the case of I degree spills and with the proper management of the ship traffic, the situation in which the uncontrolled dispersal of oil derivative substances reaches the important natural areas is unlikely.

The determination of the actual extent of spillage will be possible technically only during the event, based on current meteorological data and data on the type and potential quantity of contaminant. Therefore, at the report stage, it is not possible to make a more detailed assessment of impact on marine organisms that are the most exposed to the effects of oil spills.

The number of potential leaks is proportional to the number of vessels used to carry out the investment's implementation, its operation or decommissioning.

Oil derivatives leak (during an emergency situation)

During the construction, exploration and decommissioning phase of the Baltica OWF a leak of oil derivative substances may occur, the consequence of which will be water column and sediment contamination. A leak may occur as a result of a breakdown or collision of vessels, their allision with OWF's facilities, their sinking or grounding, as well as during seepage and operational leaks from vessels, leaks from the oil installation of a wind power station, leaks from the transformer at a power substation or oil spill related to inspections and repairs of farm elements. In the worst case scenario, during the construction or decommissioning stage, II degree spills (spills of medium size) will occur. It has been calculated that the probability of serious accidents is very small, ranging from 10^{-5} (practically impossible – 1 in 100 000 years) to 10^{-2} (rare – 1 in 100 years).

Assuming the worst case scenario and the release of 200 m^3 of diesel fuel into the marine environment, as well as taking into account its type, the behaviour in seawater, the time of the oil dispersion and drift, it is estimated that the extent of pollution will not exceed 5 to 20 km from the Baltica OWF.

The specification of this type of oil means it is neither a particularly dangerous nor laborious pollutant. Such assessment is confirmed by the analysis carried out using the ADIOS tool (Reszko, 2017). In this case, there are organisational structures, management plans for conducting actions to combat hazards and pollution and effective methods of removing pollution.

The release of chemical substances and waste

During the construction of a wind farm, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the investments) and on the project's site, the generated waste will be directly related to the process of construction. These can include, among others, damaged parts of the farm elements, cement, grout, mortar, adhesives used to connect elements of the power stations and other chemical substances used during the construction. These can be accidentally released into the sea.

Loose cement is packed in bags of about 1 m^3. It has been assumed that during transshipment about 5 m^3 of the product can sink. Grout, mortar and other sealants often contain hazardous substances. For instance, epoxy (two-component) sealants contain in various proportions: epoxy resin, alkyl glycol ethers, and polyaminoamides. Due to their high density (about 1.3 $g \cdot cm^{-1}$), after the release into the water, these substances sink and deposit on the seabed. They are considered a serious threat because they cannot be easily removed from the seabed and are toxic to marine organisms.

During the decommissioning of the farm the contamination of sediments with waste from the process seems inevitable. The size of this impact will depend on the method of conducting these works and the greatest contamination can occur in the case of the necessity to crush the gravity based structures.

It is estimated that the possible occurrence of the above emergencies will not affect the structure and functioning of marine organisms in the area of investment, nor will it cause their mortality.

The possibility of releasing waste or chemicals into the water is proportional to the activity associated with the use of chemicals.

2.5.3 Other types of releases

2.5.3.1 The release of municipal waste or domestic sewage

During the construction of the wind farm, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the investment) waste, mostly municipal and other, not directly related to the construction process, as well as domestic sewage will be generated. Waste and wastewater can be accidentally released into the sea while being transferred from the ship by another vessel and in the case of a breakdown, causing local increase in concentration of nutrients and deterioration of the quality of water and sediments.

It is estimated that the possible occurrence of the above releases will not affect the structure and functioning of marine organisms in the area of investment, nor will it cause their mortality.

2.5.3.2 Water column and seabed sediments contamination with antifouling agents

In order to protect ship hulls against fouling, biocides are used the composition of which may include for example: copper, mercury and tributyltin compounds (TBT). These substances can pass into the water column and eventually be retained in the sediments. It should be assumed that the emission of these compounds will be slight. Of these substances, the most harmful (toxic) to aquatic organisms are organotin compounds. Currently, the usage of TBT (the most harmful substance) in antifouling paints is prohibited. However, the presence of these compounds cannot be excluded in the protective coatings of older vessels. This impact can be limited by introducing the control of the type of protective coatings on vessels employed in operations at the OWF Area.

It is estimated that the possible occurrence of the above events will not affect the structure and functioning of marine organisms in the area of investment, nor will it increase their mortality.

2.5.3.3 Release of pollutants from anthropogenic objects on the seabed

It is impossible to exclude completely the possibility of the release of contaminants from anthropogenic objects lying on the seabed. In the course of geophysical surveys, in 2016, the Baltica

OWF Area was systematically checked for the presence of objects of anthropogenic origin, including packaging and containers which can contain hazardous chemicals. Such objects may come, for example, from insufficiently secured cargoes of ships passing through the Baltica OWF Area. No such objects were found on the seabed in the Baltica OWF Area. It is not excluded that such objects can be buried in the seabed and therefore have not been discovered during the geophysical surveys. During the geophysical surveys, only the reviewing magnetometric surveys have been carried out, which were to reveal only larger ferromagnetic objects. Therefore, it cannot be ruled out that during the preparatory work for the construction process, including, in particular, the survey of seabed cleanliness in terms of the occurrence of unexploded ordnance and chemical weapons, new anthropogenic objects (for example small barrels or unexploded ordnance) may be discovered. In order to determine the way of dealing with such finds, the Applicant will prepare a plan for dealing with dangerous objects, both from the point of view of operational work at sea (for example, rules for conducting works in the vicinity of potentially hazardous objects) and from the point of view of possible removal or avoidance of such objects. The basic assumption of the plan for dealing with dangerous objects is to avoid threats to human life and health and to avoid the spread of contaminants from such objects.

2.5.4 Environmental threats

2.5.4.1 Construction phase

Based on data obtained from other OWF projects and similar undertakings as well as on the authors' knowledge and experience the following potential environmental threats, which may become a source of negative impact of offshore wind farms on the environment, have been identified for the construction phase:

- oil derivatives leak as a result of collision of ships and/or helicopters, construction accident or catastrophe (during normal operation or an emergency situation);
- accidental release of municipal waste or domestic sewage;
- accidental release of building materials or chemical agents;
- contamination of the water column and seabed sediments with antifouling agents.

It should be noted that as a direct result of emergency situations and incidents, the abiotic environment, especially seawater and, to a lesser extent, seabed sediments can become contaminated. On the other hand, indirectly these events can also affect living organisms, those inhabiting or otherwise using the seabed, water column and the surface of the sea. The contamination of water and/or seabed sediments with municipal waste or domestic sewage is a direct negative impact, temporary or short-term, reversible, of local range. The scale of impact is negligible.

The collision of ships and helicopters and the resulting from it release of dangerous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small. In addition, the implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms.

The main threat to the Natura 2000 sites in the construction phase is the release of hazardous substances (especially oil derivatives) into the environment as a result of collisions of ships and helicopters. This factor may cause increased mortality and diseases of marine organisms, including those which are the subject of protection in these areas. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms. It can be assumed that this factor will not significantly affect the protected areas.

2.5.4.2 Exploitation phase

During the exploitation of the farm, threats to the environment, especially the contamination of the water column and seabed sediments by the following may occur:

- oil-derivatives;
- antifouling agents;
- accidentally released municipal waste and domestic sewage;
- accidentally released chemical agents and waste from farm exploitation.

Waste and sewage may be generated by people on ships and during exploitation while servicing towers and transmission infrastructure.

The collision of ships and helicopters and the resulting from it release of dangerous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms.

The impacts caused by the occurrence of emergency situations in the exploitation phase are identical as those that may occur during the OWF construction phase. Only the aspect regarding the accidental release of chemicals and waste is slightly different. During the farm's exploitation, the maintenance of its facilities will be carried out. An accidental release of small quantities of waste or operating fluids into the sea cannot be excluded. It is estimated that the possible occurrence of the above unexpected random incidents will not affect the structure and functioning of marine organisms in the area of investment, nor will it cause their mortality.

During the OWF's exploitation as a result of collisions and breakdowns of vessels and helicopters involved in the investment's service, harmful chemical substances, mainly fuels, motor oils or hydraulic fluids may leak into the environment. Their impact on marine organisms can be an important pathogenic factor and result in increased mortality. However, the likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events. The threat from this event can be considered as irrelevant.

The main threat to the Natura 2000 sites in the exploitation phase is the release of hazardous substances (especially oil derivatives) into the environment as a result of collisions of ships and helicopters. This factor may cause increased mortality and diseases of marine organisms, including the subject of protection in these areas. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms. It can be assumed that this factor will not significantly affect the protected areas.

2.5.4.3 Construction and exploitation phase

The collision of ships and helicopters and the resulting from it release of dangerous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events has been considered as small in the case of conducting the works related to the construction and exploitation phase separately. However, the simultaneous presence of vessels engaged in construction and service works increases the risk of collisions and the negative impacts associated with them. Therefore, the original significance of the impact (ranging from insignificant to negligible) may be increased to moderate, however, this will not require the necessity to apply mitigation measures.

2.5.4.4 Decommissioning phase

During the decommissioning of the farm, there may also be impacts resulting from the occurrence of emergency situations and other environmental hazards, in particular the contamination of water column and seabed sediments with:

- accidentally released municipal waste and domestic sewage;
- oil-derivatives;
- antifouling agents.

The risk of sewage release from the ship into the water column exists at the time of collection of sewage from a ship by another vessel and in the event of a breakdown. It may cause local increase of nutrients concentration and deterioration of water quality. The contaminants should rapidly dissipate, which will stop them from contributing to permanent environment deterioration in the investment area.

The impacts related to environmental threats in the decommissioning phase are identical to the described above impacts for the OWF construction phase.

During the OWF's decommissioning as a result of collisions and breakdowns of vessels and helicopters involved in the investment's service, harmful chemical substances, mainly fuels, motor oils or hydraulic fluids may leak into the environment. Their impact on marine organisms can be an important pathogenic factor and result in increased mortality. However, the likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events. The threat from this event can be considered as irrelevant.

2.5.5 Preventing breakdowns

The prevention of breakdowns constitutes the whole range of activities related to the protection of human life and health, the natural environment and property, as well as the reputation of all participants in the processes related to the construction, exploitation and decommissioning of the OWF. These activities include, among others:

- developing plans for safe construction, exploitation and decommissioning of the OWF;
- developing rescue plans and training of crews and personnel, including the principles of updating and verification by conducting regular exercises, in particular determining procedures for the use of own vessels and external vessels, including helicopters;
- developing a plan for counteracting threats and pollution arising during the construction, exploitation and decommissioning of the OWF;
- selecting suppliers as well as certified parts and components of the OWF;
- designating protection zones;
- accurate marking of the OWF area, its facilities and vessels moving within the area;
- planning offshore operations;
- applying the standards and guidelines of IMO, recognized classification societies and the maritime administration recommendations;

- developing plans of safe navigation within the OWF area and safe passages to ports;
- providing adequate navigational support in the form of maps and navigational warnings;
- providing direct or indirect navigational supervision using a surveillance vessel or remote radar and AIS surveillance;
- continuous monitoring of vessel traffic within the OWF, direct or remote throughout the entire period of the construction, exploitation and decommissioning of the OWF;
- the establishment of a coordination centre supervising the construction, exploitation and decommissioning of the OWF;
- maintaining regular communication lines between the OWF coordination centre and the coordinator of works at sea and other coordination centres such as Maritime Rescue Coordination Centre in Gdynia and maritime administration in Słupsk/Ustka.

2.5.6 Design, technology and organisational security expected to be applied by the Applicant

Design, technological and organizational security mainly relies on carrying out navigational risk assessments and developing prevention plans against:

- threats to human life – evacuation plans, search and rescue plans;
- fire hazards;
- threats of environmental pollution – a plan to counteract the threats and contamination by oil. The principle of the obligation to have a plan will apply not only to the facility, but also to all large and medium-sized vessels involved in the construction, exploitation and decommissioning of the OWF;
- threats of construction disasters – all structures are designed taking into account extreme conditions for at least double exploitation period.

2.5.7 Potential causes of breakdowns including extreme situations and the risk of natural and construction disasters

The OWF constructions because of their purpose are designed and built with the idea of withstanding extremely difficult atmospheric conditions. All components, despite subjecting them to extremely high loads, are adapted to many years of use. All devices are subjected to continuous monitoring and each signal about the occurrence of deviations from the situation classified as a safe operation causes an automatic activation of remote service interventions or a change of operating parameters including stopping the devices. The rotor is stopped automatically at a wind speed exceeding safe speed for an operation of a wind power station. The service plan is to ensure flawless operation.

Potentially the greatest risks occur at the construction stage, however the risk of disaster is minimal due to the fact that the planning of offshore operations always takes into account weather conditions and the possibility of their change. Every offshore operation has its limitations in terms of visibility, wind speed, sea status (height of waves) or ambient temperatures. The occurrence of negative effects of climate change in the form of too strong wind or too high waves can only result in the extension of the construction cycle and an increased demand for energy – fuel consumption.

2.5.8 The risk of major natural or constructional accidents and disasters, taking into account the substances and technologies applied, including the risk related to climate change

The risk of a major accident resulting in the emission of hazardous substances is minimal (Reszko, 2017). The probability of events such as ship collisions belong to the category of very rare events (return period over 100 years), and such as ship's contact with the OWF construction to the category of very rare events with a return period of over 200 years. Taking into account the effects in the form of 200 m^3 of diesel oil emission, the risk level is within an acceptable range. Emission of 200 m^3 of diesel oil will cause insignificant damage to the environment because it will disperse within 12 hours.

2.6 Relations between the parameters of the project and its impacts

The matrix of connections between the project's parameters and impacts has been presented in the table (Table 15).

Table 15. A matrix of connections between project parameters and impacts

Parameter	Type of emission or disturbance															
	Above-water structures	Underwater structures	Heat	EMF	Above-water noise	Underwater noise	Waste	Light effects	Seabed disturbances	Suspended solids	Resuspension of contaminants	Resedimentation	The creation of artificial reef	Water contamination	Air pollutions	Increased traffic and collision risk
Number of wind power stations	X	X			X		X	X								X
Number of foundations		X				X	X		X	X	X	X	X	X		
The type of foundations and the width of the protection against washout						X			X	X	X	X	X	X		
Foundation diameter		X				X			X	X	X	X	X			
Piling parameters						X										
Full height of structure	X				X			X								X
Rotor diameter [m]	X															
Length and type of cables		X	X	X						X	X	X				X
Depth and method of cables' laying/burying			X	X		X					X					
Number and size of power substations	X	X		X	X			X								
Organization of technological processes (number of ships, time)					X	X	X	X						X	X	X

Source: internal data

3 Environmental conditions

3.1 Location, seabed topography

The planned Baltica OWF is located on the Southern Baltic north of the Słupsk Bank, about 26 km north of the shoreline (Figure 1). The OWF Area (1 NM) is about 483 km^2. The OWF Area (1 NM) (Figure 10) includes a fragment of the northern slope of the Słupsk Bank. The depth of the seabed ranges here from 20 to 60 m. There are clear differences in the distribution of depths in the western, central, and eastern parts of the area in question.

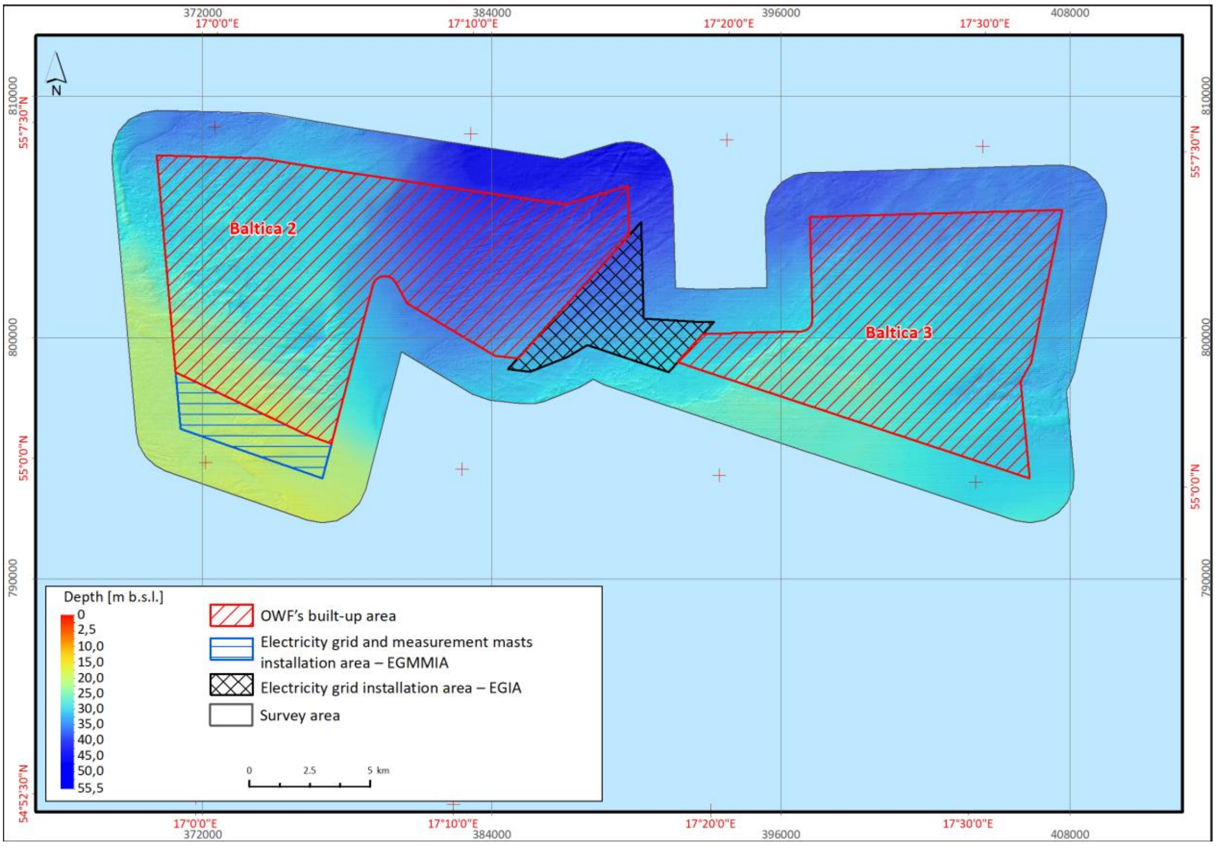


Figure 10. Bathymetric map of the OWF Area (1 NM)

Source: internal data

The eastern part of the Baltica OWF declines towards the north-east, with the depths in the south from about 20 m to about 50 m in the north-east. Seabed inclinations range here from 0° to 6°, though at places they reach about 15°. The seabed surface is varied. Most of the western area consists of a flatland of abrasive-accumulative character. In the central part of this plain, with a depth of about 30 to 40 m, there are numerous cuestas and hills with height differences up to 3 m. There are maximum inclination values of up to about 15° associated with the slopes of the perches. In the southern part, the depth of which is 20–30 m, there is an upland with numerous hills, hollows and embankments. The remaining area of the seabed, which occupies the eastern side of the central part, consists of an accumulative flatland with a depth of 40 to 50 m.

The central part of the Baltica OWF includes an area with depths between about 30 and 60 m. It constitutes a sharp decline located between the higher fragments of the western and the eastern parts. The surface is rather level, with a gentle slope (of below 2°) towards the north. The most significant height differences (of up to 3 m) and inclinations (of up to about 15°) are associated only with the slopes of cuestas and hills located in the southern part of this area.

The eastern part of the Baltica OWF with depths between about 28 and 50 m declines gently towards the north (about 1°). The most significant height differences (of up to 3 m) and inclinations (of up to about 15°) are associated only with slopes of cuestas and hills located in the south-western part, and very rarely also in the centre of this area.

3.2 Geological structure, seabed sediments, raw materials and deposits

3.2.1 Geological structure, geotechnical conditions

Description of seabed depth changes and seabed topography of the OWF Area (1 NM) were elaborated in the form of a map of types of seabed surface (Figure 11) using: the bathymetric map, the map of seabed slopes, the sonar mosaic, the map of surface sediments, the map of boulder areas, the map of ripple marks, and the sample geological cross-sections.

The following elements have been identified:

- area of a **moraine plateau (P1)**, which consists of clays with a thin, variable and discontinuous layer of sands and gravels with a thickness of up to 50 cm (in the western part), with numerous boulder areas of abrasive pavement exposed on the seabed surface in stripes. In the eastern part of this fragment, there occurs a thicker cover consisting of sands and sand and gravel in places, with a thickness exceeding 1 m;
- **moraine plateau slope (P2)**, which is of relatively wider angle of inclination (about 2°), spreading between the isobaths of 25–26 m and 31–32 m, with a character resembling that of the moraine plateau. Between the numerous strips of boulder areas, there are fields of ripple marks (with a distance between the crests of up to 50 cm) developed on a thin variable sandy layer which expands onto marginal fragments of boulder areas;
- **plateau of kame terraces (P3)**, which covers two fields with characteristics of a plateau [one of which is located in the western part of the OWF Area (1 NM), and the other in its eastern part] with numerous height differences (primarily of about 2 m), with lowerings and elevations of diverse shapes and a chaotic arrangement. These forms are associated with the processes of melting of both surface and buried ice, as well as with the formation and development of bodies of standing water, streams' flows, and soil creeps. The so-called kame terraces developed in the area between the moraine plateau and the intensively melting front of the stagnant ice-sheet are of the same nature;
- a **flat abrasive-accumulative platform (P4)** located in the eastern part of the OWF Area (1 NM). This area slopes gently (below 2°) towards the north and it has a sand and gravel cover with a thickness of over 1 m on a rough abrasive surface consisting of boulder clays with abrasive pavement in the top layer and loam-silt sediment accumulations (primarily in the northern part). Height differences do not exceed 1 m here;
- an **area with remains of hills built of old clays and modified by glaciotectonic activity (P5)** with series of cuestas and hills, the height differences of which do not exceed 3 m, while their inclination angles are up to over a dozen degrees. This area covers the southern edges of the OWF Area (1 NM).

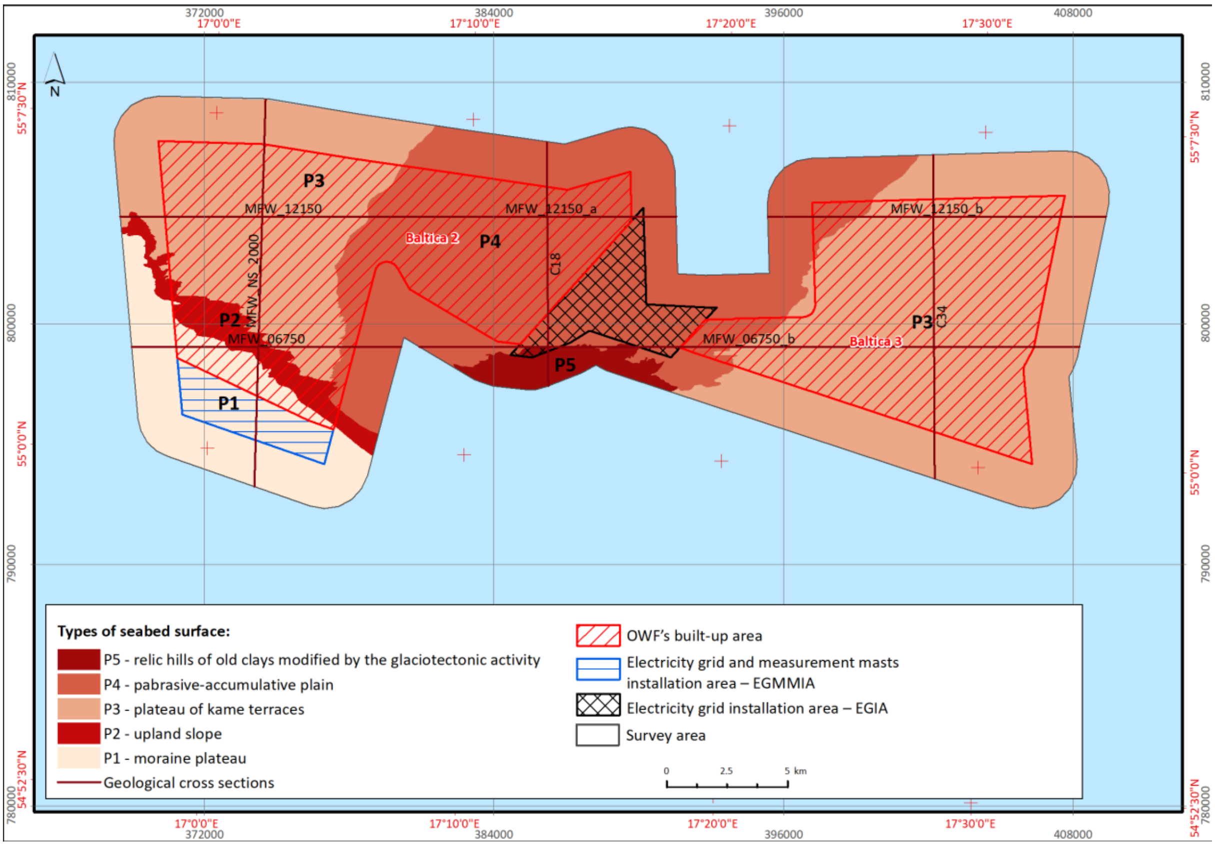


Figure 11. The map of the seabed surface types in the OWF Area (1 NM)

Source: internal data

The seabed surface of almost entire OWF Area (1 NM) is covered with a discontinuous and varied thin layer of fine- and medium-grained sands. In places, multi-grained sediments and clusters of boulders (so-called boulder areas) are accumulated on the seabed surface. Two types of sediments forming the seabed surface: fine- and medium-grained sands, and clays with abrasive pavement consisting of stones and gravel with a sandy cover have been differentiated (Figure 12). The fine-grained and medium-grained sands in the OWF Area (1 NM) mainly create compact covers with a flat surface. Within their area, the sand layer thickness is up to several meters. Clay with abrasive pavement with stones and gravel and a sandy layer form diverse areas with ripple mark fields moving over the clay surface and the abrasive pavement. In places, the seabed surface consists solely of abrasive pavement on clay. This applies to forms such as hummocks, grooves and tectonic slices of clay, which sometimes protrude 3 m above the surface of the surrounding seabed. Top surface of the clay layer forms a continuous, uneven and strongly varied surface. In most of the OWF Area (1 NM) it is deposited shallow under the seabed surface, under a thin, discontinuous layer of abrasive pavement and a sandy layer. In the western part of the OWF Area (1 NM), between the western and the central parts, and in the south-eastern part of the OWF Area (1 NM), top surface of the clay layer is deposited in places at the depth exceeding 8 m below the seabed surface. The top surface of the clay stratum forms lowerings of various types and shapes, which are usually filled with sands, silts and loams of ice-marginal origin and covered with a thin layer of sands, and in places also with multi-grained sediments. On the clay surface and in places also on the sediments of ice-marginal character there is a thin, discontinuous layer of multi-grained sediments [mainly in the western and eastern part of the OWF Area (1 NM)]. In places, it is located directly on the seabed surface or under a thin, discontinuous layer of modern marine sands (usually not deeper than 1 m below the surface of the seabed). Silt-clay sediments fill the lowerings in the clay surface in the western part of the OWF Area

(1 NM) and occur on a substantial area in the central part of the OWF Area (1 NM). A large share of silt-clay sediments has been recognized in the construction of the south-eastern part of the OWF Area (1 NM). In the southern part of the OWF Area (1 NM), there are sands, gravels and boulder areas (in the eastern part with a sand cover). In the central part of the plain there are sand-gravel deposits and boulder areas on the surface.

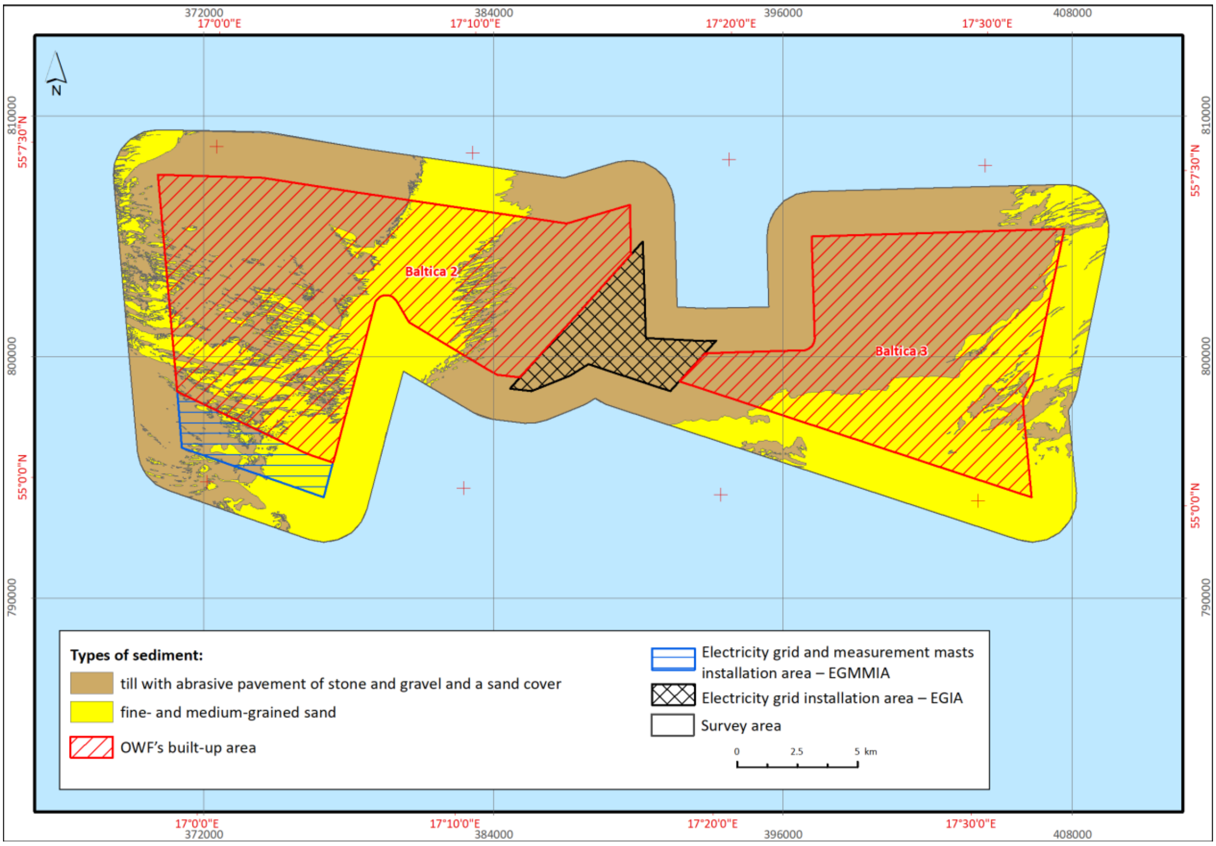


Figure 12. The map of surface sediments in the OWF Area (1 NM)

Source: internal data

3.2.2 Seabed sediments and their quality

The analysed surface seabed sediments from the OWF Area belong to the inorganic deposits of organic matter content (expressed as loss on ignition) of less than 10%. They were characterised by low nutrients content. Also the content of metals and other organic pollutants as well as radionuclides did not differ significantly from the data from the literature for sandy bottom sediments of the Southern Baltic (Uścinowicz, 2011; Szczepańska and Uścinowicz, 1994; Szefer, 2002; Bojakowska, 2001; Dembska, 2003; Dembska et al., 2011; Konat & Kowalewska, 2001; Sapota, 2006; Sapota et al., 2012; HELCOM, 2009 and Miętus & Sztobryn, 2011). The exception was mineral oils, whose slightly elevated values were found in two points: MFW_O_215 (63.87 $mg \cdot kg^{-1}$ DW) and MFW_O_148 (67.54 $mg \cdot kg^{-1}$ DW), located in the eastern part of the Baltica 2 Area. However, the increase in these concentrations is small and can be regarded as incidental.

The obtained results of PAH content have been compared with the normative values stipulated in the Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside installations and equipment (Journal of Laws of 2015, item 796), which allows to classify a sediment as "clean" in the context of practical application. The limit values included in the document are identical with the ones presented in the out-of-date Regulation of the Minister of the Environment of

16 April 2002 on the types and concentrations of substances causing the contamination of dredged material (Journal of Laws of 2002, No. 55, item 498), and despite they do not apply to the sediment transported in the water, they may provide the basis for the assessment of the contamination of sediment with chemical compounds. The comparison demonstrates that none of the examined sediment samples from the OWF Area exceeded the limit values of the substances in above mentioned regulations.

Nutrients

Nitrogen compounds present in the seabed sediments undergo cyclical changes as a result of biogeochemical processes. Oxidation of ammonia and its compounds by nitrifying bacteria leads to creation of nitrogen oxides, and later nitrates. Too intense a nitrification, however, is not desirable, as it is much easier to get the nitrates eluted form the sediments than it is in case of atomic ions.

Phosphorus acts as a productivity-limiting factor for the marine ecosystems (Weiner, 2005). The lack of phosphorus reduces the productivity level, though even a slight increase in its quantity triggers an immediate bloom of algae that make use of phosphorus ions and soluble organophosphorus compounds. In aquatic environment, when the primary production is hampered by the quantity of phosphorus, an introduction of 1 mg of P means a 100 mg growth of algae's dried weight per biological cycle (Dojlido, 1995). Phosphorus undergoes sedimentation when combined with ions of iron, calcium, aluminium, and manganese. Generally, the higher the iron and manganese content, the faster the phosphorus runoff from the water column. Meanwhile, under anaerobic (reducing) conditions, dissolution of sediments and phosphorus' release into the water column may occur in reaction to iron and manganese reduction (Alloway & Ayres, 1999).

The content of nutrients (total phosphorus and total nitrogen) in the surveyed area did not exceed the values typical for the sediments of the Southern Baltic. The percentage of phosphorus that may be released into the water column (so-called available phosphorus) is estimated at 10 to 20% of the total amount of phosphorus content in sediments (Wiśniewski et al., 2006) (Table 16).

Table 16. Average concentration of phosphorus in the surveyed seabed sediments

Nutrient	Average concentration in the examined sediments [mg·kg^{-1} DW]	Available form(so-called absorbable phosphorus) [%]
Phosphorus	321	10–20

Source: own materials and Wiśniewski et al., 2006

PAHs and PCB

The concentrations of persistent organic pollutants (i.e. PAHs, PCBs and TBT) and toxic substances such as metals or mineral oils in the Baltica OWF Area have been low and did not exceed typical values for sandy sediments of the Southern Baltic.

PAHs and PCBs present in the sediments may undergo numerous transformations and have a significant impact on the environment. The scope of impact depends on the transformations that these compounds undergo. These can be abiotic processes such as sorption, elution, oxidation, photodegradation, reactions with other compounds, and biological processes such as microbiological changes. They may hamper or stimulate the growth of microorganisms, have a phytotoxic or stimulating effect on plant growth, and a toxic impact on fauna (Galer et al., 1997). The accumulation of PAHs and PCBs in sediments is promoted by, among others, a high percentage of silt and clay fractions with the size of sediment particles <0.063 mm and characterised by a large specific surface area and significant ability for adsorption of hydrophobic pollutants and organic compounds of phosphorus, sulphur, and nitrogen.

Concentrations of PAHs and PCBs in the examined sediments and their availability have been presented in the table (Table 17).

Table 17. Concentrations of PAHs and PCBs in the examined seabed sediments in the Baltica OWF Area

PAHs/PCBs	Average concentration in the examined sediments [mg·kg^{-1} DW]	Available form [%]
Congeners from the PCB group	0.0001–0.0008 (average <0.0001)	0.5
Analytes from the PAHs group	Average 0.0116	5

Source: own materials and Gdaniec-Pietryka, 2008

Metals

The labile form of metals may constitute (depending on the type of the sediment in relation to particular metals) from 30 to 80% of the total content (Savvides et al., 1995; Parkman et al., 1996; Siepak, 1998; Usero et al., 1998; Dembska, 2003; Davutluoglu et al., 2010). The analysis of the labile form of metals in the surveyed sediments has shown that in unfavourable conditions 70% of lead and 46% of copper and zinc can pass from the sediment into the water column. Nickel and chromium present in the surveyed sediment are mostly combined permanently with it. Only 40% nickel and 25% chromium can, in favourable conditions, be passed from sediment into the water column.

The average concentrations of metals in the surveyed sediments (dry weight) and the concentrations of the labile form have been presented in the table below (Table 18).

Table 18. The concentration of metals in the surveyed seabed sediments

Metal	Average concentration in the examined sediments [mg·kg^{-1} DW]	Average concentration of the available form (labile) [mg·kg^{-1} DW]
Lead (Pb)	4.31	3.05
Copper (Cu)	1.86	0.85
Zinc (Zn)	11.20	5.11
Nickel (Ni)	2.40	0.97
Chromium (Cr)	4.95	1.24

Source: internal materials

Arsenic, cadmium, mercury and TBT in the surveyed sediment occurred at the trace level, generally below the lower limit of quantification, and therefore were not subject to further analysis.

The surveyed sediments were also characterised by low activity of the radioactive caesium ^{137}Cs isotope, which is typical for sandy sediments.

As the surveys carried out has shown, the sediments in the OWF Area have generally been characterised by a small number of fine fractions and low concentrations of metals and persistent organic pollutants.

3.2.3 Raw materials and deposits

In the Southern Baltic area, the best known and documented are the accumulations of natural aggregates, i.e. gravel, gravelly sand and sandy gravel sediments, which form deposit concentrations on the seabed. They are the following deposits of natural aggregates: the Słupsk Bank, Koszalin Bay and the Southern Central Bank (Masłowska 2005).

The data from the literature indicate the occurrence on the seabed surface of the south-west part of the Baltica 2 Area, the area of sands and gravels, and on the remaining area, sands. The sands and gravels are of varied thickness. In the north-western and eastern part of the area they do not exceed 1 m and are deposited on clay, while in the southern part of the Baltica 2 Area and south-eastern part of the Baltica 3 Area they are marked at the depth of 1 m under the seabed surface. In the case of the Baltica 2 Area, these are mostly fluvioglacial sands and gravels, and in the central part, marine sands and gravels. In the Baltica 3 Area, these are marine sands (Kramarska, 1995b). Both the map contained in the "Atlas of lithological parameters of the Southern Baltic surface sediments, with particular consideration of the geological and mining conditions of detrital resources occurrence" (Kramarska et al., 2005), as well as the generalised map of the prospective areas boundaries of the detrital resources presence and the thickness of sands and gravels against the lithology of the Southern Baltic sediments (Kramarska et al., 2005; Kramarska et al., 2006) indicate that the thickness of sandy gravel deposits in the north-western part and sands in the eastern part is smaller than 1 m. There are no current licenses for the exploration and extraction of mineral resources within the OWF Area.

The granulometry analysis demonstrates that on the seabed surface of the OWF Area, only in single samples gravelly sand sediments have been found, slightly more often noted have been the sandy gravel sediments and sandy sediments, however, it should be underlined, that these have been coarse sands with an addition of medium-grained sands or just medium-grained sands.

Sandy sediments occur on the seabed surface of the OWF Area in the south-eastern part of the OWF and in some places in the western part of the OWF, where they fill the hollows on the abrasive-accumulative platform and on the slope of the morainic plateau. It should be taken into consideration that sandy deposits occurring on the seabed surface are mainly fine sands, which do not constitute potential raw material. The lack of accumulation of detrital resources is clearly demonstrated by the results of the conducted surveys. Various-grained sediments 1 m below the seabed surface occur in the south-western part of the Baltica 2 Area and in the southern part of the Baltica 3 Area. The sandy deposits occurring in the lithic cores have usually been fine-grained sands with the interbedding of silty or medium-grain sediments. The thickness of sandy sediments in shallow lithic cores has not exceeded 2.5 m.

The conducted analysis of the occurrence of mineral material accumulation based on the analysis of data from the literature, geophysical data, shallow lithic cores and samples of surface sediments has demonstrated the presence on the surface of the OWF Area of sandy sediments, fine, with a small thickness. In the examined lithic cores no sandy gravel sediments forming a potential deposit of raw materials have been found. The lack of accumulation of detrital resources is clearly demonstrated by the results of the conducted surveys. The analyses of archival data (Kramarska et al., 2005, Kramarska et al., 2006; Mojski ed., 1989–1995) do not exclude the possibility of occurrence of other natural resources (heavy minerals, hydrocarbons) in the OWF Area.

3.3 Seawater and its quality

The characteristics of hydrophysical conditions include salinity, temperature and turbidity of the seawater, showing the seasonal variability of these elements during the year.

The salinity of the seawater remained at about 7.5 PSU with slight fluctuations of ±0.5 PSU. Only above the seabed the mean value of salinity was higher and amounted to about 8 PSU. Also, it has been characterised by significant fluctuations of up to 12.5 PSU.

The temperature in the water column has clearly been changing throughout the year. The highest values were achieved during the astronomical summer, reaching 22°C. The lowest temperature (2°C) occurred in February and March. Above the seabed, the temperature of water from mid-May to mid-October was much lower than the temperature in the water column, the maximum difference was 16°C. In the remaining months the temperature of the water above the seabed was the same as at other depths.

The turbidity of the water above the seabed has been about 1 NTU. The distinct increase in turbidity has been observed only during intense storms – at that time it reached even 40 NTU. However, this phenomenon has been short-lived and settled soon after the storm had subsided.

The water flows in the surface layer are about twice as large as the flows at greater depths. The average velocity in this layer is about 20 $cm \cdot s^{-1}$, and the maximum velocity reach 80 $cm \cdot s^{-1}$. The intensification of water flows in the entire water column occurs during storm conditions. The directions of water flows are variable, however, the prevalence of flows from the north-eastern and south-western directions is observed.

The wave climate is characterised by seasonality with a calm summer and storms during autumn-winter period. The most intense wave motion occurred in the period from October 2016 to January 2017, while the weakest from April 2016 to September 2016. The highest wave was 9.62 m high, and the highest significant wave reached a height of 6.1 m. On the Douglas scale sea state was six – 38 times, seven – 9 times and eight – 4 times. The mean values of the mean period and peak wave period oscillated around 3.7 s and 5.0 s, respectively. The maximum peak wave period reached 10.9 s. The strongest wave motion has been observed from the western and northern directions.

The average sea level was constantly fluctuating. Its maximum differences generally did not exceed 1 m.

3.3.1 Seawater quality

The examined physicochemical parameters of water in the OWF Area, including: pH, oxygenation, BOD_5, TOC, biogens, PCBs, PAHs, mineral oil, cyanides, metals, phenols and radionuclides, did not differ significantly from the typical contents of the Southern Baltic waters (Burska et al., 2005; Kruk-Dowgiałło, 2010; Zalewska et al., 2012; Miętus & Sztorbyn, 2011; Poleszczuk, 1996; Pęcherzewski & Ławacz, 1975; Andrulewicz et al., 2008; Witt, 2002; Sapota, 2004; Kot-Wasik, 2004; Zalewska et al., 2012).

These waters have been characterised by alkaline pH (pH from 7.5 to 8.7), alkalinity of approximately 1.7 $mmol \cdot dm^{-3}$ and a relatively good oxygenation, with seasonal variability characteristic of the Southern Baltic waters. The assessment of water quality in the OWF Area based on oxygen content in the near-seabed layer in the summer period (July and August 2016) indicates good condition (no oxygen deficit). The average dissolved oxygen content during this period was above the limit value of 6 $mg \cdot dm^{-3}$ (Krzymiński et al., 2013) and ranged from 8.4 to 8.8 $mg \cdot dm^{-3}$.

Throughout the entire measurement period (April 2016 – January 2017), the average BOD_5 in the water samples collected from the OWF Area in the six individual measurement periods (April, July, August, November, December 2016 and January/February 2017) was ≥2 $mg·dm^{-3}$, which may indicate a low content, in the tested waters, of organic substances that may be oxidised biochemically. The values obtained correlated with low mean TOC values, which did not exceed 5 $mg·dm^{-3}$ in individual measurement periods, and good water oxygenation.

Also, the suspended matter in the above mentioned measurement periods was at the level typical for the waters of the Southern Baltic. The lowest mean concentrations of the suspended matter in the surveyed area occurred in April 2016. In the remaining measurement periods, the suspended matter remained at more or less constant level, i.e. from about 1 to 2.5 $mg·dm^{-3}$.

The content of nutrients (total nitrogen, mineral nitrogen, nitrates, nitrites and ammonia, phosphates and total phosphorus) in the tested waters in the Baltica OWF Area was characterised by the seasonal variability typical of the Southern Baltic waters.

The waters of the Baltica OWF Area were characterised by low levels of particularly harmful substances. Polychlorinated biphenyls (PCBs), free and bound cyanides, metals (lead, cadmium, total and hexavalent chromium, arsenic, nickel and mercury) and phenols occurred at a trace level. The tested waters were also characterised by low values of caesium ^{137}Cs and strontium ^{90}Sr isotope activity, typical for the Southern Baltic waters, which confirms the very slow decreasing tendency of ^{90}Sr and ^{137}Cs concentrations in the Baltic Sea area (Zalewska, 2012).

PAHs' concentrations, slightly higher than the data from literature, have been observed in the OWF Area, which may result from the differences at the sample preparation for analysis stage (PAH has been determined in waters without separation of suspended matter) and isolated cases of slightly elevated concentrations of mineral oil, which could have been incidental. The average concentration of mineral oil in the Baltica OWF Area was low.

After comparing the results of water surveys with the limit values specified in the Regulation of the Minister of Environment of 21 July 2016 on the method of classification of the state of uniform parts of surface water and environmental quality standards for priority substances (Journal of Laws of 2016, item 1187), the OWF Area can be classified as class I water quality (very good state) due to the content of dissolved oxygen, TOC and total phosphorus. The average concentrations of nitrates and mineral nitrogen as well as total nitrogen and phosphates, and also the pH, exceeded the limit values for the class I water quality specified in the mentioned Regulation of the Minister of the Environment.

The remaining surveyed parameters, i.e. metals, phenols, cyanides and PCBs, did not exceed the limit values stipulated in the Regulation of the Minister of Environment of 21 July 2016 on the method of classification of the state of uniform parts of surface water and environmental quality standards for priority substances (Journal of Laws of 2016, item 1187).

However, in the case of PAHs and mineral oil, single cases of exceeding the limit values have been found, but the average values of these parameters for the OWF Area have not exceeded the environmental quality standards.

On the basis of the conducted surveys' results, the assessment of the examined OWF Area according to MSFD has also been carried out, i.e. the descriptive indicators of pressures W5 – eutrophication and W8 – pollutants have been assessed. The assessment of W5 indices have been conducted on the basis of the nutrients content analysis (DIP – phosphorus phosphate, TP – total phosphorus, DIN – dissolved inorganic nitrogen, TN – total nitrogen and dissolved oxygen near the seabed).

As the surveyed OWF Area lies in the north-eastern part of the Bornholm Basin, the reference values and weights typical for the Bornholm Basin have been used for the assessment. For the presented data, an assessment based on the average class value for individual factors has also been carried out (Zalewska et al., 2015) (Table 19).

Table 19. The evaluation of eutrophication in the OWF Area on the basis of measurement data (April 2016–January/February 2017)

Causative factors	**Ref**	**Analysis results**	**EQR**	**Weight %**	**EQR – weight**	**Mark/class value**
Winter DIP (average I–III) [µmol P-PO_4·dm^{-3}]	0.34	0.81	0.420	30	0.126	3
Annual average DIP [µmol P-PO_4·dm^{-3}]	0.09	0.57	0.158	15	0.024	1
TP (average VI–IX) [µmol P·dm^{-3}]	0.6	0.52	1.154	5	0.058	5
TP (annual average) [µmol P·dm^{-3}]	0.35	0.72	0.486	10	0.049	3
Winter DIN (average I–III) [µmol N·dm^{-3}]	2.5	4.31	0.580	10	0.058	4
Annual average DIN [µmol N·dm-³]	0.77	1.84	0.418	15	0.063	3
Average TN (VI–IX) [µmol N·dm^{-3}]	14	24.64	0.568	5	0.028	4
Annual average TN [µmol N·dm^{-3}]	6.96	19.34	0.360	10	0.036	4
				100	0.441	
Indirect effects	Ref	Analysis results	EQR			
Dissolved oxygen near the seabed (min. VI–IX) [mg·dm^{-3}]	4.2	6.58	1.567			5
Average						3.33
Overall rating					Moderate	Bad SubGes

Ref – reference value, EQR – ecological quality factor according to WFD, colour code: very good condition – blue (5); good condition – green (4); moderate condition – yellow (3); poor condition – orange (2); bad condition – red (1)
Source: Zalewska et al., 2015

In both methods, the assessment of W5 pressure indicators for the surveyed OWF Area indicates moderate status in accordance with the WFD, which in relation to MSFD indicates a sub-optimal state (subGES). The received evaluation is in line with the multiannual data for this area (Zalewska et al., 2015).

The assessment of W8 indices in the surveyed area could only be conducted on the basis of the tests results of caesium radionuclide (^{137}Cs) in marine waters. For the assessment of the other particularly harmful substances (e.g. metals and POPs), the content of these analytes in the tissues of living organisms is recommended (Krzymiński et al., 2014).

As the limit value for caesium radionuclides (^{137}Cs), the target concentration value of 15 Bq·m^{-3}, characteristic for the period preceding the failure of the Chernobyl nuclear power plant has been assumed (Zalewska et al., 2015). During the measurement period in the OWF Area, the average content of ^{137}Cs has been found at 24.88 Bq·m^{-3}. The WS contamination ratio (ratio of the current contamination to the reference/target concentration) for the OWF Area is 1.65, which indicates moderate status according to the WFD classification and sub-good status (subGES) according to the MSFD classification. The received evaluation is in line with the multiannual data for the area discussed (Zalewska et al., 2015).

3.4 Climatic conditions and air cleanliness

3.4.1 Climate and the risk related to climate change

The Southern Baltic basin is located in a humid temperate climate zone with the influence of the Atlantic climate introduced by the prevailing oceanic winds. The vicinity of the Atlantic Ocean, due to the large air masses inflow, largely determines the climate of the Baltic Sea. As a result the winters are mild and warm and the summers cool. In addition, it is characterised by the presence of strong winds from the west and south-west direction, and high humidity.

At PMA and in the coastal zone, long-term recordings of atmospheric parameters (mainly pressure, air temperature and humidity, wind conditions and insolation as well as precipitation size and type) and water parameters (sea level, water temperature and salinity and dynamic conditions – flows and wave motion) are carried out both at onshore stations, as well as on the high seas. In particular, the comprehensive measurements performed operationally for several decades by IMWM-NRI at stations and measuring points, and for several years also on buoys anchored in the sea could be mentioned. In addition, IMWM-NRI performs monitoring measurements in the Southern Baltic area several times a year, recording the hydrophysical and physicochemical parameters of the sea in a designated points' network. Hydrological and meteorological measurements are also carried out by other scientific and research units. In the S. Hueckel Coastal Research Station at Lubiatowo a field laboratory of the PAS Institute of Hydro-Engineering, the wind, air temperature and humidity are measured, as well as the average sea level, while the PAS Institute of Oceanology at the monitoring station located at the Sopot pier records the temperature, pressure and humidity of the air and insolation as well as the temperature and salinity of seawater. As part of the SatBałtyk project, carried out in 2010–2015, satellite measurements were made to determine the characteristics of the sea and atmosphere in the form of maps showing, among others, temperature distributions, ice caps, instantaneous flow rate, water mixing and turbidity. At the Maritime Institute in Gdańsk in the last dozen years, in various research projects and at the request of investors, the recordings of the parameters of the near the water atmospheric layer and hydrophysical and dynamic values for the entire water column have been made at various locations within the Polish Exclusive Economic Zone of the Baltic Sea.

The presented surveys related to similar registrations carried out by neighbouring Baltic countries allow determining current trends and forecasting the directions of changes in the basic climate parameters of the Southern Baltic. In addition, the information from simulation calculations of climatological numerical models of the global atmospheric circulation model available from, among others, the research carried out as part of the BALTEX Assessment of Climate Change for the Baltic Sea Basin has been applied for this purpose.

The climate typical of the coast and adjacent sea areas can be classified as coastal type climate, with small amplitudes of air temperature, high humidity, mild winters, cooler summers and strong winds. The predominant are the winds from the west and south-west directions. In the open sea areas, including in the area of the Baltica OWF, climatic conditions are characterised by the fact that the amplitudes of the air temperature are lower and the average wind velocity is higher than in the adjacent land areas.

On the basis of the available data and analyses, it is possible to present the most important forecasts of particular elements of the atmosphere and water changes in the Baltic region:

- the increase in the air temperature there is faster than the average global increase, this trend will continue;
- the increase in surface water temperature is greater than in its deeper layers, this may result in higher thermal stratification and the stabilization of thermocline during the year;
- predicted salinity changes are not clearly defined and depend on one hand on changes in air circulation conditions and the size of the exchange of water with the North Sea and on the other, on the amount of river water inflow; a decrease in the salinity level is predicted;
- an increase in atmospheric precipitation is forecasted throughout the entire Baltic Sea basin in the winter, while in the summer only in the northern part; the prevalence of extreme precipitation will increase;
- in terms of forecasting sea level changes, the effects of its global growth will not be experienced much. This is due to the fact that the Baltic Sea, being a relatively small and shallow shelf sea, is connected by the rather narrow Danish straits with the North Sea, through which only incidentally there is an exchange of oceanic waters (these are the so-called inflows). Moreover, most of its area (in the northern part) is located within the Scandinavian plateau, which is characterised by visible uplift processes (so-called isostatic rebound), which result in a decrease in the average sea level. In the southern part, however, the impact of these processes is practically negligible, and the height of the water level is determined mainly by the circulation conditions of the atmosphere;
- forecasts of wind climate changes are subject to considerable uncertainty, it is assumed that with the increase of average surface water temperature the average wind velocity over sea areas will increase;
- changes in the wave climate are mainly related to the increase in the frequency and intensity of storms – an increase in the number of extreme phenomena is forecasted;
- model calculations indicate that there will be an increase in the extent of low oxygen area in the water and anaerobic areas near the seabed.

Forecasts of climate change for Poland, including the coastal zone and sea areas under the jurisdiction of the Polish state, as well as scenarios of adaptation activities aimed at mitigating and counteracting the effects of changes are the subject of intensive work carried out by the Ministry of the Environment and the Institute of Environmental Protection, as part of the "Polish National Strategy for Adaptation to Climate Change by 2020 with forecasts until 2030" and the KLIMADA project.

Taking into account the conclusions and recommendations relating to the coast and the adjacent areas of the Baltic Sea, it has been found that the observed and predicted climate changes will have a negative impact on the functioning of the coastal zones. The negative influence of periodic sea level rise is predicted here, resulting mainly from the increase in frequency and intensity of strong storms. In the case of the Baltic Sea, this refers to a possible increase in their number, intensity and duration, whereby irregularities in the occurrence of these events will increase, i.e. after long periods of relative calm there may occur a series of rapidly following storms of considerable strength.

An additional factor accelerating the process of coastal erosion is warming of the winters, and what should be expected as a result, the reduction of the ice cover protecting the beaches from storm surges, and thereby against coastal erosion. The scenarios of sea level changes demonstrate that in the period 2011–2030 the average annual sea level along the entire coast will be about 5 cm higher compared to the values from the reference period, i.e. 1971–1990. Very important effects of the climate change will be an increase in the frequency of storm floods and more frequent flooding of low-lying areas as well as the degradation of coastal cliffs and sea shore, which will entail a strong pressure on the infrastructure located in these areas.

Due to the increase of the average water temperature and increased inflow of biogenic pollution into the sea (nitrogen and phosphorus compounds), the negative phenomenon will be the progressive eutrophication, especially on the water surface (algae blooms).

The activities carried out as part of the adaptation of the coastal zone to climate change concern areas along the Baltic Sea coastline. However, there are no detailed proposals and recommendations referring to the open sea areas, including installations and structures located there, presenting the scope of activities aimed at counteracting the effects of the forecasted changes in climatic conditions.

3.4.2 Meteorological conditions

Meteorological conditions are characterised by wind velocity and direction, temperature, pressure and humidity of the air measured by two meteorological stations at a height of 4 m above the free surface of the sea from April 2016 to April 2017. The average wind velocity for the entire measurement period 2016/2017 in the Baltica OWF amounted to approximately 7 $m \cdot s^{-1}$, and the maximum reached almost 21 $m \cdot s^{-1}$. The prevailing winds were from the north-west direction. The air temperature ranged from about -6°C to about 23°C. Atmospheric pressure varied from 979 hPa to 1043 hPa. Relative humidity was characterised by high variability, oscillating from 51% to 100%.

3.4.3 Air quality

Due to the lack of detailed information on the current parameters of the cleanliness of air over the sea areas intended for the construction of wind farms, the air quality assessment of the layer of the atmosphere near the water surface is compared with the information obtained as part of the measurements carried out by the Inspection of Environmental Protection under the National Environmental Monitoring for the nearest coastal research station (Łeba). It should be noted that due to the lack of significant sources of pollution emission over the sea area, air cleanliness parameters should not be worse than those measured at the shore.

The assessment of air quality in Poland, including at shore stations, has been carried out on the basis of the Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. In Poland, the tasks related to conducting surveys and assessments of the state of the environment, including air quality monitoring, are carried out by the Inspection of Environmental Protection under the National Environmental Monitoring, whose program is developed by the Chief Inspector of Environmental Protection and approved by the Minister of the Environment. As part of this program, the tasks related to the fulfilment of requirements contained in EU regulations and in Polish law as well as international conventions signed and ratified by Poland are implemented. Currently, the National Environmental Monitoring Program for 2016–2020 is being implemented.

Due to the fact that the monitoring of air quality is conducted only on terrestrial areas, the results obtained from the measurements for the Pomeranian Voivodship, and in particular for the coastal zone, have been taken as the reference level for the sea areas. In 2015, for the majority of the substances measured by the Inspection of Environmental Protection the concentration criteria corresponding to the class A cleanliness were obtained.

In the sea areas, which cover the territory of the planned Baltica OWF, no measurements have been made to assess the air quality in terms of their greenhouse gas content, dust concentrations and other harmful volatile substances. The closest place, where the monitoring of the air pollution has been carried out, was the coastal research station in Łeba. Based on the latest measurement data provided by VIEP in Gdańsk in the report for 2016, the following concentrations of substances have been found:

- sulphur dioxide SO_2 – the average 24-hour concentration in 2016 amounted to 7 $\mu g \cdot m^{-3}$ with a permissible value of 125 $\mu g \cdot m^{-3}$; this is the lowest value recorded in the Pomeranian Voivodship;
- nitrogen dioxide NO_2 – the average annual content measured in 2016 was 5 $\mu g \cdot m^{-3}$ with a permissible value of 40 $\mu g \cdot m^{-3}$; this is the lowest value recorded in the Pomeranian Voivodship;
- ozone O_3 – average annual content measured in 2016 was 59 $\mu g \cdot m^{-3}$, and the maximum average value from 8 hours was 142 $\mu g \cdot m^{-3}$, with the assumed target value of 120 $\mu g \cdot m^{-3}$ – this is the highest value recorded in the Pomeranian Voivodeship; however, in accordance with the assessment included in the VIEP report in the Pomeranian Voivodship, the mandatory criteria regarding the target level for the protection of human health and plant protection are met.

This level of the recorded values causes the coastal zone in the vicinity of Łeba to obtain the class A air cleanliness. Whereas, the open sea areas intended for the construction of the Baltica OWF are located at a considerable distance from the terrestrial sources of sulphur dioxide and nitrogen dioxide emission. These substances are emitted only by vessels, however, the amount of this emission depends on the intensity of traffic and type of ships. The Baltica OWF Area is devoid of any terrain obstacles impeding the spread of these substances. Therefore, the average concentrations in the air of the compounds mentioned above should have significantly lower values. Based on vessel traffic data in 2015 and 2016 using the IWRAP program, it has been calculated that in the area presented in the figure below (Figure 13), during a year, vessels use over 12 000 Mg of fuel, emitting over 40 000 Mg of CO_2, over 700 Mg of SO_2, over 1200 Mg of NO_x and over 90 Mg of dust.

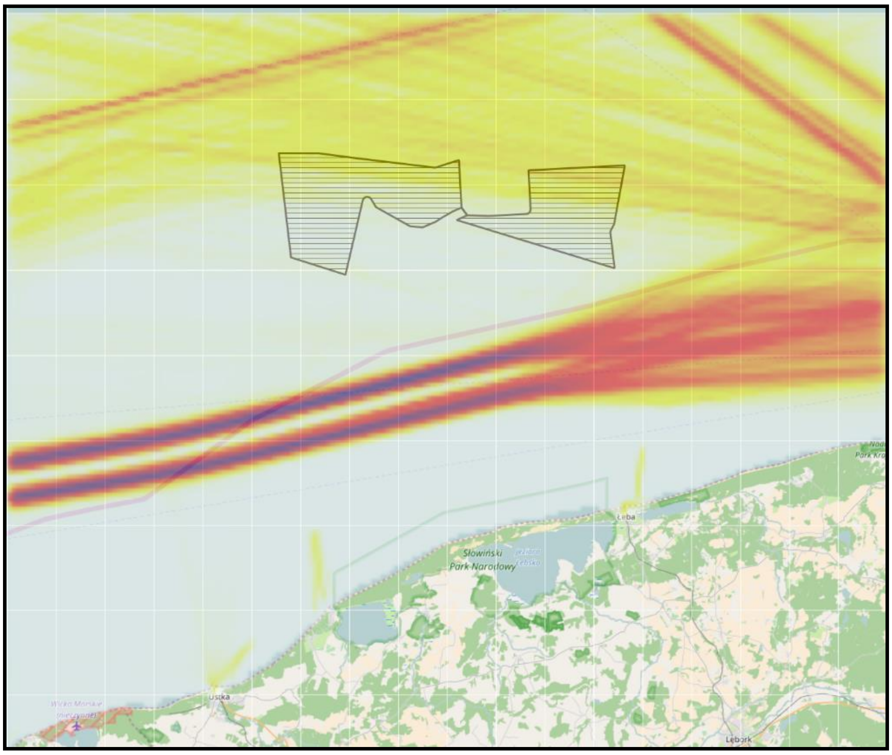


Figure 13. The distribution of pollutant emissions by vessels near the Baltica OWF in 2015–2016

Darker colour means the greater relative emission from the combustion of vessels' fuels
Source: internal materials based on AIS data

In the case of ozone concentration, which in the coastal region has a higher value than inland places, it can be assumed that the ozone concentrations in the open sea will not significantly differ from those recorded in the coastal zone, although it can be assumed that due to smaller than onshore emissions from transport (ozone precursor are, among others, nitrogen oxides coming from transport). The persistence of this ozone concentration is largely due to natural causes.

3.5 Ambient noise

In order to determine the base level of the ambient noise, noise monitoring has been carried out using 3 SM2M recorders (Photo 1) arranged at the stations presented below (Figure 14).

Photo 1. SM2M, device by the Wildlife Acoustics, Bio-acoustic Monitoring Systems

Photo by Al Sweeting Jr.

The SM2M device records all underwater sounds in the frequency range from 2 Hz to 48 kHz (www.wildlifeacoustics.com, SM2M manual, 2012), with sounds ranging from 2 Hz to 22 kHz, being analysed as recommended by the working group for underwater noise (Van der Graaf et al. 2012).

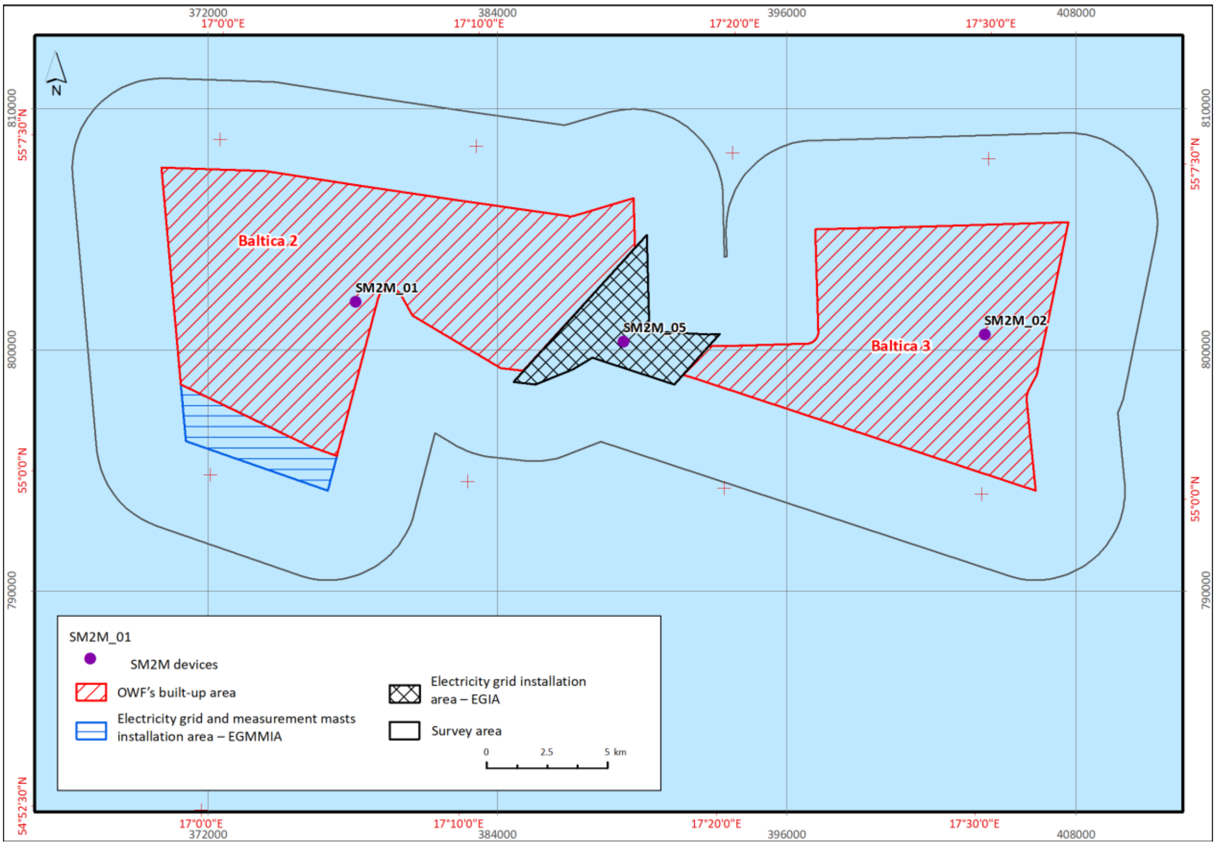


Figure 14. The location of the measuring devices for ambient noise monitoring in the Baltica OWF Area

Source: internal data

The background noise tests indicate that the ambient noise levels are characteristic of the shallow waters of the Baltic Sea. Seasonal differences in noise levels at stations and between them have been found. For all stations, the average sound pressure level (SPL) was the highest in the winter, and the spring and summer levels were significantly lower. These results are consistent with the information from the BIAS project presented by Folegot et al. (2016). This is most likely caused by seasonally specific sound propagation conditions in the sea (Folegot et al., 2016) and higher noise levels caused by atmospheric factors in the winter and autumn months.

3.5.1 Noise related to ship traffic

Ship traffic is the most important source of anthropogenic noise at low frequencies. The intensity and frequency of noise generated by ships depends largely on the size and speed of the ship, with large, slow moving ships generating lower frequency noise, and small, fast vessels generating noise with higher energy at higher frequencies. OSPAR (2009) introduces the following division:

- small vessels and recreational boats: <50 m; noise with a variable intensity 160–175 dB re 1 µPa at a distance of 1 m;
- medium-sized vessels: 50–100 m; 165–180 dB re 1 µPa at a distance of 1 m;
- large ships: >100 m; 180–190 dB re 1 µPa at a distance of 1 m.

In conclusion, it can be stated that the frequency of noise generated by traffic is usually below 1 kHz (Richardson et al., 1995). That is why most surveys focuses on low frequency noise components generated by ships. In the case of the cetaceans, such as the porpoise *Phocoena phocoena*, which are sensitive also to high frequencies, all noise components (from low to high frequency) are a problem. Hermannsen et al. (2014) studied the impact of noise components generated by vessels from medium to high frequency in Danish waters. They found that the noise from various types of ships significantly raises noise levels in the surrounding environment in the entire recorded band from 0.025 to 160 kHz at a distance of 60 m and 1000 m from the passing vessels. They also found that ships passing at a distance of 1190 m reduce the hearing threshold by more than 20 dB (at 1 and 10 kHz), and ships passing at 490 m or less cause a reduction of over 30 dB (at 125 kHz). Therefore, although there may be masking effects due to high frequencies, the range of these interactions is small. Dyndo et al. (2015) found that porpoises kept in semi-natural conditions reacted to the approaching ships. They interpreted their results concluding that harbour porpoises exhibit a behavioural response to high frequency noise.

There is a high degree of compatibility between the results of the surveys conducted at the OWF Area and the regional scale surveys. The figure (Figure 15) presents the results of Tougaard et al. (2016), obtained as part of the BIAS program and regarding noise levels in the 125 Hz band. For most of the time, the noise levels in the Baltic Sea are relatively high in the central part of the basin. These levels correspond to areas with high traffic density according to AIS data.

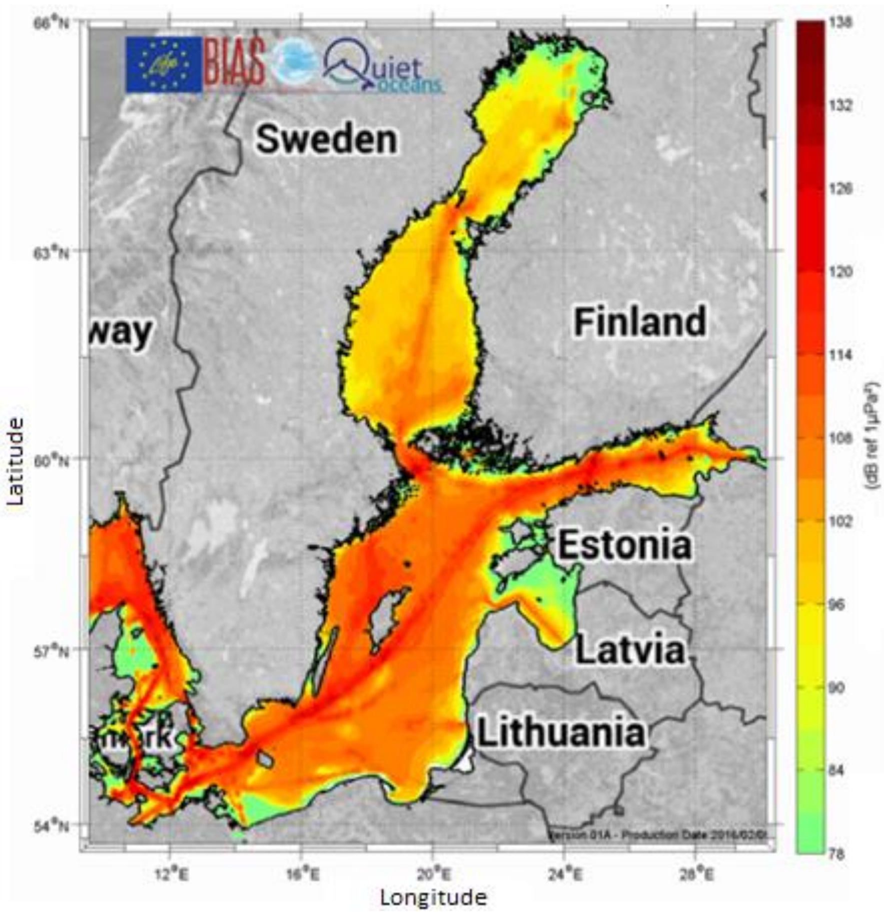


Figure 15. The maximum noise level received in the entire body of water in the 125 Hz one-third-octave band in February 2014 (the 10th–L10th percentile)

Source: BIAS (Tougaard et al., 2016)

The results of the BIAS project in the southern part of the Baltic Sea (Tęgowski et al., 2016) and the location of the Baltica 2 Area and the Baltica 3 Area have been presented in the figure (Figure 16). Based on this figure, it can be concluded that in February 2014 in the Baltica OWF Area the received noise level of the 125 Hz frequency was in the range of 85–95 dB re 1 µPa^2.

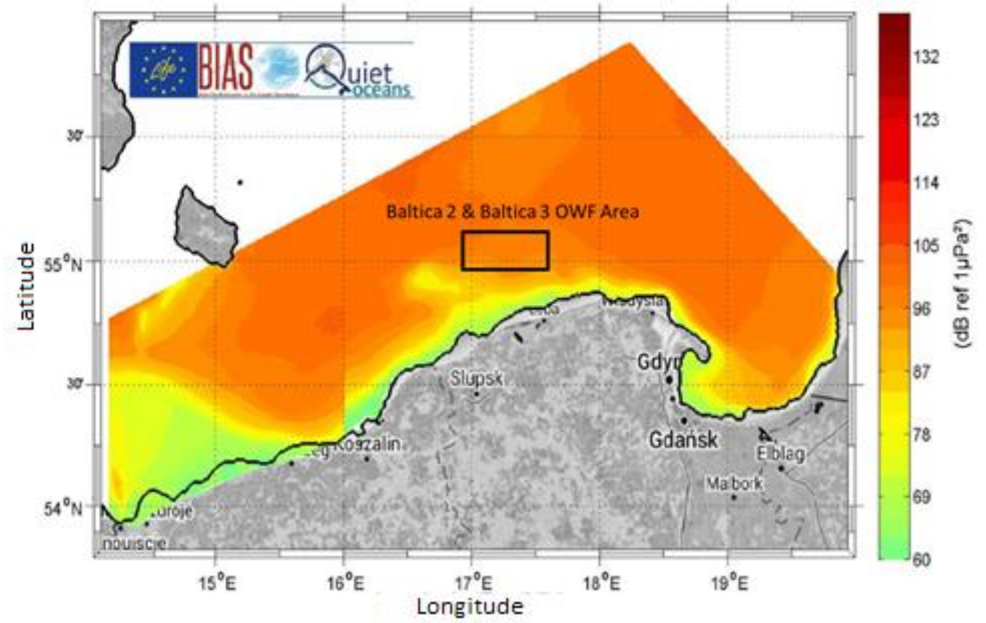


Figure 16. The maximum noise level received in the entire body of water in the 125 Hz one-third-octave band for the 50th percentile (L50th) in the southern part of the Baltic Sea in February 2014

Source: Tęgowski et al., 2016

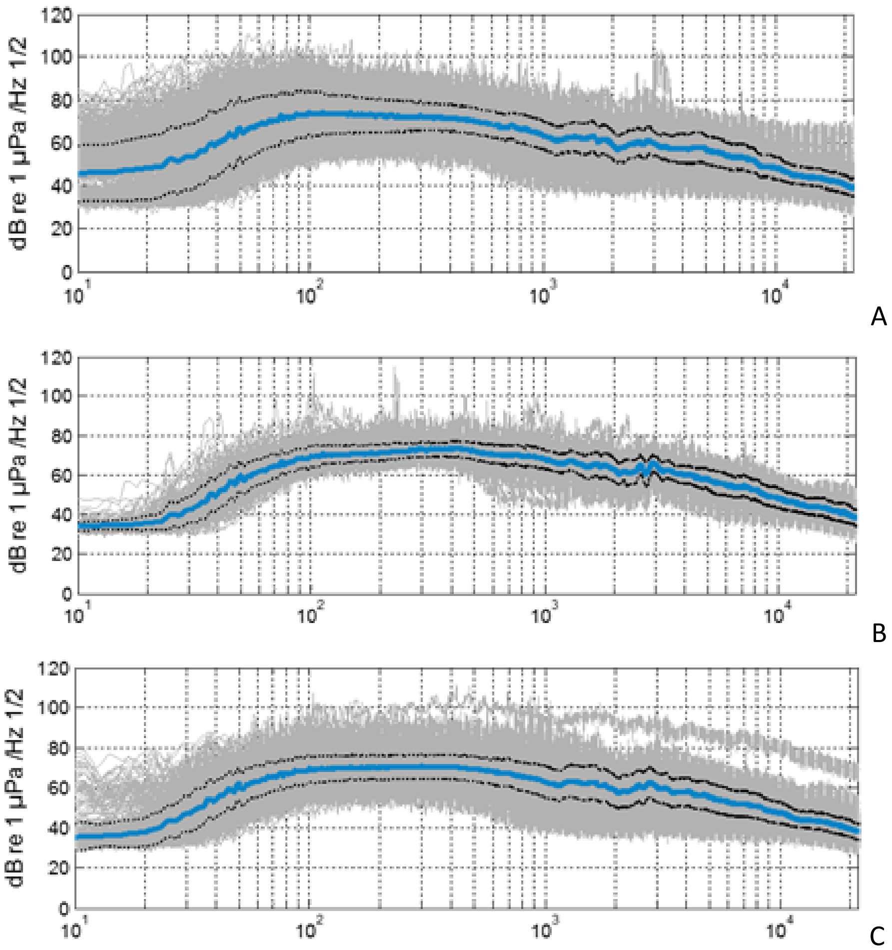


Figure 17. The noise in the surrounding environment in the survey area at the stations SM2M_01 (A), SM2M_02 (B) and SM2M_05 (C) for all seasons in total. Spectral power density in 1 Hz bands

Grey lines: individual samples, bold line: average, dashed lines: standard deviation. n-A: 2058, n-B: 2735, n-C: 1323
Source: internal data

The results of ambient noise analysis indicate that the background noise in the Baltica OWF Area is typical of the shallow waters of the Baltic Sea (Figure 17). The results of ambient noise measurements in winter from station SM2M_01 and the BIAS results for March have been compared in the figures (Figure 18, Figure 19). For the purpose of the comparison, the winter ambient noise measurements have been chosen, because in the winter the noise levels are the highest. Results from the BIAS 3 station have been used due to the geographic proximity of this station to the Baltica OWF Area. The spectra shown have a similar general shape. The BIAS spectrum has a peak at 63 Hz, which cannot be seen in the collected data. This is due to the proximity of the BIAS station and the shipping route. At higher frequencies, the shapes are identical. This and similar noise levels at 125 Hz show that the results obtained in the survey for the EIA Report are very much in line with the BIAS results.

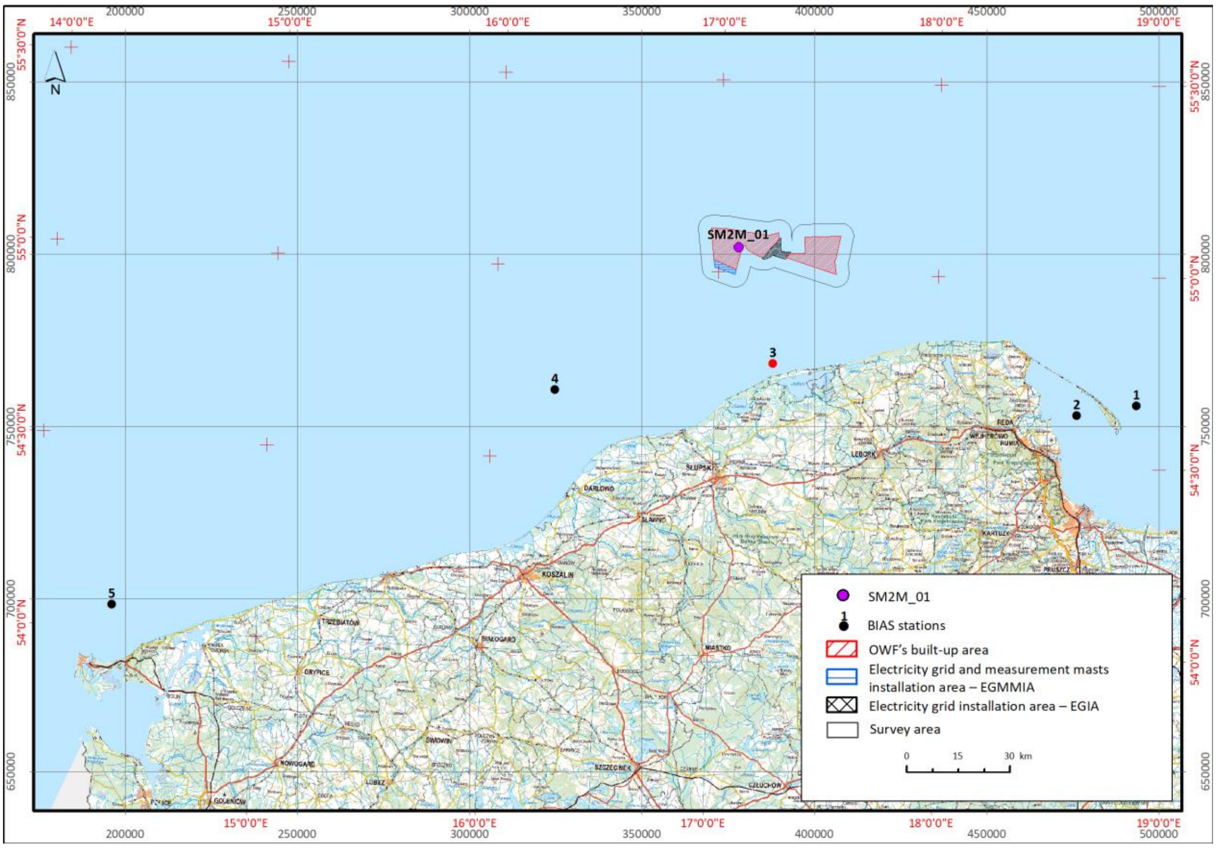


Figure 18. The location of SM2M devices and the BIAS station

The BIAS project station, for which the results of acoustic monitoring have been quoted below, have been marked in red
Source: internal data

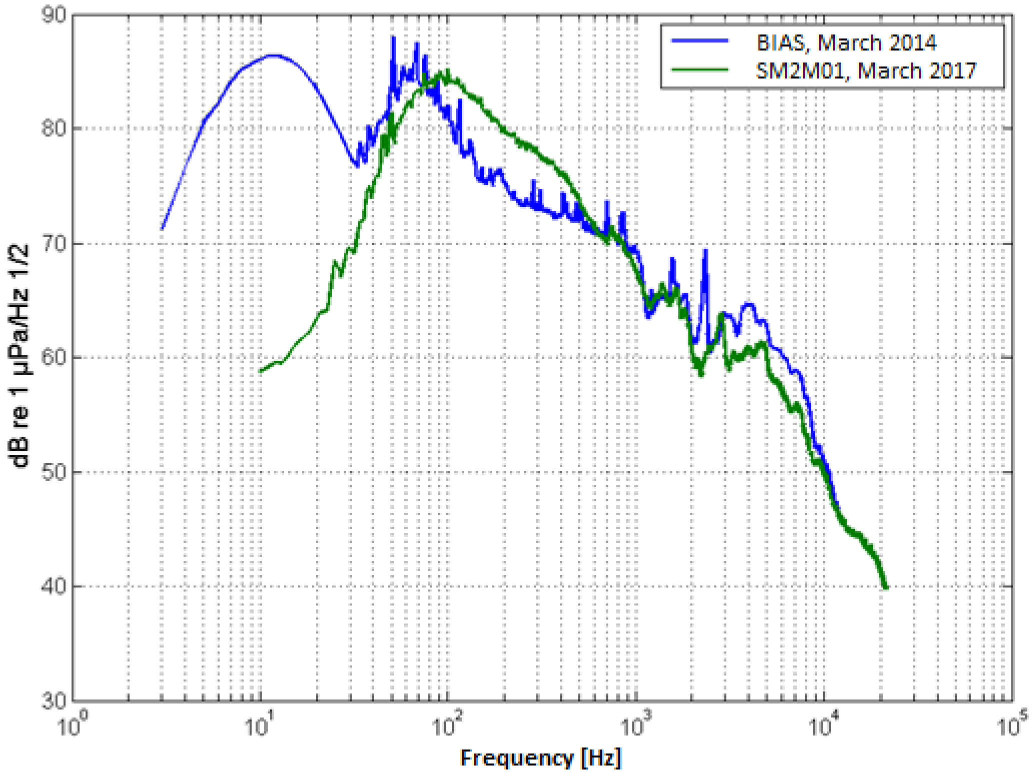


Figure 19. The averaged noise spectrum level from B3 station based on BIAS results from March 2014 compared to the data from SM2M_01 from March 2017

Source: BIAS results for: Tęgowski et al., 2016, data provided by J. Tęgowski

The sensitivity of the porpoise ear (Kastelein et al., 2002) against the noise in the marine environment at stations SM2M_01, SM2M_02 and SM2M_05 can be seen in the figure below (Figure 20). The porpoise audiogram extends up to the ultrasound frequencies (above 20 kHz), with the highest sensitivity having been recorded at approximately 100 kHz. Thus, it is possible that higher frequency sounds, such as those generated by echo sounders, affect porpoises also at higher frequencies.

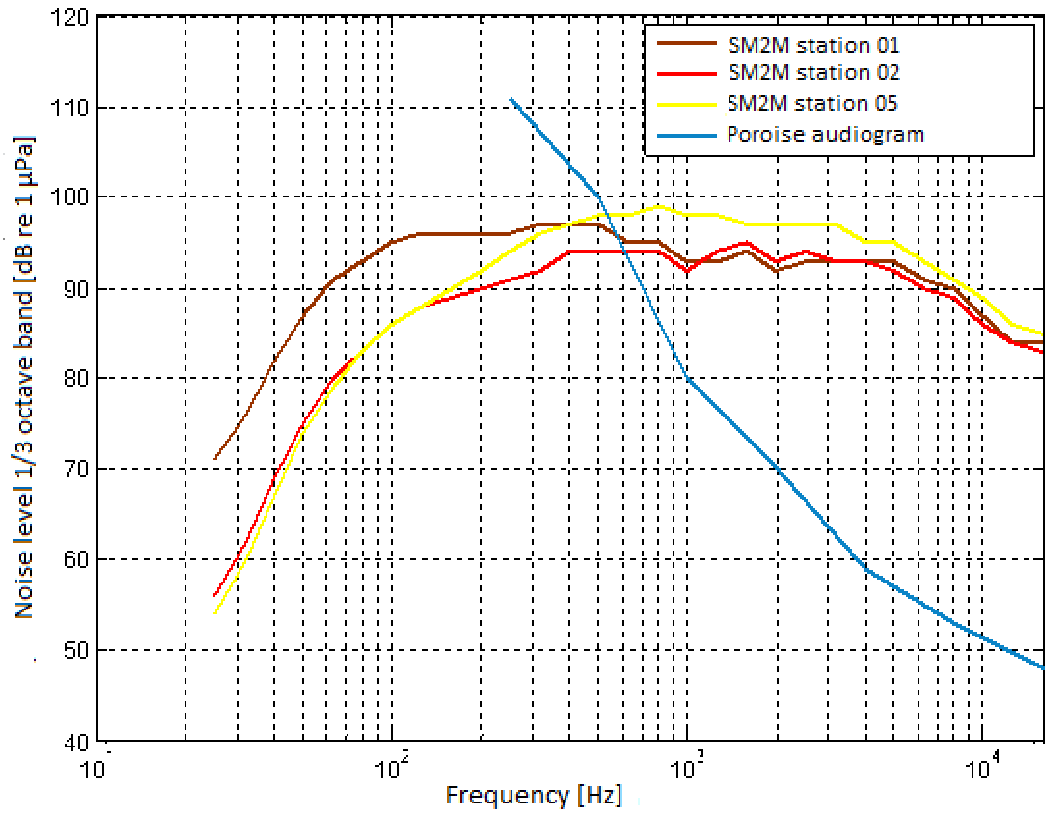


Figure 20. Levels of ambient noise in one-third-octave bands at stations SM2M_01, 02 and 05 in all seasons in relation to the porpoise sound sensitivity

Source: internal materials based on Kastelein et al., 2010

In the above figure (Figure 20) it is clearly visible that the ambient noise below 600 Hz is below the porpoise sound sensitivity. As a result, the background noise at low frequency is not detected by porpoises. At these frequencies, the background noise level in the Baltica 2 Area is higher than in the Baltica 3 Area. At frequencies higher than 600 Hz, the background noise level decreases only slightly, but at the same time the sound sensitivity of the porpoise is improved. At approximately 4 kHz, the background noise levels are approximately 40 dB higher than the audiogram values. These frequencies are the highest in the background noise at station SM2M_05. Porpoises in the OWF Area live in an environment with a constant background noise, in which the potential impact increases with the increasing frequency. However, the total levels are probably not high enough to lead to any effects on hearing (Kastelein et al., 2012, but see also: Tougaard et al., 2015).

It is also worth mentioning the status of the noise monitoring in Poland in the light of the applicable maritime strategy documents resulting from the MSFD.

The monitoring of the underwater noise impact on the marine environment is not currently conducted in Poland, thus there is no data available which could be used to carry out the national assessment of the ambient noise level (National Marine Waters Protection Programme, 2016). The decision of the European Commission (EC Decision 2017/848 of 17 May 2017 laying down criteria and methodological standards for good environmental status of marine waters as well as specifications and standardized monitoring and evaluation methods, repealing Decision 2010/477/EU) lists the criteria of the assessment to which an indicator describing the introduction of energy, including the underwater noise, should be subjected. The HELCOM CORESET project also proposed indicators that are able to define the existing conditions and pressure associated with the introduction of acoustic energy into the marine environment. The proposed evaluation criteria include, among others, the noise associated with human activity with deleterious physiological and perceptual impacts (underwater impulse sounds), the ambient noise related to human activities that exert an influence on communication and resulting in the loss of biological functions (underwater continuous low frequency sounds and underwater continuous sounds) and the electromagnetic fields due to electric voltages and currents disturbing the natural migration behaviour of individuals in the marine environment (no indices defined in the MSFD and no proposals from HELCOM).

The Marine Waters Monitoring Programme (CIEP, 2014) assumes the implementation of the underwater noise monitoring program (C11) taking into account the requirements of the MSFD. The indicators and parameters have been determined in terms of the required parameters, i.e. the occurrence of impulsive sounds in selected regional squares and the noise level at specific measurement stations. However, this monitoring has not yet started.

3.6 EMF

Electromagnetic fields in the environment can be divided into natural fields and fields of anthropogenic origin (called artificial fields). From the natural fields, the geomagnetic field of the Earth, whose intensity ranges from 16 to 56 $A \cdot m^{-1}$, is best recognized. An electric charge, which is the source of a natural electric field, accumulates on the surface of the Earth. The value of the Earth's natural electric field intensity at moderate weather conditions is approximately 120 $V \cdot m^{-1}$.

In the marine environment, the mentioned values of the electric field and the geomagnetic field are similar. There are no natural or artificial sources of electromagnetic radiation in the area of the planned Baltica OWF project. The existing 450 kV DC Sweden-Poland transmission system is located several kilometres from the planned OWF location.

Changes in natural electric fields do not have a direct impact on living organisms as well as human well-being. Natural magnetic fields show differences depending on the geographical location. They have a significant impact on some living organisms.

Electromagnetic fields created by the flow of electric current can change the natural migration behaviour of marine mammals; they can also be a source of thermal energy introduced into the sea. However, these factors are difficult to measure and according to the "Initial assessment of the state of the marine environment in the Polish Baltic Sea zone" (CIEP, 2013), are not currently monitored in Poland. It has been known for years that some animals, such as dolphins, birds and certain species of insects, in underwater migration or long-distance flights are guided by the position of the magnetic poles. These abilities to recognize the direction of the Earth's natural magnetic field can be disturbed as a result of the very strong intensity of the constant magnetic field of 1–50 Tesla.

3.7 Description of natural elements and protected areas

3.7.1 Biotic elements in the maritime area

3.7.1.1 Phytobenthos

Few places of phytobenthos occurrence have been identified in the Southern Baltic until now. It most often grows on the seabed of the Puck Bay, known as the Puck Lagoon (Kruk-Dowgiałło, 2000; Kruk-Dowgiałło and Brzeska, 2009; Natural conditions…, 2004–2009) and the Słupsk Bank's boulder area (Kruk-Dowgiałło et al., 2011). In the coastal zone of the open sea, its occurrence has been described on the stony seabed in the area of Rowy (Osowiecki and Kruk-Dowgiałło, 2006; Saniewski, 2013). Generally, the exact reconnaissance of the phytobenthos occurrence in the Southern Baltic, and in particular in the region where the areas designated for offshore wind farms are located, i.e. outside the territorial sea has not been carried out.

Phytobenthos surveys for the implementation of offshore wind farms have been carried out:

- in the BŚII area in 2013 (Błeńska et al., 2014), adjacent to the Baltica OWF Area from the west;
- in the BŚIII area in 2013 (Błeńska et al., 2015), adjacent to the Baltica OWF Area from the south-east;
- in the Baltica OWF Area in 2016 as part of surveys carried out for the purposes of this EIA Report (Appendix 1).

The results of phytobenthic surveys from 2016, carried out with the same methods as the surveys in 2013 in BŚII and BŚIII areas, also showed a trace presence of phytobenthos, only in the south-western part of the Baltica OWF Area. The occurrence of phytobenthos has been confirmed on 36% of transects studied, which have been determined on the basis of a sonar mosaic at depths of 22 to 23.3 m as potential sites for phytobenthos occurrence. These have been individual specimens of small size, very sparsely distributed on the seabed. Less than 1% of the seabed was overgrown with macroalgae, i.e. pebbles and boulders have been covered by one to several specimens on a transect with an average length of 111 m. It has been concluded that the Baltica OWF Area is not a favourable region for the occurrence of phytobenthos.

Individual specimens of macroalgae have been represented by 6 taxa recorded so far in the Southern Baltic: brown algae *Sphacelaria* sp. and *Pylaiella littoralis* as well as red algae *Rhodomela confervoides*, *Coccotylus truncatus*, *Aglaothamnion tenuissimum* and *Furcellaria lumbricalis* (formerly *F. fastigiata*). Among them, only *F. lumbricalis* is a strictly protected species pursuant to the Regulation of the Minister of Environment of 9 October 2014 on protection of plant species (Journal of Laws 2014, item 1409). Its one small specimen has been identified only in one monitoring transect, at a depth of 23.3 m.

Hence, it can be stated that in the Baltica OWF Area the *F. lumbricalis* was at the brink of its occurrence range with respect to the depth. Its occurrence should be described as incidental, especially since the region of the most abundant occurrence of *F. lumbricalis*, which can be treated as a gene pool for this species in the Southern Baltic, occurs in shallower areas, up to about 15 m – on the boulder area of the Słupsk Bank (Kruk-Dowgiałło et al., 2011), located approximately 20 km from the south-western boundary of the Baltica OWF Area.

The presence of macroalgae in trace amounts in the OWF Area (small number of taxa, low percentage of seabed coverage, negligible biomass) is a result of the habitat conditions prevailing in the area, i.e. considerable depths and limited availability of hard substrate, which is mainly covered with blue mussels, which do not favour the development of macroalgae. This poor occurrence of phytobenthos is typical for the Baltic open waters around 20 m deep (Feistel et al., 2008; Kruk-Dowgiałło et al., 2011), including the locations of offshore wind farms in the Southern Baltic: BŚII (Błeńska et al., 2014) and BŚIII (Błeńska et al., 2015).

The analysis of the criteria for phytobenthos valorisation in the OWF Area (Table 20) has shown that only one criterion has not been met, but it is the most important – phytobenthos does not create communities here, which are a perfect habitat for the development and residence of the invertebrate phytophilous fauna or ichthyofauna. Macroalgae occur predominantly in the form of residual or singular and small specimens very sparsely distributed over the seabed.

Table 20. The analysis of natural values of the OWF Area based on phytobenthos

No.	Valorisation criteria	Meeting the criteria
1.	Macroalgae occurrence	Present, but only on 9 out of 25 examined transects (which constitutes 36% of all transects delineated on the basis of a sonar and bathymetric map)
2.	Communities occurrence	None. Macroalgae occurred in the form of individual specimens (seabed cover <1%)
3.	Presence of rare and protected species	Rare species: *Rhodomela confervoides* – individual specimens on 36% of the examined transects Protected species: *Furcellaria lumbricalis* (*F. fastigiata*) – 1 specimen per 1 transect out of 25 examined
4.	Lack of dominance in the biomass of eutrophication indicator species	Lack of dominance

Source: internal materials based on Kruk-Dowgiałło et al., 2011

Although in the IMF Area, single specimens of *Rhodomela confervoides* rare in PMA have been found and one specimen of the strictly protected species *Furcellaria lumbricalis* (*F. fastigiata*), their accessory/incidental nature of occurrence and poor quantitative structure (low percentage of seabed cover, residual or small size of thalli) do not increase significantly the natural assets of the OWF Area. Moreover, the possible destruction of these specimens as a result of the planned investment implementation will not influence the changes in these species' population in the PMA.

No domination of species considered as eutrophication indicators, mainly brown algae, has been recorded in the OWF Area. This is not due to the good condition of macroalgae, and poor sunlight conditions prevailing at the depths greater than 20 m, the conditions which can still be tolerated only by red algae, i.e. for example *Rhodomela confervoides* and *Furcellaria lumbricalis*.

Against the background of the subsea vegetation of the PMA, e.g. the Puck Bay or the Słupsk Bank boulder area, where phytobenthos forms multispecies communities overgrowing densely wide areas of the seabed (Osowiecki and Kruk-Dowgiałło, 2006; Kruk-Dowgiałło and Brzeska, 2009; Kruk-Dowgiałło et al., 2011), the phytobenthos of the OWF Area has very little natural values.

3.7.1.2 Zoobenthos

The knowledge of zoobenthos in the area of the Baltica OWF until the beginning of the second decade of the 21st century was very limited. In the vicinity of the OWF Area there is the P14 station which is monitored within the framework of the National Environmental Monitoring carried out by the IMWM-NRI in Gdynia. At the soft seabed in 2008, only 9 species were found at the P14 station (Radziejewska et al., 2012). The information provided orally indicates that in the following year's zoobenthos monitoring at this station was discontinued.

For the purposes of the elaboration of this EIA Report, in 2016, zoobenthos surveys were carried out in the OWF Area. Zoobenthos survey results included in reports from zoobenthos surveys in the BŚIII and BŚII OWFs areas (Błeńska et al., 2014; Błeńska et al., 2015) may serve as a reference material for the assessment of the taxonomic composition and the constancy of zoobenthos occurrence in the OWF Area. The first report (Błeńska et al., 2014) includes the results of zoobenthos surveys conducted in June 2013 in the region of the BŚIII OWF, which is located about 23 km to the north of Łeba and the surface of which is about 185 km^2 (including a buffer zone). In the BŚIII OWF area and its 1 mile wide buffer zone 175 samples of zoobenthos have been collected from the sandy seabed using a Van Veen Grab Sampler and a DAK frame for the hard seabed. As a result of the tests carried out, 27 zoobenthos taxa have been found, which is a slightly lower number than the one found in the OWF Area in 2016. The group of the most common taxa included three out of the five taxa recorded in the Baltica OWF Area in 2016 (Table 21).

The second report (Błeńska et al., 2015) includes the results of zoobenthos surveys conducted in June 2013 and May 2014 in the area of the BŚII OWF, which is located about 37 km to the north of the shoreline, at the latitude of the Smołdzino municipality and the urban municipality of Łeba and has the surface of approximately 188 km^2 (including a buffer zone). In the BŚII OWF area and its 1 mile wide buffer zone 117 samples of zoobenthos have been collected from the sandy seabed using a Van Veen Grab Sampler and a stone grab for the hard seabed. As a result of the tests carried out, 32 zoobenthos taxa have been found, which is a number close to the amount found in the OWF Area in 2016. The group of the most common taxa (absolutely constant) included two out of the five taxa recorded in the Baltica OWF Area in 2016 (Table 21).

Table 21. Zoobenthos characteristics in the Baltica OWF Area in 2016 against the results of zoobenthos surveys conducted in the BŚIII and BŚII OWFs areas in 2013 and 2014

Parameter	**OWF Area (2016)**	**BŚIII OWF Area (2013)**	**BŚII OWF Area (2013, 2014)**
Number of stations	402	175	117
Depth range [m]	21–54	26–42	23–44
Number of taxa (max., range)	33; 4–18	27; 4–16	32; 3–12
Most common taxa (absolutely constant)	*Marenzelleria* sp., *Pygospio elegans, Limecola balthica, Bylgides sarsi, Diastylis rathkei*	*Pygospio elegans, Marenzelleria* sp., *Limecola balthica, Hediste diversicolor*	*Pygospio elegans, Marenzelleria* sp.

Source: internal materials based on Błeńska et al., 2014 and 2015

A comparison of the zoobenthos surveys results carried out within the three aforementioned projects, in 2013–2016, in a similar depth range (21–54 m b.s.l.) in three regions of the open waters of the Southern Baltic showed that zoobenthos has not differed in terms of composition characteristics nor taxonomic diversity in any of them.

The results of qualitative surveys of zoobenthos carried out for the purposes of this EIA Report, i.e. of its taxonomic composition and the constancy (frequency) of taxa occurrence at individual stations distributed in the OWF Area on seabed consisting of sand or gravel (sampled with the van Veen grab designed to take samples of the soft seabed) indicated that the region is inhabited by a diverse benthic macrofauna.

In the Baltica OWF Area in 2016, 33 taxa of zoobenthos were found. Taxa, which are typical for shallow and mid-deep seabed (up to 50 m b.s.l.) of the Southern Baltic open waters have prevailed. In the group of absolutely constant species were: polychaete worms *Marenzelleria* sp. and *Pygospio elegans* and the characterised by a wide range of tolerance to environmental factors: Baltic clam *Limecola balthica* as well as *Bylgides sarsi* and *Diastylis rathkei* (Table 22).

Table 22. The characteristics of zoobenthos in the Baltica OWF Area in 2016

Parameter	**Soft seabed**	**Hard seabed**
Number of taxa: Total; range at stations	33; 4–18	15; 6–9

Parameter	Soft seabed	Hard seabed
Abundance [indiv.·m^{-2}]: av.; the range	1211; 37–5 663	74 620; 51 600–102 200*
Biomass [g WW·m^{-2}]: av.; the range	23.11; 0.32–124.32	2961.89; 498.12–4265.52*
Index B: av.; the range	3.10; 1.95–4.44	-
EQR: av.; the range	0.633; 0.398–0.906	0.800; 0.50–1
The most common taxa	*Marenzelleria* sp., *Pygospio elegans*, *Limecola balthica*, *Bylgides sarsi*, *Diastylis rathkei*	*Bylgides sarsi*, *Mytilus trossulus*, *Gammarus salinus*, *Hediste diversicolor*, *Amphibalanus improvisus*

**Quantitative data applies to Mytilus trossulus*
av. – the average value
Source: internal data

The valorisation of the OWF Area has shown that the soft seabed zoobenthos did not have high natural qualities. In the OWF Area its condition has been assessed as moderate. The valorisation of the hard seabed carried out with the use of the TSP indicator has shown a **high** degree of value of this type of habitat. In the OWF Area, the condition of the hard seabed zoobenthos communities has been described as very good (Table 23).

Table 23. B and EQR index values (range and average ± standard deviation) and the valorisation of the soft and hard seabed zoobenthos communities in the OWF Area

Parameter	OWF Area
Soft seabed	
B index (min.–max.)	1.95–4.44
Index B (av. ± stand. dev.)	3.10 ±0.393
EQR (min.–max.)	0.398–0.906
EQR (av. ± stand. dev.)	0.633 ±0.080
Status and class of the zoobenthos communities	Moderate (III)
Hard seabed	
EQR (av. ± stand. dev.)	0.800 ±0.158
Status and class of the zoobenthos communities	Very good (I)

Source: internal data

The aggregated assessment of qualities in the OWF Area, taking into account partial evaluations of soft and hard seabed valorisation and the percentage of stations located within them, has shown that the qualities of zoobenthos inhabiting it were in good condition based on the zoobenthos indexed with B and TSP indices (Table 24).

Table 24. The aggregated assessment of the OWF's Area qualities based on the assessment of the zoobenthos communities of the soft and hard seabeds

Parameter	OWF Area
Soft seabed	
EQR	0.633
Percentage of the number of stations on the soft seabed	80.24

Parameter	OWF Area
Hard seabed	
EQR	0.800
Percentage of the number of stations on the hard seabed	19.76
In total	
EQR of the Area	0.666
Status and class of the zoobenthos communities	Good (II)

Source: internal data

The analysis of the EQR values spatial distribution in the OWF Area has indicated that the north-western and central part of the examined area has been characterised by the highest qualities. The fragments of the seabed with the highest qualities coincided in this part of the OWF Area with the presence of the boulders on the seabed. The valorisation has also shown that on the soft seabed (fine-grained and medium-grained sands) in the south-eastern part, seabed fragments characterised by the qualities of the zoobenthos inhabiting it described as poor has been found (Figure 21).

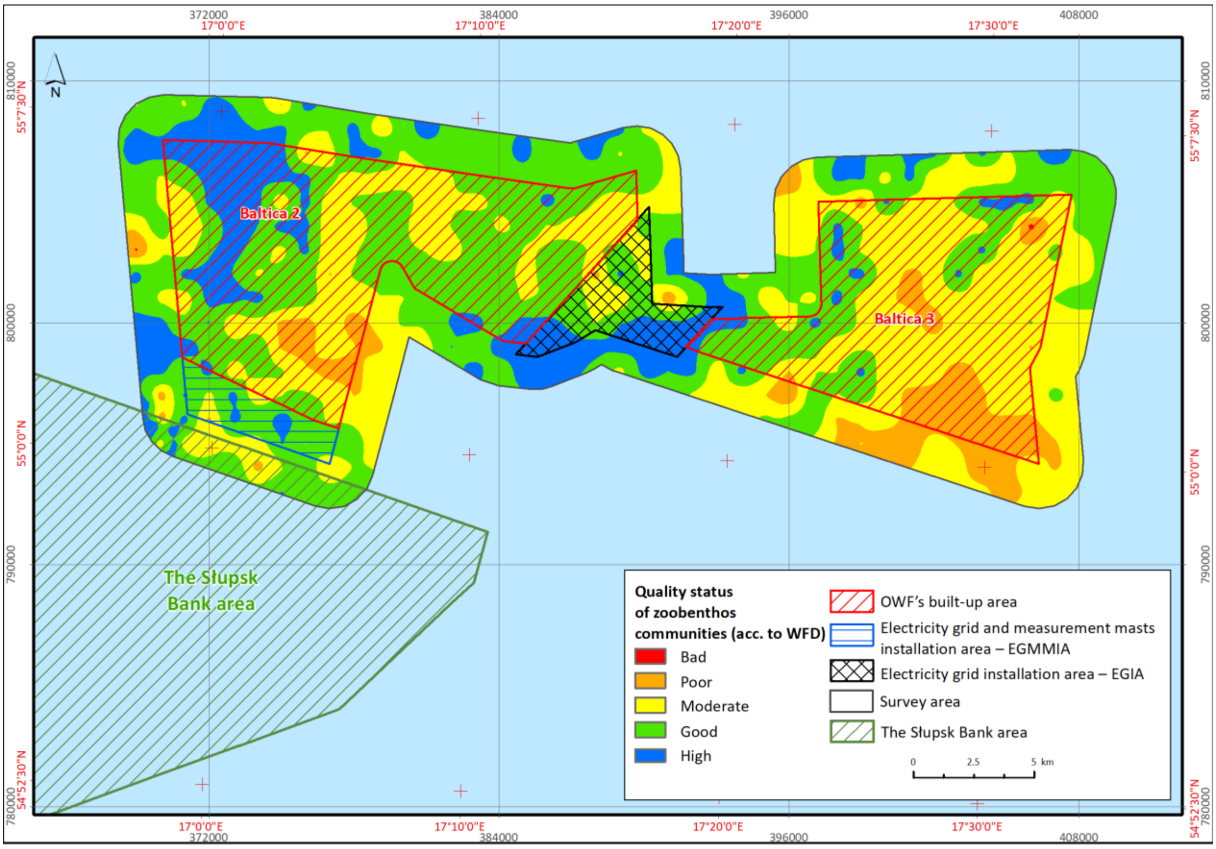


Figure 21. Spatial distribution of the zoobenthos valorisation gradient in the OWF Area

Source: internal data

3.7.1.3 Ichthyofauna

Taking into account the information from literature and the results of ichthyofauna surveys carried out for the purposes of the development of this EIA Report, it may be assumed that the following taxa may spawn in the Baltica OWF Area: sprat *Sprattus sprattus*, autumn spawning herring *Clupea harengus*, sand lance *Ammodytidae* (great sand eel *Hyperoplus lanceolatus* and lesser sand eel

Ammodytes tobianus), turbot *Scophthalmus maximus*, gobies *Gobiidae* and common seasnail *Liparis liparis*. However, the observed higher numbers and more frequent occurrence of some taxa larvae that release demersal roe at small depths (common seasnail, sand lance, gobies, shorthorn sculpin *Myoxocephalus scorpius*) at the stations located in the western part of the OWF Area adjacent to the Słupsk Bank may indicate that they come from this region. The appearance of the larvae of the species, the spawning of which is not possible in the OWF Area because of too low salinity (cod *Gadus morhua*, flounder *Platichthys flesus*, fourbeard rockling *Enchelyopus cimbrius*, plaice *Pleuronectes platessa*) is the effect of the juveniles drifting in with the currents of water from the spawning ground in the Słupsk Furrow and their continued active journey in search of food.

In the Baltica OWF Area, the larvae of fish covered by partial species protection listed in the Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws of 2016, item 2183) have been found. These were gobies, which occurred abundantly from late spring to winter (June–January), and common seasnail, which was also recorded in spring and summer though less abundantly.

Apart from herring and sprat, also few specimens of cod, great sand eel, mackerel *Scomber scombrus*, European anchovy *Engraulis encrasicolus*, flounder, lumpfish *Cyclopterus lumpus* and three-spined stickleback *Gasterosteus aculeatus* have been caught in the course of pelagic control hauls aimed at investigating the share of individual species for the purposes of estimating pelagic fish biomass.

The result of demersal fishing in the OWF Area using fixed nets is 1560.75 kg of fish belonging to 12 taxa. Flounder and cod have prevailed, and the other species (plaice, shorthorn sculpin, turbot, herring, lumpfish, great sand eel, mackerel, pogge *Agonus cataphractus* and sprat) have constituted a small by-catch.

The fish belonging to 19 taxa have been caught in all the survey tools in the OWF Area (Table 25). The permanent fish complexes include cod, flatfish *Pleuronectiformes*, herring, sprat and sparsely occurring shorthorn sculpins, lumpfish, great sand eels and viviparous eelpout *Zoarces viviparus*. Species such as European anchovy or mackerel migrate to the Southern Baltic from the North Sea usually during inflows. The observed occurrence of the larvae of such species as gobies, fourbeard rockling, rock gunnel *Pholis gunnellus* or common seasnail, does not indicate a permanent inhabitation of the area by adult fish.

Table 25. Specification of all the taxa recorded in the course of survey fishing in the Baltica OWF Area

No.	Species	Pelagic catches	Demersal catches	Ichthyoplankton catches
1.	Cod	X	X	X
2.	Flounder	X	X	X
3.	European plaice		X	X
4.	Turbot		X	X
5.	Herring	X	X	X
6.	Sprat	X	X	
7.	Great sand eel	X	X	X
8.	Small sandeel			
9.	Shorthorn sculpin		X	X
10.	Lumpfish	X	X	

No.	Species	Pelagic catches	Demersal catches	Ichthyoplankton catches
11.	Eelpout		X	
12.	Atlantic mackerel	X	X	
13.	Pogge		X	
14.	Three-spined stickleback	X		
15.	European anchovy	X		
16.	Gobies			X
17.	Fourbeard rockling			X
18.	Rock gunnel			X
19.	Common seasnail			X

Source: internal data

The results of the acoustic tests of the biomass size, control fishing efficiency and the biological surveys have demonstrated that **herring** occurred sparsely in the OWF Area, except during the summer season, when it could have been a commercial fishing object. There were no large numbers of juvenile fish (<16 cm total length) that were subject to protective regulations. In the OWF Area, 1-year-olds of the local population of spring spawning herring occurred in the period from summer to autumn. The lack of fish in the spawning phase (stage VI of the gonadal maturity) throughout the annual cycle of surveys, as well as the small presence of larvae, allows to state that there are no spawning grounds important for the recruitment of the species in the area. Generally, the low intensity of feeding herring (with the exception of the summer) leads to the statement that the analysed OWF Area does not belong to feeding grounds preferred by herring. Their presence there is rather related to the seasonal migrations to deeper, adjacent waters where, due to the more favourable hydrological conditions, they find better food supply.

The results of pelagic control fishing indicate that a small part of the OWF Area was at the beginning of spring (March 2016) and the beginning of summer (June 2016) a place of sprats' seasonal spawning migration between the main deep water spawning grounds of this species, located outside the survey area. In the autumn (October 2016), the OWF Area was the site of the above mentioned feeding migrations of adult sprats. In the winter (January 2017), the OWF Area was the place of a temporary migration of part of the sprat population engaged in an advanced by about two months spawning in the neighbouring Słupsk Furrow. It should be noted that in January sprat fishing yields were the smallest on the scale of all analysed survey cruises.

The results of biological tests have shown the presence of the smallest size cod in the OWF Area, which indicates the existence of nursery grounds of this species of fish in this area, but there are also favourable conditions for the occurrence of larger cod, which can be caught by the commercial fleet. The depth range (20–50 m) occupied by the OWF Area also supports the occurrence of cod of a varied range of length. Such a wide range of depth allows for the separation of smaller cods that prefer shallower waters (about 20 m deep) from adult cods inhabiting deeper waters. Such a division helps to avoid cannibalism periodically happening in cods. The variety of sizes of cod occurring in the above mentioned area results mostly from the considerable surface of the OWF Area in the context of the grounds currently inhabited by cod (primarily the Southern Baltic). Whereas, the significant latitudinal extension and the location of this area between the deeps of the Baltic Sea (Słupsk Furrow and Bornholm Deep) and the shallow coastal zone causes the migration of cod into the spawning grounds through the area, and afterwards their return to the shores where cod feeding grounds are located, to be related to the inevitable occurrence of cod in the OWF Area. The discovery of mainly crustaceans in cod's food indicates the existence of a favourable composition of fauna constituting a food supply for both smaller cod and those of larger sizes, as both of these length groups feed on crustaceans. The situation would be less favourable if in the OWF Area there were only adult clupeids or sand lance which are unavailable for the smallest (over a dozen centimetres long) cod. The analysis of the gonadal maturity stages confirms that the OWF Area is not a cod spawning ground. Occurrence of fish in gonad maturity stage VIII (resting) and II (resting) confirms that the OWF Area is a place where cod is present after reproduction, mainly in order to feed and to prepare the fish of this species for the next cycle of spawning migration and the spawning itself.

The results of survey fishing confirm the occurrence of plaice in the surveyed area, however, based on the small number of individuals caught, it is difficult to determine the significance of the area for this species. Plaice for spawning requires higher salinity than flounder, so the areas on which this species can be successfully reared in the Baltic Sea are not as extensive as in the case of flounder (Nissling et al., 2002). This is why as a basin with low salinity, the Baltic Sea is characterised by a smaller population of plaice in comparison with other basins.

Concluding, out of the 19 taxa observed during the ichthyofauna surveys carried out in 2016 and 2017 for the purpose of the planned project, 6 are of particular economic importance, being the subject of industrial fishing. These are: sprat *S. sprattus*, herring *C. harengus*, cod *G. Morhua*, flounder *P. flesus*, plaice *P. platessa*, turbot *S. maximus*. Salmon *Salmo salar* and sea trout *Salmon trutta* were not observed during the survey fishing (no standardised survey methods, low density), however, these two species are found in commercial fishing.

In survey fishing conducted in the area of the Baltica OWF, the most numerous were: sprat, herring, cod and flounder, which form the basis of industrial fishing.

In addition, in the course of the monitoring studies mentioned above, the occurrence of 27 larval gobies, belonging most probably to the partially protected species – **sand goby** *Pomatoschistus minutus,* and 16 larval **common sea snail** *L. liparis*, which is also under partial protection in Poland, were recorded in the ichthyoplankton samples.

In order to assess the importance of the OWF Area with respect to ichthyofauna, its following values have been considered: taxonomic diversity, the occurrence of protected and endangered species, feeding and/or spawning grounds, migration routes. On the basis of the aforementioned functions, the natural qualities of this have been assessed as medium. The assessment has been based on experts' judgment. The characteristics of the above mentioned natural qualities have been as follows:

- the total number of ichthyoplankton (roe and larvae) has been characterised by seasonal variability and has been lower than that found in the neighbouring regions of the planned offshore wind farms BŚII and BŚIII;
- ichthyoplankton has been medium diverse in terms of taxa (12 taxa). The biggest number of taxa was observed in late spring and summer months (8), while the lowest number was recorded in the autumn (5);
- the larvae of fish covered by partial species protection listed in the Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws of 2016, item 2183) have been found. They were the numerous gobies (from late spring to winter) and much less numerous common seasnail (from spring to summer);

- altogether, 19 ichthyofauna taxa were caught in all research tools. The permanent fish complexes include cod, flatfish, herring, sprat and sparsely occurring shorthorn sculpins, lumpfish, great sand eels and viviparous eelpout;
- the nine species of ichthyofauna caught are classified as LC, i.e. the least concern, according to the International Union for the Conservation of Nature (IUCN). The LC category includes widely distributed and numerous taxa, i.e.: pogge, herring, fourbeard rockling, European anchovy, three-spined stickleback, great sand eel, common seasnail, flounder, plaice, salmon, sea trout (Fernandes et al., 2014; Florin et al., 2014; Freyhof, 2014; Herdson & Priede, 2010; Iwamoto et al., 2015; Munroe, 2010; Tous et al., 2015);
- only the Atlantic cod has the status of an endangered species according to the IUCN red list (Freyhof and Kottelat, 2008; Sobel, 1996). Atlantic cod was included in the VU category in 1996, it is a high-risk species and is endangered with extinction due to a population reduction below 50% in the recent period, and the reasons for this reduction are known, reversible and possible to stop;
- the seabed of the OWF Area can perform an important feeding functions for commercially-fished species such as flatfish and cod;
- ichthyoplankton surveys indicate the occurrence of sprat spawning, however, the comparison of the numbers of larvae caught during the survey with the average number observed in the Southern Baltic area does not indicate the importance of this area as a spawning ground. The spawning of the sand lance, common seasnail, shorthorn sculpin and turbot cannot be excluded, but their reproduction in the waters of the nearby Słupsk Bank is more likely;
- the results obtained during the survey do not indicate the occurrence of cod's spawning; in the case of herring, the lack of fish in the spawning phase (stage VI of the gonadal maturity) throughout the annual survey cycle, as well as the small presence of larvae, allow to state that there are no spawning grounds important for the recruitment of the species in the area;
- the OWF Area is a place of seasonal feeding migration of pelagic fish and cod as well as spawning flounders.

In 2016, an environmental assessment was carried out based on the ichthyofauna occurring within the PMA open sea zone (ICES 25-26) in accordance with MSFD. The assessment was made on the basis of feature 1, which concerns biodiversity. For this purpose, the fish size index in open waters (LFI1) was used, which obtained the subGES rating, i.e. below the good state.

In 2015, an environmental assessment was carried out based on the ichthyofauna occurring within the open sea zone of the entire Baltic Sea in accordance with MSFD. The assessment was made on the basis of 2 indicators of feature 3, which concerns commercially exploited fish populations and invertebrates. These indicators are used to determine the level of fishing pressure and reproductive capacity of the stock. The obtained assessment of the level of fishing pressure for herring stock (ICES 25-29 and 32 Ex GoR) was defined as GES, while for sprat school (ICES 22-32) as subGES. In the case of breeding capacity for these schools: herring (ICES 25-29 and 32 Ex GoR) and sprat (ICES 22-32), the criterion was reached, which means that the mark was within the limits of GES.

3.7.1.4 Marine mammals

In the PMA there is one species of cetacean: porpoise *Phocoena phocoena*, and three species of seals: harbour seal *Phoca vitulina*, grey seal *Halichoerus grypus* and occasionally ringed seal *Pusa hispida*.

Porpoises belong to the family Phocoenidae. They are one of the smallest cetaceans in the world. Female porpoise have an average length of 150–160 cm and weigh from 60 to 65 kg, while males reach an average length of 140–145 cm and weigh from 46 to 50 kg.

Porpoises have a spindle-shaped body and are heterogeneously coloured. They have a dark dorsal side and white or light grey lateral abdominal side. They are distinguished from the remaining cetaceans by a small triangular dorsal fin. In the European waters, the maximum life expectancy of porpoises is on average 15–20 years. Females achieve sexual maturity at the age of 3 or 4, males a bit later. The reproductive period for these cetaceans lasts from June to August, and the mating season from May to September. The gestation period is 10–11 months and females give birth to a single calf. She takes care of it for 8–10 months, but a young porpoise can remain close to its mother until the next birth. In the breeding and feeding periods, porpoises occur in many places in the Baltic Sea, also in Polish waters (WWF Poland, the Hel Marine Station of the Institute of Oceanography of the University of Gdańsk in Hel).

Porpoises usually prefer shallow coastal waters with depths not exceeding 200 m. They can dive to a depth of 220 m and stay under the water for up to five minutes, but most often they dive to small depths for no longer than two minutes. They live alone or in small groups. Larger groups can be found in areas where there is a large abundance of food and during migration.

Trends in the porpoises' travels are varied. Telemetry field studies conducted in the Fundy Bay (Canada) indicate that the distance covered by these animals per day varies from 15 to 58 km. Teilmann (2000), on the other hand, stated that in the Danish waters, porpoises can cover up to 80 km a day. This was also confirmed in telemetry studies, in which the maximum daily distance covered by porpoises was up to 100 km (Sveegaard, 2011). By means of tracking the passage routes of 63 individuals of this species, Teilmann et al. (2008) have determined several areas with a high density of these animals. Also the seasonal nature of their occurrence has been determined. Based on the surveys conducted in the south-western part of the Baltic Sea in 2002–2006, Gilles et al. (2009) recorded very significant differences in the abundance of harbour porpoises between the areas – in the western part, the frequency turned out to be much higher. The results have also shown seasonal differences – the highest number of porpoises was recorded in the summer, and the lowest in the winter and early spring.

The porpoises get food mainly near the seabed or near the surface of the water. As far as their food consumption is regarded, they are the so-called opportunists. Their body has limited energy storage capacity, and therefore they need constant food availability. Therefore, they do not have specific, permanent feeding grounds, and their occurrence depends on the availability of food. In order to get food, they can migrate over very long distances and stay longer in areas rich in food suitable for them. Porpoises feed on variety of fish species depending on the area and season. In the Baltic Sea the main foods of these small cetaceans are: herring, sprat and cod. Their diet also includes benthic and demersal fish species.

Similarly to all odontocetes, porpoises also use the echolocation system for inter-individual communication, navigation, searching for food and detecting obstacles or barriers.

The abundance and areas of porpoise occurrence in the North Sea and the western Baltic Sea were surveyed on a larger scale twice – in 1994 and 2005. The abundance changed slightly between these counts and amounted to 340,000 and 375,000 respectively (Hammond et al., 2002; SCANS, 2006). The porpoise occurrence density varies depending on the area analysed. In the Baltic Sea this density is significantly reduced towards the east – it is high in Danish internal waters, and low further to the east, including in Polish waters. Historical data suggest that porpoises formerly occurred throughout the entire Southern Baltic, but their numbers have drastically decreased. The decline was mainly due to fishing for these animals and, at present, bycatching in fishing nets.

The precise state of the porpoise population in the PMA is unknown, but it is widely recognized that its abundance is low. Some surveys indicate that the Polish coast is the eastern boundary of the occurrence range of this species in the Baltic Sea. The conducted analyses have shown the appearance of porpoises in the eastern part of the Baltic with some regularity. Between 2009–2011, the Hel Marine Station of the Institute of Oceanography of the University of Gdańsk in Hel conducted acoustic monitoring of porpoises using 48 C-POD devices in the Bay of Puck (part of the Gdańsk Bay). The survey demonstrated the presence of these animals within the surveyed area throughout the year, with the highest number of detections recorded in the winter months. It is worth indicating that the C-POD detectors were located very close to each other and were placed on the seabed in two, not too distant from each other, lines. Therefore, it is not possible to exclude the multiple detections of a small number of individuals appearing in the area surveyed. Thus, the obtained results are only information about the occurrence of an undetermined number of porpoises in a small area. The confirmation and the source of information on the presence of porpoises in the Bay of Puck are also the reports on bycatches in fishing nets collected by the Hel Marine Station of the Institute of Oceanography of the University of Gdańsk in Hel. Between 1986–2009, the station recorded 69 cases of porpoise bycatch, the majority of which took place in March.

Among the surveys on marine mammals in Poland, also the monitoring conducted within the framework of the cooperation between the WWF Poland and the Hel Marine Station of the University of Gdańsk was also important. It was implemented as part of the project called "Supporting the restitution and protection of Baltic mammals in Poland," which finished in 2012 but is currently continued under the name of "Protection of habitats of marine mammals and birds." The project assumes, among others, the collection of data from the observation of porpoises, finding dead individuals on the shore and bycatches in fishing nets within the Polish coast from 2009 to the present day. In 2015, marine mammals surveys within the National Environmental Monitoring began. According to the data obtained during the implementation of the SAMBAH project, Polish waters represent areas with low detection rate, indicating a low occurrence of these animals in the area (SAMBAH Final Report, 2016).

On the red list of endangered species published by IUCN, the Baltic porpoise population has been classified as critically endangered in the C2a criterion (Hammond, 2008). Thus, this species is on the lists of protected species of many legal acts, on an international and regional scale, including the Bern Convention, the Habitats Directive, the Bonn Convention, ASCOBANS, the Washington Convention, the Helsinki Convention HELCOM, the Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws of 2016, item 2183), the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880 with amendments).

The major threat to porpoises in the discussed area is the large bycatch of these animals in the Baltic (Koschinski, 2002), which is considered the most important cause of mortality associated with human activity (Hammond et al., 2008; HELCOM, 2013). According to the data on bycatch and the individuals thrown ashore, collected by the Hel Marine Station of the Institute of Oceanography of the University of Gdańsk in Hel, between 1990–2009, in total, there were 66 porpoises in the bycatch (the database of the Hel Marine Station and WWF). The largest percentage of animals was caught as bycatch in the semi-drifnets for salmonids (39%), followed by the gillnets for cod, other anchored gillnets, pelagic trawls and driftnets (EC-DGMARE 2014, ASCOBANS 2016). Even after the ban on driftnets in 2008, fishing using semi-driftnets for salmonids in Polish coastal waters has been continued. The nets have been classified as anchored gillnets, and not as they should have been, i.e. as driftnets. The main area in which fishing with semi-driftnets for salmonids is conducted is the Gdańsk Bay together with the Bay of Puck, which is also a "hotspot" of porpoise bycatch (EC-DGMARE, 2014).

The spatial distribution of porpoise detection probability per month and the total number of fishing hours in ICES squares using gillnets with mesh size ≤90 mm has been presented in the figure (Figure 22) (SAMBAH, 2016a; ASCOBANS, 2016). In the figures, it can be seen that fishing activity in the Baltica OWF Area is slightly increased between April–September compared to October–May. The probability of detection seems similar in both seasons and equals approximately 10%. In general, in October-May period, the range of occurrence and the presence of porpoises along the Polish coast are greater.

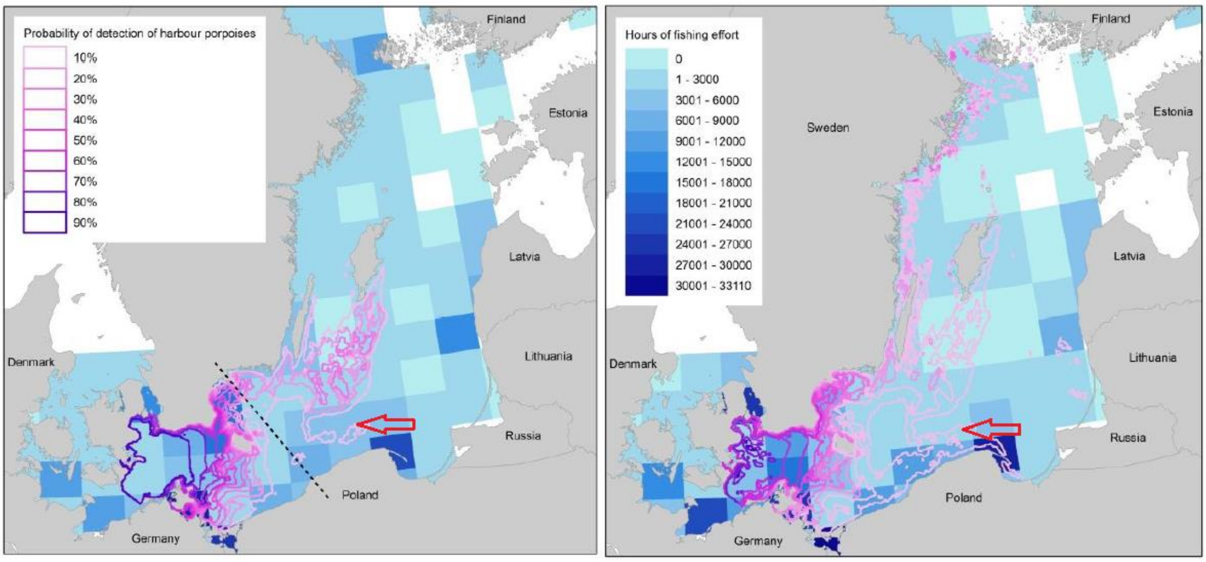


Figure 22. Monthly probability of porpoise detection in 2011–2013 in the SAMBAH area, including the total number of fishing hours in the ICES rectangle using gillnets with mesh size ≤90 mm in April-September and October-May 2014 respectively

The borderline used to estimate the porpoise population's abundance in SAMBAH has been marked with a dashed line (data from ASCOBANS 2016). The square in which the Baltica OWF Area is located has been indicated with red arrows
Source: ASCOBANS, 2016

Grey seal *Halichoerus grypus* is a mammal from the seal family and a representative of the genus *Halichoerus*. It occurs in coastal waters of the northern hemisphere of moderate temperature, throughout the North Atlantic. Grey seals occurring in the Polish Baltic Sea belong to one Baltic population, which in the past was very numerous (up to 100,000 individuals at the beginning of the last century). The population's numbers dropped sharply to just 2000 in the 1970s. Since the 1980s, the number of this species has been steadily increasing, in 2015, the counting of seals indicated the presence of 32,000 individuals. Although the number of grey seals is constantly rising, their recolonisation in the Southern Baltic region is very slow (HELCOM, 2015) (Figure 23).

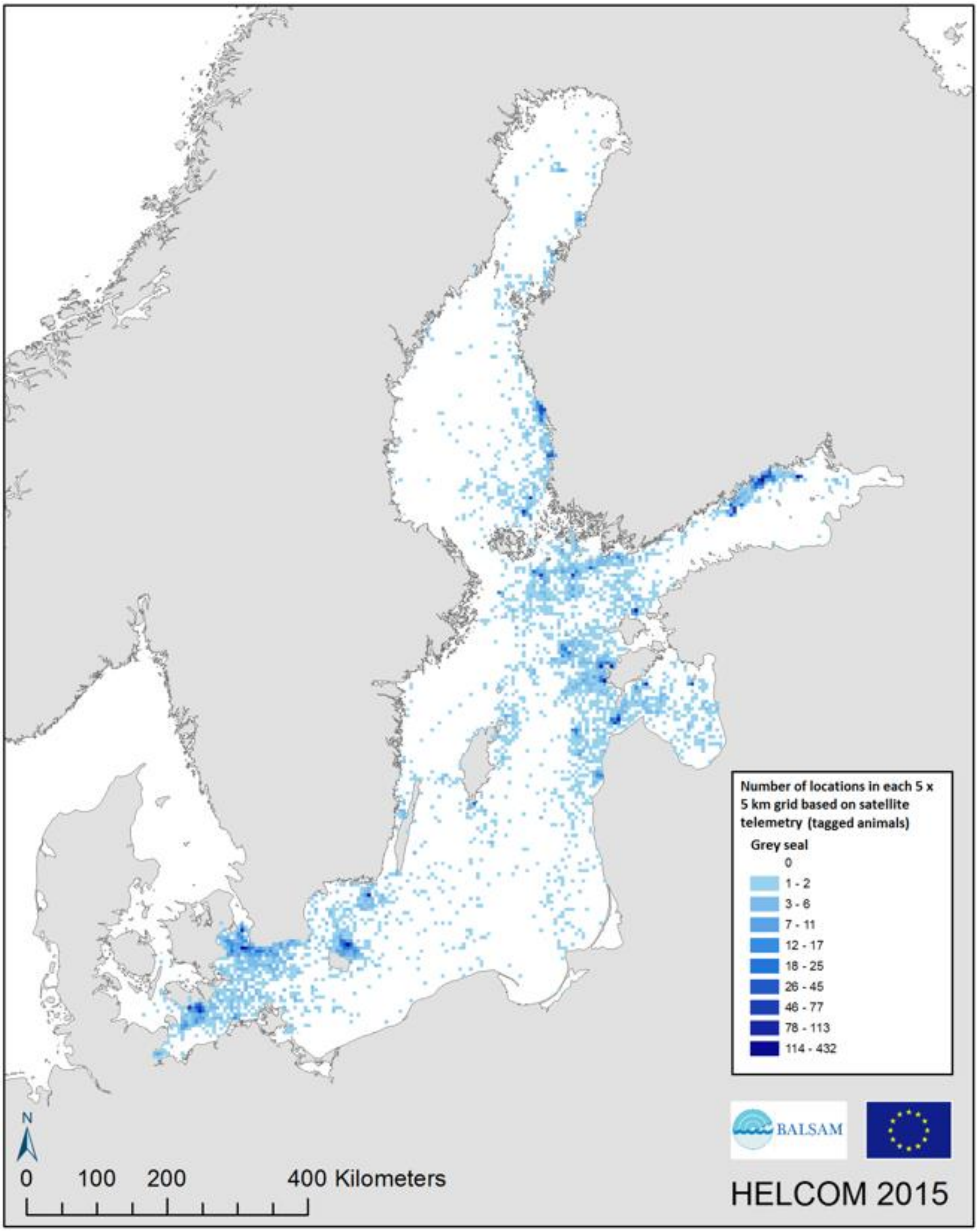


Figure 23. The distribution of grey seal in the Baltic Sea (based on satellite telemetry)

Source: HELCOM, 2015

Grey seal is sexually dimorphic. Males are larger than females, and their snouts are more massive and elongated. Adult males weigh between 170–300 kg, and females between 100–190 kg (Hall, 2009). The average body length is from 1.65 to 2.1 m. Males are evenly dark coloured, while females have grey backs and light bellies with dark patches. Grey seals gather in groups during breeding, moulting and rest between feeding periods. Males live on average 25, and females 35 years. Females become sexually mature at the age of 3–5; males reach this maturity of about 6 years of age. The pregnancy of a grey seal lasts for 8 months, but due to the delayed implantation of the egg, the birth takes place 10–11 months after fertilization. Most females give birth to one pup each year in the winter, at the turn of February and March. The pup is born on ice or on land, covered with white lanugo fur. It ceases to be fed by the mother after about two weeks, and then the female enters oestrus.

The feeding area of grey seals is very large, and the species composition of the food consumed varies greatly depending on the location of these animals, the season and the availability of food. Grey seals feed on many fish species, most of which are herring, sprat, cod, whitefish and salmon.

The **harbour seal** *Phoca vitulina* belongs to the seal family Phocidae and occurs in coastal waters, in the arctic and moderate climate of the northern hemisphere. The harbour seals are divided into five subspecies based on the area of their occurrence and their genetic data. The individuals occurring in the Baltic Sea belong to the subspecies *Phoca vitulina vitulina* (Figure 24). The number of harbour seals in the Baltic Proper is estimated at 800 individuals.

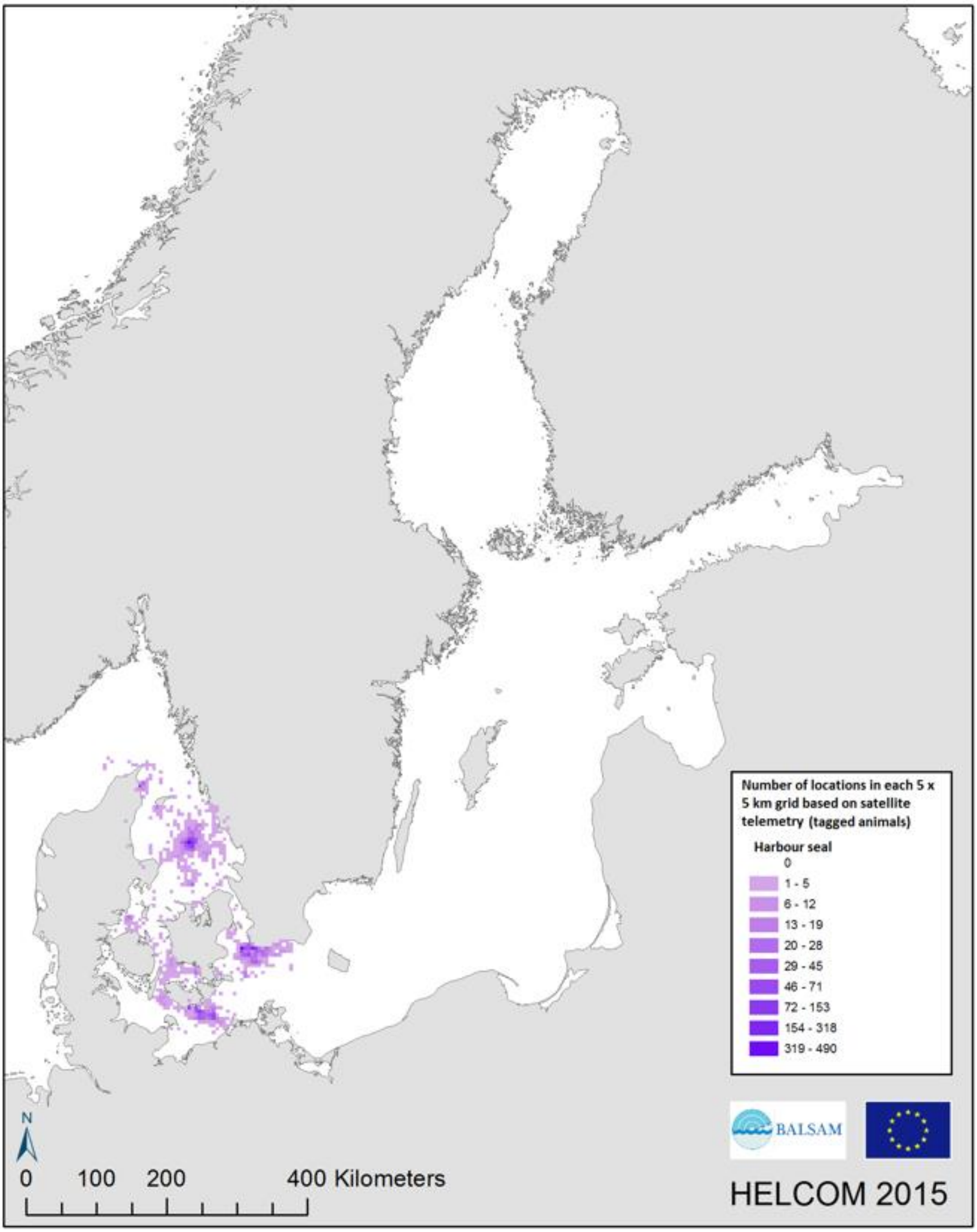


Figure 24. The distribution of harbour seal in the Baltic Sea (based on satellite telemetry)

Source: HELCOM, 2015

The harbour seals show a high degree of attachment to the habitat and usually remain relatively close to the breeding grounds and the places of rest between feeding periods (Olsen, 2014). Adult females reach on average 146 cm length and weigh 67 kg. Males are on average 156 cm long and weigh 75 kg. On average, the maximum life expectancy of the harbour seal is 36 years (Härkönen, 1990). The fur of the harbour seal is grey (shades from light to dark) with white or dark grey dots on the dorsal side, slightly lighter on the abdomen (Jørgensen, 2003).

Harbour seals reach sexual maturity at the age of about 3 to 5 years. Most females give birth to one young each year. The time of birth varies greatly depending on the place of species occurrence and happens in the period from March to September (IUCN Red List of Threatened Species. Version 2017-2). Pregnancy lasts 10–11 months and the pup grows white lanugo fur during fetal development. The birth of harbour seals takes place on sheltered beaches, sandbanks or rocks. In contrast to grey seals, lanugo is dropped before birth, and puppies come into the world covered with adult fur, so that they can enter the water with their mother soon after birth. The mating of harbour seals takes place after the end of the mother's period of care for the young, most often in June (Jørgensen, 2003). It takes place in water, and males may try to attract females by vocalizing underwater (Van Parijs, 2000).

Harbour seals usually get food near places where they come ashore between periods spent in water, mostly in shallow waters (<100 m). Their diet consists mainly of pelagic, benthic and demersal fish. They mainly hunt species available in large quantities in a given season and place (Härkönen, 1991).

The **ringed seal** *Pusa hispida* belongs to the seal family Phocidae. It is one of the most numerous species found in the Arctic regions. Ice is a very important element of the this species' life cycle. Therefore, the ringed seals are susceptible to any changes in the amount of ice cover associated with the global warming.

The ringed seals occurring in the Baltic Sea belong to a separate subspecies of *Pusa hispida botnica*. The number of this species' individuals in the Baltic Sea has been estimated at 10 000 (HELCOM, 2015). They occur mainly in the northern part of the Baltic Sea (Figure 25). In the PMA, they have been recorded sporadically, however, due to their incidental occurrence, they are not subject of this assessment.

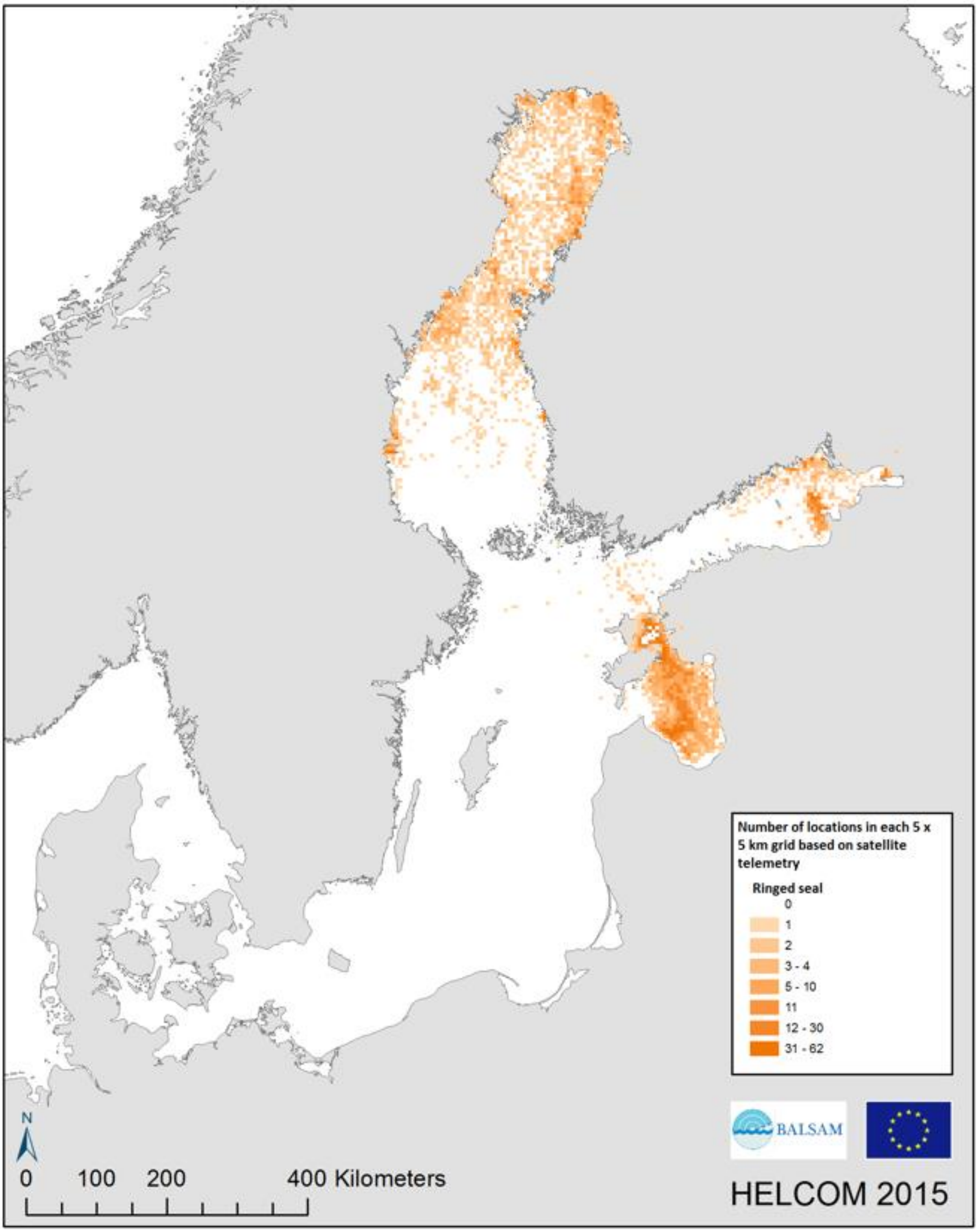


Figure 25. The distribution of ringed seal in the Baltic Sea (based on satellite telemetry)
Source: HELCOM, 2015

Males and females reach the same body size, i.e. 1.5 to 1.75 m in length and not more than 120 kg in weight (HELCOM, 2013). Their fur is light grey on the ventral side and darker on the dorsal side, covered with light or dark grey characteristic rings.

The average life expectancy of the ringed seal is around 46 years. These animals reach sexual maturity at the age of about 4–6 years. Every year, females give birth to one pup covered with light lanugo fur. As with other seals of this family, the pregnancy lasts about 11 months (taking into account the delayed implantation of the egg). Puppies are born on ice between February–March in small pits dug by in the snow by the mother. The function of these shelters is most probably protection against predators. Puppies drop lanugo in 2nd–3rd week of life, but the period of mother's care over the young lasts longer, from 4 to 6 weeks. The female is fertilized immediately after the mother has stopped feeding the baby. Mating, during which the males defend their territory, take place in the water.

Ringed seals feed on fish and invertebrates. The specimens living in the Gulf of Bothnia mainly hunt three-spined stickleback, Baltic herring and smelt.

The conducted surveys on the occurrence of seals in the Polish part of the Baltic Sea has shown that among the three species occurring in this area, the grey seal is the most numerous. Despite the presence of seals in the Polish part of the Baltic Sea, there is no data on their reproduction in this area. Twice, the newly born harbour seal have been spotted in the Gdańsk Bay (WWF Poland, 2013). It is not known, however, where these individuals have been born.

According to the available data obtained during the implementation of the WWF Poland and the Hel Marine Station of the University of Gdańsk in Hel Institute of Oceanography projects, the seals are found along the entire Polish coast, in all seasons. From 1 January 2007 to the end of 2014, 2012 individuals were recorded, of which 86% (1725) were live individuals. Of the seals observed, the vast majority, i.e. 75% (1518 individuals), were grey seals. The harbour seals accounted for 4% and the ringed seals 1% of all the seals observed. The largest number of seals is recorded in the Gdańsk Bay area (86% of observations), and within it, in particular, in the Mewia Łacha Nature Reserve. The occurrence of seals in the EEZ area has been confirmed by HELCOM, according to which the Polish part of the Baltic Sea is regularly visited by grey seals, the western part by harbour seals, and a small area in the northernmost part of Polish waters by ringed seals (HELCOM, 2015).

The results of marine mammals surveys

In the OWF Area, surveys of marine mammals have been conducted for 13 months, from March 2016 to April 2017. The results from basic surveys in the area of the planned project and in the adjacent waters have been obtained. The results have been discussed in the light of the large-scale surveys, such as the BIAS and SAMBAH projects.

During the whole period of the survey conducted, 177 visually confirmed recordings of porpoise clicks have been obtained. The clicks were registered at three stations between June and August 2016 (54 detections). The largest number of detections (98) was recorded at one research station between August and November 2016. Detections of porpoise were also recorded from January to March 2017 at other research stations (22 detections), and three detections were recorded at one surveys station during the last measuring devices service as part of the marine mammal survey conducted for the planned investment, between March and April 2017.

The surveys have shown the presence of marine mammals in the Baltica OWF Area and the adjacent waters. The species registered have been the porpoise and the grey seal. The fact that no porpoise has been recorded during the entire visual observation period indicates that porpoises are rarely found in the surveyed area. Sporadic porpoise detections have been recorded on C-POD devices. In contrast to passive acoustic surveys, the visual observations provide an instantaneous picture of the marine mammals' occurrence in a larger area. However, occasional occurrence may not be detected during air observations.

The significance of the grey seal and harbour seal is assessed as medium, taking into account their conservation status and abundance. Porpoises, on the other hand, are of great significance due to their protection status and also critically endangered status, even though their presence in the Baltica OWF Area should be considered as very low.

3.7.1.5 Birds

3.7.1.5.1 Migratory birds

This section presents a summary of the results of migratory birds surveys, carried out in the spring and autumn of 2016 and in March 2017 in the Baltica OWF Area. July is taken for the first month initiating the autumn migration period due to the fact that during this time migratory birds are expected to return from nesting areas towards wintering grounds. The data collected using horizontal and vertical radar, visual observations and acoustic recordings have been included.

During all the measuring seasons (spring and autumn 2016 and March 2017), in the OWF Area, 57,112 birds have been registered. These belonged to 145 species, of which 126 have been recorded during visual observations (the feral pigeon has been excluded from analysis, as a domesticated species), and 48 have been identified on acoustic recordings. The list of species together with their national conservation status, European conservation status (Annex 1 of the Birds Directive) and the international category of endangered species for this part of the world (IUCN) has been presented in the table (Table 26).

Most of the observed bird species is, according to the Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws of 2016, item 2183), the subject of strict protection in Poland. 37 of these species are listed in Annex 1 of the Birds Directive. Of these species, 58 have been recorded less than 10 times during the entire period of the birds survey for the purposes of the project's implementation (total visual observations and acoustic recordings). Considering only the visual observations, 71 species have been observed sporadically. Therefore, it can be concluded that these observations have been accidental and do not represent species typical of migrations passing through the OWF Area. Only 3 observed species belong to the vulnerable category (VU) according to the IUCN (Table 26).

Table 26. Migratory birds observed and registered in the OWF Area during the spring and autumn migration of birds in 2016 and 2017 for the purpose of the investment in question

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
1	Razorbill	*Alca torda*	0	630	156	786	Strict	Not	NT
2	Ruff	*Philomachus pugnax*	0	5	2	7	Strict	Yes	LC
3	Common snipe	*Gallinago gallinago*	43	10	0	53	Strict	Not	LC
4	Barnacle goose	*Branta leucopsis*	0	13	4	17	Strict	Yes	LC
5	Northern wheatear	*Oenanthe oenanthe*	0	2	2	4	Strict	Not	LC
6	Red knot	*Calidris canutus*	0	0	1	1	Strict	Not	NT
7	Dunlin	*Calidris alpina*	0	15	0	15	Strict	Yes	LC
8	Smew	*Mergellus albellus*	0	2	0	2	Strict	Yes	LC

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
9	White-tailed eagle	*Haliaeetus albicilla*	0	0	1	1	Strict	Yes	LC
10	Montagu's harrier	*Circus pygargus*	0	1	1	2	Strict	Yes	LC
11	Western marsh harrier	*Circus aeruginosus*	0	0	2	2	Strict	Yes	LC
12	Hen harrier	*Circus cyaneus*	0	1	1	2	Strict	Yes	LC
13	Great tit	*Parus major*	3447	144	1	3592	Strict	Not	LC
14	Common sandpiper	*Actitis hypoleucs*	5	0	0	5	Strict	Not	LC
15	Sand martin	*Riparia riparia*	0	15	1	16	Strict	Not	LC
16	Common teal	*Anas crecca*	25	251	50	326	G	Not	LC
17	Garganey	*Anas querquedula*	0	3	4	7	Strict	Not	LC
18	Northern lapwing	*Vanellus vanellus*	0	74	7	81	Strict	Not	NT
19	Great egret	*Egretta alba*	0	4	2	6	Strict	Yes	LC
20	Grey heron	*Ardea cinerea*	0	45	28	73	Partial	Not	LC
21	Common redpoll	*Carduelis flammea*	0	7	0	7	Strict	Not	LC
22	Tufted duck	*Aythya fuligula*	0	25	6	31	G	Not	LC
23	Eurasian siskin	*Carduelis spinus*	17	223	3	243	Strict	Not	LC
24	Song thrush	*Turdus philomelos*	1707	1	0	1708	Strict	Not	LC
25	Redwing	*Turdus iliacus*	2265	0	0	2265	Strict	Not	NT
26	Merlin	*Falco columbarius*	0	3	3	6	Strict	Yes	LC
27	Barn swallow	*Hirundo rustica*	0	117	14	131	Strict	Not	LC
28	Greenfinch	*Carduelis chloris*	38	22	0	60	Strict	Not	LC
29	Common eider	*Somateria mollissima*	0	18	20	38	Strict	Not	NT
30	Garden warbler	*Sylvia borin*	0	1	0	1	Strict	Not	LC
31	Rook	*Corvus frugilegus*	0	2	6	8	Strict	Not	LC
32	Common goldeneye	*Bucephala clangula*	0	1	3	4	Strict	Not	LC
33	Red-backed shrike	*Lanius collurio*	0	2	0	2	Strict	Yes	LC
34	Greater white-fronted goose	*Anser albifrons*	0	560	21	581	G	Not	LC
35	Greylag goose	*Anser anser*	0	244	94	338	G	Not	LC
36	Bean goose	*Anser fabalis*	0	65	11	76	G	Not	LC
37	Bullfinch	*Pyrrhula pyrrhula*	0	8	0	8	Strict	Not	LC
38	Common pochard	*Aythya ferina*	0	0	1	1	G	Not	VU
39	Common wood pigeon	*Columba palumbus*	0	8	1	9	G	Not	LC
40	Brambling	*Fringilla montifringilla*	61	97	0	158	Strict	Not	LC

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
41	Common swift	*Apus apus*	0	12	6	18	Strict	Not	LC
42	Ruddy turnstone	*Arenaria interpres*	0	9	2	11	Strict	Not	LC
43	Black kite	*Milvus migrans*	0	1	1	2	Strict	Yes	LC
44	Jackdaw	*Corvus monedula*	0	6	3	9	Strict	Not	LC
45	African stonechat	*Saxicola torquata*	0	1	0	1	-	Not	LC
46	Eurasian hobby	*Falco subbuteo*	0	1	1	2	Strict	Not	LC
47	Black redstart	*Phoenicurus ochruros*	0	1	1	2	Strict	Not	LC
48	Great black cormorant	*Phalacrocorax carbo*	0	438	295	733	Partial	Not	LC
49	Common blackbird	*Turdus merula*	3959	2	1	3962	Strict	Not	LC
50	Gadwall	*Anas strepera*	0	5	0	5	Strict	Not	LC
51	Eurasian sparrowhawk	*Accipiter nisus*	0	13	9	22	Strict	Not	LC
52	Mallard	*Anas platyrhynchos*	0	374	105	479	G	Not	LC
53	European serin	*Serinus serinus*	0	1	0	1	Strict	Not	LC
54	Whimbrel	*Numenius phaeopus*	0	4	1	5	Strict	Not	LC
55	Eurasian curlew	*Numenius arquata*	493	745	47	1285	Strict	Not	NT
56	Fieldfare	*Turdus pilaris*	47	3	0	50	Strict	Not	LC
57	Common greenshank	*Tringa nebularia*	0	15	1	16	Strict	Not	LC
58	Woodlark	*Lullula arborea*	0	5	0	5	Strict	Yes	LC
59	Long-tailed duck	*Clangula hyemalis*	0	6104	995	7099	Strict	Not	VU
60	Tundra swan	*Cygnus columbianus*	10	41	12	63	Strict	Yes	LC
61	Whooper swan	*Cygnus cygnus*	0	129	54	183	Strict	Yes	LC
62	Mute swan	*Cygnus olor*	0	26	27	53	Strict	Not	LC
63	Wood sandpiper	*Tringa glareola*	1	11	1	13	Strict	Yes	LC
64	Common linnet	*Carduelis cannabina*	0	26	1	27	Strict	Not	LC
65	Common scoter	*Melanitta nigra*	11	4688	1154	5853	Strict	Not	LC
66	Eurasian tree sparrow	*Passer montanus*	17	0	0	17	Strict	Not	LC
67	Caspian gull	*Larus cachinnans*	0	21	0	21	Partial	Not	LC
68	Glaucous gull	*Larus hyperboreus*	0	0	1	1	Strict	Not	LC
69	Mediterra-nean gull	*Larus melanoce-phalus*	0	2	0	2	Strict	Yes	LC

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
70	Little gull	*Larus minutus*	0	425	207	632	Strict	Yes	LC
71	Great black-backed gull	*Larus marinus*	17	49	7	73	Strict	Not	LC
72	Common gull	*Larus canus*	31	350	51	432	Strict	Not	LC
73	European herring gull	*Larus argentatus*	6890	545	105	7540	Partial	Not	LC
74	Black-headed gull	*Larus ridibundus*	70	331	89	490	Strict	Not	LC
75	Lesser black-backed gull	*Larus fuscus*	186	361	42	589	Strict	Not	LC
76	Eurasian blue tit	*Parus caeruleus*	865	4	0	869	Strict	Not	LC
77	Red-breasted flycatcher	*Ficedula parva*	0	0	1	1	Strict	Yes	LC
78	Spotted flycatcher	*Muscicapa striata*	8	0	0	8	Strict	Not	LC
79	European pied flycatcher	*Ficedula hypoleuca*	0	1	0	1	Strict	Not	LC
80	Goldcrest	*Regulus regulus*	1935	24	1	1960	Strict	Not	LC
81	Common buzzard	*Buteo buteo*	0	0	1	1	Strict	Not	LC
82	Rough-legged buzzard	*Buteo lagopus*	0	0	2	2	Strict	Not	LC
83	Black-throated loon	*Gavia arctica*	0	101	142	243	Strict	Yes	LC
84	Red-throated loon	*Gavia stellata*	0	73	118	191	Strict	Yes	LC
85	Black guillemot	*Cepphus grylle*	0	7	4	11	Strict	Not	LC
86	Goosander	*Mergus merganser*	0	33	24	57	Strict	Not	LC
87	Common murre	*Uria aalge*	0	295	45	340	Strict	Not	LC
88	Greater scaup	*Aythya marila*	0	111	41	152	Strict	Not	LC
89	Common shelduck	*Tadorna tadorna*	0	2	0	2	Strict	Not	LC
90	Common house martin	*Delichon urbicum*	0	18	0	18	Strict	Not	LC
91	Ortolan	*Emberiza hortulana*	1	0	0	1	Strict	Yes	LC
92	Mistle thrush	*Turdus viscivorus*	11	0	0	11	Strict	Not	LC
93	Eurasian treecreeper	*Certhia familiaris*	0	1	0	1	Strict	Not	LC
94	Great crested grebe	*Podiceps cristatus*	0	3	0	3	Strict	Not	LC
95	Red-necked grebe	*Podiceps grisegena*	0	0	2	2	Strict	Not	LC
96	Sanderling	*Calidris alba*	0	1	0	1	Strict	Not	LC
97	Willow warbler	*Phylloscopus trochilus*	1	0	0	1	Strict	Not	LC
98	Lesser whitethroat	*Sylvia curucca*	0	1	0	1	Strict	Not	LC

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
99	Common chiffchaff	*Phylloscopus collybita*	32	1	1	34	Strict	Not	LC
100	Common redstart	*Phoenicurus phoenicurus*	0	3	0	3	Strict	Not	LC
101	Grey wagtail	*Motacilla cinerea*	2	1	0	3	Strict	Not	LC
102	White wagtail	*Motacilla alba*	1192	196	14	1402	Strict	Not	LC
103	Western yellow wagtail	*Motacilla flava*	148	15	5	168	Strict	Not	LC
104	Northern shoveler	*Anas clypeata*	0	141	40	181	Strict	Not	LC
105	Dunnock	*Prunella modularis*	6	1	0	7	Strict	Not	LC
106	Common reed bunting	*Emberiza schoeniclus*	18	6	0	24	Strict	Not	LC
107	Common kestrel	*Falco tinnunculus*	0	6	0	6	Strict	Not	LC
108	Pintail	*Anas acuta*	0	21	16	37	Strict	Not	LC
109	European robin	*Erithacus rubecula*	5764	29	0	5793	Strict	Not	LC
110	Tern	*Chlidonias leucopterus*	0	0	1	1	Strict	Not	LC
111	Black tern	*Chlidonias niger*	0	139	74	213	Strict	Yes	LC
112	Sandwich tern	*Sterna sandvicensis*	0	8	3	11	Strict	Yes	LC
113	Arctic tern	*Sterna paradisaea*	0	17	1	18	Strict	Yes	LC
114	Common tern	*Sterna hirundo*	59	49	6	114	Strict	Yes	LC
115	Caspian tern	*Sterna caspia*	0	1	1	2	Strict	Yes	LC
116	Osprey	*Pandion haliaetus*	0	1	2	3	Strict	Yes	LC
117	Twite	*Carduelis flavirostris*	0	12	0	12	Strict	Not	LC
118	Green sandpiper	*Tringa ochropus*	11	0	0	11	Strict	Not	LC
119	Eurasian collared dove	*Streptopelia decaocto*	0	1	0	1	Strict	Not	LC
120	Common ringed plover	*Charadrius hiaticula*	0	8	0	8	Strict	Not	LC
121	European golden plover	*Pluvialis apricaria*	7	202	5	214	Strict	Yes	LC
122	European sand martin	*Pluvialis squatarola*	0	4	1	5	Strict	Not	LC
123	Stock dove	*Columba oenas*	0	2	2	4	Strict	Not	LC
124	Eurasian skylark	*Alauda arvensis*	559	199	26	784	Strict	Not	LC
125	Eurasian wren	*Troglodytes troglodytes*	9	13	0	22	Strict	Not	LC
126	Goldfinch	*Carduelis carduelis*	18	12	0	30	Strict	Not	LC
127	Red-breasted	*Mergus*	0	22	17	39	Strict	Not	LC

No.	Name of the species	Binomial nomencla-ture	Acoustics	Observa-tions	Bird-tracker	Total	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN [2]
	merganser	*serrator*							
128	Bar-tailed godwit	*Limosa lapponica*	0	8	0	8	Strict	Yes	NT
129	Common starling	*Sturnus vulgaris*	67	559	102	728	Strict	Not	LC
130	Tree pipit	*Anthus trivialis*	16	4	0	20	Strict	Not	LC
131	Meadow pipit	*Anthus pratensis*	31	60	3	94	Strict	Not	NT
132	Red-throated pipit	*Anthus cervinus*	1	0	0	1	Strict	Not	LC
133	Eurasian wigeon	*Anas penelope*	49	419	108	576	Strict	Not	LC
134	Wood warbler	*Phylloscopus sibilatrix*	0	2	0	2	Strict	Not	LC
135	Yellow-browed warbler	*Phylloscopus inornatus*	2	0	0	2	Strict	Not	LC
136	European honey buzzard	*Pernis apivorus*	0	4	2	6	Strict	Yes	LC
137	Yellowhamme r	*Emberiza citrinella*	5	1	0	6	Strict	Not	LC
138	Velvet scoter	*Melanitta fusca*	0	743	267	1010	Strict	Not	VU
139	Long-eared owl	*Asio otus*	0	8	1	9	Strict	Not	LC
140	Short-eared owl	*Asio flammeus*	0	4	1	5	Strict	Yes	LC
141	Hooded crow	*Corvu corone cornix*	0	1	0	1	Partial	Not	-
142	Parasitic jaeger	*Stercorarius parasiticus*	0	38	24	62	Strict	Not	LC
143	Pomarine skua	*Stercorarius pomarinus*	0	3	3	6	Strict	Not	LC
144	Common chaffinch	*Fringilla coelebs*	528	375	40	943	Strict	Not	LC
145	Common crane	*Grus grus*	0	171	66	237	Strict	Yes	LC

[1]Pursuant to the Regulation of the Minister of the Environment of 16 December 2016 on protection of animal species (Journal of Laws of 2016, item 2183): Strict – strictly protected species; Partial – partially protected species; pursuant to the Regulation of the Minister of the Environment of 11 March 2015 on the development of a list of game species (Journal of Laws of 2005, No. 45, item 433). G – game species

[2]IUCN – classification provided by the International Union for the Conservation of Nature and Natural Resources: VU – vulnerable species; NT – near threatened species; LC – species of the least concern

Source: internal data

In the OWF Area, surveys on migratory birds using vertical and horizontal radars, visual observations and acoustic monitoring have been carried out at three survey stations, the distribution of which has been presented in the figure (Figure 26).

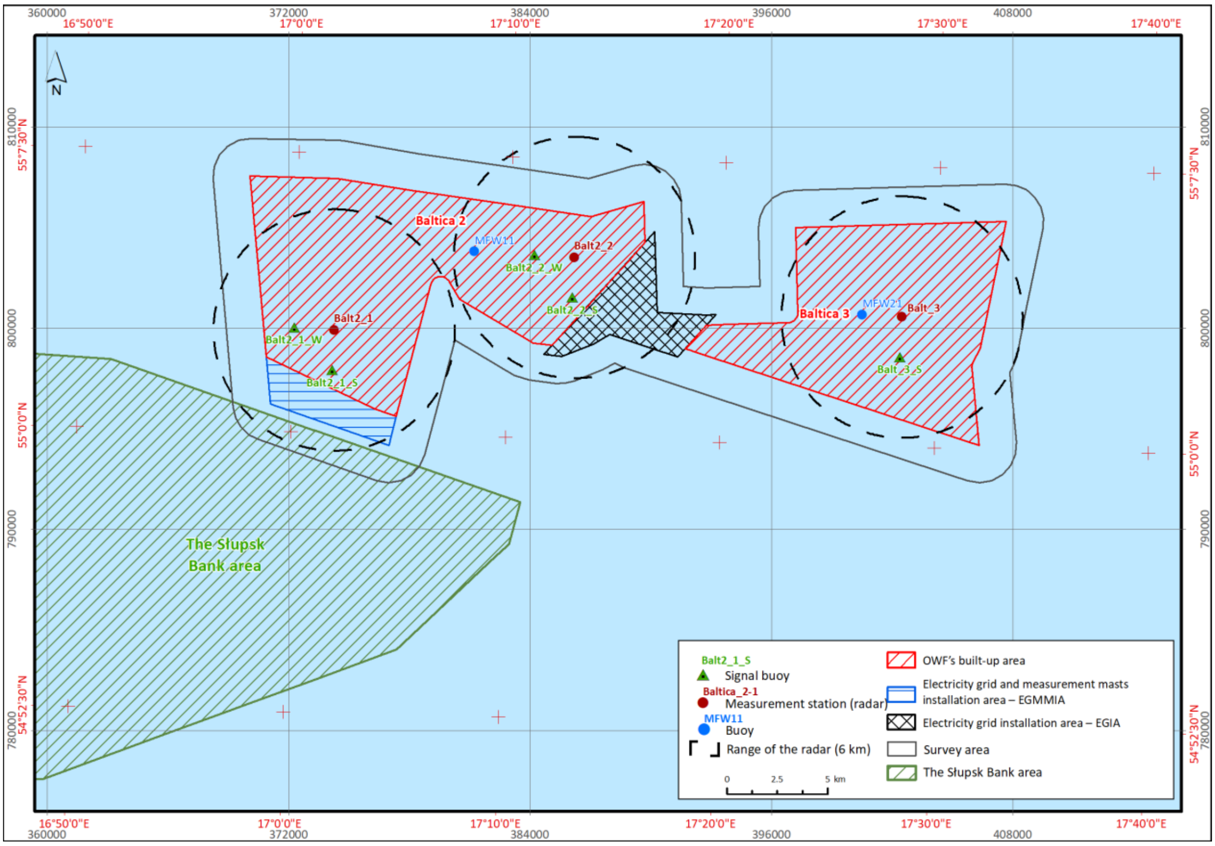


Figure 26. The distribution of stations for the surveys of migratory birds in the OWF Area

Source: internal data

Out of the migratory birds observed, the species and families of birds such as swans and terns have been presented in the table (Table 27). In the case of the species that were irregularly and rarely registered in the Baltica OWF Area, i.e. those whose number of observations does not exceed 30 individuals (10 for each survey station), these observations have been considered as exceptions that do not indicate a regular passage through the Baltica OWF Area. Also the species that were recorded in numbers between 30 and 50 individuals, but have been observed in several flocks (1–5), have not been subjected to detailed analyses. The detailed results for the selected group of species have been presented in Appendix 1 to the EIA Report.

Table 27. List of species/groups of migratory birds species included in the environmental impact assessment with an indication of the size of the biogeographic population, estimated percentage of the biogeographic population passing over the area, conservation status and significance of the species

Name of the species	Binomial nomenclature	Biogeographic population abundance	Baltic population abundance	Migration season	Migration stream in the season	% of the biogeographic population	% of the Baltic population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species significance
Long-tailed duck	*Clangula hyemalis*	1,600,000	350,000	Spring	76,589	4.8%	21.9%	Strict	Not	VU	Non-SPEC	High
				Autumn	44,982	2.8%	12.9%					
Common scoter	*Melanitta nigra*	550,000	500,000	Spring	53,917	9.8%	10.8%	Strict	Not	LC	Non-SPEC	High
				Autumn	24,407	4.4%	4.9%					
Velvet scoter	*Melanitta fusca*	450,000	170,000	Spring	9242	2.1%	5.4%	Strict	Not	VU	SPEC 3	High
				Autumn	8330	1.9%	4.9%					
Eurasian wigeon	*Anas penelope*	1,500,000	Lack of data	Spring	1984	0.1%	Lack of data	Strict	Not	LC	Non-SPEC	Low
				Autumn	3010	0.2%	Lack of data					
Common teal	*Anas crecca*	>1,000,000	>500,000	Spring	2480	0.2%	0.5%	G	Not	LC	Non-SPEC	Low
				Autumn	2066	0.2%	0.4%					
Mallard	*Anas platyrhynchos*	>4,000,000	>1,000,000	Spring	1462	<0.1%	0.1%	G	Not	LC	Non-SPEC	Low
				Autumn	5651	0.1%	0.6%					
Greater scaup	*Aythya marila*	310,000	>12,000	Spring	1230	0.4%	10.3%	Strict	Not	LC	SPEC 3	Average
				Autumn	1000	0.3%	8.3%					
Geese	*Anserini*	>3,500,000	Lack of data	Spring	3167	0.1%	Lack of data	Not applicable				
				Autumn	10,444	0.3%	Lack of data					
Greater white-fronted goose	*Anser albifrons*	Not applicable						G	Not	LC	Non-SPEC	Low
Greylag goose	*Anser anser*							G	Not	LC	Non-SPEC	Low

Name of the species	Binomial nomenclature	Biogeo-graphic popu-lation abun-dance	Baltic po-pulation abun-dance	Migration season	Migration stream in the season	% of the biogeo-graphic popul-ation	% of the Baltic population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species significance
Bean goose	*Anser fabalis*							G	Not	LC	Non-SPEC	Low
Swans	*Cygnidae*	300,000	100,000	Spring	528	0.2%	0.5%	Not applicable				
				Autumn	4777	1.6%	4.8%					
Tundra swan	*Cygnus columbianus*	Not applicable						Strict	Yes	LC	SPEC 3	High
Whooper swan	*Cygnus cygnus*							Strict	Yes	LC	Non-SPEC	Average
Mute swan	*Cygnus olor*							Strict	Not	LC	Non-SPEC	Low
Loons	*Gaviiformes*	>400,000	8600	Spring	3140	0.8%	36.5%	Not applicable				
				Autumn	2893	0.7%	33.6%					
Black-throated loon	*Gavia arctica*	Not applicable						Strict	Yes	LC	SPEC 3	Average
Red-throated loon	*Gavia stellata*							Strict	Yes	LC	SPEC 3	Average
Auks	*Alcidae*	Not applicable		Spring	19,077	Not applicable						
				Autumn	36,778							
Razorbill	*Alca torda*	>1,000,000	23,000	Spring	13,366	1.3%	58.1%	Strict	Not	NT	Non-SPEC	Low
				Autumn	22,060	2.2%	95.9%					
Common murre	*Uria aalge*	>4,000,000	19,000	Spring	4751	0.1%	25.0%	Strict	Not	LC	Non-SPEC	Low
				Autumn	15,159	0.4%	79.8%					
Great black cormorant	*Phalacrocorax carbo*	405,000	100,000	Spring	2496	0.6%	2.5%	Partial	Not	LC	Non-SPEC	Low
				Autumn	3456	0.9%	3.5%					
Little gull	*Larus minutus*	>72,000	50,000	Spring	8762	12.2%	17.5%	Strict	Yes	LC	SPEC 3	High
				Autumn	7383	10.3%	14.8%					

<table>
<tr><th>Name of the species</th><th>Binomial nomenclature</th><th>Biogeographic population abundance</th><th>Baltic population abundance</th><th>Migration season</th><th>Migration stream in the season</th><th>% of the biogeographic population</th><th>% of the Baltic population</th><th>Species protection in Poland[1]</th><th>Annex 1 to the EU Birds Directive</th><th>IUCN[2]</th><th>SPEC[3]</th><th>Species significance</th></tr>
<tr><td rowspan="2">Black-headed gull</td><td rowspan="2">Larus ridibundus</td><td rowspan="2">>4,770,000</td><td rowspan="2">1,350,000</td><td>Spring</td><td>4191</td><td>0.1%</td><td>0.3%</td><td rowspan="2">Strict</td><td rowspan="2">Not</td><td rowspan="2">LC</td><td rowspan="2">Non-SPEC</td><td rowspan="2">Low</td></tr>
<tr><td>Autumn</td><td>3115</td><td>0.1%</td><td>0.2%</td></tr>
<tr><td rowspan="2">Lesser black-backed gull</td><td rowspan="2">Larus fuscus</td><td rowspan="2">>1,200,000</td><td rowspan="2">56,000</td><td>Spring</td><td>2861</td><td>0.2%</td><td>5.1%</td><td rowspan="2">Strict</td><td rowspan="2">Not</td><td rowspan="2">LC</td><td rowspan="2">Non-SPEC</td><td rowspan="2">Low</td></tr>
<tr><td>Autumn</td><td>3892</td><td>0.3%</td><td>7.0%</td></tr>
<tr><td rowspan="2">Common gull</td><td rowspan="2">Larus canus</td><td rowspan="2">1,000,000</td><td rowspan="2">>75,000</td><td>Spring</td><td>3229</td><td>0.3%</td><td>4.3%</td><td rowspan="2">Strict</td><td rowspan="2">Not</td><td rowspan="2">LC</td><td rowspan="2">SPEC 2</td><td rowspan="2">Low</td></tr>
<tr><td>Autumn</td><td>2668</td><td>0.3%</td><td>3.6%</td></tr>
<tr><td rowspan="2">Terns</td><td rowspan="2">Sternidae</td><td rowspan="2">>1,800,000</td><td rowspan="2">>440,000</td><td>Spring</td><td>6940</td><td>0.4%</td><td>1.6%</td><td rowspan="2" colspan="5">Not applicable</td></tr>
<tr><td>Autumn</td><td>7539</td><td>0.4%</td><td>1.7%</td></tr>
<tr><td>Black tern</td><td>Chlidonias niger</td><td rowspan="5" colspan="6">Not applicable</td><td>Strict</td><td>Yes</td><td>LC</td><td>SPEC 3</td><td>Average</td></tr>
<tr><td>Sandwich tern</td><td>Sterna sandvicensis</td><td>Strict</td><td>Yes</td><td>LC</td><td>SPEC 2</td><td>Average</td></tr>
<tr><td>Rybitwa popielata</td><td>Sterna paradisaea</td><td>Strict</td><td>Yes</td><td>LC</td><td>Non-SPEC</td><td>Low</td></tr>
<tr><td>Common tern</td><td>Sterna hirundo</td><td>Strict</td><td>Yes</td><td>LC</td><td>Non-SPEC</td><td>Average</td></tr>
<tr><td>Caspian tern</td><td>Hydroprogne caspia</td><td>Strict</td><td>Yes</td><td>LC</td><td>SPEC 3</td><td>Low</td></tr>
<tr><td rowspan="2">Parasitic jaeger</td><td rowspan="2">Stercorarius parasiticus</td><td rowspan="2">>100,000</td><td rowspan="2">>2000</td><td>Spring</td><td>335</td><td>0.3%</td><td>16.8%</td><td rowspan="2">Strict</td><td rowspan="2">Not</td><td rowspan="2">LC</td><td rowspan="2">Non-SPEC</td><td rowspan="2">Low</td></tr>
<tr><td>Autumn</td><td>368</td><td>0.4%</td><td>18.4%</td></tr>
<tr><td rowspan="2">Eurasian curlew</td><td rowspan="2">Numenius arquata</td><td rowspan="2">>700,000</td><td rowspan="2">>200,000</td><td>Spring</td><td>9876</td><td>1.4%</td><td>4.9%</td><td rowspan="2">Strict</td><td rowspan="2">Not</td><td rowspan="2">NT</td><td rowspan="2">SPEC 2</td><td rowspan="2">Average</td></tr>
<tr><td>Autumn</td><td>1833</td><td>0.3%</td><td>0.9%</td></tr>
<tr><td rowspan="2">Plovers</td><td rowspan="2">Pluvialis sp.</td><td rowspan="2">>820,000</td><td rowspan="2">>150,000</td><td>Spring</td><td>1385</td><td>0.2%</td><td>0.9%</td><td rowspan="2" colspan="5">Not applicable</td></tr>
<tr><td>Autumn</td><td>1010</td><td>0.1%</td><td>0.7%</td></tr>
<tr><td>European golden plover</td><td>Pluvialis apricaria</td><td rowspan="2" colspan="6">Not applicable</td><td>Strict</td><td>Yes</td><td>LC</td><td>Non-SPEC</td><td>Low</td></tr>
<tr><td>European sand martin</td><td>Pluvialis squatarola</td><td>Strict</td><td>Not</td><td>LC</td><td>Non-SPEC</td><td>Low</td></tr>
</table>

Name of the species	Binomial nomenclature	Biogeo-graphic popu-lation abun-dance	Baltic po-pulation abun-dance	Migration season	Migration stream in the season	% of the biogeo-graphic popul-ation	% of the Baltic population	Species protection in Poland[1]	Annex 1 to the EU Birds Directive	IUCN[2]	SPEC[3]	Species significance
Common crane	*Grus grus*	410,000	40,000	Spring	559	0.1%	1.4%	Strict	Yes	LC	SPEC 2	Low

[1]Pursuant to the Regulation of the Minister of the Environment of 16 December 2016 on protection of animal species (Journal of Laws of 2016, item 2183): Strict – strictly protected species; Partial – partially protected species; pursuant to the Regulation of the Minister of the Environment of 11 March 2015 on the development of a list of game species (Journal of Laws of 2005, No. 45, item 433): G – game species

[2]IUCN – classification by the International Union for the Conservation of Nature and Natural Resources, the world list, version 2017-2: EN – endangered species; VU – vulnerable species; NT – near threatened species; LC – species of the least concern

[3]The SPEC (Species of European Conservation Concern) categories of special concern assigned by the BirdLife International federation: Non-SPEC – species whose European population does not exceed 50% of the world's population, and whose conservation status in Europe has been classified as favourable; SPEC 2 – species whose European population exceeds 50% of the world's population and whose conservation status has been classified as unfavourable, SPEC 3 – species whose European population does not exceed 50% of the world's population and whose conservation status in Europe has been classified as unfavourable

Source: internal data

Quite a large diversity of passerine migratory birds has been registered in the Baltica OWF Area during surveys – 32 species were recorded in spring, and 33 in autumn (Table 28). However, the number of observations and their frequency was low, especially when considering the very large biogeographic populations of these species. The migration streams – the abundance in the passage over the Baltic Sea – have never been surveyed for the passerines. The only existing information is estimate, for example it has been estimated that more than 100 million passerines begin autumn migration every year from the Swedish coast southwards. More detailed surveys on the impact of offshore wind farms on passerines are also unavailable.

The impact of mortality (natural, during migration, at breeding grounds, as a result of human activity, etc.) on populations of small passerine species is minor compared to other bird species, mainly due to the fact that the passerines live short and reproduce at a faster pace (they have more young) than, for example, birds of prey.

Table 28. Passerine bird species observed in the spring and autumn of 2016 and in March 2017 in the Baltica OWF Area

No.	Name of the species	Binomial nomenclature	Spring 2016	Autumn 2016	March 2017	Total
1	Passerine of an unidentified species	Passeriformes indet.	340	574	78	992
2	Common starling	*Sturnus vulgaris*	310	167	82	559
3	Common chaffinch	*Fringilla coelebs*	83	202	90	375
4	Eurasian siskin	*Carduelis spinus*	8	211	4	223
5	Eurasian skylark	*Alauda arvensis*	79	78	42	199
6	White wagtail	*Motacilla alba*	118	71	7	196
7	Great tit	*Parus major*	13	128	3	144
8	Barn swallow	*Hirundo rustica*	101	16	0	117
9	Fringilla of an unidentified species	Fringilla indet.	66	0	33	99
10	Brambling	*Fringilla montifringilla*	0	97	0	97
11	Meadow pipit	*Anthus pratensis*	31	29	0	60
12	European robin	*Erithacus rubecula*	7	22	0	29
13	Common linnet	*Carduelis cannabina*	21	0	5	26
14	Goldcrest	*Regulus regulus*	9	13	2	24
15	Greenfinch	*Carduelis chloris*	4	18	0	22
16	Common house martin	*Delichon urbicum*	17	1	0	18
17	Western yellow wagtail	*Motacilla flava*	4	11	0	15
18	Sand martin	*Riparia riparia*	11	4	0	15
19	Unidentified pipit	Anthus indet.	11	3	0	14
20	Eurasian wren	*Troglodytes troglodytes*	6	7	0	13
21	Twite	*Carduelis flavirostris*	0	12	0	12
22	Goldfinch	*Carduelis carduelis*	3	8	1	12
23	Common swift	*Apus apus*	8	4	0	12
24	Unidentified finch	Carduelis indet.	8	0	0	8
25	Unidentified thrush	Turdidae indet.	6	2	0	8

No.	Name of the species	Binomial nomenclature	Spring 2016	Autumn 2016	March 2017	Total
26	Bullfinch	*Pyrrhula pyrrhula*	1	7	0	8
27	Common redpoll	*Carduelis flammea*	1	6	0	7
28	Common reed bunting	*Emberiza schoeniclus*	1	5	0	6
29	Woodlark	*Lullula arborea*	3	0	2	5
30	Eurasian blue tit	*Parus caeruleus*	0	4	0	4
31	Tree pipit	*Anthus trivialis*	4	0	0	4
32	Fieldfare	*Turdus pilaris*	0	3	0	3
33	Common redstart	*Phoenicurus phoenicurus*	0	3	0	3
34	Phylloscopus of an unidentified species	Phylloscopus indet.	2	0	0	2
35	Northern wheatear	*Oenanthe oenanthe*	0	2	0	2
36	Red-backed shrike	*Lanius collurio*	0	2	0	2
37	Common blackbird	*Turdus merula*	1	1	0	2
38	Wood warbler	*Phylloscopus sibilatrix*	2	0	0	2
39	African stonechat	*Saxicola torquata*	0	1	0	1
40	Black redstart	*Phoenicurus ochruros*	0	1	0	1
41	Eurasian treecreeper	*Certhia familiaris*	0	1	0	1
42	Lesser whitethroat	*Sylvia curucca*	0	1	0	1
43	Unindentified swallow	Hirundo sp.	1	0	0	1
44	Acrocephalus of an unidentified species	Acrocephalus indet.	1	0	0	1
45	Yellowhammer	*Emberiza citrinella*	0	1	0	1
46	Song thrush	*Turdus philomelos*	1	0	0	1
47	Garden warbler	*Sylvia borin*	1	0	0	1
48	European serin	*Serinus serinus*	1	0	0	1
49	European pied flycatcher	*Ficedula hypoleuca*	1	0	0	1
50	Common chiffchaff	*Phylloscopus collybita*	1	0	0	1
51	Grey wagtail	*Motacilla cinerea*	1	0	0	1
52	Dunnock	*Prunella modularis*	1	0	0	1

Source: internal data

A total of 48 species have been identified on acoustic recordings (and five categories in which the voices have been assigned to the family, for example "unidentified seagull"). Out of all the recognized species, the silver seagull has been the most frequently recorded. The third largest category has been the unidentified seagull category. European herring gulls are most probably non-migratory birds nesting along the Polish Baltic Sea coast. The large number of recordings may be related to the fact that gulls are particularly interested in ships and often stay in their vicinity for a long time. 23 species have been recorded during the daytime, 18 at night, and seven species have been recorded both during the day and at night (with the exception of birds of unidentified species).

Flight altitude* – *visual observations

Based on visual observations, it can be concluded that over 92% of all the birds observed in the Baltica OWF Area in the spring of 2016 flew at altitudes not exceeding 30 m (Figure 27). During the autumn surveys it was 86.1% of birds (Figure 28), while in March 2017 – 95.6% (Figure 29). It should be noted, however, that the assessment of flight altitude by observers includes an error directly proportional to the flight altitude, so the results are primarily an information about the tendency of waterbird species to fly at low altitudes.

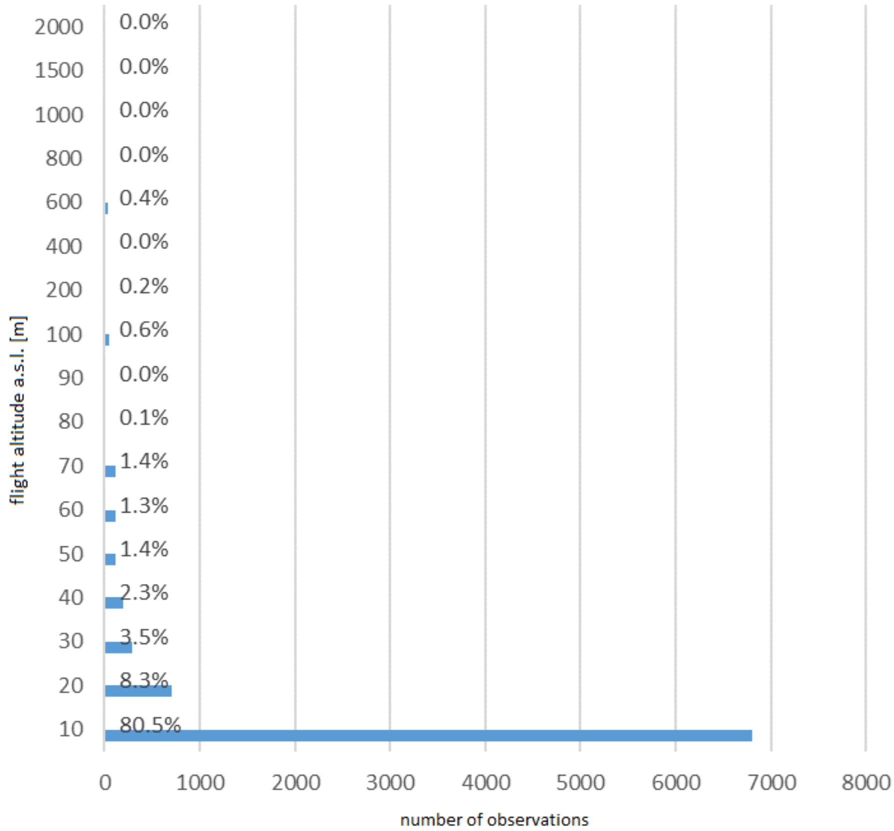


Figure 27. Percentage of flight altitude of the birds observed in the spring 2016

Source: internal data

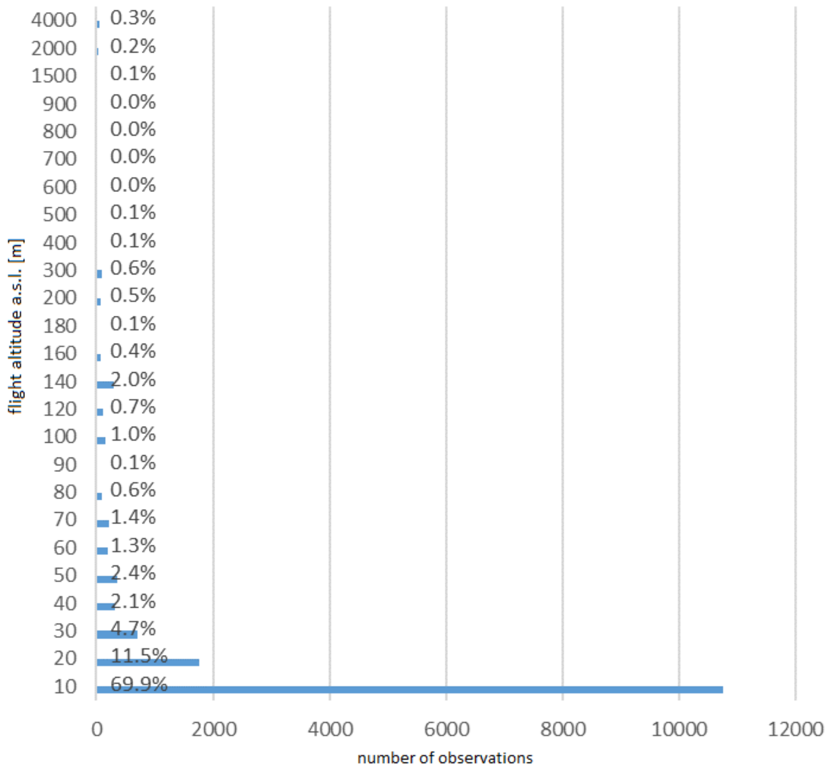


Figure 28. Percentage of flight altitude of the birds observed in the autumn 2016

Source: internal data

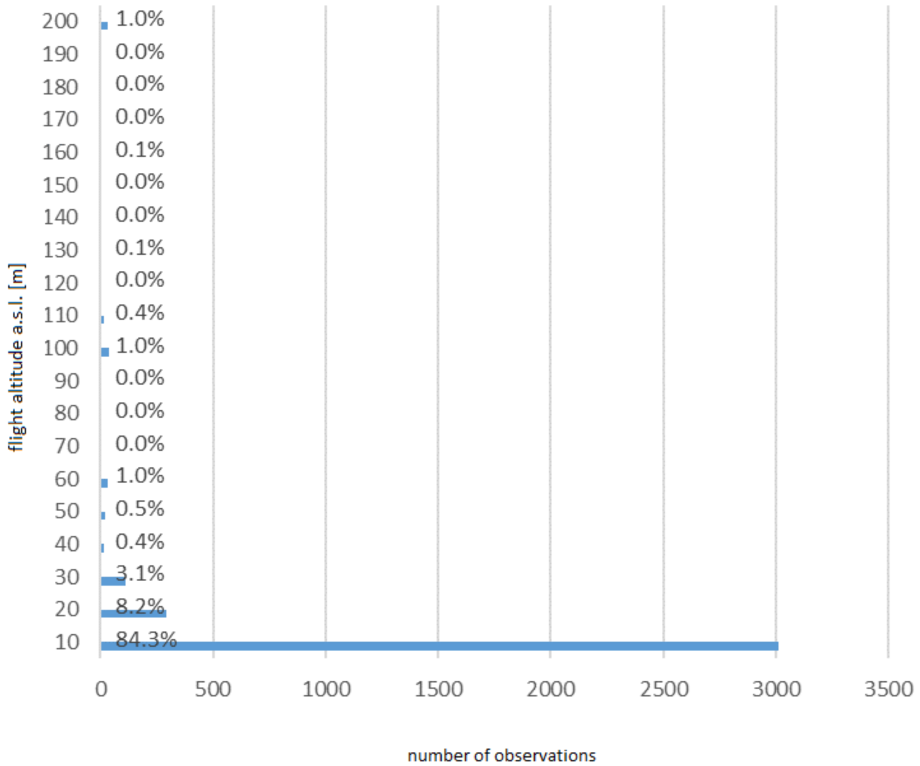


Figure 29. Percentage of flight altitude of the birds observed in March 2017

Source: internal data

Flying low is typical of sea ducks and auks, and most of these birds have flown below 20 m a.s.l. (Table 29). Seagulls and swans have been seen at higher altitudes; however, they still dominated at heights up to 20 m a.s.l.

Table 29. Flight altitudes of individual species of ducks, auks and other most numerous groups of birds observed during surveys in the Baltica OWF Area

No.	Name of the species	Binomial nomenclature	<20 m a.s.l.	>20 m a.s.l.	Total	% of birds flying up to 20 m a.s.l.
1	Razorbill	*Alca torda*	628	2	630	99.7%
2	Common teal	*Anas crecca*	237	14	251	94.4%
3	Garganey	*Anas querquedula*	3	0	3	100.0%
4	Tufted duck	*Aythya fuligula*	25	0	25	100.0%
5	Common eider	*Somateria mollissima*	18	0	18	100.0%
6	Common goldeneye	*Bucephala clangula*	1	0	1	100.0%
7	Geese	*Anserini*	1146	1453	2599	44.1%
8	Gadwall	*Anas strepera*	5	0	5	100.0%
9	Mallard	*Anas platyrhynchos*	306	68	374	81.8%
10	Long-tailed duck	*Clangula hyemalis*	6026	75	6101	98.8%
11	Swans	*Cygnidae*	247	42	289	85.5%
12	Common scoter	*Melanitta nigra*	4377	311	4688	93.4%

No.	Name of the species	Binomial nomenclature	<20 m a.s.l.	>20 m a.s.l.	Total	% of birds flying up to 20 m a.s.l.
13	The family Laridae	*Laridae*	1680	401	2081	80.7%
14	Unidentified duck	*Anatinae indet.*	1493	254	1747	85.5%
15	Unidentified auk	*Alca indet.*	753	4	757	99.5%
16	Black guillemot	*Cepphus grylle*	7	0	7	100.0%
17	Common murre	*Uria aalge*	295	0	295	100.0%
18	Greater scaup	*Aythya marila*	111	0	111	100.0%
19	Common shelduck	*Tadorna tadorna*	2	0	2	100.0%
20	Terns	*Sternidae*	261	17	278	93.9%
21	Eurasian wigeon	*Anas penelope*	303	116	419	72.3%
22	Velvet scoter	*Melanitta fusca*	684	59	743	92.1%
23	Common crane	*Grus grus*	13	158	171	7.6%

**The geese species included: greylag goose, greater white-fronted goose, taiga bean goose, barnacle goose, unidentified geese*
Source: internal data

Flight altitude – data from vertical radar

The largest number of birds echoes in March 2016 was registered at altitudes from 0 to 1050 m a.s.l.; at lower altitudes (0–300 m a.s.l.), the echoes were more numerous during the day than at night. Night echoes were more numerous than daytime ones at altitudes from 800 to 1050 m a.s.l. At the beginning of April 2016, night echoes were more numerous than daytime ones in all altitude ranges. Significantly more echoes were recorded at an altitude above 1 km a.s.l. than in other migration periods, but generally the majority of nocturnal migration occurred at altitudes below 500 m a.s.l., while daily migration happened mainly at altitudes below 300 m a.s.l. At the end of April 2016, during the third survey, most of the echoes have been focused at altitudes from 0 to 150 m a.s.l. Echoes recorded at night prevailed as the Baltica_2-2 and Baltica_3 (Figure 26) stations, while at the Baltica_2-1 station daytime echoes dominated. In the first half of May 2016, most of the echoes were still recorded between 0 and 150 m a.s.l. Echoes from 150–1500 m a.s.l. were dominated by the echoes of night birds. In the second half of May 2016, daytime echoes of up to approx. 150 m a.s.l. dominated at all three stations. Birds flying at higher altitudes were most often nocturnal migrants. In July 2016, most of the echoes were recorded during the day, especially at the Baltica_2-2 station.

At the end of July 2016, significant numbers of nocturnal echoes began to be recorded, which means that nocturnal migratory species began autumn migration towards wintering grounds. Already during the first survey in August 2016, night echoes dominated at all altitudes.

The second half of August 2016 did not abound in echoes, and the average number of birds echoes registered in the radar image was never higher than 5 at all three stations. In September 2016, during the first survey (second week of September), the greatest intensity of echoes was recorded at 50–100 m a.s.l.

The migration peak, based on the number of echoes during the autumn migration, took place at the end of September 2016 with a large number of echoes recorded up to about 400 m a.s.l., and then at the end of October 2016 with the greatest daytime migration at an altitude below 300 m a.s.l. and nocturnal migration at an altitude below 500 m a.s.l. At the end of October, nocturnal migration was greater than daytime migration. Intensive migration was also noted during the survey in November 2016.

In November 2016, echoes in daytime hours were almost as numerous as echoes in the night. At 150–900 m a.s.l. at the Baltica_2-1 station, daily echoes were more numerous than night ones. No such situation has been noted at the other two stations.

In 2017, only during the first survey (9–10 March 2017) echoes recorded during daytime hours exceeded the number of night echoes. During the following surveys, night echoes dominated at all altitudes. In mid-March 2017, higher activity was recorded at night at altitudes of about 1000–1500 m a.s.l. The highest activity was recorded at the end of March 2017 (March 30–31, 2017) at altitudes below 300 m a.s.l.

Flight direction

The detailed data on the most important species have been presented in Appendix 1 to the EIA Report. Overall, the data on flight directions from visual and horizontal radar observations indicate the same ranges of directions. As an example, the results obtained for common scoter have been presented below (Figure 30).

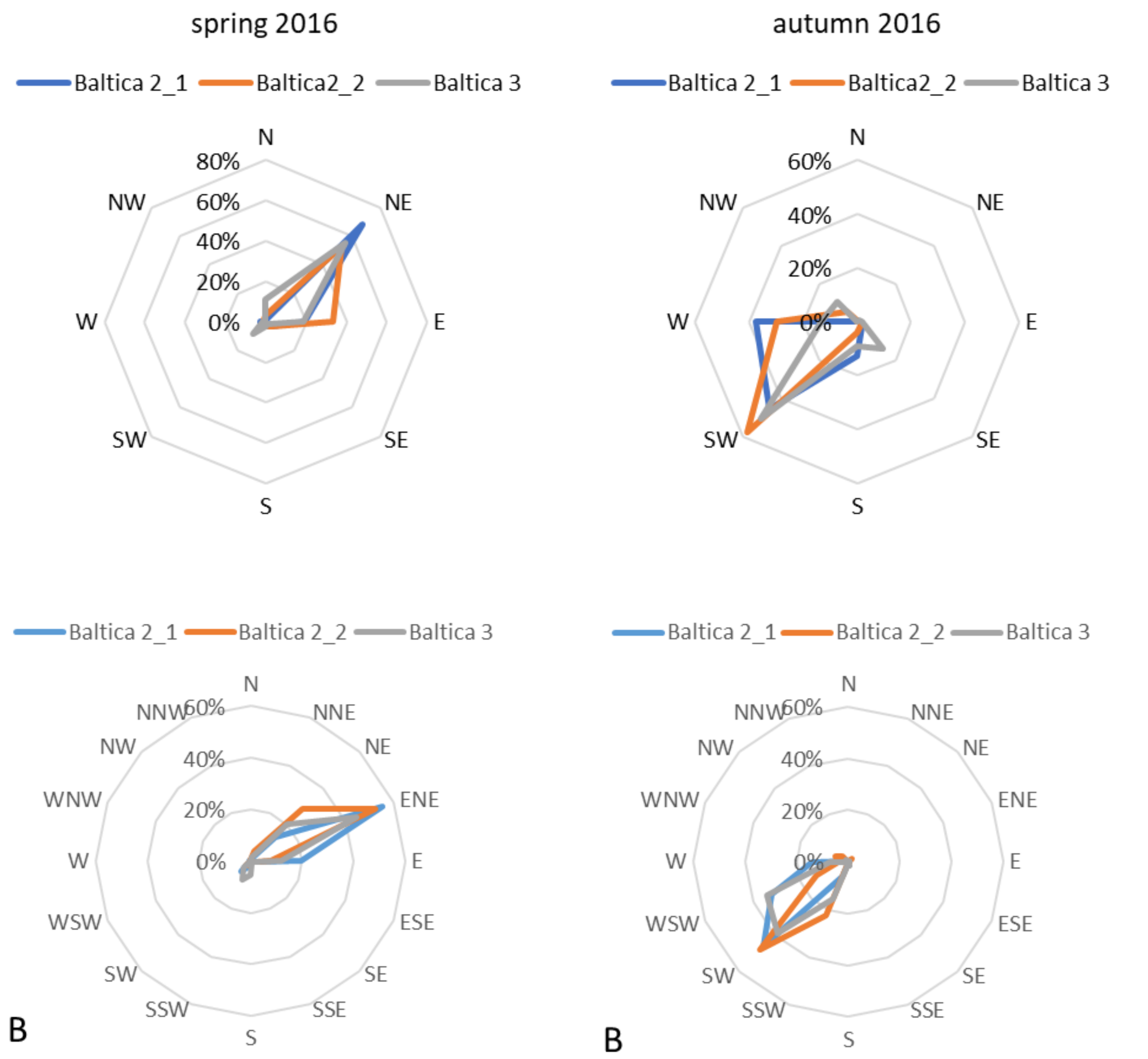


Figure 30. The comparison of the common scoter flight direction based on visual observations and flight paths from horizontal radar for spring and autumn 2016

A – visual observations
B – flight paths from the horizontal radar
Source: internal data

The migratory birds' predominant flight direction through the Baltica OWF Area in the spring was the north-eastern – east direction (Figure 31), and in the autumn south-western – west (Figure 32).

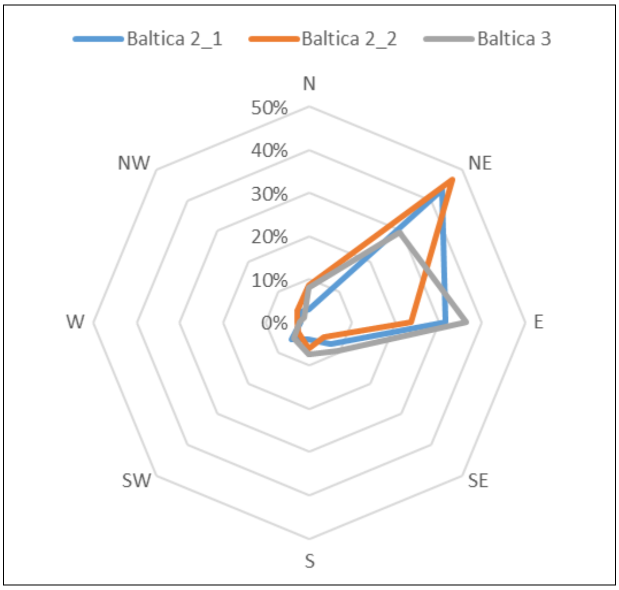


Figure 31. The direction of migratory birds flight on the basis of all the observations in the spring 2016
Source: internal data

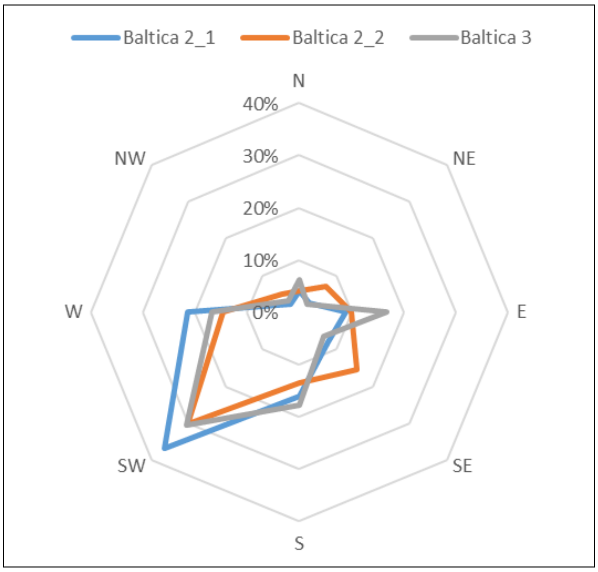


Figure 32. The direction of migratory birds flight on the basis of all the observations in the autumn 2016
Source: internal data

In March 2017 (Figure 33), part of the birds was heading in other than expected directions, which is related to the fact that the observations included birds that have not yet begun spring migration and were still within wintering grounds near the Baltica OWF Area, flying on short distances, moving, for example, in search of food. These could also be partially local birds that nest along the Polish coast of the Baltic Sea.

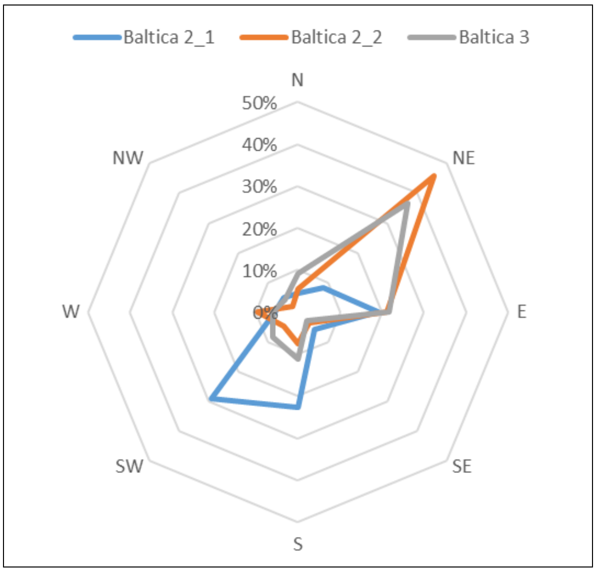


Figure 33. The direction of migratory birds flight on the basis of all the observations in March 2017

Source: internal data

3.7.1.5.2 Seabirds

The discussed species of seabirds use the Baltic Sea basin primarily as a place for wintering and stops along the migration route. Most of them reach the biggest abundances in the offshore area, located over 1 km from the shore. Gulls which accompany fishing boats to fishing grounds are an exception and their occurrence in the open sea is strongly conditioned by human activity.

Species composition and the domination structure of the waterbirds staying in the Baltica OWF Area

During the 23 inspections carried out at the OWF Area, a total of 14 bird species staying on the water has been found, including 12 species connected to the marine environment and two species of waterbirds rarely found at sea far from the shore (Table 30). The above mentioned table lists the abundance and percentage share in the birds group of all these species observed in the OWF Area. The numbers given refer to the birds observed in the transect belt and not to all the individuals recorded during survey cruises. Therefore, the values given in the table (Table 30) adequately reflect the share of individual species in the entire birds group in the Baltica OWF Area.

The total number of all the birds observed along the transects in the Baltica OWF Area has equalled 5129 individuals. The most numerous was the long-tailed duck representing 69% of all the identified birds. The second species in terms of abundance – razorbill – has accounted for 12% of the entire birds group. The threshold of 5% share in the group has yet been crossed by the common murre and European herring gull (Table 30). In the Baltica OWF Area, the occurrence of 13 bird species covered by strict species protection in Poland (long-tailed duck, razorbill, common murre, black guillemot, black-throated loon, red-throated loon, lesser black-backed gull, little gull, great black-backed gull, black-headed gull, common gull, common scoter, velvet scoter) and one species covered by partial protection (European herring gull) has been found. Three species of birds staying on the water, listed in Annex 1 of the Birds Directive (black-throated loon, red-throated loon, and little gull) have been noted in the OWF Area. Two species of birds (black guillemot and common gull) had the SPEC 2 rank, and four species (velvet scoter, black-throated loon, red-throated loon, little gull) SPEC 3 rank. Two of the observed species (long-tailed duck and velvet scoter) had an elevated VU category (vulnerable), and the razorbill had an NT category (near threatened), according to The IUCN Red List of Threatened Species.

Table 30. The total abundance and percentage share in the group of individual bird species staying on the water found in the Baltica OWF Area during the whole period of surveys

Species	**The number of individuals observed**	**Share in the group**
Seabirds		
Long-tailed duck *Clangula hyemalis*	3547	69.2%
Razorbill *Alca torda*	608	11.9%
Common murre *Uria aalge*	439	8.6%
European herring gull *Larus argentatus*	382	7.4%
Black-throated loon *Gavia arctica*	15	0.3%
Lesser black-backed gull *Larus fuscus*	8	0.2%
Velvet scoter *Melanitta fusca*	7	0.1%
Little gull *Hydrocoloeus minutus*	7	0.1%
Black guillemot *Cepphus grylle*	6	0.1%
Great black-backed gull *Larus marinus*	5	0.1%
Common scoter *Melanitta nigra*	3	0.1%
Red-throated loon *Gavia stellata*	3	0.1%
Waterbirds rarely encountered at sea far from the shore		
Black-headed gull *Chroicocephalus ridibundus*	1	0.0%
Common gull *Larus canus*	19	0.4%
Birds not classified to species		
Razorbill or common murre *Alca torda/Uria aalge*	69	1.3%
Unidentified loons *Gavia* sp.	8	0.2%
Unidentified swans *Cygnus* sp.	1	+
Unidentified terns *Sterna* sp.	1	+
Total	5129	100%

+ Percentage share smaller than 0.1%
Source: internal data

Among the species indicated during the transect survey, on the list of birds mentioned in Annex 1 of the Birds Directive are: black-throated loon, red-throated loon, little gull, horned grebe, sandwich tern, common tern, Arctic tern, black tern, little tern, whooper swan, barnacle goose, common crane, short-eared owl and ruff. Only some of these species have been present in the OWF Area (black-throated loon, red-throated loon, little gull), others have only been flying over it (horned grebe, sandwich tern, common tern, Arctic tern, black tern, little tern, whooper swan, barnacle goose, common crane, short-eared owl and ruff).

Horned grebe has an elevated IUCN category (VU category – vulnerable). The long-tailed duck and velvet scoter also have an elevated IUCN category (VU category – vulnerable) and have occurred in great numbers along the transects of the survey cruises carried out for the purposes of the project (The IUCN Red List of Threatened Species. Version 2017-2). The participation of at least 1% of the group of birds staying in the Baltica OWF Area during the phenological period has been reached by (beside the long-tailed duck and velvet scoter) the razorbill, common murre, European herring gull, common gull and lesser black-backed gull.

Long-tailed duck *Clangula hyemalis*

In the Baltic Sea there are currently about 1.5 million wintering individuals, which is a decrease by 65% in comparison to the abundance observed at the turn of the 1980s and 1990s (Skov et al., 2011). The population wintering within the Baltic Sea is about 30% of the global population estimated for about 5 million birds (Wetlands International, 2017). The long-tailed duck belongs to species that have recently clearly reduced their numbers in the Baltic Sea (Skov et al., 2011); hence it has been classified as a vulnerable species (The IUCN Red List of Threatened Species. Version 2017-2).

The food of long-tailed ducks in the non-breeding period is primarily macrozoobenthos (mussels and crustaceans), but also small fish. In search of food these birds are able to dive up to 60 m (Cramp & Simmons, 1977).

The long-tailed duck was the most abundant bird species both in the OWF Area and in the Słupsk Bank. It is a species widespread in the Baltic Sea, and these birds concentrate mostly in areas of moderate depth (up to 20–30 m) rich in zoobenthos which is their food. The Słupsk Bank is one of the most important wintering grounds in the Baltic Sea (Durinck et al., 1994; Skov et al., 2011).

This species dominated in each of the phenological periods. During the transect survey, a total of 69,149 individuals of the long-tailed ducks (sitting on water and in flight) have been found in the entire surveyed area, which constituted 83.8% of the birds group. In the OWF Area, 3547 individuals of the long-tailed duck sitting on water (69.2% of the birds group) and 1813 individuals in flight have been observed.

During the spring migration, the number of the long-tailed ducks staying in the OWF Area was estimated at 2250 individuals (70.6% of the birds group) and the birds in flight at 1100 individuals. The long-tailed duck's abundance in spring 2016 was the highest during the first inspection carried out in March. In the second half of March and at the beginning of April the number of individuals of this species in the OWF Area remained at a similar level of 400–600 birds. It is also worth noting that although the number of the long-tailed ducks in the OWF Area was smaller than in the Słupsk Bank area, the OWF Area has a higher share of the long-tailed ducks observed in flight, which may result from the more frequent local movements in this area (Meissner, 2017). From mid-April, throughout the summer and in September no long-tailed ducks were observed.

In autumn, the first long-tailed ducks appeared in October, and in November there was an increase in the number of this species. In the autumn, only 74 specimens of the long-tailed duck sitting on the water (23.9% of the birds group) were observed in the OWF Area. It was the second most abundant species of birds in this area in autumn, giving way to a more numerous common murre. In autumn, 257 specimens of the long-tailed duck in flight over the OWF Area (20.6% of the birds group) were found. During this phenological phase, the airspace over the OWF Area has been used to a greater extent than by the long-tailed ducks, by the European herring gull.

In the winter, there were very large fluctuations in the number of the long-tailed ducks in the OWF Area, which were also noted in March 2017. The share of the long-tailed duck in the birds group was very high both in the OWF Area and in the Słupsk Bank area. In the OWF Area, in the winter, 1223 specimens of this species were found sitting on the water (95.8% of the birds group) and 4 individuals in flight (51.6% of the birds in flight group).

The long-tailed duck was the most numerous bird species outside the summer period and it had a decisive influence on the image of the average birds density in the surveyed area. Both in the spring 2016 and in March 2017, no long-tailed ducks were found in the large part of the Baltica 2 Area. In a significant part of the Baltica 3 Area in 2016, the average densities exceeded 5 indiv.$\cdot$km^{-2}, while in March 2017 they were clearly lower, and moreover, in its northern part the long-tailed ducks were not found. In March 2017, the highest average density of the long-tailed duck was recorded in the Baltica 2 Area near the border with the Słupsk Bank, where in a small area they reached even 100 indiv.$\cdot$km^{-2}.

During the autumn migration, the long-tailed ducks formed three separate groups in the Baltica OWF Area, where the density below 1 indiv.$\cdot$km^{-2} prevailed but locally reached up to 5 indiv.$\cdot$km^{-2}. Similarly to the spring migration period, there was an increase in the density of birds near the border with the Słupsk Bank.

The density of the long-tailed duck in the Baltica OWF Area was significantly lower than in the area of the Słupsk Bank. In the Baltica OWF Area, the long-tailed ducks gathered on an elongated shape area, in densities of up to 5 indiv.$\cdot$km^{-2}, and in two small areas they reached up to 50 indiv.$\cdot$km^{-2}. There has been a clear increase in their numbers in the direction of the Słupsk Bank, where the density between 10 and 50 indiv.$\cdot$km^{-2} have prevailed (Meissner, 2017).

For the sea ducks the most energy profitable is feeding in shallower (up to 20–30 m deep), nutrient-rich waters and only the decrease in the density of benthic organisms forces them to move to other places (Kirk et al., 2008, Meissner, 2010c). The phenomenon of changing feeding grounds after the depletion of benthic resources is most likely typical of sea ducks not only in this part of the Baltic Sea (Bräger et al., 1995; Kirk et al., 2008; Meissner, 2010c) and could also take place in the case of the long-tailed ducks in the surveyed area. In the autumn, the number of the long-tailed ducks in the deeper than the Słupsk Bank area, the neighbouring part of the Baltica 2 Area was very low. In the winter and spring, the long-tailed ducks in high densities reaching up to 100 indiv.$\cdot$km^{-2} appeared in the adjacent to the Słupsk Bank, the shallowest part of the Baltica 2 Area. A similar movement of the long-tailed ducks has been recorded between the Słupsk Bank and the adjacent area of the BŚII OWF, which is located near the Baltica 2 Area (Meissner, 2015a).

The large number of the long-tailed duck individuals staying in the surveyed area correlated with the fact that the long-tailed duck was the most abundant bird species observed in flight (11,444 individuals in total over the OWF and the Słupsk Bank). However, the altitude of the long-tailed ducks' flights above the water surface was mostly low and below 20 m (11 293 individuals, 98.68% of the long-tailed ducks). Whereas, at the altitudes that could cause collisions of the flying birds with the operating wind turbine rotor (20–100 m and 100–250 m), only 151 individuals of this species have been found during the entire survey period (1.32% of the long-tailed ducks). This will have a significant impact on the possibility of the long-tailed ducks' collisions with wind power stations, however, it will not influence the scaring away effect of the offshore wind farm on these birds.

Velvet scoter *Melanitta fusca*

The Baltic Sea is the most important wintering ground for velvet scoters. The results of the surveys carried out in 1992–1993 showed there, in January, about 1 million birds, which accounted for 90% of the world's population (Durinck et al., 1994; Wetlands International, 2017). At the beginning of the 1990s, a decrease in the number of velvet scoters in the Baltic Sea was noticed and currently its number is estimated at 373,000 individuals. This means a decrease by as much as 60% (Skov et al., 2011), hence it has been classified as a vulnerable species (The IUCN Red List of Threatened Species. Version 2017-2). During the survey within the framework of the Monitoring of Wintering Seabirds for the period 2011–2016, a statistically significant moderate decrease in the number of the velvet scoters in the area of the Słupsk Bank was also observed (Chodkiewicz et al., 2016). The largest concentrations of this species in the Baltic Sea have been observed for many years in the Pomeranian Bay and the Gulf of Riga (Durinck et al., 1994; Skov et al., 2011). Velvet scoters avoid areas with depths exceeding 30 m (Skov et al., 2011).

Like other sea ducks, velvet scoter, outside the breeding period, feeds on mussels, crustaceans and polychaetes (Cramp and Simmons, 1977).

This species is less abundant than the long-tailed duck, and the number of areas in the Baltic Sea in which it winters in great numbers is limited. These include the Pomeranian Bay, the Gulf of Riga as well as the coastal waters of Lithuania and Latvia (Skov et al., 2011).

A total of 4227 velvet scoters have been observed in the entire area covered by the survey (the OWF Area together with the Słupsk Bank). This put them in second place in terms of numbers, right after the long-tailed duck, but they constituted only 5.1% of the birds group.

In the OWF Area, the velvet scoter has been observed sporadically, and instead a common murre and razorbill have appeared, two species which feed on fish, mainly pelagic (sprat and herring). The total number of the velvet scoters staying in the OWF Area has only equalled 7 individuals (0.1% of the birds group). In addition, 97 individuals of this species have been recorded flying over the OWF Area.

The changes in the velvet scoters numbers in the OWF Area, the second in terms of abundance species, proceeded similarly to the long-tailed duck's. As in the case of the long-tailed duck, the highest concentration of velvet scoters appeared during the first inspection in March 2016, except that in the OWF Area these were almost exclusively flying birds, and the total number of the velvet scoters during any of the inspections there did not exceed 25 individuals. The number of velvet scoters sitting on the water in the OWF Area totalled only 6 individuals in the entire spring period (0.2% of the birds group), and a total of 66 individuals of this species were observed flying (2.1% of the birds group). From May to the end of the summer, velvet scoters were not observed, and in the autumn the first birds, in small numbers, appeared in September. In the autumn, only one individual of velvet scoters sitting on the water (0.3% of the birds group) and 12 individuals flying (0.7% of the birds in flight group) were observed in the OWF Area. In the winter, no individuals of velvet scoters sitting on the water were found in the OWF Area. There were only 19 specimens of this species flying (2.2% of birds in flight group) there. During the whole period of surveys in the OWF Area, mainly birds flying over it have been observed, which indicates that the velvet scoters have avoided this area and clearly preferred the shallower area of the Słupsk Bank.

In the OWF Area in the spring, velvet scoters appeared only locally and in a very small number. In the autumn, there were very few velvet scoters in the OWF Area. During wintering in the OWF Area, velvet scoters appeared sporadically.

The vast majority of velvet scoters passed over the surveyed area at heights below 20 m (1037 specimens, 95.58% of velvet scoters). Whereas, only 48 velvet scoters individuals (4.42% of velvet scoters) have been flying during transect observations at the height of the wind power station's rotor operation (20–100 m above the water surface). The number of velvet scoters in the OWF Area was very low (Meissner, 2017).

Razorbill *Alca torda* and common murre *Uria aalge*

The common characteristics of the razorbills and common murres occurrence is justified because the species are closely related and have very similar habitat requirements (Cramp & Simmons, 1983).

The world population of razorbills is estimated at approx. 430–770 thousands of breeding pairs. The European population of this species is estimated at about 0.9–1.5 million adults (BirdLife International, 2004). There are 15 thousand pairs of razorbills nesting in the Baltic Sea, and in the years 1988–1993, about 156 thousand individuals wintered there (Durinck et al., 1994; BirdLife International, 2004). By far the most important area for this species is the northern part of the Kattegat, where in the winter there is as much as 85% of all the Baltic razorbills (Durinck et al., 1994). In the rest of the Baltic Sea, this species is highly dispersed (Durinck et al., 1994). The razorbill in the Baltic Sea feeds almost exclusively on fish, sometimes, however, polychaetes and crustaceans have also been found in its stomachs (Cramp, 1985).

The total abundance of the world's common murre population is estimated at 2–2,7 million pairs. The European population of this species is estimated at about 4–5.5 million adults (BirdLife International, 2004). In the years 1988–1993 it was estimated that about 86 thousand birds of this species winters in the Baltic Sea (Durinck et al., 1994). The largest concentrations have been observed in the northern part of the Kattegat, where about 55% of the Baltic population was wintering (Durinck et al., 1994). In the rest of the Baltic Sea, this species is highly dispersed (Durinck et al., 1994). Common murre in the Baltic Sea feeds only on fish (Cramp, 1985).

The razorbill was second, and the common murre third bird species in terms of abundance staying in the OWF Area. 608 razorbills (11.9% of the birds group) sitting on water and 465 individuals of this species flying have been observed. The presence of 439 common murres sitting on water (8.6% of the birds group) and 103 individuals of this species flying have also been recorded. In addition, there have been 69 birds in the OWF Area (1.3% of the birds group), which have been classified as razorbill or common murre. Therefore, the razorbills and common murres constituted a total of 21.8% of the birds group in the OWF Area. The relatively high number of adult common murres with young in the summer has not yet been reported in the national literature, which may partly result from the small number of surveys conducted on the high seas in the period immediately after breeding. However, the observations carried out in the nearby BŚII and BŚIII areas have not provided data on such large groups of this species. The razorbill and common murre feed on fish, mainly pelagic (sprat and herring). Most probably the OWF Area and the easternmost part of the Słupsk Bank, where the common murres have been notably more numerous, are important places of their concentration due to the rich food supply. High, as for the Polish Baltic Sea area, abundance of razorbills and common murres (see Chodkiewicz et al., 2016) indicates the great significance of the surveyed sea area for both species.

The razorbills were most often observed during the first inspection in March 2016, however, the abundance of this species at this time was several times higher in the OWF Area than in the area of the Słupsk Bank. In the OWF Area in the spring, 522 individuals were observed sitting on water (17.3% of the birds group) and 364 individuals in flight (11.7% of the birds in flight group). In the spring of 2016, the most numerous razorbills were in the OWF Area, especially in the Baltica 3 Area, where the prevailing density was from 1 to 5 indiv.$\cdot$km^{-2}, locally reaching 10 indiv.$\cdot$km^{-2}. In the spring of 2017, the observations were carried out only in March, hence the distribution of birds in this phenological period is incomplete. The razorbills were then highly dispersed, with slightly larger groups of this species recorded in three small areas near the boundaries of the area covered by the survey. Except for the spring period, the number of razorbills staying in the surveyed area was low and did not exceed several dozens of individuals sitting on the water. In the summer, no razorbills sitting on the water were observed in the OWF Area. Only 2 individuals of razorbills were observed flying over the OWF Area (0.4% of the birds in flight group). In the autumn the numbers of razorbills flying over the OWF and the Słupsk Bank area were comparable, however, in the OWF Area, the razorbills constituted a several times greater percentage of the group of birds sitting on the water (45 indiv. – 14.5% vs. 14 indiv. – 0.2%) and flying birds (respectively, 64 indiv. – 3.8% vs. 39 indiv. – 1.2% respectively) than in the Słupsk Bank area. During the autumn migration, in most of the Baltica 2 Area the razorbills were not found. In the remaining part of the surveyed area, the prevailing concentration was from 0.1 to 1 indiv.$\cdot$km^{-2}, locally reaching up to 5 indiv.$\cdot$km^{-2}. In the winter in the OWF Area, 11 razorbills sitting on the water were identified (0.9% of the birds group) and 35 individuals in flight (4.0% of the birds in flight group). The presence of the razorbills in the OWF Area in the winter was limited to the northern part of the Baltica 2 Area and the greater part of the Baltica 3 Area. The razorbills densities ranging from 0.1 to 1 indiv.$\cdot$km^{-2}.

Also, the common murre appeared significantly more numerous in the OWF Area, but unlike the razorbills, the largest abundance of this species was recorded in the summer and to a lesser extent in the autumn. In the spring, common murres staying in the OWF Area were less abundant than in the summer and autumn, but they were three times more numerous than in the Słupsk Bank area (79 indiv. – 2.5% vs. 24 indiv. – 0.1% respectively of the birds sitting on the water). In contrast, the numbers of the birds flying over both areas in the spring were comparable (22 indiv. – 0.7% vs. 18 indiv. – 0.4% respectively of the birds in flight group). In the spring of 2016, in the majority of the OWF Area, the concentrations reached the value of 1 indiv.$\cdot$km^{-2} and only locally were slightly higher. In the spring of 2017, the surveys were conducted only in March, when the number of the birds of this species was low. Common murres appeared then in the surveyed area in several distant from each other places, and in none of them their density exceeded the value of 5 indiv.$\cdot$km^{-2}. In the summer, the common murre was the most abundant species observed in the OWF Area. In most of this area the prevailing density was from 0.1 to 5 indiv.$\cdot$km^{-2}. The largest grouping of this species was recorded in the OWF Area during the second cruise in July and the first in August 2016 (birds sitting on the water: 229 indiv. – 64.3% of the birds group, birds flying: 5 –1% of the birds in flight group). Also in the autumn, the common murres were more numerous in the OWF Area than in the Słupsk Bank area (sitting: 124 indiv. – 40% vs. 22 indiv. – 0.3% of the birds group, 46 indiv. – 2.8% vs. 21 indiv. – 0.6% of the birds in flight group respectively). In the winter, the number of the common murres in the surveyed area was lower than in other phenological periods. In the winter, mainly flying birds were observed, however, the numbers of the common murres in both areas were comparable and relatively low (the OWF and the Słupsk Bank area respectively: sitting 7 indiv. – 0.5% vs. 11 indiv. – <0.1%; flying 30 indiv. – 3.4% vs. 33 indiv. – 0.7%). In contrast to the autumn migration period, in the winter, the common murres appeared in smaller numbers in the OWF Area than in the Słupsk Bank area. In the OWF Area, the picture of their distribution was similar to that in the autumn, but the extent of the area of the largest densities reaching up to 5 indiv.·km^{-2} was clearly smaller. In the winter in the OWF Area, individual common murres were observed, and a small flock of them appeared in the southern part of the Baltica 3 Area.

The vast majority of the razorbills and common murres flew over the water surface of the surveyed area at an altitude below 20 m (614 indiv., 98.24% of the razorbills in flight; 174 indiv., 99.43% of the common murres in flight). Whereas, the air space in the 20–100 m height zone, which is contained in the wind power station's rotor operation zone, has been used by only 11 of the observed razorbills (only 1.76% of the razorbills in flight) and one common murre (Meissner, 2017).

European herring gull *Larus argentatus*

The wintering population in Europe is currently estimated at around 4 million birds (Wetlands International, 2017). In the Baltic Sea, around 310,000 individuals winters outside the coastal zone (Durinck et al., 1994), but the greatest concentrations of the European herring gulls in the winter is observed near fishing ports and on municipal landfill sites (Meissner et al., 2007; Neubauer, 2011). These birds often accompany fishing boats in fisheries, hence their presence in sea areas is largely dependent on fishing activity (Garthe, 1997; Garthe & Scherp, 2003) and the preferences regarding the depth zones cannot be unequivocally determined. The natural food of European herring gulls is composed of fish and invertebrates, however, anthropogenic components such as fish waste and food leftovers deposited at municipal landfill sites have a significant share in their diet (Meissner, 2015a, b).

The European herring gull is not a species with high conservation priority (it is subject to only partial species protection, it is not included in the list of birds in Annex 1 of the Birds Directive and is a species of the least concern according to the IUCN), however, due to its high share in the waterbirds group, it was included in the environmental impact assessment.

The European herring gull has been observed relatively often. It is widespread in the Baltic Sea basin. These birds penetrate large areas in search for food, including the waste produced by fishing hauling and processing aboard fishing boats. For this reason, they often accompany fishing vessels in fisheries away from the coast. This is why most observations of herring gulls involved specimens flying over the surface of water. 382 specimens of this species have stayed in the OWF Area throughout the entire survey period (7.4% of the birds group), while 1596 European herring gulls have been observed flying over this area. This type of behaviour of the European herring gulls is explained by the lack of distinct periods of both migrations in the image of changes in the number of this species. The changes in the European herring gulls abundance over time have not shown any regularities, while their distribution in all phenological periods was marked by flocking. Most of the individuals were observed in the spring of 2016 (densities mainly from 1 to 5 indiv.·km^{-2}). In the summer, European herring gull appeared in most of the area covered by observations. Only locally their density exceeded the value of 1 indiv.·km^{-2}, reaching up to the maximum of 5 indiv.·km^{-2} in limited surface areas. During the autumn migration, the distribution of European herring gulls was similar to the summer one. In the winter, European herring gulls were observed in the large part of the Baltica 2 Area. Whereas, in the Baltica 3 Area their occurrence was mainly limited to the buffer zone. The densities below 1 indiv.·km^{-2} dominated, and only locally reached the value of 5 indiv.·km^{-2}.

Much of the European herring gulls flights took place at the altitudes (20–250 m) of the possible collisions with working rotors of wind power stations (1297 indiv., 49.02% of the flying European herring gulls). A similar percentage of these birds' flights has been recorded below this altitude (1328 indiv., 50.19%), while only few European herring gulls have flown above 250 m (21 indiv., 0.79%) (Meissner, 2017).

Common gull *Larus canus*

The world's common gull population is estimated at about 2.5–3.7 million individuals. The European population of this species is estimated at 0.64–1.08 million pairs, or 1.28–2.16 million adults (BirdLife International, 2017). Less than 4% of the sea gull's breeding population winters in the Baltic Sea outside the coastal zone (Durinck, 1994). In high densities, this species has been observed outside the coastal zone exclusively in the Gulf of Riga, where the wintering population of this gull has been estimated at 16 thousand individuals. An important places of wintering for the common gull are also the north, north-east and west coast of Bornholm. It is estimated that there are 15.3 thousand individuals of this species wintering there mainly in areas of intense fishing activity. In many sea areas the density of these gulls is very low. According to the surveys carried out between 1988–1993, in the area of the Baltic Sea, where the Słupsk Bank is located, the density of the wintering common gulls was 0.1–0.99 individual per km^2 (Durinck 1994).

The foods of common gulls are earthworms, insects, other aquatic and terrestrial invertebrates (e.g. crustacean plankton, molluscs) and small fish (BirdLife International, 2017). Common gulls may also feed on the remains of fish and food waste from landfills (Durinck, 1994).

The common gull belongs to a group of waterbirds rarely seen at sea away from the coast. This species was included in the assessment of the Baltica OWF impact on seabirds due to its relatively large share in the birds group staying in the Baltica OWF Area in the summer (4.2%, 15 individuals). However, the total number of the common gulls in the surveyed area was low. In the Baltica OWF Area, a total of only 19 specimens of this species sitting on the water and 52 individuals flying have been observed throughout the entire survey period.

The top common gulls flight altitude above the surveyed area was very close to the top flight altitude of the European herring gulls. Also in this case, about half (46%) of these birds' flights took place at the level of the working wind power stations' rotors, and half (54%) below this level (Meissner, 2017). Due to the similarity of the behaviour at sea between the common gull and the European herring gull, these species will be assessed jointly in the assessment of the OWF's impact on seabirds.

Little gull *Hydrocoloeus minutus*

Little gull is mentioned in Annex 1 to the Birds Directive. The research conducted all over the Baltic Sea in the years 1988–1993 confirmed the wintering of around 2 thousand birds of this species highly dispersed (Durinck et al., 1994). During the wintering, the little gull prefers the sea. Their food is composed of insects, other invertebrates and small fish (Cramp & Simmons, 1983).

During the transect surveys, carried out for the purposes of the project, 29 individuals of little gull were recorded. They accounted for less than 0.1% of the observed birds group. In the OWF Area, only seven birds were observed on the water, all of which were spotted exclusively in the spring. 12 individuals of the little gull were observed flying over the OWF Area. The majority (73.33%) of little gulls flew at an altitude below 20 m. Only 4 specimens flew at an altitude of 20–100 m (Meissner, 2017).

Lesser black-backed gull *Larus fuscus*

Lesser black-backed gulls appear in the Polish zone of the Baltic Sea mainly during migration periods, which last from March to mid-May and from July to December (Neubauer, 2011). This species winters in Poland very rarely (Tomiałojć & Stawarczyk, 2003). Out of the 5 subspecies, in Poland by far the most-noted is *L. f. fuscus* which inhabits Sweden, Norway, Finland and Russia as far as the White Sea. It winters in Africa and south-west Asia. Occasionally, the lesser black-backed gulls' nests have also been found in Poland (Cramp & Simmons, 1983; Tomiałojć & Stawarczyk, 2003). The breeding population of this subspecies is estimated at 56 thousand individuals and shows a decreasing inclination (Wetlands International, 2017).

As in the case of the common gull, this species has also been included in the assessment of the Baltica OWF impact on seabirds due to its relatively large share in the birds group staying in the surveyed area during the summer. This period was characterised by low abundance of the whole birds group. Therefore, even a small number of the lesser black-backed gulls (48 individuals throughout the entire surveys area during the entire period of the surveys) in the summer exceeded 1% of the birds group present in the Baltica OWF Area and the Słupsk Bank area. During this period, five specimens of this species were observed staying in the Baltica OWF Area as well as 15 individuals of the lesser black-backed gulls flying in the entire survey area. Slightly more than half (58.33%, 21 indiv.) of the birds seen flying travelled at an altitude below 20 m. The remaining part of the observed birds (only 15 indiv.) flew at altitude 20–100 m (Meissner, 2017).

Black-throated loon *Gavia arctica* and red-throated loon *Gavia stellata*

The common characteristics of the black-throated loon and the red-throated loon occurrence are justified because the species are closely related and have very similar habitat requirements (Cramp & Simmons, 1977).

250–500 thousand individuals of the black-throated loon and about 150–450 thousand individuals of the red-throated loon winters throughout Europe (Wetlands International, 2017). 0.9–2.1% of the European black-throated and red-throated loons population winters in the Baltic Sea (Skov et al., 2011), which indicates the low significance of this area for these species. In the years 1988–1993 the abundance of both species of loons was estimated at 56.7 thousand birds, and in 2007–2009 only at 8.6 thousand. This indicates over 80% decline in the population of these species wintering in the Baltic Sea. However, it is not known whether this decrease affects the entire European population or is local (Skov et al., 2011). Both species of loons are listed in Annex 1 of the Birds Directive.

During the transect surveys, a total of 47 black-throated loons were found staying in the surveyed sea area and 21 individuals flying, with the black-throated loons observed sitting on the water twice as numerous in the Słupsk Bank area as in the OWF Area (respectively, 32 indiv. vs. 15 indiv.). The number of the red-throated loons found in the surveyed area has been much smaller. In total, only 5 specimens of this species sitting on the water and 18 individuals flying have been found in both areas (the OWF and the Słupsk Bank). The observed individuals from both species constituted a small percentage of birds in the group. Most of the black-throated and red-throated loons have been found in the winter and spring. In the autumn only single individuals were found, and during the summer these birds were not recorded. Most of the black-throated loons flew over the surveyed sea area at an altitude below 20 m (66.67%). Also about half of the red-throated loons flew at this altitude. The remaining dozen birds flew at an altitude of 20–250 m above the surface of the water (Meissner, 2017).

3.7.1.6 Bats

The surveys to determine the impact of wind power stations on bats have begun at the end of the last century. The surveys of bats behaviour at wind farms have been conducted in connection with the surveys on the impact of such investments on birds. Numerous publications (Bach et al., 1999; Johnson et al., 2000) have indicated that the number of dead bats sometimes outnumbered the number of dead birds found within the onshore wind farms placed near a forest, but also in exposed areas. Collisions have also been recorded with the rotors of offshore wind farms (European Commission, 2011). The results presented by e.g. Ahlèn (1997) and Ahlèn at al. (2007, 2009) or Hobbs et al. (2013) confirmed the information about the collisions of the studied species with wind stations and provided the most likely causes of these events on both wind farms located on land and at sea. On the basis of onshore surveys, it has been found that as a result of a collision with a wind power station, 20 species of European bats suffer death and 21 species are potentially exposed to it (Rodrigues et al., 2008).

The surveys on bats' activity in the OWF Area was carried out in the spring migration period (May 2016, April–May 2017) and during the autumn migration (August–September 2016). A total of 79 records were registered, which confirmed the bats' activity. The measurements carried out have confirmed theses included in the literature on the subject (Ahlèn, 1997; Ahlèn et al., 2009; Hobbs et al., 2013) regarding the migration abilities of bats. The recorded materials were ascribed to the following species: the common noctule *Nyctalus noctula*, Nathusius' pipistrelle *Pipistrellus nathusii*, the soprano pipistrelle *Pipistrellus pygmaeus*, the lesser noctule *Nyctalus leisleri* and Daubenton's bat *Myotis daubentonii.*

The activity of the common noctule was recorded during the autumn migration. This species belongs to the vesper bats family, and its range in Europe includes the areas from the Iberian Peninsula in the west, to the Urals and the Caucasus in the east (Ignaczak et al., 2009). It is a typically forest species. Due to the wide range of distribution it is commonly believed to be a migratory species (Petit and Mayer 2000; Łupicki et al., 2007). It migrates over great distances of up to 1600 km separating its summer localities (in north-eastern Europe) from the wintering grounds (in south-western Europe). During the migration period it has been observed flying over the open sea (Kepel et al., 2011; Ahlèn et al., 2009).

In Poland, it is one of the largest bats. It winters mainly abroad. However, in recent years the information about this species' hibernation in the country has been appearing more often. It hibernates in the above-ground parts of buildings and tree hollows. Occasionally it has been found in underground facilities, but the reports of wintering in caves are rare (Ignaczak et al., 2009; Łupicki et al., 2007). The common noctule is characterised by a very high exposure to mortality in contact with a wind power station due to the fast and low agility flight which is the results of the body size, as well as due to the achievement of significant heights during the flight and the use of open spaces as feeding grounds. In the temperate zone, the common noctule dominates among bats that die on wind farms, constituting a total of 33.21% of all individuals (Kepel et al., 2011). The data relates to the onshore wind farms located all over Europe, including the Mediterranean region. Similar surveys for offshore wind farms have not been carried out.

The individuals identified as the Nathusius' pipistrelle have been registered during both the spring and autumn migrations. Just like the common noctule, the Nathusius' pipistrelle is a forest species which belongs to the family *Vespertilionidae*. It inhabits trees and building in almost entire Europe. It flies long-distance of up to 1900 km between the locations – the summer one in the north-eastern Europe and the winter one in the south-western Europe. The longest recorded flight was 2100 km (Strelkov, 1969). The individuals of this species may fly over the open sea (Ahlèn et al., 2009).

Similarly to the common noctule, it is characterised by a fast and low agility flight which is the result of the body size, as well as the achievement of significant heights during the flight and the use of open spaces as feeding grounds. Therefore, the Nathusius' pipistrelle belongs to the bat species with a very high exposure to mortality resulting from the contact with a wind power station. In the temperate zone, the Nathusius' pipistrelle occupies the second place after the common noctule in terms of mortality resulting from the contact with wind farms. It constitutes about 23.25% of all the individuals (Kepel et al., 2011).

The soprano pipistrelle has been recorded during the spring and autumn migration. Just like the two species already mentioned, it belongs to the family of vesper bats. It is the smallest species of all the European bats. This bat inhabits areas located in the vicinity of water bodies and waterlogged areas. It is not considered to be a migratory species, though its occurrence has been recorded at offshore wind farms (Ahlèn et al., 2009). Due to the fairly agile but not very fast flight as well as hunting at lower altitudes and at a smaller distance from vertical obstacles, the soprano pipistrelle compared to the Nathusius' pipistrelle, is classified as a species with a high degree of exposure to mortality resulting from the contact with a wind power station (Baagoe, 1987; Kepel et al., 2011).

The lesser noctule has been registered during the autumn migration. It is a forest species belonging to the family of vesper bats. The European zone of deciduous forests is its habitat. This bat is a migratory species, which spends winter in the southern and western parts of Europe. It flies over long distances between its summer and winter grounds (even over 1500 km). The lesser noctule, similarly to the common noctule is characterised by a high degree of exposure to mortality resulting from the contact with the wind power station (Kepel et al., 2011).

The Daubenton's bat spotted once during the spring migration is connected to the aquatic environment. It prefers areas with various types of surface waters – river valleys, lakes, fish pond complexes – where it hunts for small insects, collecting them from the surface of the water. Foraging sites are usually about 900–1200 m away from the colonies, up to a maximum of 10 km from the hideaway. It may carry out short-distance migration (Sachanowicz & Ciechanowski, 2005). Due to hunting at low altitudes above the ground or surface of the water, slow but very agile flight and medium distance migration, the Daubenton's bat is classified as species with low exposure to mortality resulting from the contact with the wind power station (Kepel et al., 2011).

The identified species of bats have been mentioned in the Red List of mammals (IUCN, 2017) and have been considered to be the species of the least concern (LC category). At the international level, bats are protected on the basis of: the Habitats Directive (Annex 4), the Bonn Convention (Annex 2) on the Conservation of Migratory Species of Wild Animals and the Bonn Agreement on the conservation of bats in Europe, the Berne Convention (Appendix 2) on the conservation of wild flora and fauna species and their habitats as well as the "Agreement on the Conservation of Populations of European Bats" (EUROBATS) of 4 December 1991 (Journal of Laws of 1999, no. 96, item 1112). In Poland, all the occurring species of bats are subject to strict species protection under the Nature

Conservation Act of 16 April 2004 (consolidated text, Journal of Laws of 2016, item 2134 with amendments) and the Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws of 2016, item 2183).

Due to the low level of annual birth rate and high average life expectancy, even a small additional mortality may be a threat to bats (European Commission, 2011), therefore offshore wind farms may pose a significant threat to bats on a local, regional or supra-regional scale. The recorded species of bats and their degree of mortality risk resulting from the contact with the wind farm has been presented in the table below (Table 31) (the migrating species that occur in Europe have been chosen for the presentation and their collisions with a wind power station located onshore which have been recorded).

Table 31. Bats species and their degree of mortality risk in contact with a wind power station

Name of the species	Binomial nomenclature	Protection status[1, 2]	Mortality observed in Europe[3]	Level of exposure to mortality
Common noctule	*Nyctalus noctula*	LC, DSIV	+++	Very high
Lesser noctule	*Nyctalus leisleri*	LC, DSIV	+++	Very high
Soprano pipistrelle	*Pipistrellus pygmaeus*	LC, DSIV	+++	High
Nathusius' pipistrelle	*Pipistrellus nathusii*	LC, DSIV	+++	Very high
Daubenton's bat	*Myotis daubentonii*	LC, DSIV	+	Low

[1]Protection status on the basis of The IUCN Red List of Threatened Species; LC – least concern
[2]DSIV – Annex IV to the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
[3]Mortality observed: + single, ++ regular, +++ very often
Source: internal materials based on Kepel et al., 2011; Rodrigues et al., 2008

During the bat activity surveys, mainly low activities and a single moderate activity have been recorded. The activity index for particular species for the entire spring and autumn migration period indicates **low bats' activity in the surveyed part of the OWF Area**. The low activity of bats **does not indicate the existence of migration corridors** in the OWF Area. However, it cannot be excluded that migration routes of some species of bats do not pass through the OWF Area. The surveys conducted off the coast of Sweden confirm the presence of about 11 species of bats in the Southern Baltic area out of 18 species which are known to occur in this part of Europe (Ahlèn et al., 2009).

3.7.2 Conservation areas including Natura 2000

The Baltica OWF Area is located outside the boundaries of the protected areas in accordance with the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880), including outside the European ecological network Natura 2000. The four conservation sites of the Natura 2000 located closest to the OWF Area are: the Słupsk Bank (PLC990001), *Przybrzeżne wody Bałtyku* (PLB990002), *Ostoja Słowińska* (PLH220023) and *Pobrzeże Słowińskie* (PLB220003) (Figure 34). They have been designated under two European directives, i.e. the Birds Directive and the Habitats Directive. Within the *Ostoja Słowińska* site (PLH220023) there is the main complex of the Słowiński National Park, including its part located in maritime areas.

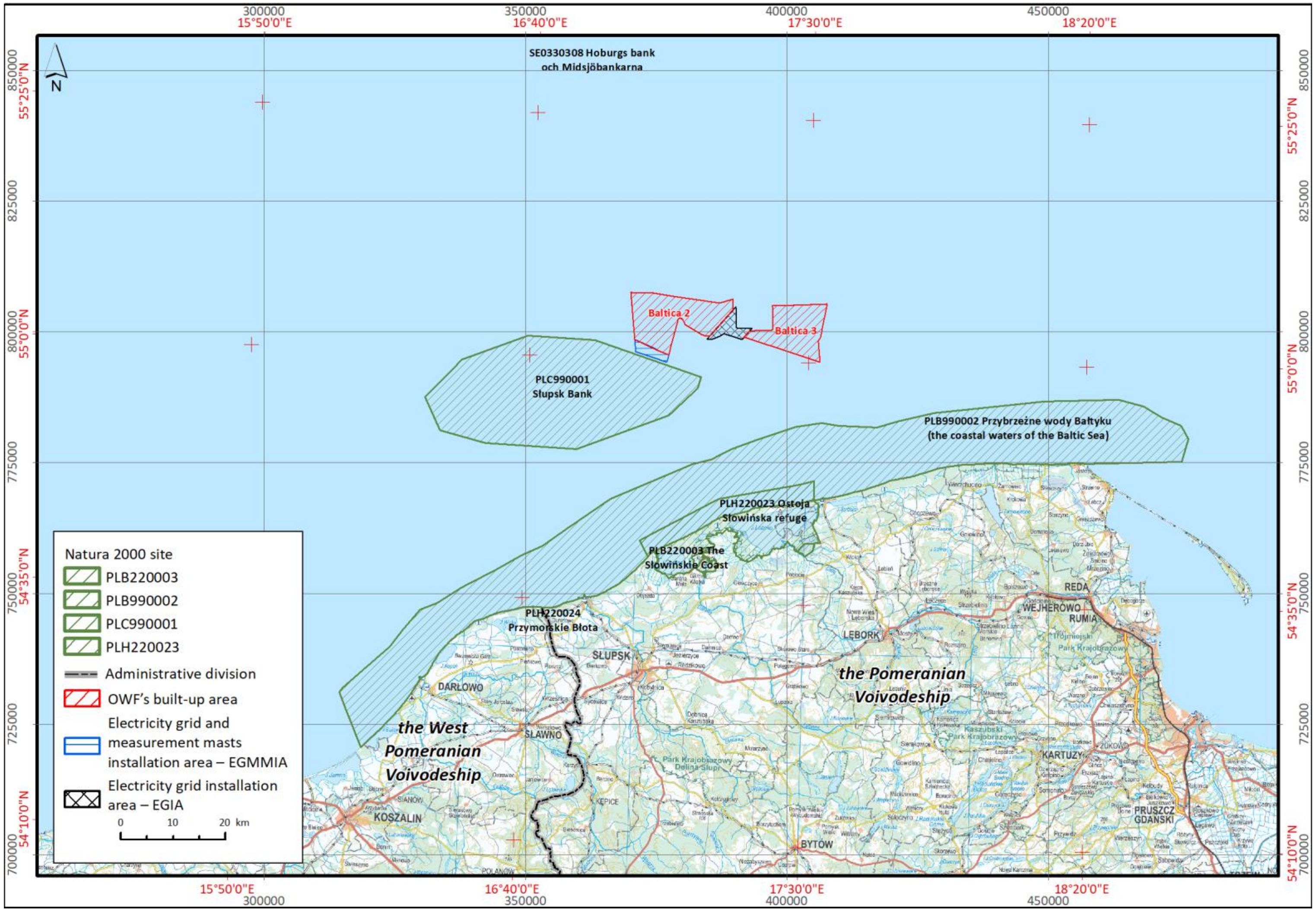


Figure 34. The location of the Natura 2000 European ecological network sites in relation to the location of the OWF Area

Source: internal data

The Słupsk Bank site (PLC990001)

The boundary of the built-up area of the Baltica OWF is located at a distance of not less than 2 km from the Słupsk Bank site (PLC990001) designated under the Birds Directive and the Habitats Directive within common borders.

The Słupsk Bank is an area in the Southern Baltic which covers the area with a shallow seabed. The boundaries of which were delineated along the course of the 20 m isobath. The area has a very diversified seabed structure with numerous lowerings and elevations. The shallow water is inhabited by numerous invertebrates which provide a rich food supply for the flocks of wetland birds stopping there in the autumn and winter. The prevailing plants are macroalgae, including among others the red algae: *Furcellaria lumbricalis*, *Ceramium diaphanum*, Black siphon weed *Polysiphonia fucoides* (Kruk-Dowgiałło et al., 2011). Two bird species from the ones listed in the Appendix 1 of the EU Birds Directive i.e. The black-throated loon and red-throated loon winter in this area. During the winter there is at least 1% of the long-tailed duck and black guillemot migratory population there. Wetland birds are present in concentrations above 20,000 individuals.

Within the boundaries of the Natura 2000 site the Słupsk Bank (PLC990001), there are two bird species which are the subjects of protection in this area (Table 32):

- black guillemot;
- long-tailed duck

and two natural habitats which are the subject of protection in this area (Table 33):

- Sublittoral sandbanks (1110);
- Reefs (1170).

The long-tailed duck was the most frequently observed species of bird during the transect surveys in 2016 and was, unlike the very few black guillemots, included in the assessment of the Baltica OWF's impact on seabirds. During the surveys for the EIA Report for the BŚIII project, the average number of the long-tailed ducks wintering in the Słupsk Bank area was estimated at about 120,000, which is considerably above the values specified in the standard data form for this area or even in the BirdLife International database. According to the data from the literature (the surveys conducted between 2012–2014) 2850 specimens of the black guillemot were observed within this area during the winter (Meissner, 2014).

Table 32. Basic information about seabirds in the Słupsk Bank site (PLC990001)

Species	**Type of population in the area**	**Evaluation of the area for the population***	**Abundance (specimens)**	**Percentage of the migratory population**
Black guillemot Cepphus grylle	Wintering	C	400–1000**	At least 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	25 000– 32 000**	At least 1%
Black-throated loon *Gavia arctica*	Wintering	D	Single	Below 1%
Red-throated loon *Gavia stellata*	Wintering	D	140	Below 1%

**Class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%; area assessment for population D (species not subject of protection of the area)*

***In the SDF the size of the population was given incorrectly. The values quoted here have been taken from the BirdLife International database (http://www.birdlife.org/datazone/sitefactsheet.php?id=9562; accessed 16-06-2017) containing the data provided in the SDF*
Source: own materials based on SDF Słupsk Bank (2017)

The detailed information on the birds of the Słupsk Bank area and the Baltica OWF Area, including the presentation and discussion of the results of the water and migratory birds' surveys carried out for the purposes of the EIA Report, have been included in the Appendix 1.

The Sublittoral sandbanks habitat (1110) (Table 33) in the Słupsk Bank site (PLC990001) is one of the three localities of such habitat within the PMA. The conventional boundary of the habitat is the 20 m isobath (Interpretation Manual of European Union Habitats, 2013). In the Słupsk Bank site there is a sandy gravel sediment, with island-like rocks and postglacial boulders.

The Reefs habitat (1170) (Table 33) is located in the north-western part of the Słupsk Bank. It is a unique area in the southern part of the Baltic Sea due to the nature of the geological structure and the type of rock substrate (Kotliński, 1985; Kramarska, 1991a, 1991b). This is the only place identified thus far, within the PMA, distant from the shore, where numerous macroalgae grow on the rocky seabed (Okołotowicz, 1991; Andrulewicz et al., 2004).

Table 33. Basic information about natural habitats within the Słupsk Bank site (PLC990001)

Code of the habitat	Name of the habitat	Coverage [ha]	Representativeness[1]	Relative surface[2]	Conservation status[3]	General assessment[4]
1110	Underwater sandbanks	16010.06	A	A	A	A
1170	Reef	48030.18	A	A	A	A

[1]The classification system of representativeness assessment: A: excellent, B: good, C: considerable, D: negligible representativeness
[2]Class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%
[3]The classification system of conservation status assessment: A: excellent, B: good, C: average or impoverished status
[4]The classification system of general assessment: A: excellent, B: good, C: considerable
Source: internal data based on: SDF Słupsk Bank (2017)

Przybrzeżne wody Bałtyku site (PLB990002)

The second closest to the Baltica OWF conservation area designated for the protection of birds is the *Przybrzeżne wody Bałtyku* site (PLB990002). The boundary of the sea zone covered by the Baltica 2 Area is about 20 km away, while the boundary of the Baltica 3 Area is about 10 km away from the *Przybrzeżne wody Bałtyku* site. The *Przybrzeżne wody Bałtyku* site (PLB990002) includes the Baltic Sea coastal waters of the depth from 0 to 20 m. Its boundaries stretch for 200 km beginning at the base of the Hel Peninsula and ending in the Pomeranian Bay. The seabed is uneven, the height differences reach 3 m. Small crustaceans dominate in the benthic fauna. Two bird species from the ones listed in the Appendix 1 of the EU Birds Directive i.e. The black-throated loon and red-throated loon winter in this area. During the winter there is over 1% of the migratory species of long-tailed duck in here and at least 1% of the black guillemot and velvet scoter. Among the species included in the assessment of the Baltica OWF's impact on seabirds within the *Przybrzeżne wody Bałtyku* site (PLB990002), the wintering populations of the long-tailed duck, velvet scoter, razorbill and European herring gull are under protection. It is estimated that 90–120 thousand individuals of the long-tailed duck, 14–20 thousand individuals of velvet scoter, and 8–15 thousand individuals of European herring gull winters in this area (Meissner, 2010a). Whereas, the population of razorbills wintering in this area is estimated at 500 to 1000 individuals (SDF *Przybrzeżne wody Bałtyku*, 2017). In the *Przybrzeżne wody Bałtyku* site (PLB990002), the wintering and passing population of the common scoter and the wintering population of the black guillemot are also under protection. (Table 34)

During the transect surveys in the OWF Area, only a few specimens have been found sitting on the water along the route followed by the survey cruise. On the other hand, numerous individuals of the common scoter flew through the part of the OWF Area where the survey has been carried out. Therefore, the assessment of the Baltica OWF's impact on the common scoter has been included in the section on the migrating birds. The number of the black guillemot individuals staying in the surveyed sea area has been low and has not exceeded 1% of the birds group.

Table 34. Basic information about seabirds in the *Przybrzeżne wody Bałtyku* site (PLB990002)

Species	**Population type**	**Evaluation of the area for the population***	**Abundance (specimens)**	**Percentage of the migratory population**
Black-throated loon *Gavia arctica*	Wintering	D	200–500	Below 1%
Red-throated loon *Gavia stellata*	Wintering	D	100–500	Below 1%
European herring gull *Larus argentatus*	Wintering	C	8000–15 000	Below 1%
Common gull *Larus canus*	Wintering	D	1000	Below 1%
Black guillemot *Cepphus grylle*	Wintering	B	200–1100	At least 1%
Razorbill *Alca torda*	Wintering	C	500–1000	Below 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	90 000–120 000**	Above 1%
Velvet scoter *Melanitta fusca*	Wintering	C	14 000–20 000**	At least 1%
Common scoter *Melanitta nigra*	Wintering	C	5000–8000	Below 1%
Common scoter *Melanitta nigra*	Passing	C	3000	Below 1%

**Estimating the size of the species population and its density in relation to the national population; class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%; area assessment for population D (species not subject of protection of the area)*
***In the SDF the size of the population was given incorrectly. The values quoted here have been taken from the BirdLife International database (http://www.birdlife.org/datazone/sitefactsheet.php?id=9562; accessed 16-06-2017) containing the data provided in the SDF*
Source: internal data based on: SDF Przybrzeżne Wody Bałtyku (2017)

Ostoja Słowińska site (PLH220023)

The *Ostoja Słowińska* site (PLH220023) includes land and sea area. Its marine boundary is located about 28 km from the Baltica 2 Area and about 23 km from the Baltica 3 Area. In its maritime part, the *Ostoja Słowińska* site (PLH220023) includes a strip of coastal waters about 2 NM wide within the boundaries of the Słowiński National Park. The marine area of the *Ostoja Słowińska* site (PLH220023) is a habitat for two species of marine mammals and five species of fish and lampreys connected to the marine environment (Table 35). In the western part of this area there is a boulder area constituting a natural habitat The Reefs (1170) (Table 36).

Table 35. The basic information on species of marine mammals, fish and lampreys connected to the marine environment in the *Ostoja Słowińska* site (PLH220023)

Species	Population type	Area's assessment			
		Population[1]	Conservation status[2]	Isolation[3]	In total[4]
Grey seal (*Halichoerus grypus*)	Migrating	C	B	B	B
Porpoise *Phocoena phocoena*	Migrating	B	B	B	B
Twaite shad *Alosa fallax*	Migrating	C	B	C	C
River lamprey *Lampetra fluviatilis*	Migrating	B	B	C	B
Sabrefish *Pelecus cultratus*	Settled	C	B	C	C
Sea lamprey *Petromyzon marinus*	Migrating	C	B	C	B
Atlantic salmon *Salmo salar*	Migrating	D			

**The estimation of the size of the species population and its density in relation to the national population; class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%; area assessment for population D (species not subject of protection of the area)*

[2]The classification system of conservation status assessment: A: excellent condition; B: good condition; C: medium or degraded conservation status

[3]The classification system of the isolation assessment: A: population (almost) isolated; B: population not isolated, but occurring on the peripheries of the species range; C: population not isolated within a large area of occurrence

[4]The classification system of general assessment: A: excellent, B: good, C: significant

Source: internal data based on: SDF Ostoja Słowińska (2017)

Table 36. The basic information on natural habitats occurring within the maritime part of the *Ostoja Słowińska* site (PLH220023)

Code of the habitat	Name of the habitat	Coverage [ha]	Representativeness[1]	Relative surface[2]	Conservation status[3]	General assessment[4]
1170	Reef	402.06	B	C	A	B

[1]The classification system of representativeness assessment: A: excellent, B: good, C: considerable, D: negligible representativeness

[2]Class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%

[3]The classification system of conservation status assessment: A: excellent, B: good, C: average or impoverished status

[4]The classification system of general assessment: A: excellent, B: good, C: considerable

Source: internal data based on: SDF Ostoja Słowińska (2017)

Pobrzeże Słowińskie site (PLB220003)

A land area, including morphological forms occurring on the Gardnieńsko-Łebska Spit, with unique coastal barchans and the two largest brackish water lakes, Łebsko and Gardno, along with the adjacent meadows, peatlands, woods and forests. In the *Pobrzeże Słowińskie* site (PLB220003), which is entered on the list of the Ramsar Convention areas, there are at least 28 species of birds from the Annex 1 of the Birds Directive, mostly associated with terrestrial environments. During the migration period at least 1% of the migratory route population of the three species of waterbirds:

smew, bean goose and goosander occurs in there. The great black cormorant, greater white-fronted goose and Eurasian wigeon occur in relatively large numbers. A large population of European herring gull nests there. The subject of protection in this area are the migratory populations of the greater white-fronted goose, bean goose, common pochard, smew, goosander, and great black cormorant, as well as the breeding population of the European herring gull. Of these species, only the European herring gull has been included in the assessment of the OWF's impact on seabirds. According to the standard data form for this area, the population has 400 individuals of the European herring gulls (less than 1% of the migratory route population).

The Słowiński National Park

The Słowiński National Park is one of the two land and sea national parks in Poland. Its area is 32,744 ha. The main subject of the Park's protection is the Łeba Spit, which forms a complex of unique geomorphological forms and places where the natural processes of the sea shore remodelling take place. There are also valuable forest and non-forest communities and water ecosystems in the Park, including the two largest coastal lakes – Gardno and Łebsko – and a coastal sea area with a width of 2 NM.

3.7.3 Ecological corridors

The ecological corridor, in accordance with the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004 no. 92, item 880, as amended), is an area enabling the migration of plants, animals or fungi. The network of ecological corridors connecting the European ecological network Natura 2000 in Poland was developed in 2011 (Jędrzejewski et al., 2011). In this study, no ecological corridors have been indicated in the PMA. Nevertheless, according to the general classification of the aquatic and wetland birds migration system in Eurasia, Poland is located within two large migration corridors: the East Atlantic and the Mediterranean and Black Sea one.

The migration tactics and corridors of the seabirds in the Baltic Sea region are very poorly known. In the summer, in July and August, the passage of sea ducks (mainly the common scoter's males) from the Gulf of Finland to the moulting areas located in the Danish straits is observed. They are accompanied by the common eiders *Somateria mollissima* and velvet scoters, however, the number of both species is much lower than that of the common scoter. These birds stop in our waters only exceptionally. The period of seabirds autumn migration is very extended in time. A number of waterbird species have been found in the PMA since August. Some of them only pass this way and do not stay for the winter (e.g. the terns of the Sterna and Chlidonias genera), others are observed throughout the whole period of migration and wintering (sea ducks, razorbills, loons, grebes). In the spring, large flocks of sea ducks (long-tailed ducks, velvet scoters and common scoters) which stop in the Polish zone of the Baltic Sea while travelling towards the breeding grounds are observed (Sikora et al. 2011).

3.7.4 Biological diversity

As a result of the surveys conducted in the OWF Area no phytobenthos communities have been recorded. Individual specimens of macroalgae have been represented by 6 taxa: brown algae *Sphacelaria* sp. and *Pylaiella littoralis* as well as red algae *Rhodomela confervoides*, *Coccotylus truncatus*, *Aglaothamnion tenuissimum* and *Furcellaria lumbricalis* (formerly *F. fastigiata*).

On the sandy seabed in the OWF Area, the occurrence of 33 zoobenthos taxa representing the following classes: hydrozoans *Hydrozoa*, priapulid worms *Priapulida*, polychaetes *Polychaeta*, oligochaetes *Oligochaeta*, malacostracans *Malacostraca*, snails and slugs *Gastropoda*, bivalves *Bivalvia*, and gymnolaemates *Gymnolaemata* have been recorded. Whereas, on the hard bottom (surface of stones) 15 taxa belonging to the classes of: hydrozoans *Hydrozoa*, *Rhabditophora*, polychaetes *Polychaeta*, oligochaetes Oligochaeta, *Hexanauplia*, malacostracans Malacostraca, snails and slugs *Gastropoda*, bivalves Bivalvia, and gymnolaemates Gymnolaemata have been recorded.

As part of the survey on the ichthyofauna in the OWF Area, 19 taxa of fish such as: cod, flounder, plaice, turbot, herring, sprat, great sand eel, lesser sand eel, shorthorn sculpin, lumpsucker, viviparous eelpout, mackerel, pogge, three-spined stickleback, European anchovy, gobies, fourbeard rockling, rock gunnel and common seasnail have been found.

In the OWF Area, 12 species of seabirds (long-tailed duck, velvet scoter, common scoter, razorbill, common murre, black guillemot, black-throated loon, red-throated loon, European herring gull, lesser black-backed gull, little gull and great black-backed gull) and two species of waterbirds rarely found at sea away from the coast (black-headed gull and common gull) have been found.

Of the four marine mammals found in the Baltic Sea, in the OWF Area, the presence of two, i.e. porpoise and grey seal, has been registered as a result of environmental surveys.

Due to the research effort, the surveys conducted in the Baltica OWF Area can only be compared to the inventory surveys for the BŚII and BŚIII OWFs. The comparison of other surveys results with a smaller range of the surveyed groups and with smaller research effort does not allow for the objective discernment of differences and similarities.

Out of benthic organisms, in the Baltica OWF Area, 33 macrozobenthos taxa have been confirmed on the sandy bottom – 32 and 27 for BŚII and BŚIII respectively and 6 phytobenthos taxa – 8 and 4 taxa for BŚII and BŚIII respectively. In other groups of organisms the following have been found – for fish 19, 15 and 15 taxa (for the Baltica OWF, BŚII and BŚIII respectively), for seabirds 12, 18 and 15 taxa and for marine mammals 2, 3 and 3 taxa respectively. The differences between areas are little and may result from the differences in environmental conditions (e.g. different depths, size of areas, distance from the Słupsk Bank). The indicated values of the number of taxa do not entitle to the conclusion that the compared areas differ in terms of biodiversity.

The taxonomic structure of individual groups of organisms surveyed for the purposes of the environmental surveys for the needs of the EIA Report is typical for the surveyed area, as indicated by the comparison with other surveyed areas with similar environmental conditions.

3.7.5 Environmental valorisation of the sea area

The conducting of the environmental valorisation is based on the assumption that the reflection of the proper status of the environment is a typical, consistent with natural ecological conditions, species composition of the organisms inhabiting it, including stenotopic species, which are sensitive to changes. The assessment of the natural value is carried out on the basis of the analysis of the occurrence of organisms from one or several systematic groups. The most common organisms used to assess the natural value of the selected area are vascular plants and/or birds.

The results of the environmental surveys carried out for the purposes of the EIA Report indicate that the OWF Area due to the species occurrence is in most cases homogeneous. In these cases, it is impossible to indicate parts of areas with higher natural values than the others.

The environmental components that can be used to assess the environmental value of the OWF Area are seabirds during wintering. In the south-western part of the OWF Area, the presence of 12 species have been confirmed (long-tailed duck, velvet scoter, common scoter, razorbill, common murre, black guillemot, black-throated loon, red-throated loon, European herring gull, lesser black-backed gull, little gull, great black-backed gull). Their numerous groupings were recorded in the winter and spring, near the border with the Natura 2000 site, the Słupsk Bank (PLC990001). The area within these borders is characterised by low depth, and the Słupsk Bank itself is one of the most important wintering grounds for the seabirds in the Baltic Sea.

3.8 Cultural amenities, monuments and archaeological objects and sites

There are no elements of the underwater cultural heritage in the Baltica OWF Area.

At a distance of about 10 km east of the Baltica OWF, there is a wreck of the Wilhelm Gustloff which has a status of a war grave. Pursuant to the Regulation No. 9 of the Director of the Maritime Office in Gdynia of 23 May 2006 on the prohibition of diving on shipwrecks – war graves (Official Journal of Pomeranian Voivodeship of 2002, No. 62, item 127) to protect its property against plunder, as well as protect the marine environment, diving within a 500 m radius from the position of the ship is prohibited.

During the geophysical surveys conducted in 2016, 3 unknown wrecks were found in the Baltica OWF Area, two of which were reported as potential elements of the underwater cultural heritage to the Provincial Monument Conservator in Gdańsk. Until the submission of this EIA Report, the conservation services have not decided whether the findings will be subject to special protection. The Applicant assumes that in the case that these wrecks will be provided with special protection in places where they are located and in the direct protection zones, the work related to the construction and operation of the OWF will not be carried out.

3.9 Use and development of the area and material goods

The Baltica OWF Area is characterised by small extent of exploitation by human activity (Figure 35).

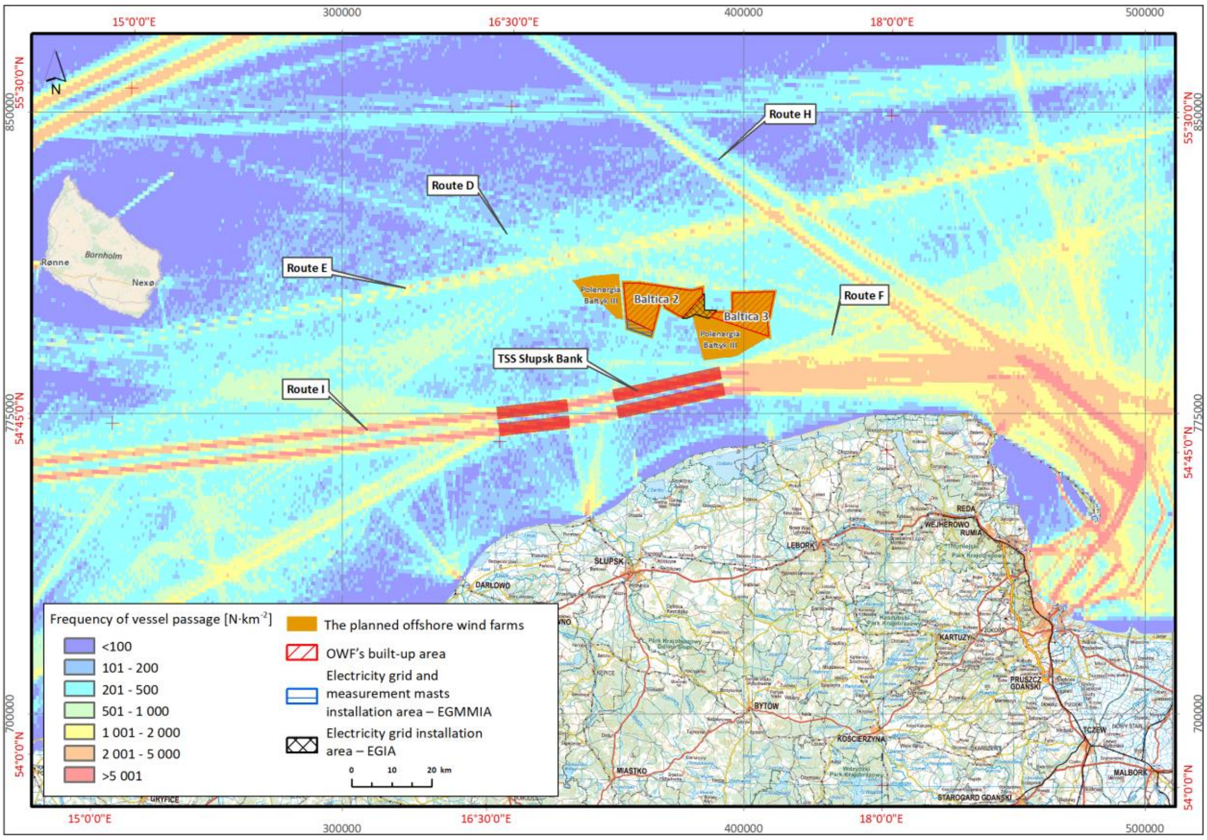


Figure 35. Main shipping routes in the vicinity of the OWF Area

Red – sections of routes, change of which must be internationally agreed and approved by the IMO
Source: internal materials based on AIS data

Through the Baltica OWF Area, there is currently a regular shipping route connecting the ports of the Gdańsk Bay with the Bornholm Strait, used primarily by tankers and merchant vessels (bulk carriers) (Figure 35). In 2013, 398 ships used it (merchant vessels 53%, tankers 17.5% and the remaining 22%) (Zaucha & Matczak, 2015), while in 2015–2016, 557 vessels (merchant 69%, tankers 24% and other 7%). This route has been for many years a component of the planned by the Polish maritime administration, the deep-water D route of strategic importance (for large tankers and LNG carriers). Due to the location decisions issued for the construction of offshore wind farms (PSZW), the Maritime Office in Gdynia, as part of the work on the project of the Spatial Development Plan for Polish Marine Areas in the scale of 1 : 200 000, has made an attempt to modify the course of this route. The route would come out from the Gdańsk Bay and by-pass the location of the planned wind farms from the east. The proposed change in the course of the route will slightly extend it, which will result to a certain extent in the negative phenomena proportional to the change in the length of the route, i.e.: the increased costs and length of sailing time, the increased emissions (CO_2, CO, SO_2, NO_x), the increased probability of failure and accidents (assuming that the probability is proportional to the distance travelled).

To the south of the Baltica OWF Area there is the second most intensively used customary sailing route leading from the Danish straits to the Polish and Russian ports of the Southern Baltic. In 2013, 6686 vessels used it (16.7% tankers, 44.4% merchant, 1% passenger, special 6.7% and others 30.6%) (Zaucha & Matczak, 2015). Polish AIS stations (data from 2015–2016) registered that 5641 vessels have sailed through it. These are mainly merchant vessels (78%), tankers (15%), passenger ships

(1.5%) and others (5.5%). This route has a traffic separation system made from two sections: Łeba – Rowy and Ustka – Jarosławiec, known as TSS Słupsk Bank.

To the north of the Baltica OWF Area there is a customary shipping route connecting Klaipeda with the ports of the Southern Baltic – mainly in Świnoujście, Sassnitz and Mukran. It is used mostly by cargo-railway ferries (Mukran – Klaipeda) and cargo ships. In 2013, 893 vessels used it (1.5% tankers, 38.5% merchant vessels, 23% fast ferries and 32% the remaining) (Zaucha and Matczak, 2015). Polish AIS stations (data from 2015–2016) registered that 761 vessels have sailed through it. These are mainly merchant vessels (46%), tankers (4%), ferries (45%) and others (5%).

The area is used to a small extent by recreational vessels.

There are no structures permanently attached to the seabed in the Baltica OWF Area. There are also no licenses for prospecting, exploration and production of hydrocarbons from deposits. The prospecting and reconnaissance licenses existing in this area a few years ago expired in 2016 and until the date of the submission of this EIA Report have not been renewed. Also, the applications submitted to the PMASMP do not apply to the Baltica OWF Area.

In the vicinity of the Baltica OWF Area (in the 1 NM buffer zone), there is a Navy training area of P-19 reference, which is not a closed zone in the light of the Ordinance of the Minister of National Defense of 3 April 2014 regarding the zones closed to shipping and fishing in the maritime areas of the Republic of Poland (Journal of Laws of 2014, item 482). The training area is intended for submarine exercises.

As part of the work on this EIA Report, the surveys on fishing activity has been carried out, including the size and value of catches, the size of fishing effort in the Baltica OWF Area and the determination of the impact of the extension of the sailing routes of fishing vessels to fisheries.

The Baltica OWF (together with the buffer zone) is located in the area of five fishing squares: L8, M8, N8, M7, N7 (Figure 36, Table 37).

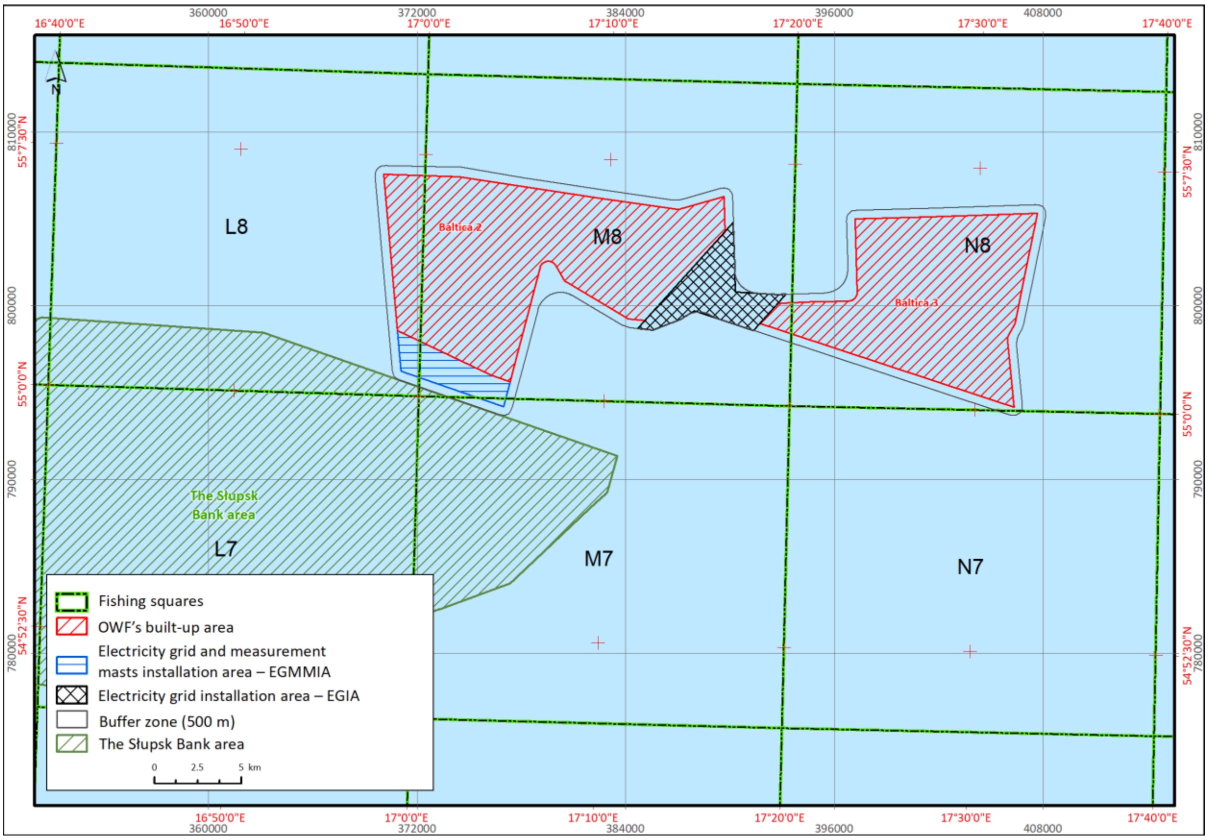


Figure 36. The location of the Baltica OWF Area with a buffer zone (500 m) on the background of fishing squares

Source: internal data

The analysis of the volume and value of catches and fishing effort (days and number of fishing vessels) has been prepared on the basis of the full data from the catch reports of fishing vessels taking into account fish species, fishing month and the type of vessel (vessels up to 12 m and over 12 m)[1]. The analysis includes a review of the catch data for the years 2012–2016. The value of catches has been estimated based on the average price of the first sale of particular fish species in a given year and the volume of catches. Since the most detailed information on fishing catches is available for the fishing squares (an area of about 400 km^2), which do not overlap with the Baltica OWF Area, to determine, with the greatest accuracy, the impact of the investment on fisheries in the area of the Baltica OWF itself (including the 500 m buffer zone, i.e. the maximum area that the maritime administration can exclude from navigation around the structures and installations), the relative share of the area occupied by the Baltica OWF to the total area of the fishing square has been taken into account. It is a simplification in which the possible variation in the size of catches within a given square is omitted (e.g. due to the depth or type of the bottom), but there is no other possibility of a more accurate reference to the place of the fish caught.

[1] *The criterion of 12 m has been applied in order to distinguish vessels that can be classified as the vessels of coastal fisheries (small scale fisheries <12 m), in accordance with the provisions of the Council Regulation 1198/2006.*

Table 37. The size of the surface occupied by the Baltica OWF Area, including the buffer zone

Fishing square	The area of the fishing square taken by the Baltica OWF [%]
M7	0.5
N7	0.1
L8	6.9
M8	42.9
N8	30.6
In total	16.2

Source: internal data

The size and value of fish catches

The total volume of fish catches in the area of the five analysed squares in 2016 amounted to approximately 700 Mg, which constituted 0.5% of the total size of Polish Baltic catches by the Polish Baltic fisheries this year. The value of catches amounted to approximately 2.7 million PLN, which accounted for 1.2% of the total value of landings from Polish fishing in the Baltic Sea. The average long-term size and value of the share of catches from the area of the five squares in the general Baltic catches in the years 2012–2016 was 0.6% and 1.4%, respectively.

The significance of the Baltica OWF Area for fisheries varies for vessels registered in particular fishing ports. Naturally, the highest share of the size and value of catches realized in the area of the five analysed fishing squares in relation to the total catches in the Baltic Sea have the ships registered in the ports closest to the analysed area. These include ships registered in Ustka, Łeba and Darłowo. In the years 2012–2016, the average share of fish caught in the area of the squares located in the area of the planned project in relation to the total catches of vessels registered in the three ports mentioned was 3.1%, 6.5% and 5.1% respectively in terms of quantity and 7.0%, 7.3% and 5.9% in terms of value (Table 38, Table 39).

Table 38. The average volume of catches in the fishing squares L8, M8, N8, M7 and N7 in 2012–2016 in relation to the general Polish catches in the Baltic Sea, divided into registration ports

Harbour	The catch in the fishing squares: L8, M8, N8, M7, N7 [Mg]	Baltica OWF Area [Mg]	The Baltic Sea in total [Mg]	The catch in the fishing squares [%]	The Baltica OWF Area [%]
Ustka	470	95	14992	3.1	0.6
Łeba	129	14	1967	6.5	0.7
Darłowo	60	8	1170	5.1	0.7
Władysławowo	62	20	36833	0.2	0.1
Świnoujście	15	5	3729	0.4	0.1
Kołobrzeg	25	6	36948	0.1	0.0
Jarosławiec	3	0	214	1.2	0.2
Dziwnów	53	1	5389	1.0	0.0
Others	3	0	28369	0.0	0.0
In total	819	149	129611	0.6	0.1

Source: internal data based on the FMC data

Table 39. The average value of catches in the fishing squares L8, M8, N8, M7 and N7 in 2012–2016 in relation to the general Polish catches in the Baltic Sea, divided into registration ports

Harbour	The catch in the fishing squares: L8, M8, N8, M7, N7 [thousand PLN]	The Baltica OWF Area [thousand PLN]	The Baltic Sea in total [thousand PLN]	The catch in the fishing squares [%]	The Baltica OWF Area [%]
Ustka	1923	397	27368	7.0	1.5
Łeba	427	48	5817	7.3	0.8
Darłowo	276	38	4670	5.9	0.8
Władysławowo	99	32	51434	0.2	0.1
Świnoujście	53	17	6994	0.8	0.2
Kołobrzeg	63	15	54483	0.1	0.0
Jarosławiec	13	2	933	1.3	0.3
Dziwnów	139	2	8174	1.7	0.0
Others	12	1	59823	0.0	0.0
In total	3003	552	219695	1.4	0.3

Source: internal data based on the FMC data

The volume and value of the fish catches in the individual fishing squares, in which the Baltica OWF is planned is diversified. As can be seen in the figure (Figure 37), the squares M8 and L8, the two located most northwest of the five analysed squares, are definitely of the greatest importance for fishing. This is due to the higher cod catches in the deeper waters compared to the other squares.

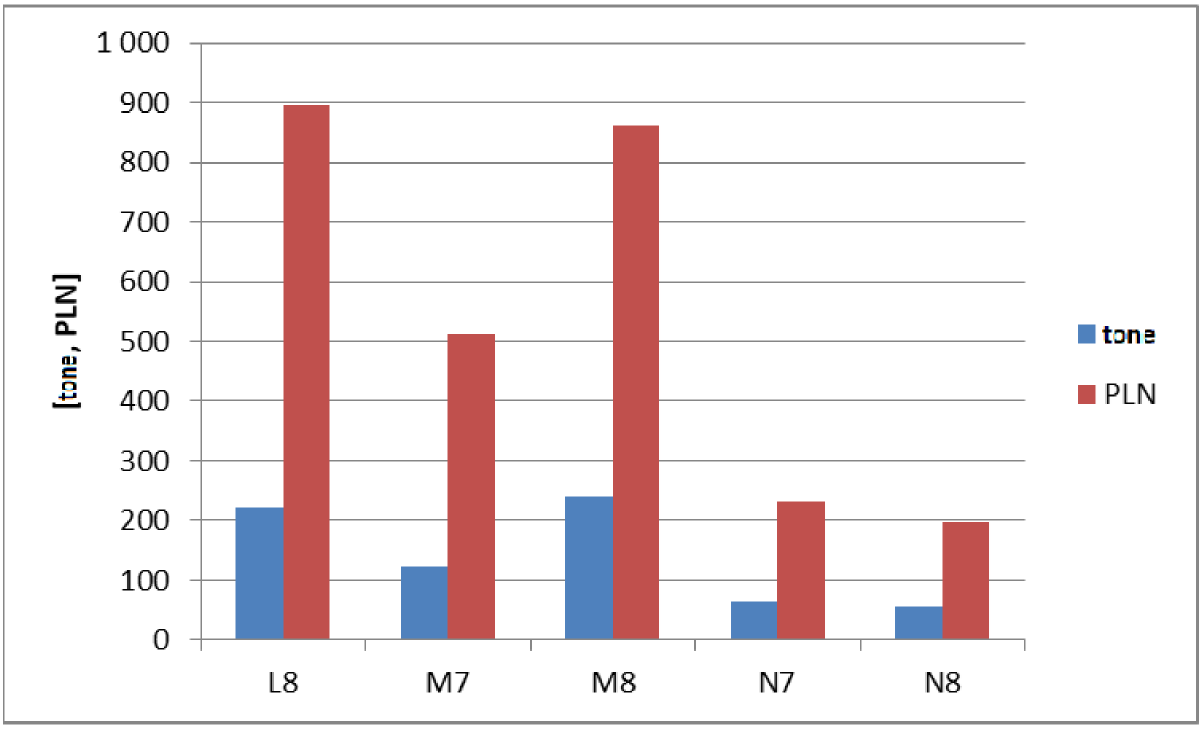


Figure 37. The volume and value of the catches in the fishing squares L8, M8, N8, M7 and N7 in 2016

Source: internal data based on the FMC data

The basic fish species caught in the area of the six analysed squares in 2012–2016 were cod and flounder (Table 40), corresponding to 59% and 22% of the total catches size and 78% and 9% of the caught fish value (Figure 38). The remaining part fell to the catch of herring, 11% and 5% share in the size and value of catches respectively.

Table 40. The size and value of the catches in the fishing squares: L8, M8, N8, M7 and N7 in 2012–2016, according to the most important species

Species	2012		2013		2014		2015		2016	
	Mg	thousand PLN	Mg	thousand PLN	Mg	thousand PLN	Mg	thousand PLN	Mg	thousand PLN
Sprat	99	101	0	0	92	91	20	18	84	79
Herring	137	256	91	142	61	94	74	95	87	121
Cod	772	3896	363	1782	449	2098	405	1829	434	2131
Flounder	238	461	205	328	231	318	113	158	86	115
Sea trout/salmon	10	223	5	123	0	8	1	31	5	138
Other	6	72	11	126	5	53	2	20	8	112
In total	1262	5009	675	2501	838	2662	615	2151	704	2695

Source: internal data based on the FMC data

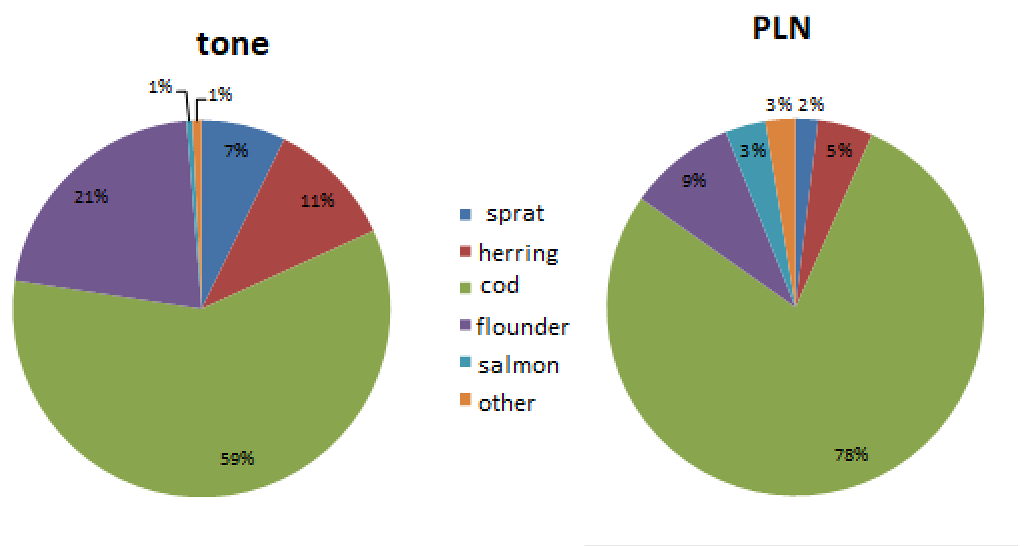


Figure 38. Species structure of the catches in the area of the fishing squares: L8, M8, N8, M7 and N7 in 2012–2016

Source: internal data based on the FMC data

During the analysed period (2012–2016) the vast majority of the sizes and values of catches in the area of the five analysed squares was achieved by vessels longer than 12 m in total length (Table 41). The share in the size and value of catches of this vessels group was 65% and 62% respectively.

Table 41. The size and value of the catches in the fishing squares: L8, M8, N8, M7 and N7 in 2012–2016, divided by the vessel type due to their length

Values	Length of vessels	2012	2013	2014	2015	2016
Tonnes	Up to 12 m	385	294	285	201	254

Values	Length of vessels	2012	2013	2014	2015	2016
	12 m and more	878	380	553	413	450
Thousand PLN	Up to 12 m	1599	1145	966	783	1165
	12 m and more	3409	1355	1696	1368	1530
In total: tonnes		1262	675	838	615	704
In total: thousand PLN		5009	2501	2662	2151	2695

Source: internal data based on the FMC data

The estimate of the value of the catches in the individual fishing squares and the estimate of the value of the catches in the Baltica OWF Area have been presented in the table (Table 42). The value of the catches in the Baltica OWF Area has been calculated proportionally to the size of the area to be occupied by the Baltica OWF (including the 500 m buffer zone) in the given fishing square. In 2016, the estimated value of fish caught in the Baltica OWF Area was about 500 thousand PLN. The highest value of catches was achieved in 2012 (1.2 million PLN), in subsequent years it decreased by as much as 1 million PLN, which was mainly the result of a sharp decline in cod catches, especially in the coastal zone (due to the poor individual condition of these fish).

Table 42. The value of the catches in the fishing squares: L8, M8, N8, M7 and N7 as well as the estimated value of the catches in the Baltica OWF Area (in thousands of PLN)

Fishing square	The area of the fishing square taken by the Baltica OWF [%]	Squares					The Baltica OWF				
		2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
M7	0.5	541	465	425	309	511	3	3	2	2	3
N7	0.1	407	405	358	355	231	0	0	0	0	0
L8	7.0	1148	816	1135	938	896	80	57	79	66	63
M8	42.9	1736	744	587	336	861	745	319	252	144	370
N8	30.6	1176	71	157	212	197	360	22	48	65	60
In total		5009	2501	2662	2151	2695	1189	401	382	277	496

Source: internal data based on the FMC data

The analysis of the monthly variability of fish catches in the Baltica OWF Area indicates the concentration of fishing fleet activity in two seasons: spring-summer (March–June) and autumn (September–November) (Figure 39). The total size of catches in these months in 2016 was 600 Mg, which accounted for 84% of the total catches in the area of the five squares. In both fishing seasons the vast majority of catches was provided by cod, accounting for 46% of the size of catches in the March–June period in 2012–2016 and 38% in the September–November period.

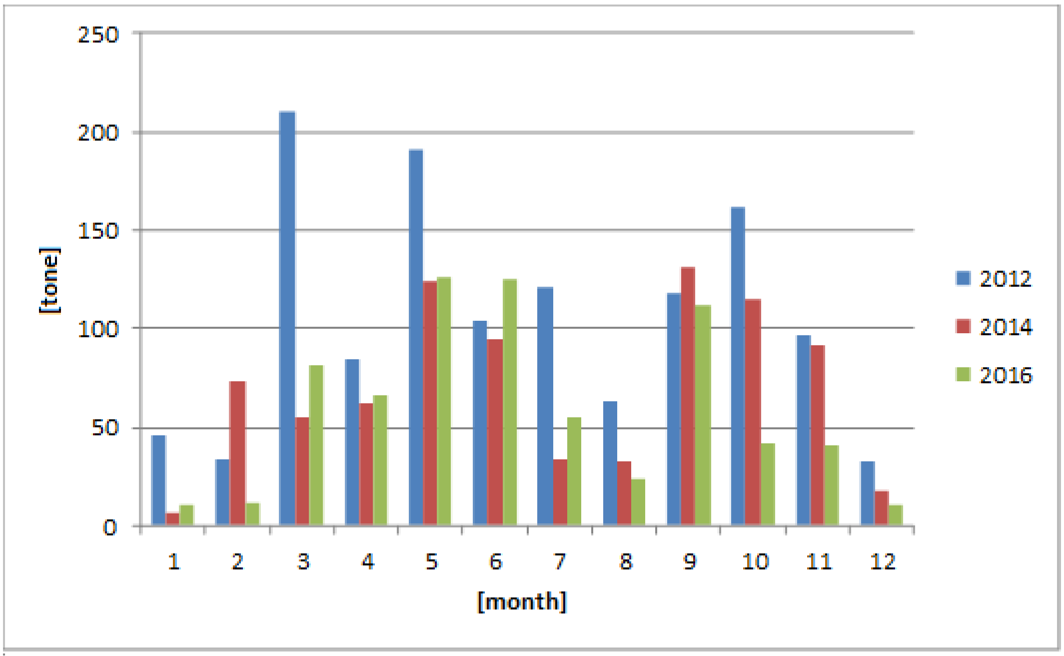


Figure 39. Monthly size of the fish catches in the area of the squares L8, M8, N8, M7 and N7 in 2012, 2014 and 2016

Source: internal data based on the FMC data

During fishing in the Baltica OWF Area, in 2012–2016, the most often used were fixed tools (gillnets and longlines), followed by bottom trawls and pelagic trawls. The fixed tools (mainly cod gillnets) had about 63% share in total catches from the area of the 5 analysed squares. While, the share of the bottom trawling was 19%. Fishing with fixed tools dominated in March–June and September–November periods (Figure 40). Fishing using bottom trawls was concentrated in the September–November period, that is after the end of the summer protective season for cod.

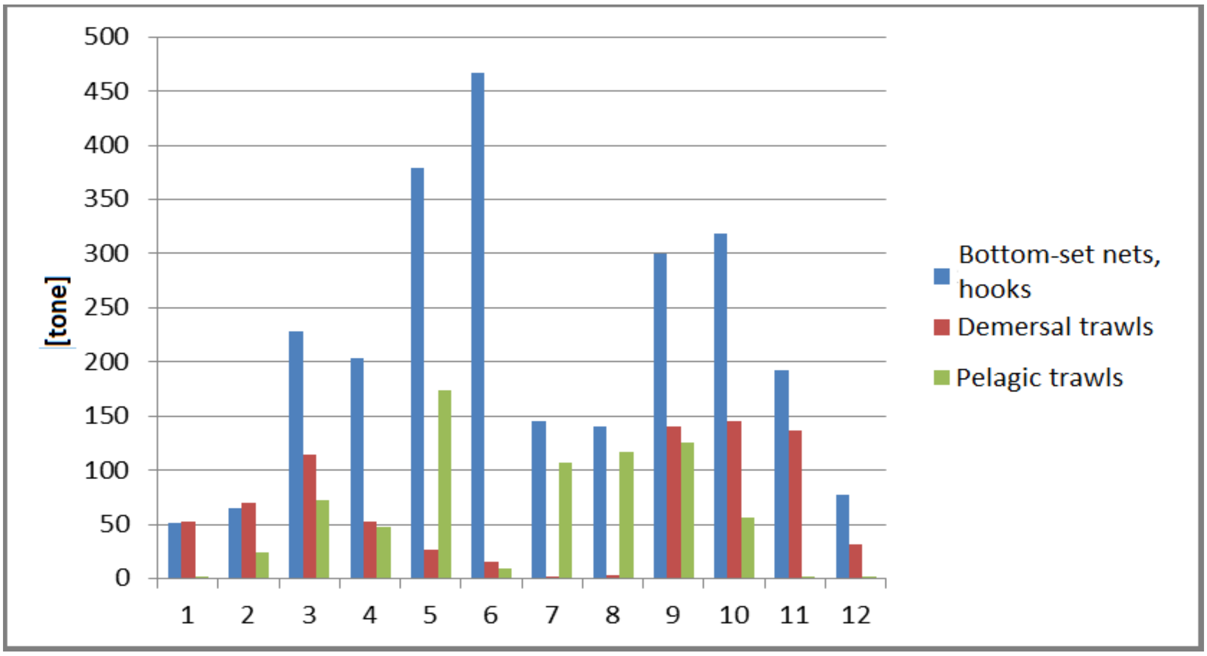


Figure 40. The size of the individual tool catches in the area of the fishing squares: L8, M8, N8, M7, N7 in 2012–2016

Source: internal data based on the FMC data

The seasonality of fishing was mainly influenced by the activity of larger fishing vessels, with a total length exceeding 12 m, which is particularly evident in the autumn season (Figure 41). The catches of vessels up to 12 m in total length showed a smaller monthly variation, although with an apparent increase in catch volumes in March–June period.

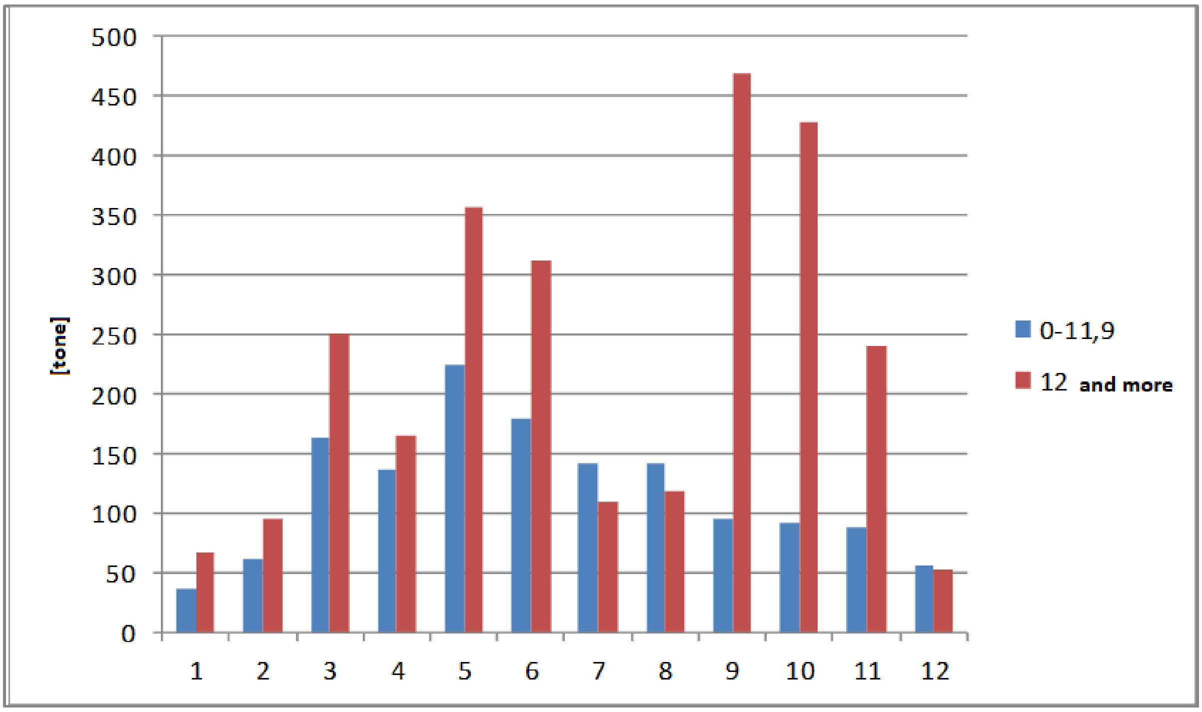


Figure 41. The size of the catches in the area of the fishing squares: L8, M8, N8, M7, N7 in 2012–2016, divided by the vessel type due to their length

Source: internal data based on the FMC data

The size of the fishing effort

In the years 2012–2016, in the area of the fishing squares L8, M8, N8, M7 and N7 fishing was carried out by from 68 to 98 fishing vessels (Table 43). The relative share of the vessels below and above 12 m long in the analysed period was around 66% and 34% respectively. In 2016, the number of fishing vessels operating in the analysed area was notably reduced compared to the previous year (from 79 to 68). This concerned both small fishing vessels and the vessels over 12 m in length. The reason for this could be the reduced fishing capacity of cod, especially in shallow waters. The share of the number of vessels operating in the analysed area in relation to the total number of active vessels in 2016 was 8% and was decreased in comparison to 2012 by 4 percentage points.

Table 43. The number of fishing vessels engaged in fishing in the fishing squares: L8, M8, N8, M7, N7 in 2012–2016

Year	The number of vessels			Total share in the Baltic Sea [%]		
	Up to 12 m	12 m and more	In total	Up to 12 m	12 m and more	In total
2012	31	67	98	5	35	13
2013	28	55	83	5	29	11
2014	31	50	81	5	26	10
2015	26	53	79	4	29	10
2016	24	44	68	4	24	8

Source: internal data based on the FMC data

The total fishing effort (measured by the number of fishing days) in the analysed period in the area of the 5 squares was decreased by 39% from 1424 days in 2012 to 866 days in 2016 (Table 44). The decrease in effort may be related to the previously mentioned deteriorating condition of cod stocks. The reduction in the number of fishing days was especially evident for larger vessels (over 12 m) and amounted to 51%. The boats up to 12 m decreased the engagement in the area of the five analysed squares from 564 to 445 fishing days (a decrease by 21%). In contrast to the size of catches and the size of the effort expressed by the number of vessels, the average share of vessels over 12 m in fishing days in the period 2012–2016 was similar to the share of boats below 12 m – the ratio of 48% to 52% of the reported vessels involvement, respectively.

Table 44. Fishing effort (fishing days) of the Polish fishing fleet in the fishing squares L8, M8, N8, M7 and N7 in 2012–2016

Vessels' length	Fishing tool	2012	2013	2014	2015	2016
Up to 12 m	Fixed nets, longlines	544	608	532	402	445
	Demersal trawls	20		7	18	
Total		564	608	539	420	445
12 m and more	Fixed nets, longlines	647	352	459	291	333
	Demersal trawls	187	116	117	158	74
	Pelagic trawls	23	13	15	11	14
Total		857	481	591	460	421
Altogether		1421	1089	1130	880	866

Source: internal data based on the FMC data

The relative share of the effort of vessels fishing in the area of the five fishing squares in the total effort of Polish fishing vessels operating in the Baltic Sea in 2016 amounted to 1.2% and was lower than the share registered in 2012 (2.2%).

The monthly distribution of the fishing effort (fishing days) employed in the fishing squares: L8, M8, N8, M7and N7 in 2012–2016 was similar to the previously presented seasonality expressed by the size of catches (Figure 42).

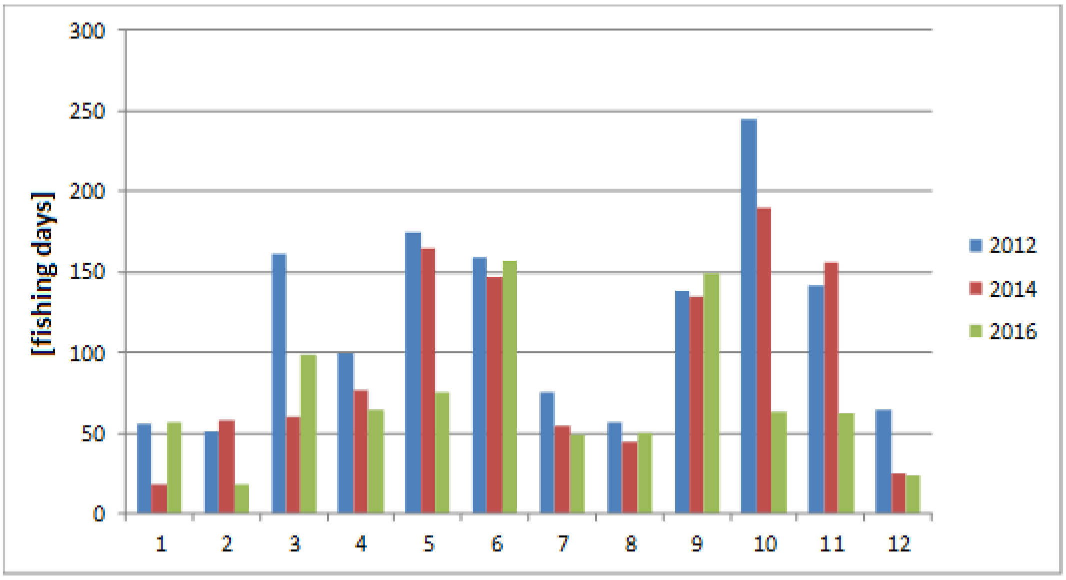


Figure 42. Monthly seasonality of the fishing effort employed in the fishing squares: L8, M8, N8, M7 and N7 in 2012, 2014 and 2016

Source: internal data based on the FMC data

3.10 Landscape, including the cultural landscape

The location of the Baltica OWF covers an area located at a distance of about 26 to about 46 km from the shore. The landscape varies depending on the weather conditions, in calm days the sea is calm and monotonous, while with the increased wind strength, reduced insolation and increased cloudiness and humidity, including precipitation, the sea state, wave motion and air transparency also change. Water vapour hangs above the water, which further reduces visibility, thus making it difficult for the observer to determine the point of contact of the sea and the sky on the horizon.

The land is practically invisible from the Baltica OWF Area.

In the Baltica OWF Area, people stay sporadically and briefly. Through the Baltica OWF (Figure 35) and in its area in the several to several dozen kilometres distance there are important customary and planned shipping routes and other frequented routes used by ships such as: oil carriers, container ships, cargo and railway ferries and passenger ferries, passenger and freight ships, freighters, tankers and others. On the northern side of the Baltica OWF Area, the proposed new north-east shipping route corridor is supposed to run, but it has not yet been established.

The Baltica OWF is located in parts of five fishing squares and the fishing vessels movement takes place in there (Figure 36). Other forms of land development located the closest to the Baltica OWF are the areas of concessions for exploration and prospection of crude oil and natural gas deposits, and the nearest mining platform Baltic-Beta which is placed at a distance of over 55 km, i.e. outside the scope of visibility from the Baltica OWF (Figure 43).

It was estimated that in the zone of up to 50 km from the OWF Area, in the period between 2007–2013, in a day there were, on average, between 162 and 203 vessels, which stayed in the visibility zone of the OWF from the ship (up to 50 km) for up to several hours.

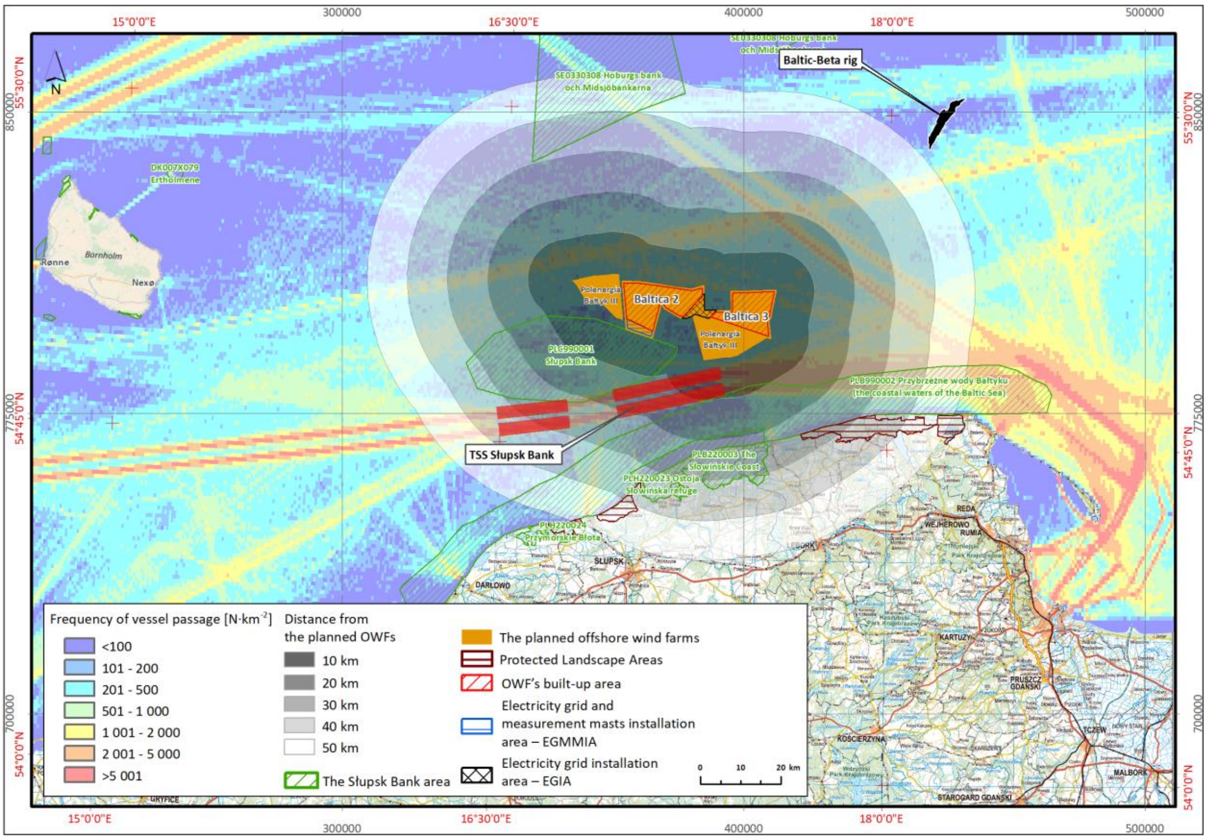


Figure 43. The development and use of the area in the vicinity of the OWF Area

Red – sections of routes, change of which must be internationally agreed and approved by the IMO
Source: internal data

The marine cultural landscape includes the anthropogenic development and use of both the sea and the seabed, which is available only to divers and the operators of underwater vehicles. The Baltic Sea landscape is not subject to classification, and only the BALANCE project "Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning" (2005–2007) has developed the concept of submarine landscapes. There are no fixed elements of development in the Baltica OWF Area and its vicinity. There is movement of vessels, including fishing vessels.

Within the area of the OWF's potential impact on the landscape zone there is a land area in the stretch from Wicko in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the Baltica OWF can be seen from the beaches in this section. According to the physico-geographical division of Poland (Kondracki, 2002) this is the Słowińskie Coast, constituted of a narrow strip of land along the shore of the Baltic Sea. This area is characterised by a post-glacial formation. There are dune embankments here, ranging from a few to several dozen meters above sea level, overgrown with forest, obscuring the view of the sea as well as swamps and wetlands, and coastal lakes with sandbars from the sea. The landscape is enriched by narrow valleys of watercourses entering the sea. There are various protected areas, including landscape protection of the areas located within them. These are: The Protected Landscape Area "Coastal Belt west of Ustka", the nature and landscape complex "Ostoja Łabędzi" in Ustka, the Protected Landscape Area "Coastal Belt east of Ustka", the Słowiński National Park, the "Sarbska Spit" Landscape Reserve, The Coastal Protected Landscape Area, the Polish Coastal Landscape Park. At the discussed section, the OWF will potentially be visible from the town and from the higher placed observation points; these are: Ustka, Rowy, Czołpino lighthouse, dunes in the Słowiński National Park, Łeba, Stilo lighthouse and Jastrzębia Góra.

3.11 Population and living conditions of people

The population of the coastal districts in the Pomeranian Voivodship, in the immediate vicinity of the OWF, is characterised by a low birth-rate and a high positive migration balance. In most of these municipalities: Ustka (town and municipality), Smołdzino, Łeba, Wicko and Krokowa, there are and are planned the complexes of land wind power stations, because of, among others, very favourable wind conditions. Coastal areas are characterised by multiple tourist and recreational values, including those related to the use of the sea. They are the basis of existence of a significant number of residents. This applies to, among others, fishing, maritime tourism, navigation, sports and other human activities related to the immediate proximity of the sea.

The Baltica OWF Area was subject to the prospection and periodic exploitation of aggregate. The exploration and prospection of subsea hydrocarbon deposits have also been conducted in these areas.

Southwest of the Baltica OWF at a distance of about 16 NM there are zones periodically excluded from shipping and fishing due to military exercises.

Theoretically designated centre of the Baltica OWF is located near the border between the Baltica 2 Area and the Baltica 3 Area, at the distance to the nearest ports:

- Łeba – 37.6 km;
- Ustka – 58 km;
- Władysławowo – 86.5 km;
- Darłowo – 89 km.

Due to the size of the transportation vessels and vessels used for the construction of the OWF, the facilities for the construction and decommissioning of the OWF will be most probably in the ports of Gdańsk and Gdynia located 145 km away from the OWF.

The OWF Area is located partly in the area of important, commonly used and planned shipping routes and fishery routes. Their significance for the Baltic Sea shipping is proven by the number of nearly 2 thousand vessels that in 2016 used the Baltica OWF Area.

The Baltica OWF Area is located in parts of the fishing squares: L8, M8, N8, M7 and N7.

In conclusion, it should be noted that the Baltica OWF Area is relatively unimportant for the commercial and recreational navigation as well as fishing.

In the Baltica OWF Area, there are no threats of electromagnetic radiation accompanying submarine cables, substations, radio communication devices and radiolocation devices related to the functioning of the OWF.

4 Modelling for the purposes of the investment’s impact assessment

Three sets of numerical model tests have been performed for the purposes of the environmental impact assessment of the investment. Their aims were:

- to obtain information on the range and concentration of suspended solids as a result of installation and construction works (Appendix 3);
- to obtain information on the range and intensity of underwater noise generated by installation and construction works (Appendix 2);
- to obtain information on the potential number of collisions of flying marine birds with the offshore wind power stations (Appendix 4).

The following subsections describe shortly the method of modelling the suspended solids and underwater noise dispersion, collisions with offshore wind power stations and the conclusions drawn from the model tests. The technical reports on the model tests are included in the appendices to the EIA Report.

4.1 Suspended solids dispersion in the OWF Area

The model tests of suspended solids dispersion in the OWF Area are concerned with spreading of suspended solids in the water depth, its deposition on the seabed, and spatial distribution of its maximal concentration in the water.

The report on suspended solids dispersion modelling in the OWF Area (Appendix 3) presents different variants of suspended solids spread, concentration and sedimentation during works preparing the seabed for installation of foundations for the offshore wind power stations (in this case, gravity based structures were selected for the modelling purposes as they require the most intensive works associated with transportation of sediments) and burying of electricity grid.

A numeric model was constructed to represent suspended matter transportation in a dynamic marine environment when carrying out subsea and dredging works at seabed in the Baltica OWF Area.

The created model was used to analyse maximum distances reached by suspended matter of specific concentrations travelling in water (created during long-term works at the seabed), as well as thickness and range of deposition of this suspended matter on the seabed.

Variant calculations were carried out, with different data regarding the type of soil where seabed works were carried out, as well as the size of the base of the settled support structure and the depth at which they were carried out. The variant calculations have been performed for different depths (depth from 23 to 30 m, depth from 30 to 40 m, and depth from 45 to 52 m), different seabed types (cohesive and non-cohesive soils) and two sizes of installed foundations (the Applicant’s variant allowing for foundation base diameter equal 40 m and the rational alternative variant with the foundation base diameter of 35 m).

There were force conditions assumed and applied in the model, in a form of winds blowing over the entire surveyed sea area as well sea currents which are natural factors that force the movement of water and at the same time the travel of suspended matter in the sea deep.

The results of calculations unambiguously indicate that the works carried out on cohesive soil seabed cause greater impact of suspended matter on marine environment than works on non-cohesive soils (in surface layers of the seabed areas in question, there is an insignificant prevalence of cohesive soils). Concentrations of suspended matter when carrying out works related with settlement of foundations reach value higher than concentrations present when laying energy cables. Therefore, higher concentration values have been taken into consideration in analyses of the planned investment’s impact on the environment because the above-mentioned actions (works) take place in the same areas, but at a different time. When determining thickness of newly created sediments, the effect of both types of actions is added up.

The results of the carried out simulations lead to the following conclusions:

- the greatest suspended matter impact ranges are present at moderate winds, with determined direction;
- the highest concentration of suspended matter is generated at lowest current speeds (around several $cm \cdot s^{-1}$) and circulatory character of small speed currents;
- higher suspended matter concentrations (between more than twenty up to several tens of $mg \cdot l^{-1}$) have a local range as compared to the place of dredging works;
- the greatest thickness of newly created sediments in the least favourable conditions (current arrangements, work in cohesive soils in shallower waters) at the distance of 100 m from the place the works are carried out does not exceed the value of 18 mm as a result of preparatory works for the foundations and 9 mm as a result of laying energy and teletechnical cables;
- thickness of newly formed sediments at a distance of 1000 m from the place the works are carried out does not exceed the value of 4 mm;
- environmental impact of suspended matter on the marine environment in the least favourable scenario does not last for longer than 42 hours, counting from the moment the works at the seabed are started with regard to a single foundation (this condition is determined by the moment the negligible concentration is achieved, lower than 2 $mg \cdot l^{-1}$);
- dredging works are carried out concurrently in two locations of settlement of support structures within the distance of over 3 km from one another, and with regard to the joint impact of suspended matter they do not impact one another in the case of works in non-cohesive soils and have a minimum impact in the case of cohesive soils.

The model tests results on suspended solids spread have been accounted for in the environmental impact assessment, especially concerning the impact on benthic organisms and fish.

4.2 Underwater noise modelling

Noise, including underwater noise, is made at each stage of an OWF implementation – from construction, through exploitation to decommissioning. It is expected, however, to have the greatest impact at the stage of construction due to the high levels of noise from pile driving. Many marine biota may be sensitive to underwater noise (especially fish and marine mammals), which spreads in water to significant distances. The local bathymetric and hydrological conditions have a great impact on dispersion of underwater noise, which is why the modelling has accounted for the local bathymetric and hydrological conditions prevailing during the surveys in the OWF Area and data on the Baltic Sea within the range of over 150 km.

The model tests results including description of the model and the method of its development are included in Appendix 2.

Due to the centreless character of the EIA Report, the model tests have been performed for a single scenario of pile driving – driving of foundations with the diameter of 12.5 m, which has never been performed so far, including application of the measures for reducing underwater noise (e.g. bubble curtain or similar noise reducing measures). The performed modelling proves that even with so large a pile diameter it is possible to apply noise reducing measured allowing to limit underwater noise in the critical areas (e.g. at the boundary of the Ostoja Słowińska reserve, where the harbour porpoise is protected) to the levels that will not have a significant impact on marine biota. In the case of the harbour porpoise, it is 140 dB re 1 μPa^2s as porpoises do not react (e.g. escape) to noise up to this level. Additionally, noise propagation analyses have been performed for the frequencies that may be registered by harbour porpoises, seals and fish. The analyses indicate that the lowest noise level that changes behaviours of the animals is in the range of approx. 24 km, 4.1 km and 24.1 km respectively for harbour porpoises, seals and fish. It cannot be excluded that due to the approach of the Applicant, who declares a willingness to apply the latest and innovative methods at the stage of the investment construction (which is the reason for application of the centreless conception in description of the enterprise), the values will decrease after selection of a specific model or models of wind power stations and, consequently, size of piles to be driven.

4.3 Collision risk modelling

Due to their size, wind farms, both offshore and on land, may generate collisions with birds in flight. This applies especially to moving parts of the wind power stations, i.e. rotors with the blades. The collision risk was calculated based on the basic model developed by Band (2012) for most species. The basic model assumes that a certain past of the passing bird population flies within the range of the rotor blades. Thanks to a significant amount of information obtained during the migratory bird surveys it was possible in the case of some marine duck species to apply the extended model, which accounts for the detailed distribution of the bird flight altitudes.

The results of calculations performed for both the Baltica OWF and the cumulative case (the Baltica OWF together with the BŚII and BŚIII) are presented in Appendix 4 to the EIA Report.

The collision modelling results indicate clearly that irrespective of the bird species, the number of potential collisions will be very low if a spacing of at least 20 m is kept between the endings of operating rotor blades and the seabed surface. The appendix includes an assessment of the impact on individual species, which was not significant at most.

5 The description of the envisaged environmental effects in the event of a failure to undertake the project, taking into account available environmental information and scientific knowledge

Lack of realisation of the investment (the planned Baltica OWF) in the Applicant's variant or the rational alternative variant may take place in two case:

- firstly, if the offshore wind energy sector is abandoned in the Polish Exclusive Economic Zone, which implies the necessity to acquire energy from other sources;
- secondly, if the discussed Baltica OWF enterprise with the power output of 2550 MW is abandoned but other equivalent offshore wind farms are implemented within the Polish Exclusive Economic Zone.

These two options are fundamentally different. The first one means abandonment of energy acquisition from alternative sources of significant power output (which covers over 7% of the national demand for electricity) over several decades. This would have to be compensated for by usage of the conventional sources of energy with similar power output but including emission of gas and dust pollutants from fuel combustion (hard coal or lignite), production of approx. 20% of waste from combustion in relation to the used fuel and, indirectly, environmental changes in the regions of fossil fuels recovery.

An important premise for the investment is the possibility to avoid emission of hazardous substances into the atmosphere. With a conservative assumption of 40% capacity utilization and 25 years of exploitation an OWF with a capacity of 2550 MW can produce 223.38 TWh/804.168 PJ of electricity, which would avoid the emission of over 80 million Mg of CO_2, over 1 million Mg of SO_2, about 150,000 Mg of nitrogen oxides and over 2 million Mg of dust in lignite-fired power stations.

In the first option, also a delay in implementation in the Polish Exclusive Economic Zone of the concepts proposed by the Polskie Sieci Morskie, which are being merged with the National Power System. In accordance with the adopted provisions, with time the Polskie Sieci Morskie would become able to integrate with the subsea networks of other Baltic countries thus allowing trans-border transfers of electric power. It is of great importance for improvement of the energy security and reliability of the power supply in the northern regions of the country as well as coastal areas of the other Baltic countries. Integration of power transmission systems of the Baltic countries is one of the strategic economic objectives primarily because of the power supply security.

The above mentioned option provides local benefits associated with renouncement from development of marine areas. In practice, lack of investments in the offshore wind energy – wind farms, energy cables connecting single power stations with substations will mean that no complex impacts associated with construction, exploitation, decommissioning of the above mentioned OWF elements will occur in the following several decades. This implies also lack of restrictions in use of these sea areas for navigation, fisheries, tourism and possible hydrocarbons exploitation (crude oil and natural gas from under the seabed).

The second option means implementation of other wind farms in other sea basins impacting the marine environment and human activities implemented there (navigation, hydrocarbons exploitation, fisheries, offshore tourism) to an extent that is yet hard to determine. This options has, however, an advantage as it limits the results of the national fossil fuels exploitation (by means of mining) and combustion of these fuels in conventional power plants. At the same time, when limiting the share of the conventional energy sources in production of electric power, it will be possible, in accordance with the trends in the European energy sector, to further enhance integration of the national extra high voltage transmission systems of Poland with Germany, Denmark and Sweden.

Below there is presented a prognosis for development of marine mammals populations in the Polish waters and impact on seabirds in relation to the two above mentioned options in which the investment remains not implemented.

If development of offshore wind farms is abandoned in the Polish waters (the first option), further development of the harbour porpoise and seals populations in the Baltica OWF Area and adjacent waters will be determined solely by other kinds of pressure. Data obtained thus far indicate that harbour porpoises had occurred widely in the entire Baltic Sea and that abundance of its populations decreased significantly in the middle of the 20th century, which was caused, to a large extent, with direct catches and by-catches of the species (Berggren et al., 2002). The greatest danger for harbour porpoises inhabiting the Baltic Sea are by-catch and pollutions. Some researches indicate a decrease in these hazards. Another danger is underwater noise from ship traffic. Because of the unique uncertainty regarding the number of porpoises in the Polish areas of the Baltic Sea and their population trends, it is impossible to determine the future trends in abundance with regard to the option in which no offshore wind farm is implemented. Since the 1980’s the number of grey seals in the Baltic Sea has been constantly growing. It is hard to determine the trends regarding the harbour seals as their number in the Polish Exclusive Economic Zone is very low and there are no breeding grounds. As far as seals are concerned, by-catch could be an important factor impacting these animals. This applies first of all to grey seals, which area known to migrate across the entire Baltic Sea, including the Baltica OWF Area, and may use these places because of the availability of food they offer. Pollutions and seismic surveys could also have a negative impact on seals in the area. Despite these pressures, it seems that population of the grey seal is increasing (HELCOM, 2013) and it is possible that this trend continues after the first of the above mentioned options is adopted. Its very low abundances do not allow assessing the trends for the harbour seal.

The impact on seabirds will remain unchanged in relation to the current conditions. Possible changes in abundance and distribution of birds in this area will be conditioned by natural factors and impact of investments located in the neighbouring sea areas.

In the second option, the noise levels will increase significantly though only temporarily in relation to the current noise levels. This would lead to a temporary abandonment of the construction site by harbour porpoises and seals. It is possible that offshore wind farms may result in reduction of certain environmental pressures is the fisheries activity is limited. This may lead to a decrease in by-catch in the area of offshore wind farms. The option has been discussed recently by Scheidat et al. (2011), who recorded an increase in abundance of harbour porpoises following construction of a wind farm on the Danish coast in relation to the state from before its implementation. It should be noted that the survey results are hard to assess as an upward trend in abundance of harbour porpoises is being observed in this part of the North Sea, which may be the only reason behind the results obtained in this object [see: by-catch, edited by Thomsen et al. (2006a)]. Decrease in the pressure associated with by-catch is possible also in the case of seals.

In relation to marine birds, the case in which the offshore wind energy sector is developed but the Baltica OWF is not implemented may be compared to the situation of accumulated impact with other wind farms, which has been described in section 7. The forecast accumulated impact of a group of wind farms planned for implementation in the north-eastern stock of the Słupsk Bank would decrease by the impact of the Baltica OWF on marine birds as described in this Report. Of course, in this case it cannot be excluded that the OWF would be implemented in other place, where it would also generate impact on seabirds.

6 Identification and assessment of the investment impacts

The impacts analysis was carried out for the construction phases, overlapping construction and exploitation phases (estimated time 8 years), exploitation and decommissioning of an offshore wind farm. It should be noted that at the current stage of works there are neither known or detailed project solutions for the Baltica OWF, nor courses of cable connections, therefore the presented considerations and conclusions will be further verified in the following works stages.

6.1 Variant proposed by the Applicant

6.1.1 Construction phase

6.1.1.1 Impact on geological structure, seabed sediments, access to resources and deposits

The construction phase may cause various types of seabed impacts:

- disruption of the seabed structure;
- change of the seabed morphology;
- change of the sediments' substrate composition;
- ground subsidence;
- resuspension and sedimentation of suspended solids.

6.1.1.1.1 Impact on geological structure

Disruption of the seabed structure

Some works carried out during construction of the OWF will cause local disruption of the seabed structure. These include particularly installation of foundations and laying power cables. Disruptions will be also caused due to anchoring of sailing vessels.

In case gravity foundations are used, disruption of the seabed structure will necessitate surface preparation prior to the placement of foundations. This design requires a stable base, so it will be necessary to replace it with rock material with a greater capacity. Usually a layer of sediment with a thickness of approx. 2–3 m is removed. If the sediments deposited below the seabed surface have a low bearing capacity, it may be needed to remove the entire overburden down to a layer with relevant load-bearing capacity (e.g. till) where foundation is possible. It concerns particularly areas where mud-loam sediments are present in the deep structure.

In the case of using large-diameter piles, disruption of the seabed structure will be caused by drilling or driving in the foundation pile with a length up to 80 m (depending on field conditions). The driving in or drilling in of the pile causes vibrations, which can cause liquefaction of the surface layer of sandy of mud-loam sediments in a radius of a couple meters from the pile. This effect may take place in areas with a layer of sandy sediments or sands on muds and loams. The process of liquefaction does not usually leave any forms on the seabed and stops along with finishing of the vibrations. Large-diameter piles can be used on a gravel, sand or clay seabed, provided there is an underlying stable relining layer. The large-diameter piling technique is less suitable in conditions where there are a lot of boulders and rocks as well as where mud-loam sediments predominate in the deep structure (Hammar et al., 2008).

Settlement of tripod and jacket type foundations is related to digging or drilling into the bottom of three-four piles with a length up to 70 m (depending on field conditions), upon which the later structure of the foundation will be fixed. Driving the piles in causes vibrations, which can cause liquefaction of sediments just like in the case of large-diameter piles. Liquefaction process can occur in the areas of sandy or mud-loam sediments. The process of liquefaction ceases when the vibrations stop. This technique is not the best of alternatives in the areas when there is a compact stony cover.

The used foundation type depends on the results of geotechnical examinations, which will be carried out at the stage of drafting the construction design.

The disruption of the seabed structure will also occur during the laying of power cables. The depth of the groove for the cable may reach up to 3 m, and its width up to approx. 3 m.

The most vital technical parameters affecting the level of impact are size and number of foundations. The biggest influence on the settlement will occur in the event of having to replace the ground for the gravity-based foundations with the maximum possible diameter of 40 m, along with a protective layer against washing away. Laying of cables is associated with ploughing of the bottom or jetting sediment with a stream of water under high pressure to form a cable trench.

The seabed degree of disruption in a given location will depend directly on its construction.

Till, which is a compact sediment, hardly undergoes washing out in natural conditions. Due to a discontinuous layer of sands and gravel with variable thickness and the compact structure of till, susceptibility to surface sediment agitation is low. Disruption of sediment structure will be of little significance here, even in case of using big gravity-based foundations.

Mud-loam sediments with a layer of sandy sediments make up a basement of low stability, therefore it is necessary to replace it before settling gravity based foundations. In these areas the launching of suspension can occur at a higher intensity.

Disruption of the seabed structure in the construction phase will be a negligible impact with a local scope.

Change of the seabed morphology

As a result of construction works carried out on the seabed, particularly: driving in or drilling in foundation piles; preparation of the seabed for other types of foundations or cables; laying a protective layer against washing out around the foundation base; replacement of the basement in the place of planned settlement of the gravity based foundation with a material with a greater bearing capacity and placing the dredged material in the farm area; locally there will be changes in the seabed morphology (shape).

Use of gravity-based foundations is unequivocally associated with a change of the seabed shape and an arising need to store the dredged material. Currently it is not determined where the dredged material will be deposited, it is, however, assumed that it will be within the area of the farm. The dredged rock material is often used as ballast for gravity foundation, provided that the material consists of sandy deposit (Peire et al., 2009).

In case of using large-diameter piles, change of seabed morphology will involve mostly lining a protective layer against washing out around the pile.

The settling of foundations of tripod and jacket type is associated with relatively small changes of the seabed morphology, in comparison to gravity foundations or large-diameter piles, because in their case a protective layer against washing out is rarely used.

A small change of the seabed shape can also occur when laying power cables. The seabed sediments disrupted during these works may be washed out during exploitation. In result, a hollow can form along the cable and/or it can even be temporarily uncovered.

The degree of seabed morphology changes in a given location will depend directly on its construction.

Compact forms, such as boulder clay, are not very susceptible for morphology changes. The susceptibility of sandy seabed areas is high, but on the other hand they equally easily return to the original state as a result of processes occurring near the seabed (the movement of sediments by currents and waves). As a result of these processes, on seabed areas with a sandy layer, some elements of the OWF infrastructure may be covered or uncovered.

Change of seabed morphology in the construction phase will be a negligible impact with a local scope.

Change of seabed sediment substrate composition

Change in the substrate composition of seabed sediments can occur as a result of two types of works carried out during the farm construction phase, that is, laying the protective layer against washing out around the basis of foundation, replacement of the substrate in the place of the planned gravity foundation settlement with a material with greater bearing capacity.

Foundations used in the OWF objects, particularly the gravity based foundations and large-diameter piles, are prone to washing out of sediments in the immediate vicinity of their bases. Therefore, a protective layer against washing out will be arranged around them. For this purpose, most commonly, rock material, stones and boulders are used to surround the base of the foundation at a width between few and less than twenty meters. Materials neutral to the environment are used.

For a gravity based foundation the change of a substrate composition will take place at the greatest area (40 m – foundation diameter plus over a dozen meters of protective layer against washing out, counting from the edge of the foundation). A layer with a width between 12.5 m and 20 m is usually put around a large-diameter pile, depending on the variant, and around each pile in a jacket or tripod structure – with a width up to 10 m (in the case of the latter two types of foundations it is usually not necessary to be applied).

The layer of stones and boulders can also be used to cover the power cables if they are not buried at an adequate depth. The decision on use of protective layer and its width can be taken at the construction design phase, after deciding on the field conditions in specific locations of foundations.

The degree of change in the sediment substrate composition in a given location will depend directly on the structure of the seabed. Outcrops of tills with a variable cover of sand and gravel, with numerous boulder areas on the surface will have low susceptibility to changes in the substrate composition due to weak sorting (the presence of all fractions in the composition). Tills are also a stable base for structures of wind power stations. Mud-loam sediments with a layer of sandy sediments make up a basement of low stability, therefore it is necessary to replace it before settling foundations. These areas have high sorting degree and change of substrate composition of sediments will be more noticeable there.

The change of the sediment substrate composition is a negligible impact with a local range.

Ground subsidence

A foundation of a wind power station or other OWF object installed in the seabed will cause compaction of the ground, that is densification resulting from decreasing the amount of empty spaces between the sediment grains. As a result the foundation will subside. This process will take place mainly in the scenario where heavy gravity based foundations are used. Impact of large-diameter, tripod and jacket structures will be much lower. The level of ground compaction in a given location will depend directly on the seabed structure. The impact will be more noticeable in areas with mud-loam and loosely packed sand and gravel sediments. Till areas are less exposed to ground subsidence. This results from the fact that tills have low sensitivity to sediment compaction under pressure and therefore they form a stable basement for settling the construction.

Ground subsidence will be a negligible phenomenon with a local range.

Suspended matter agitation and sedimentation

In the construction phase, foundations of the power stations and other farm objects will be placed on the seabed. This will cause agitation of seabed sediments and a temporary rise of suspension in the water deep. The engineering practice informs that the largest amount of sediment is launched when settling gravity based foundations. The phenomenon is of short-term character and its range is local. The agitated sediment will move mainly in the farm area and within several kilometres from its boundaries at most, and when descending it will cover the seabed with an average thickness no greater than 1 mm, which is comparable to the amount of suspended matter descending as a result of natural processes during the year. The impact during construction phase will depend on how many foundations are installed at any given time.

Suspended matter agitation and sedimentation will be a negligible phenomenon with a local range.

To sum up, the significance of impact on the Baltica OWF seabed in the construction phase was assessed as negligible, with a local range because:

- disruption of the seabed structure will involve the preparation of seabed before settling the foundation, drilling in or driving foundations, installation of the support structures, placing or possibly burying cables, dredging works, heaping rock material and anchoring water crafts used during construction;
- changes in the seabed morphology will result from installation of the wind farm elements and the possible deposition of the rock material from the seabed prepared for installation of foundations;
- there will be a change in the sediment substrate composition – some foundation types require protective layers against washing out to be placed around them; it will also depend on the materials that make up the seabed. For this purpose, the most common crushed rock, stones and boulders are used;
- ground subsidence will take place – depending on the bass, the foundation may cause soil compaction and its subsequent subsidence;
- suspended matter agitation and sedimentation will take place – during construction works, suspended matter will rise locally, which will cause a subsequent increase in water turbidity. The suspended matter generated as a result of sediment disturbance during dredging works will descend mainly in the farm area and within several kilometres from its boundaries at most, and when descending it will cover the seabed with an average thickness no greater than 1 mm, which is comparable to the amount of suspended matter descending as a result of natural processes during the year.

The assessment has been made despite the fact that seabed is an important habitat forming factor. The range of impact on the seabed is, however, only local, and the seabed is so uniform in the area that the impact may be assessed as insignificant despite the part seabed plays in the environment.

6.1.1.1.2 Impact on seabed sediments

In the construction phase, the most significant impacts on seabed sediments and therefore on waters will be:

- release of contaminants and nutrients from the sediment into the sea deep;
- accidental release of municipal waste and domestic wastewater.

Moreover, impacts on the state of seabed sediments and waters will be related with the following construction works phases:

- preparation of the seabed before installing the foundations, including dredging, removing layers of sediment with a thickness of approx. 2–3 m and replacing them with rock material with a higher bearing capacity (only when using gravity foundations);
- drilling in or installing foundations (only when using large-diameter piles);
- anchoring jack-up platforms and auxiliary vessels during the construction of farm's elements;
- laying of cables in the seabed;
- storage of excavated material from the preparation of seabed for foundations.

It was assumed that in the Applicant's variant, using gravity based foundations, the removed sediment layer has a thickness of 3 m and a diameter of 70 m (40 m of the foundation diameter + 15 m belt from its boundary), which totals to 175,851 m^3 of agitated sediment in the form of suspended matter (Appendix 3). The amount of sediment lifted from the seabed to the sea deep will be lower than in the case of decision to use other foundation types. For example, in the case of large-diameter piling technology, it is usually not required to prepare the seabed, apart from that the diameters of driven in foundation piles will be many times lower than the diameter of a gravity based foundation. In this type of foundations, the sediment will be agitated only as a result of vibrations caused by operation of a pneumatic drill, when driving large-diameter piles into the seabed.

In case of driving a single large-diameter pile with a diameter of 12.5 m the amount of sediment which is agitated equals no more than 100 m^3.

Regardless of the selected foundation, sediment will be moved while laying the cable. The width of a cable trench is approximately 3 m, the average depth – up to 3 m and the length – maximum up to 418 km, which gives 207,662 Mg of sediment in the form of suspended matter at maximum (for the entire internal cable network) in the OWF Area (Appendix 3).

The impact of the investment on the increase of water turbidity in the construction phase was assessed as negligible due a short-term character of this disturbance, its small amplitude and range (Appendix 3).

At the phase of construction, the resources may be used in construction of farm elements, e.g. to create a gravity based foundation or as its filling (ballast) is considered an impact on resources. Construction may cause disturbance of the seabed structure due to the need to properly prepare the seabed before the foundation is settled, drill in or drive in foundations, install towers, assemble foundation structures, lay or possibly bury foundations, dredging works, heaping rock material. Dredged material for settling foundations is often used as ballast for gravity foundations, on the condition that it is sandy sediment (Peire et al., 2009). During the construction phase, disturbance of sediment traffic in the benthic zone may also occur. The built foundations of power stations form an obstacle for the moved sediment. As a result, it can lead to accumulation and/or washing out of sediments, thus washing out or covering up of deposit sediments.

There were no accumulations of mineral resources found in the OWF Area, therefore there will be no such impact.

The impact of foundation on resources depends on its type. Gravity based foundation occupies the largest surface of the seabed. The occupied seabed surface may prevent access to resource deposits. The gravity based foundation also requires an additional preparation of the seabed. Some resource deposits can be extracted during the preparation of the ground for the foundation. Other types of foundations, despite their occupying a smaller seabed surface may hinder or prevent extraction and exploration of resources (McElfish et al., 2013).

6.1.1.2 Impact on marine waters and the quality of marine waters and seabed sediments

6.1.1.2.1 Impact on marine waters

Within the framework of the works the following parameters were analysed: wave motion, water currents, turbidity, electrolytic conductivity and temperature of water. Water turbidity proved to be the only sensitive element at the construction phase. Assessment of significance of the resulting turbidity is located in section 6.1.1.1.

6.1.1.2.2 Impact on the quality of marine waters and seabed sediments

Contamination with accidentally released wastewater

Wastewater may be generated by people present on ships, as well as be generated during foundation construction process, installation of elements (subassemblies) of wind power stations (towers, nacelles, rotors) and laying cables.

The risk of sewage release from the ship into the water column exists at the time of collection of sewage from a ship by another vessel and in the event of a breakdown. It may cause local increase of nutrients concentration and deterioration of water quality. Emitted contamination should, however, rapidly dissipate, which will not contribute to a permanent water quality deterioration in the investment area.

There is also a potential threat caused by accidental release of waste generated during foundation construction process, installation of elements (subassemblies) of wind power stations (towers, nacelles, rotors), laying and connecting cable into the environment. In order to prevent it, it is necessary to create procedures related to waste management. When applying such procedures, the scale of such impacts will not be significant. Another source of waste generated in the course of large-diameter foundations construction may be the binders used for binding the elements. During the construction of this type of foundations there is a danger of these substances getting into sea deep. These substances are considered a threat, as they may not be easily removed from the seabed and are toxic to aquatic organisms. These threats may be minimised by performance of all works with utmost care (Gajewski & Jarzębowski, 2007). For the type of investment such as the OWF, usually a detailed action plan is developed against threats and contamination emerging during construction and decommissioning of the OWF, containing a procedure of proceeding in case of such events (Veldhuizen et al., 2014).

Contamination of water and/or seabed sediments with municipal waste or domestic waste is a **direct, negative, short-term, reversible impact with a local range. Scale of impact is negligible.**

The significance of wastewater impact on marine water quality was assessed as negligible despite a great significance of the resource (water) as a habitat forming element. The probability of sewage perspiring into the seawater will be small and the amount of possible pollutions that can be released into the water at a single occasion is also small.

Release of contaminants and nutrients from the sediment into the water deep related with resuspension (agitation) of seabed sediment

Sediments resuspension (agitation) due to settlement (construction) of foundations for towers, anchoring of ships are all activities that propagate release of pollutants from the sediments into the sea deep (Uścinowicz, 2011; Bojakowska, 2001; Frostner, 1980; Bourg & Loch, 1995; Dembska, 2003). During this process, contaminants passing from the sediment into the water may be: labile forms of metals, organic pollutants, i.e. polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) as well as nutrients (nitrogen and phosphorus).

Intensiveness and consequences of the described processes depend on the sediments quality, that is on the content of contamination (metals, PAHs, PCB) and nutrients, as well as the type of sediment (granulometry). The most unfavourable situation may occur when sediment is characterized by a higher content of harmful substances and nutrients and a large amount of fine fractions (mud and loam fractions). In this case there may be a significant deterioration in the water quality due to increase in concentration of harmful substances and nutrients (due to transition from the sediment into the sea deep as a result the sediment resuspension process). Resuspension process during construction of foundations will also (in the case of sediment with a significant content of fine fractions) cause long-term suspension of fine fractions in the sea deep at a significant area (generation of long retained suspended matter) which may negatively impact the change of oxygen conditions in the sea deep.

The most important factors which influence the impact are:

- type, size and number of foundations;
- cable length and the method it is buried (laid);
- type and amount of contaminants and nutrients deposited in the seabed sediment;
- type of seabed sediment.

From all types of foundations, the greatest impact on the seabed sediments and the quality of seabed water will be observed during the construction of gravity based foundations. Their construction requires preparation of the seabed, which involves removal of a layer of sediments, not only in the place of settling the foundation but also in its immediate vicinity. In the case of the remaining considered technologies (e.g. large-diameter piles) the volume of agitated sediment will be much lower, which is described in detail in section 6.1.1.1.

Taking into account the content of pollutions and nutrients in the seabed sediment in the OWF Area as well as possibility of their movement into sea deep (section 3.2.2), as well as the volume of sediment which may be resuspended as a result of foundation construction and laying cable (section 6.1.1.1), the estimates of emissions of metal, nutrients and organic pollutions into the sea deep which may take place in the Applicant’s variant as a result of construction of a maximum of 234 foundations (209 + 25 additional structures) as well as placing 418 km of cable routes inside the OWF Area (Table 45). The calculations assume an average bulk density of the sediment of 1.8 $g{\cdot}cm^{-3}$ (1800 $kg{\cdot}m^{-3}$) and an average humidity of sediment in the amount of 20.13%.

Table 45. Comparison of contaminants and nutrients mass, which can potentially be released into the sea deep during construction of the Baltica OWF (construction phase, maximum number of foundations) with the load brought by the Baltic Sea via rivers and wet precipitation

Parameter	The variant proposed by the Applicant (234 foundations)	Cable routes (418 km)	Annual load launched with the rivers into the Baltic Sea	Annual load launched with wet precipitation into the Baltic Sea
The volume of agitated sediment [m^3]	175,851	115,368	No data available	No data available
The weight of agitated sediment [Mg]	316,532	207,662	No data available	No data available
Dry weight of agitated sediment [Mg]	252814	166,130	No data available	No data available
Lead [Mg]	0.760	0.498	50	200

Parameter	The variant proposed by the Applicant (234 foundations)	Cable routes (418 km)	Annual load launched with the rivers into the Baltic Sea	Annual load launched with wet precipitation into the Baltic Sea
Copper [Mg]	0.215	0.141	100	No data available
Zinc [Mg]	1.291	0.847	No data available	No data available
Nickel [Mg]	0.245	0.161	No data available	No data available
Chromium [Mg]	0.303	0.199	700	No data available
Cadmium [Mg]	Concentration in the sediments in the OWF Area below the bottom limit of quantification		No data available	7
Mercury [Mg]	Concentration in the sediments in the OWF Area below the bottom limit of quantification		No data available	3
Congeners from the PCB group [g]	0.11–0.97	0.08–0.71	715,000	260,000
Analytes from the PAHs group [g]	146.88	96	No data available	No data available
Available phosphorus [Mg]	16.26	10.67	12,000 (P tot.)	No data available

Source: internal data and Uścinowicz, 2011

Amounts of heavy metals, pollutions and nutrients which may be released from the sediment to the sea deep as a result of sediment resuspension during the construction of foundations and burying the cable in the Applicant's variant are not significant. They are much lower than loads brought into the Baltic Sea each year by rivers and wet precipitation (Uścinowicz, 2011).

Concentration of arsenic, cadmium, mercury and TBT in the surveyed sediment occurred on a trace level, generally below the bottom limit of quantification. Therefore, risk of water contamination related to remobilization of these chemical compounds from seabed sediments during the construction of the farm was considered negligible and was not subjected to further analysis.

It was assumed that all the sediment that will be removed from foundation's construction sites due to preparation of the seabed, will be left in the farm area. In case of using a different type of foundations (e.g. large-diameter piles), where the surface of disrupted seabed and sediment located there is much lower, the impact will be on a significantly lower level.

The release of pollutions and nutrients from seabed sediments to the sea deep during the construction phase will cause a direct, negative, short-term, repeatable, reversible or irreversible impact with a local range. The scale of impacts for waters and sediments is small. The value of the resource both for water and sediments is large, and it is related with the habitat forming nature of both components of the environment.

During the construction of foundations, anchoring vessels and burying cable, the processes of nutrients or pollutions entering the sea deep will be observed, which may have a negative impact on its quality. Due to low concentration of the listed substances in the seabed sediment, the loads of these substances will not be large. However, after cessation of activities associated with the construction, after reaching the equilibrium state, these substances will re-enter the sediment. Therefore the release of nutrients and pollutions from the seabed sediment to the sea deep and their resedimentation are considered of little significance for waters and negligible for sediments, despite large significance of waters/sediments and a small scale of impact. It results from the fact that even though pollutions may temporarily deteriorate the water quality, the disturbance will disappear after resedimentation, total amount of pollutions will not increase.

6.1.1.3 The climate impact, including emissions of greenhouse phases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

Within the framework of identification of impacts of the investment on meteorological conditions, yearly meteorological measurements were analysed, which included wind, pressure, humidity and air temperature as well as the available literature on air quality and climate conditions for the Baltic Sea were analysed.

During the wind farm construction, the increased emission of pollutions entering the atmosphere is expected (including greenhouse gases), which will be related with increased traffic of ships involved in the implementation of the investment. At the current stage is it not possible to assess the size of this emission to the atmosphere, as the type and time of use of specialised vessels will be determined only as late as in the execution design. It was assumed that only the vessels that comply with pollution emission regulations included in standards that result from international agreements as well as national ones will be used. It can be assumed that the expected flue gas emission for the Baltica OWF Area will be similar to the emission estimated for the neighbouring BŚII and BŚIII farms. Based on the available documentation, in these OWFs, the emission of pollutants to the air due to ship traffic will be shaped in the following manner: NOx – 20–50 $kg \cdot m^{-3}$ of fuel, PM10 – 1–2.6 $kg \cdot m^{-3}$ of fuel, SO_2 – 1.7–17 $kg \cdot m^{-3}$ of fuel.

At the construction phase, the significance of the climatic and greenhouse gases-related impacts of the planned investment will be negligible, as there will be no factors which could have any noticeable impact on their change.

The impact of the planned investment construction on air quality will have a transitory character and will disappear after the works are ceased. Moreover, due to the fact that it is an open area with no obstacles, the concentration of pollutions will quickly decrease. With regard to the above, the significance of the impact will be of little importance.

6.1.1.4 Impact on nature and protected areas

6.1.1.4.1 Impact on biotic elements in the sea area

6.1.1.4.1.1 Phytobenthos

Due to trace amount of phytobenthos present outside the Baltica OWF Area, it was assumed that even though the significance of phytobenthos generally in the PMA is large due to the uniqueness of this resource in the PMA, in the OWF Area the significance of this resource is low.

So far in the PMA no offshore wind power station was built yet, therefore in order to assess the impact of the investment in question on phytobenthos, the authors based on data from the literature regarding other marine areas of the Baltic Sea. Analysis of literature on the subject matter shown that at the phase of construction of the investment, there are potentially 4 factors that impact the phytobenthos:

- disruption of the basement structure;
- increase of suspended matter concentration in the sea deep;
- sedimentation of suspended matter;
- redistribution of contaminants and nutrients from the sediment into the sea deep.

In accordance with the analysis of suspended matter propagation (Appendix 3) the greatest amplitudes of the impacts above will be present for the gravity based foundations, which take up the greatest seabed area. In the case of burying cables for all types of foundations, the impacts remain the same.

Among these factors, the one of the most significant impact on phytobenthos – as mentioned by Köller et al. (2006), Zucco et al. (2006), Birklund (2007) – is the disruption of the basement structure (Table 46): sandy, mud-sand, or stony seabed sediments, overgrown by phytobenthos. The phenomenon takes place when removing dredged material for foundations and possible preparation of seabed for a scour protection layer, but also during the use of jack-up installation units which are equipped with legs placed on the seabed. This results in local physical damage of phytobenthos in places where the seabed is disturbed.

Table 46. The assessment of the impact of wind power stations in the OWF Area on phytobenthos, during the investment construction phase – disruption of the basement structure

Description of the impact (based on data from the literature)	**Action the impact (based on data from the literature)**	**Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)**
When removing dredged material for foundations and during any works on the seabed related with construction of structures and laying cables (e.g. anchoring jack-up units)	Physical damage to natural phytobenthos communities (negative impact)	In the OWF Area, phytobenthos is present in trace amounts, only outside the construction zone. No impact

Source: internal data based on Köller et al., 2006; Zucco et al., 2007; Birklund, 2007

Another potential factor impacting phytobenthos is an increase of suspended matter concentration in the sea deep (Leonhard, 2006; Zucco et al., 2006) present during dredging works – seabed disturbance during works related with settling foundations (Table 47). Turbidity of water changes locally and at the same time there is a limitation in access of light to plants present in the area of works. In the case of increase of suspended matter concentration in the OWF Area, the impact on trace amounts of phytobenthos beyond the construction zone will be very unlikely due to the distance of phytobenthos from works carried out on the seabed and due to the type of sediments in the construction region – fine and medium grained sands (Appendix 1). Large water dynamics in the area (Appendix 1) causes quick diffusion of possible suspended matter, then even a temporary decrease of light access in the benthic zone which results in insignificant, short-term disruption of the photosynthesis process of trace amounts of phytobenthos will be very unlikely in the case of this investment.

Table 47. Assessment of impact of wind power stations in the OWF Area on phytobenthos in the construction phase of the investment – increase of suspended matter concentration in the sea deep

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)
When resuspending sediments during dredging and installation works, water turbidity increase will take place	The decrease of access of light in the benthic zone – shading plants on the seabed – which may disrupt their photosynthesis process (negative impact)	Plants present outside the OWF Area construction zone will most probably not be vulnerable to decrease of access of light resulting from the increase of suspended matter in water in the region where works are carried on at the seabed. In the worst case, if the impact takes place it will be: indirect simple short-term temporary reversible local negative Scale of impact: negligible. Significance of a resource in the OWF Area: small Significance of impact: negligible

Source: internal data based on Leonhard, 2006; Zucco et al., 2006

Impact related with sedimentation of suspended matter (backfilling phytobenthos communities) (Table 48) is the strongest locally, in places where works are carried out on the seabed, e.g. when removing dredged material for foundations (Zucco et al., 2006). Large intensity of works that cause large densities of sediment in water could cause physical destruction of natural phytobenthos communities or limitation of their development by covering the plants with a layer of sediment, which would cause temporary halting of the photosynthesis process. The results of this impact, similarly to the increase in concentration of suspended solids in the water depth are, however, of local nature and they are dependent on the depth and sediment type. They usually do not impact significantly occurrence of phytobenthos but in the case of the OWF Area an impact of suspended solids sedimentation on phytobenthos, which occurs in the region only outside the construction site and in trace amounts, is not probable due to distance between the phytobenthos and the sites where works will be conducted in the seabed, as well as the type of sediments in the constriction area, namely fine- and medium-grained sand (Appendix 1).

Table 48. The assessment of the impact of wind power stations in the OWF Area on phytobenthos, during the investment construction phase – suspended matter sedimentation

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)
Suspended matter was created as a result of resuspension of sediments during dredging works descends to the seabed in accordance with the regional water dynamics	Physical destruction (backfilling) of natural physical communities of limitation of their development by disturbance of the photosynthesis process	Plant present outside the OWF Area construction zone will most probably not be threatened with backfilling. In the worst case, if the impact takes place it will be: indirect simple

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)
	(negative impact)	short-term temporary reversible local negative Scale of impact: negligible. Significance of a resource in the OWF Area: small Significance of impact: negligible

Source: internal data based on Zucco et al., 2006

The last factor which potential impact on phytobenthos, in accordance with the data from the literature, is redistribution of nutrients and pollutions from sediments into the sea deep (Zucco et al., 2006) (Table 49). It takes place as a result of resuspension of sediments during works at the seabed – during the construction of the offshore wind farm. Phytobenthos communities are then exposed to increased concentration of nutrients and pollutions in the water (e.g. heavy metals). This impact, similarly to the increase of suspended matter concentration in sea deep, has a mainly local character, depending on the depth and type of sediments which impact the degree of nutrient and pollutions content in sediments (generally, the higher the depth and the finer the sediment, the greater the content of above mentioned compounds that are retained in the sea deep for a longer time). In the case of the OWF Area, the impact of compounds released from sediments on phytobenthos present in trace amounts in the area beyond the construction zone will be unlikely due to the distance of phytobenthos from works carried out on the seabed and due to low content of nutrients and pollutions in the sediments in the OWF Area (Appendix 1).

Table 49. Assessment of impact of wind power stations in the OWF Area on phytobenthos in the construction phase of the investment – redistribution of nutrients and pollutions to sea deep

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)
Release of nutrient and pollutions load to the sea deep (e.g. heavy metals) due to resuspension of sediments during works on the seabed	Exposure of phytobenthos communities to increased concentration of nutrients and pollutions in the water (negative impact)	Plant present outside the OWF Area construction zone will most probably not be threatened with increased concentration of nutrients and pollutions in seabed. In the worst case, if the impact takes place it will be: indirect simple short-term temporary reversible local negative Scale of impact: negligible. Significance of a resource in the OWF Area: small Significance of impact: negligible

Source: internal data and Dziaduch (2015)

In the assessment of potential impacts of the construction of an offshore wind farm in the OWF Area on phytobenthos, particular attention should be paid to protected species in accordance with the Regulation of the Minister of the Environment of 9 October 2014 on plant species protection (Journal of Laws no. 2014, Item 1409). In the zone outside the construction area, one individual from a strictly protected species was found – red algae *Furcellaria lumbricalis* (formerly *F. fastigiata*) (Appendix 1). The presence of only one individual indicates that its presence in the region was incidental. The place in Poland where it is most abundant was identified in the boulder area of the Słupsk Bank (Kruk-Dowgiałło et al., 2011), located approx. 20 km from the south-western boundary of the OWF Area.

In accordance with the above description of pressure factors on phytobenthos, it will be concluded that the construction of the wind farm will have no impact on the protected species of the red algae *F. lumbricalis*, because it is located outside the construction site, and the impact of the factors above is unlikely. Possible destruction of single individuals of this species as a result of actions related with the implementation of the planned investment will not have impact on the population of this species in the PMA.

To sum up, in the OWF Area at the phase of investment construction there may be insignificant impacts on phytobenthos with a negligible scale (Table 50).

Table 50. The matrix determining the greatest significance of the impact of the Baltica OWF in the construction phase on phytobenthos

Impact significance Impact significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.4.1.2 Zoobenthos

On the basis of analysis of the literature on the subject matter, 4 basic potential factors were identified which may impact zoobenthos in the construction phase:

- disruption of seabed sediment structure;
- increase of suspended matter concentration in the sea deep;
- sedimentation of suspended matter;
- redistribution of contaminants from the sediment into the sea deep.

In accordance with the analysis of suspended matter propagation (Appendix 3) the greatest impacts are associated with for the gravity based foundations, which take up the greatest seabed area. In the case of burying cables for all types of foundations. the impacts remain the same.

Disruption of the seabed sediments structure is a factor with the strongest impact on the zoobenthos that inhabits the surface and interior of seabed sediments (Köller et al., 2006; Zucco et al., 2006; Birklund, 2007). It concerns particularly the zoobenthos species that inhabit the surface of sandy sediments, mud sediments and stony seabed, which are not able to move inside the sediments. The phenomenon of disruption of sediment structure takes place when removing dredged material for foundations and scour prevention layer, levelling the seabed and heaping the dredged material in the storage location, as well as during the operation of jack-up type installation units. This results in elimination of zoobenthos in places where the seabed is disturbed. In the case of the OWF Area, the impact on zoobenthos will be limited only to the area of works carried out on the seabed. Due to the fact that in the OWF Area zoobenthos is not unique with regard to qualitative and quantitative composition in the context of zoobenthos that inhabits the same habitats of the remaining part of sea areas (low value of the resource), the scale of impact is negligible and the zoobenthos is characterised by high capacity to rebuild its resources in a relatively short time, this impact will be considered negligible (Table 51).

Table 51. The assessment of the impact of wind power stations in the OWF Area on zoobenthos, during the investment construction phase – disruption of the seabed sediments structure

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Assessment of impact on zoobenthos
Disruption of sediments structure as a result of removing dredged material for foundations and performance of all kinds of works on the seabed related with settlement of structures (e.g. anchoring jack-up units) and laying cables	Physical damage to natural zoobenthos communities	Impact: direct simple long-term constant lasting local negative Scale of impact: negligible. Value of the resource: low Significance of impact: negligible

Source: internal data

The increase of suspended matter concentration in sea deep is a factor that is most often present during dredging works – dredging for foundations (Leonhard, 2006; Zucco et al., 2006) as well as when laying cables. Excessive suspended matter concentration in sea deep causes reduced feeding effectiveness of filtering organisms in zoobenthos as a result of clogging of the filtration system. In the case of increase of suspended matter concentration in the OWF Area, the impact zoobenthos will be negligible due to the type of sediments in the construction region – fine and medium grained sands (Appendix 1). The high dynamics of water in the area (Appendix 1) will result in fast propagation of possibly suspended solids. The result of this impact will be considered negligible (Table 52).

Table 52. Assessment of impact of wind power stations in the OWF Area on zoobenthos in the construction phase – an increase of suspended matter concentration in the sea deep

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Assessment of impact on zoobenthos
During the dredging and installation works occurs resuspension of sediments	Elevated concentration of the suspended matter causes reduced feeding effectiveness of filtering organisms (clogging) *clogging*)	Impact: direct simple short-term temporary reversible local negative Scale of impact: small Value of the resource: low Significance of impact: negligible

Source: internal data

Suspended matter sedimentation is an impact that is spatially limited to the region where works are carried on at the seabed such as e.g. when removing dredged material for foundations and its direct neighbourhood (Zucco et al., 2006). The negative character is related with zoobenthos backfilling (especially the fraction living on the surface of sediments – epifauna), which have a limited capacity to move inside sediments. In the case of an increase of suspended matter concentration in the OWF Area, the impact zoobenthos will be negligible due to the type of sediments in the construction region – fine and medium grained sands (Appendix 1). The high dynamics of water in the area (Appendix 1) will result in fast propagation of possibly suspended solids. Therefore, descending of resuspended seabed sediments on zoobenthos in the OWF Area and outside it will be local and short-term. The result of the presence of such impact will be considered negligible due to the fact that the average thickness of sediments deposited as a result of construction works in the least favourable case, which in accordance with the suspended matter modelling calculations (Appendix 3) will not exceed 1 mm in the entire Baltica OWF Area (Table 53). It should be added that many zoobenthos organisms are well adopted to survive the processes of sedimentation (e.g. those inhabiting the regions where tides occur; agitation and sedimentation of sediments may cause even 300 mm differences in the seabed level in a single cycle). Laboratory analyses indicate that different zoobenthos species survive so significant fluctuations in sediment thickness to a varying degree, but the most important factor limiting the possibility of their survival is access to oxygen dissolved in water, which is able to penetrate from 1 to 2 mm of sediment in the process of diffusion (Hinchey et al., 2006). This knowledge allows us to assume that even the organisms not able to produce energy in anoxic conditions will be able to survive being buried under a 1 mm thick layer of sediment.

Table 53. The assessment of the impact of wind power stations in the OWF Area on zoobenthos – suspended solids sedimentation

Description of the impact (based on data from the literature)	**Action of the impact (based on data from the literature)**	**Assessment of impact on zoobenthos**
Suspended matter generated as a result of resuspension of sediments during dredging works falls to the seabed	Physical destruction of zoobenthos individuals present on the seabed surface – epifauna	Impact: direct simple short-term temporary reversible local negative Impact scale: low Value of the resource: low Importance of the impact: irrelevant

Source: internal data

Redistribution of pollutions from the sediments to the sea deep is a factor with potential impact on zoobenthos (Zucco et al., 2006). It takes place as a result of resuspension of sediments during works at the seabed – during the construction of the offshore wind farm. Zoobenthos communities are then exposed to increased concentration of pollutions contained in sediments (e.g. heavy metals). Due to the fact that seabed sediments in the OWF Area are characterised by low degree of pollution (see: Appendix 1) the impact should be considered negligible (Table 54).

Table 54. Assessment of the impact of wind power stations in the OWF Area on zoobenthos in the construction phase – redistribution of pollutions from sediments to the sea deep

Description of the impact (based on data from the literature)	Action of the impact (based on data from the literature)	Assessment of impact on zoobenthos
Release of pollutions to the sea deep (e.g. heavy metals) due to resuspension of sediments	Exposure of zoobenthos communities to increased concentration of pollutions in the water	Chemical analyses of seabed sediments shown that seabed sediment is characterized by low pollution degree (see: Appendix no. 1) Impact: direct simple short-term temporary reversible local negative Impact scale: low Value of the resource: low Importance of the impact: irrelevant

Source: internal data and Dziaduch (2015)

Table 55. The matrix determining the greatest significance of the impact of the Baltica OWF in the construction phase on zoobenthos

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Analysis of pressure factors on zoobenthos at the construction phase shown that their greatest impact is identified as small in the scale of impact as well as with low value of the resource, which gives us negligible impact significance in total (Table 55). Concurrent presence of all the above-mentioned impacts will not cause noticeable results which could cause the need to increase the impact significance. It will also be noted that even concurrent presence of these impacts will be related with shift in time of maximum impacts – for instance the decrease of suspended matter concentration will be accompanied by the increase of the deposited sediment layer.

6.1.1.4.1.3 Ichthyofauna

The main impacts on ichthyofauna will be:

- emission of noise and vibrations;
- increase in the concentration of suspended matter;
- release of contaminants and nutrients from the sediment into the water deep;
- change of habitat;
- creation of a mechanical barrier.

All fish have receptors sensitive to acoustic stimuli, but their capacity to receive them varies and depends on the morphology of particular fish. With respect to hearing capacity, two groups may be differentiated in ichthyofauna. The first one includes specialised species with morphological structures that make it possible to detect acoustic pressure. It takes place through a connection of the inner ear with the swim bladder. Their vulnerability to sound reaches frequencies up to 3000–4000 Hz. Clupeids are among the representatives of this group. The second group consists of non-specialised fish who only receive the movement of water particles generated by acoustic waves. It includes species that have no swim bladder (e.g. adult flat fish) that receive sound waves only using the inner ear. Their sensitivity to acoustic stimuli reaches the frequency of 500 Hz (Popper et al. 2003).

The most important factors that influence the intensity of the impact are: the construction of the hearing organs, distance from the sound source and the characteristics of the sound that makes the impact. The degree of sensibility to acoustic stimuli may also depend on the developmental stage of a specific fish. Results may vary depending on the noise intensity and the distance between the fish and the source of noise. Table below (Table 56) presents results of noise impact on ichthyofauna.

Table 56. Results of noise impact on adult fish

Impact effect	Impact characteristics	Threshold
Death	Death due to damage resulting from exposure to sound	>203 dB re 1 μPa²s SEL_{cum}; >207 dB re 1 μPa peak
Damage to tissue; disturbance of physiology	Example damage: haemorrhage, damage to organs filled with gas, such as swim bladder and surrounding tissues	>203 dB re 1 μPa²s SEL_{cum}; >207 dB re 1 μPa peak
Damage to hearing system	Damage of hair cells, temporary (TTS)or permanent threshold shift (PTS)	186 dB re 1 μPa²s SEL_{cum} (TTS) or >203 dB re 1 μPa²s SEL_{cum} (PTS)
Behavioural changes	Disturbance of normal activities, such as: feeding, spawning, creating shoals, migration, movement from preferred areas, effect of avoidance	>140 dB re 1 μPa peak 142 dB re 1 μPa²s SEL

Source: internal data based on Popper et al., 2014

In case of larvae it was found out that the scope of impact on the TTS level will not exceed several hundreds of metres (Popper et al., 2014).

Wilhelmsson et al. (2010) estimate that the risk of death or serious injury associated with noise generated during construction occurs only on a local scale and is small taking into account the possibility of fish escape and use of mitigating actions.

During the works related with settling foundations, noise and vibrations are emitted, which may range up to 260 dB re 1 μPa²s (Wilhelmsson et al., 2010). It should be stressed that the noise reduction level planned by the Applicant is meant to limit these emissions at the source and does not expect such noise levels. In accordance with the provisions adopted in Appendix 2 for modelling noise, the noise reduction level is meant to lower the noise level at the source to the equivalent level of 210.6 dB re 1 μPa²s. Additional source of noise is increased ship traffic. Intensity of impacts depends largely on propagation of sound depending on the seabed morphology. Lethal effect may take place up to several tens of metres (Wilhelmsson et al., 2010), damage to hearing and tissue up to several hundreds of metres (Nedwell et al., 2003), therefore the effect of avoidance may appear even at a distance of more than twenty kilometres from the sound source.

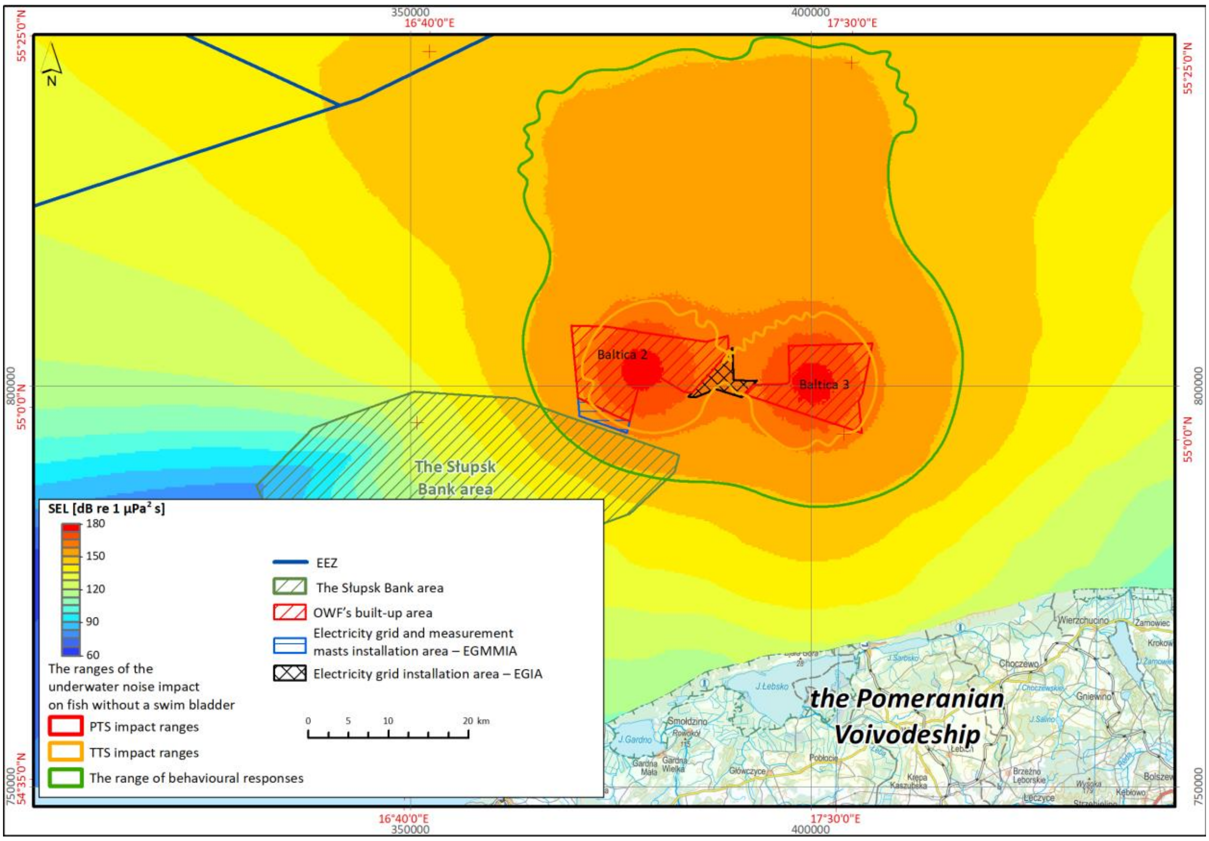
The *Effects of offshore wind farm noise on marine mammals and fish,* Thomsen et al. (2006) report indicate that the effect of avoidance does not have to be a constant process due to the acclimatisation capacity of fish and that behavioural effect differs between species and depends on physical sound properties, hydrological conditions etc. Also Rönbäck and Westerberg state in the *Evaluation of the Effect of Noise from Offshore Pile Driving on Marine Fish* report (1996) that acclimatisation of fish to noise, particularly in case it is not continuous in nature, causes the effect of avoidance to stop.

The models presenting the maximum SEL range equal 142 dB re 1 μPa^{2}s for the Applicant's variant (use of a noise reduction system) expect that the scope of impact that causes behavioural reactions will be equal 87.9 km at most. In the case of impacts of noise and vibrations that causes TTS the scope will not exceed 0.1 km in the case of a single impact and 29.5 km in case of SEL_{cum}.

Moreover, the use of the "soft start" procedure which is meant to scare ichthyofauna before starting the works from the area which is subject to impact will additionally counteract impacts that cause TTS. Due to this fact, the analysis does not include a possibility of increased ichthyofauna lethality or tissue damage.

The area of the OWF is not a place of cod spawning or a spawning ground for deep water spawning flounder, which is predominant in this area, due to the prevailing hydrological conditions. In the course of ichthyological studies, spawning of sprat and probably spawning of herring were stated. Nevertheless, the area is small compared to the vast spawning grounds of these pelagic fish.

A



B

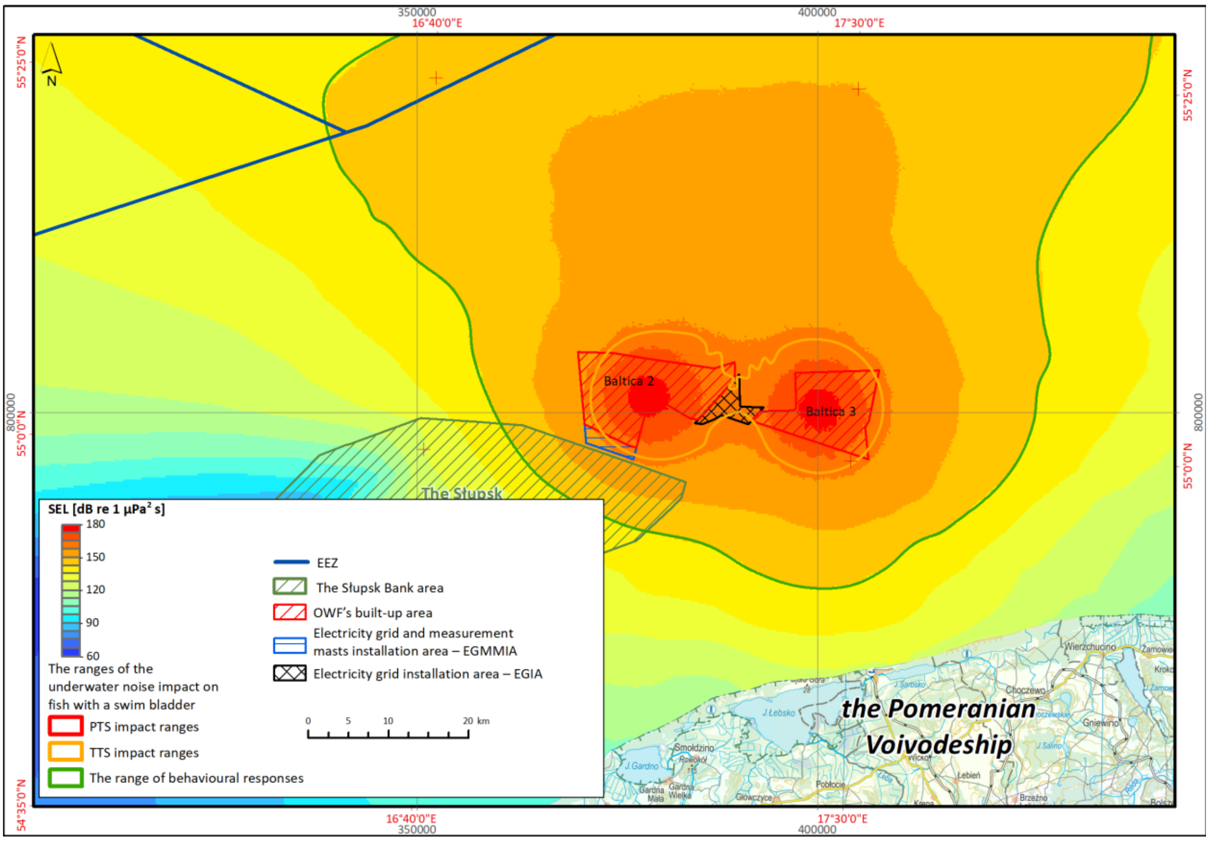


Figure 44. Map of measurement of subsea noise propagation SEL (dB re 1 µPa²s) caused by a single impact for fish for the Baltica OWF for 2 simultaneous piling works at a distance of 20 km from one another

A – fish without a swim bladder; B – fish with a swim bladder; TTS and PTS scopes for SEL_{cum}
Source: internal data

Table 57. The vibration and nose impact range for specific impact effects (Applicant's variant) for two simultaneous pilings distant by 20 km

Impact effect of the factor		SEL threshold value (dB re 1 µPa²s)	Impact range	
			Average distance [km]	Maximum distance [km]
Fish without swim bladders	Behavioural reaction	142	26.1	50.2
	TTS (single impact)	186	0.1	0.1
	TTS (SEL_{cum})	186	10.8	29.5
	PTS (single impact)	216	0.1	0.1
	PTS (SEL_{cum})	216	0.1	0.1
Fish with swim bladders	Behavioural reaction	135	38.5	87.9
	TTS (single impact)	186	0.1	0.1
	TTS (SEL_{cum})	186	10.8	29.5
	PTS (single impact)	203	0.1	0.1
	PTS (SEL_{cum})	203	0.9	1.0

Source: internal data

Criteria used to determine the significance of the resource based on Environmental Impact Assessment methods were presented in table (Table 58).

Table 58. Criteria for assessment of the significance of resources

Species	Global IUCN 2017-2	HELCOM (HELCOM, 2013)	National legislation	Importance of the resource	Rationale of the assessment
Cod	VU	VU	No legal protection	Average	Vulnerability acc. to IUCN and HELCOM
Flounder	LC	Not on the list	No legal protection	Low	
European plaice	LC	Not on the list	No legal protection	Low	
Turbot	Not on the list	NT	No legal protection	Average	Near threatened acc. to HELCOM
Herring	LC	LC	No legal protection	Average	Important for the functioning of the ecosystem
Sprat	Not on the list	Not on the list	No legal protection	Average	Important for the functioning of the ecosystem
Gobies	LC	Not on the list	Partial protection	High	Partial protection on national level
Common seasnail	LC	LC	Partial protection	High	Partial protection on national level
Salmon, sea trout	LC	VU	No legal protection	Average	Vulnerability acc. to HELCOM

Source: internal data

Table 59. Resistance of specific ichthyofauna species to noise and vibration impacts

Species	Impact resistance
Cod	Average (a fish with the swim bladder)
Flounder, plaice	High (no swim bladder)
Turbot	High (no swim bladder)
Herring	Average (a fish with the swim bladder)
Sprat	Average (a fish with the swim bladder)
Protected species (gobies, common seasnail)	High (higher resistance of larvae that in adult stages – Popper et al., 2014)
Salmonids (salmon, sea trout)	Average (a fish with the swim bladder)

Source: internal data

Noise and vibration impacts on adult fish will be: negative, direct, simple, short-term, instantaneous, reversible and regional. In the case of protected fish, during the surveys only larvae stages appeared, for which the impact will have a local character.

Table 60. Classification of noise and vibrations on fish in the Applicant's variant

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Low	Insignificant
Flounder, plaice	Low	Low	Irrelevant
Turbot	Average	Low	Insignificant
Herring	Average	Low	Insignificant
Sprat	Average	Low	Insignificant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant

Species	Importance of the resource	Impact's scale	Impact's significance
Salmonids (salmon, sea trout)	Average	Low	Insignificant

Source: internal data

During dredging and installation works, sediment resuspension takes place, which results in the increase of suspended matter concentration in water and a decrease in visibility. The vulnerability of ichthyofauna is specific for the species and stage of life. The size of impact depends on the suspended matter concentration, time of exposure and character of suspended matter particles. Increased amount of suspended matter may have a direct negative impact on the development and survival rage of eggs by inhibiting gas exchange and making discharge of harmful metabolites impossible (Chapman, 1988; Argent & Flebbe, 1999; Kiørboe et al., 1981). Such an effect was observed for pelagic eggs for values as low as 5 $mg \cdot l^{-1}$ (Rönnbäck & Westerberg, 1996). The same authors indicate a significant increase of cod larvae mortality rate at suspended matter concentrations exceeding 10 $mg \cdot l^{-1}$.

The effect of avoiding a region with elevated suspended matter concentration by herring and cod larvae was found at concentration of 3 $mg \cdot l^{-1}$.

Adult ichthyofauna stages, as opposed to a eggs and larvae more often suffer from sublethal rather than lethal impact of suspended matter. It is caused by the possibility to move to an area with a higher suspended matter content in the sea deep (effect of avoidance). The suspended matter concentration values causing an effect of avoidance of contaminated areas differ depending on the species and development stage of fish. In the case of juvenile forms of herring, the effect occurs at a suspended matter concentration of 12 $mg \cdot l^{-1}$ (Messieh et al., 1981), and in the case of adult fish, 10 $mg \cdot l^{-1}$ (Johnston & Wildish 1981). The suspended matter concentration of 10 $mg \cdot l^{-1}$ had no significant impact on distribution of fish neither after 1 day, nor after a month from the construction of the Öresund farm.

Apart from the effect of avoidance, other effects of elevated suspended matter concentration were found as well, such as disorientation, lowered reaction time, increased or decreased predation, feeding disturbances. An adverse reaction is also possible in the case of species that prefer increased turbidity level that causes a decrease of predatory pressure (Kjelland et al., 2015; ECORP Consulting, Inc. Report, 2009).

The negative impact was classified acc. to Bergström et al. (2014) as medium, while acc. to Wilhelmsson et al. (2010) as small (negative/positive impact).

The data from the literature mentioned above indicate an increase of fish larvae mortality rate at suspended matter concentrations of approx. 10 $mg \cdot l^{-1}$. In accordance with the results of model calculations of spreading suspended matter in the OWF Area carried out for gravity based foundations, such a concentration may be present during the works regarding the construction of a foundation for a wind power station on the seabed covered with cohesive soils at the least favourable conditions (maximum concentration envelope curve for the entire simulation period) at a maximum distance of 1000 m from the site of works. Assuming works are carried out simultaneously at three foundations, the total area subject to impact will not exceed 10 km^2.

Regarding pelagic eggs, the negative impact of suspended matter may be present at concentration of 5 $mg \cdot l^{-1}$. At the least favourable scenario (depth 30 < h < 45 m, cohesive soil, gravity based foundation diameter – 40 m) the impact of such concentration may include an area of approx. 20 km^2 (estimated value) around the place where the foundation is settled. Therefore it can be assumed that at simultaneous works at three foundations (assumptions of the model involve the use of a maximum three dredgers) increased pelagic egg mortality rate may occur on the area of approx. 60 km^2. When assessing the significance of this impact it must be taken into account that during the surveys that precede the Report preparation only relatively scarce presence of pelagic sprat eggs were found. The area under influence of a very negative impact of suspended matter is a very small part of vast sprat spawning areas, therefore its significance for the population of this species is not high.

An important factor determining the impact of suspended matter is the time elevated concentrations are maintained in the sea deep. The result of modelling works indicate that the, suspended matter impact on marine environment in the least favourable scenario does not last longer than 42 hours, counting from the moment the works at the seabed are started at a single foundation. Therefore, it will be a short-term impact.

The result of redeposition of suspended matter in the seabed is a new layer of sediment with thickness, according to the model calculations, may reach several millimetres within a distance of 1000 m from the site of works. It may lead to a negative impact on the common seasnail and gobies reproduction by backfilling the eggs laid by these species. However, the impact in the case of the first listed species may not be significant due to small probability of dredging works being carried out during spawning of this species from November to March, that is when unfavourable weather conditions are present. Higher probability of negative impact is present in the case of eggs of demersal sand goby, eggs of which takes place in the period between march and September. Taking into account small, area of the OWF, compared with the coastal areas and nearby Słupsk Bank which offer more favourable conditions, it can be assumed that possible impact will have a very local character.

The increase of suspended matter concentration will regard relatively small areas compared to the entire area of spawning and feeding areas. At the same time, the modelling results of suspended matter propagation in the OWF Area indicate that the increase of its concentrations in the sea deep will be short-term and local (Appendix 3).

Impact related with the increase of suspended matter concentration will be a negative, direct, local, simple, short-term and reversible impact.

Table 61. Resistance of specific ichthyofauna species to suspended matter concentration impacts

Species	Impact resistance
Cod	High (no spawning grounds in the area)
Flounder, plaice	High (no spawning grounds in the area)
Turbot	Medium (potential spawning grounds)
Herring	Medium (presence of seabed eggs)
Sprat	Medium (spawning ground, impact on eggs buoyancy)
Protected species (gobies, common seasnail)	Medium (larvae found in the area)
Salmonids (salmon, sea trout)	High (no spawning grounds – spawn in rivers)

Source: internal data

Table 62. Impact of suspended matter increase on fish

Species	Impact's scale	Impact's significance
Cod	Negligible	Irrelevant
Flounder, plaice	Negligible	Irrelevant
Turbot	Low	Insignificant

Species	Impact's scale	Impact's significance
Herring	Low	Insignificant
Sprat	Low	Insignificant
Protected species (gobies, common seasnail)	Low	Moderate
Salmonids (salmon, sea trout)	Negligible	Irrelevant

Source: internal data

During dredging and installation works the sediments will be resuspended, and pollutions (e.g. heavy metals, polychlorinated biphenyls, pesticides, petroleum products) as well as nutrients from the sediment will be released to the sea deep.

Exposure of ichthyofauna to elevated concentration of pollutions and nutrients may cause increased mortality rate and diseases (e.g. skin diseases, damage to liver and gills). Wilhelmsson et al. (2010) assess the risk of a negative impact as low and limited spatially.

The risk of release of larger amounts of harmful chemical substances from sediments (according to the HELCOM classification) is small, due to their low concentrations found in the Southern Baltic Sea sediments, confirmed by the results of surveys carried out for the investment.

Impacts related with release of pollutions and nutrients from the sediment to the sea deep will be a negative, direct, simple, short-term, instantaneous, reversible and local.

Resistance of specific ichthyofauna species to the impact related with the release of pollutions and nutrients from the sediment to the sea deep is large.

Table 63. Impact related with the release of pollutions and nutrients from the sediment to the sea deep is significant for fish

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Vulnerability of ichthyofauna to loss of habitat which may take place in the course of construction of the hard basement on the seabed depends on the species or stage of life of a fish. It is related with various habitat requirements for a given developmental stage and a given species (Wilson et al., 2010). The scale of impact is influenced by the size of the lost area, long-term character and the season when the works are carried out.

Among the species subject to assessment, the herring is the most exposed, as a fish that prefers specific habitats, characterized by shallow depth and a correct basement for attaching eggs (Kiorboe et al., 1981; Posford Duvivier Environment and Hill, 2001). Disruption of a habitat during construction works may also cause deterioration of the food supply of benthivorous fish by loss of habitat for part of organisms that inhabit the sediment (Daan et al., 1990; Cohen et al., 1980; Sissenwine et al., 1984; Jones, 1984 in: ICES, 2001).

The scale of habitat loss is defined as a percentage of seabed surface damaged during construction of the foundations and burying of cables compared to the total area of the Baltica OWF is small. Assuming the temporary loss of habitat regards a surface equal to a double total surface of gravity based foundations and surface that includes a three-metre belt along the connection cables, we get the surface of damaged seabed that equals approx. 2.3 km^2 for the Applicant's variant. This surface equals 0.5% of the total surface of the Baltica OWF Area.

A change of habitat during construction will lead to the total destruction of benthos in the areas of foundation pits and ditches where cables will be placed. This will result in depletion of food resources for benthivorous fish. The surface on which the change of habitat completely eliminates benthic organisms will be relatively small (<1% of the total investment area). Taking into account active movement of fish in search of food, such a loss of organisms included in the diet of benthivorous fish may be considered negligible.

In addition, potential limiting a fish food base due to the negative impact of the increase of suspended matter concentration in the sea deep on fish as well as impact of covering the bottom with a layer of fine sediment from the sea deep should not be significant. Assessment of zoobenthos vulnerability to both factors was assessed as small and the significance of their impact as negligible.

The impact was considered long-term and regarding relatively small areas compared to the entire area of spawning and feeding areas.

Impacts related with change of habitat will be negative, direct, simple, short-term, instantaneous, reversible and local.

Resistance of specific ichthyofauna species to impacts related with change of habitat is high.

Table 64. Impact related with change of habitat for a fish

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Construction of subsea structures may be a migration barrier for fish with routes that may pass in this location. Intense marine traffic during the construction may also enhance the above-mentioned effect. Observations carried out in the areas of Danish OWFs show that due to the possibility of active movement of fish, the above-mentioned factors do not significantly disturb the migration processes (Leonhard et al., 2011). The scale of impact will possibly have a local range and be short-term, causing only temporary avoidance of the area when the works are carried out.

Density of offshore wind power stations will be sufficiently low so that it has no impact on the migratory capacity of ichthyofauna.

Impacts related with appearance of a mechanical barrier will be negative, direct, simple, short-term, instantaneous, reversible and local.

Resistance of specific ichthyofauna species to impacts related with appearance of a mechanical barrier is high.

Table 65. Impact related with appearance of a mechanical barrier for a fish

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Table 66. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on ichthyofauna

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Ichthyofauna is subject to moderate impact of the investments in the construction phase in the OWF Area due to great significance of a receptor [justification: presence of protected species (common seasnails and gobies)] as well as small scale of impact, the assessment of which results from the impact of noise and vibrations as well as increased suspended matter concentration. It is possible that fish will be spooked by the subsea noise from the direct range of other impacts, which will diminish their significance. Since it is the underwater noise which has the greatest significance, it is assumed that during the construction phase the investment will be characterised by a moderate impact level.

6.1.1.4.1.4 Marine mammals

This section refers to impacts on porpoise and two seal species: grey seal and harbour seal. In the PMA, the third seal species found in the Baltic Sea, that is the ringed seal, is not found, therefore it was not included in the assessment because its population existing in the northern part of the Baltic Sea is outside the impact ranges of the investment. The key impact on marine mammals at the stage of construction of the planned Baltica OWF will be the subsea noise.

Hearing is the key sense for porpoise, used in most of their life functions. The hearing acuity is exceptionally good in this species and includes a very broad frequency range (Popov et al., 1986; Andersen, 1970; Kastelein et al., 2002; Kastelein et al., 2010). It has been presented in the audiogram below (Figure 45). Harbour porpoises are very sensitive to sounds in the frequency range of 10–180 kHz. It means that they are basically less sensitive to many sounds of anthropogenic origin, such as noise generated by ship traffic or piling because most energy from these emissions is included in the low frequencies range (that is below 1 kHz). Emissions generated by piling and ship traffic also generate noise in the high frequency range, which may be received by porpoises and may impact them (see: Dyndo et al., 2015).

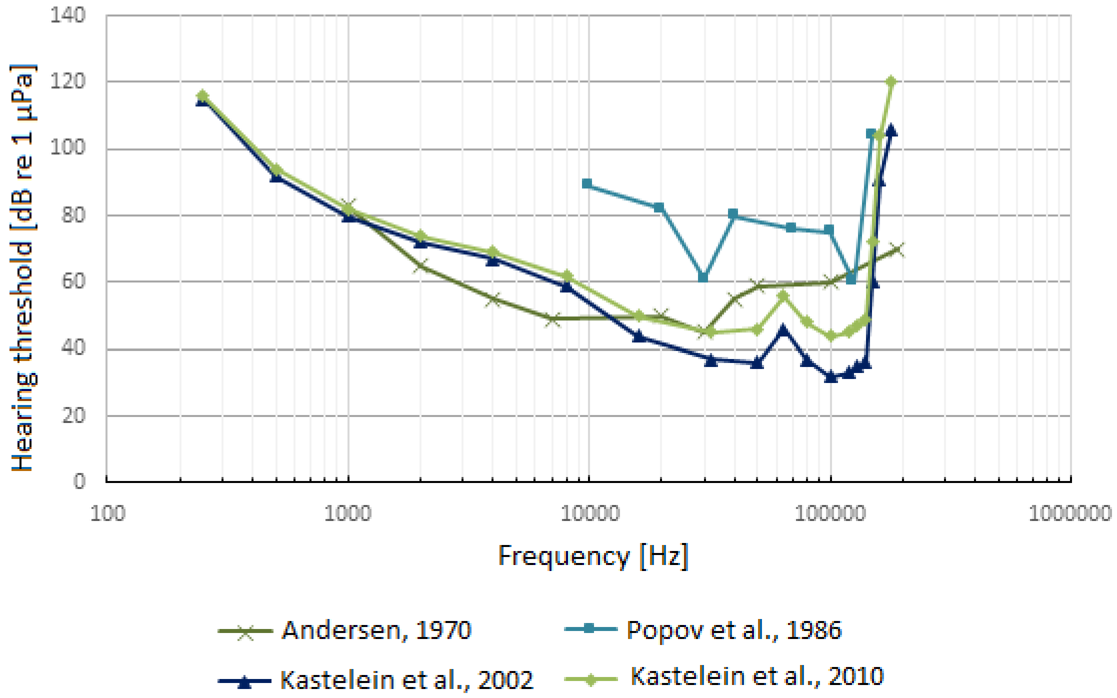


Figure 45. Audiograms of hearing thresholds for porpoises

Source: internal materials on the basis of Andersen, 1970; Popov et al., 1986; Kastelein et al., 2002, Kastelein et al., 2010

Harbour seals and grey seals are amphibious animals with good hearing both on air and underwater. Many scientific surveys were carried out on hearing of harbour seals underwater (Møhl, 1968; Terhune, 1988; Kastak & Schusterman, 1998). On the other hand, hearing capacity of grey seals underwater was surveyed only once (Ridgway & Joyce, 1975). This survey was carried out using auditory evoked potentials which are not directly comparable to psychophysical data obtained in the case of harbour seals. Schusterman (1981), however, assumes that the hearing capacity of both species may be very similar. Generally, it is recommended to apply the estimated hearing threshold of harbour seals as a conservative estimate of hearing threshold of earless seal species whose hearing was not checked in a sufficiently accurate manner (Southall et al., 2007).

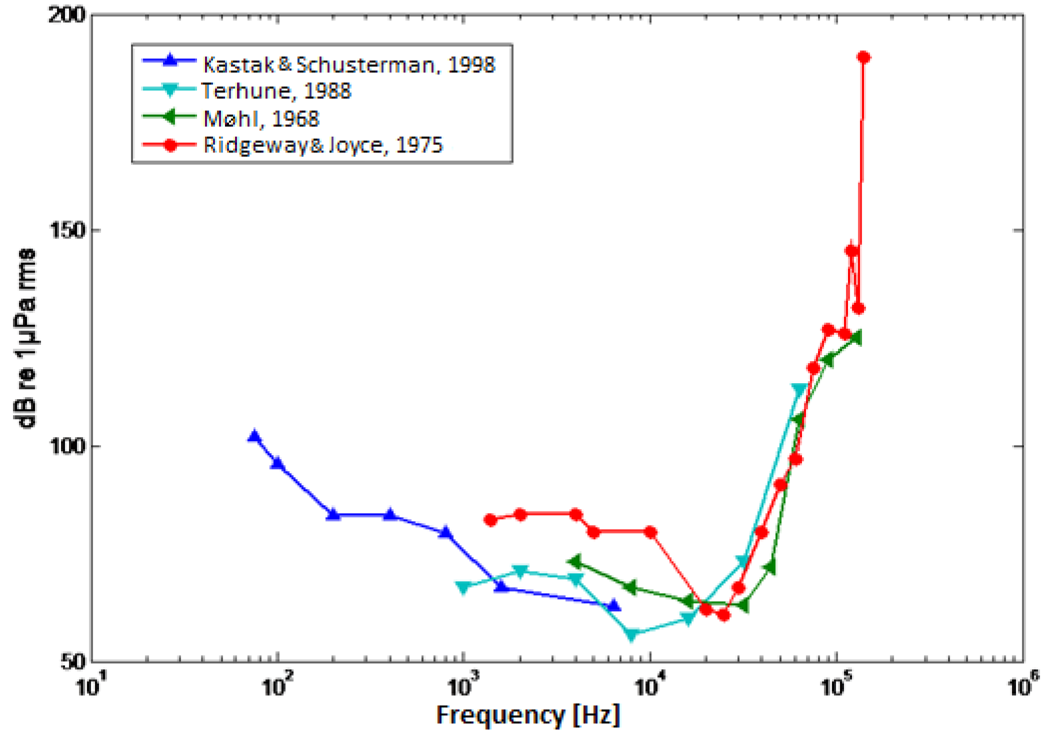


Figure 46. Audiograms of hearing thresholds for harbour seals and grey seals

Source: internal materials on the basis of Møhl, 1968; Terhune, 1988; Kastak & Schusterman, 1998 for harbour seals and on the basis of Ridgway & Joyce, 1975 for grey seals

In the appendix with the information about the subsea noise modelling results (Appendix 2) an information was included about the manner the audibility threshold were taken into consideration in calculations of impact scopes. Currently, various methods are used for calculation of actual energy for subsea sounds which may be heard by marine mammals and which have impact on these animals (NMFS, 2016). It means that not all sounds (or, more accurately, not all sound frequencies) are heard equally by animals. With the above in mind, in order to correctly assess the impact ranges, the full sound spectrum (and related sound energy) will be converted into the spectrum heard by specific organisms. Because such is the nature of sound it can be said that organisms are impacted by smaller sound energy than the total sound energy introduced to the water. In the latest guidelines regarding the inclusion of sound in environmental assessments (NMFS, 2016) several groups of marine mammals were differentiated and assigned various functions of weighing the sound energy. The region of the MFW Baltica area there are marine mammals from two groups of animals described in the guidelines – seals (PW weighing function) as well as cetaceans that use high frequency sounds (in the case of the Baltica OWF it is the porpoise and the weighing function HF). Earlier analyses used the M weighing function (proposed by Southall et al., 2007) and so far the results are often compared with the analyses to this function.

The construction of offshore wind farms potentially causes adverse effects on marine mammals. The greatest impact takes place during the construction phase, because high intensity sounds are emitted as a result of piling. Piling is the source of the greatest noise in all phases of the investment. In theory, these sounds may lead to physical damage to marine mammals remaining in the immediate vicinity of the sound source and the highest degree of this damage may be organ damage, except for the hearing organ. One of the possible forms of impact is hearing loss (permanent threshold shift, PTS). High intensity sounds during piling may also lead to temporary loss of hearing (temporary threshold shift, TTS) (Thomsen et al., 2006). Lower noise levels may cause behavioural reactions and hide significant biological signals (Figure 47). The noise is detectable for animals when its value exceeds the background noise level. The second manner of impact is caused by physical settlement of foundations for offshore wind power stations which may lead to loss or creation of new habitats as a result of creation of artificial reefs, which may impact marine mammals (Thompson et al., 2010).

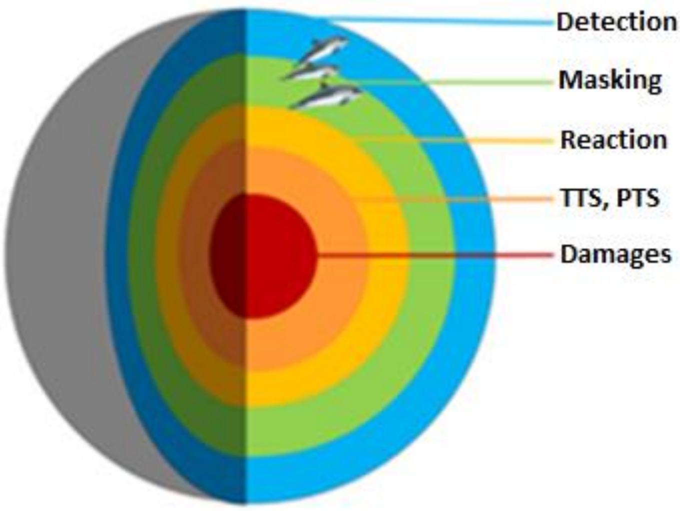


Figure 47. Zones of sound impact on marine mammals

Source: Gülce Yalçın vide Richardson et al. (1995)

The phase of construction of the offshore wind farm will have the greatest impact on marine mammals. Actions related with piling in the phase of settling the construction introduce the greatest noise in the marine environment. Therefore, the assessment of the noise impact generated at the phase of construction of the OWF Area was carried out on the basis of modelling of dispersion of sound in sea deep. During modelling, the expected sound levels generated when driving construction piles using pile drivers were considered as sources of noise.

During surveys, proofs of behavioural disruptions in animals were found, resulting from noise generated during piling, which indicate that the porpoise vulnerability zone may exceed 20 km (Carstensen et al., 2006; Tougaard et al., 2009; Brandt et al., 2011). In 2009, Tougaard et al. (2009) stated that impact on a zone at least 20 km from the source returns to the initial level after 4–5 hours after the piling is finished. In 2011, C-POD surveys on the Danish coast of the Nord See shown negative reaction to piling due to limited porpoise activity in the zone up to 18 km during the construction, compared with the initial state (Brandt et al., 2011). Brandt et al. (2011) did not indicate a negative impact on porpoises, which were recorded by a device on a C-POD station located 21.2 km from the place of piling works, which may indicate lack of behavioural reactions of individuals remaining at such distance. In 2014, Dähne et al. confirmed a 20 km behavioural impact zone during the latest survey on a German research platform Alpha Ventus (German part of the North Sea). The effect of the impact was short-term (average duration equalled 16.8 h) (Dähne et al., 2014).

Generally, impact of noise on marine mammals may be divided into five general categories which largely depend on the distance of the individual from the sound source:

- detection;
- masking;
- reaction;
- temporary or permanent hearing threshold shift (TTS, PTS);
- other damage.

The boundaries of specific impact zones are not acute and zones overlap to a large extent. Pulse noise, like one generated during piling works, causes practically no masking (Madsen et al., 2006; see: Thomsen et al., 2006b), while noise related with an increase in ship traffic may cause such an effect (Dyndo et al., 2015; Hermannsen et al., 2015).

Sounds used for underwater communication by harbour seals and grey seals overlap more with the noise related with ship traffic (Van Parijs et al., 2000), therefore masking communication signals may take place at significant distances (75 km based on values of noise from ships – Arveson & Vendittis, 2000), similarly to hearing threshold shifts (Møhl, 1968; Terhune, 1988; Kastak & Schusterman, 1998).

Lucke et al. (2009) found out that porpoises in captivity exposed to noise from areas in the air shown an effect of avoidance as received noise exposure levels in the vicinity of 145 dB re 1 μPa^2s. Research on the impacts of piling works on the behaviour of wild common porpoises confirmed these arrangements and in several cases indicated the reaction thresholds to be even lower, in the region of 140 dB re 1 μPa^2s (Brandt et al., 2011; Dähne, 2013; see: Betke, 2014).

Table 67. Research which gauged reaction of porpoises on piling works

Source	Level	Stimulus	Comments
Tougaard et al., 2009	130 dB re 1 µPa rms	Piling works- Horns Rev I I	No set threshold
Brandt et al., 2011	149 dB re 1 µPa rms	Piling works- Horns Rev II	Most probably overestimated, because the dampening impact of the reef was not taken into consideration
Tougaard et al., 2012	130 dB re 1 µPa rms	Playback (a record)	It was not actual piling
Dähne et al., 2013	140 dB re 1 μPa^2s SEL	Piling works – Alpha Ventus	Supported by aerial visual observations

Source: internal data based on Maxon et al., 2015

Research by Dähne et al. (2013) was considered the most reliable because they were based on a large and representative set of data and it was possible to determine the reaction threshold. On the basis of these studies, the reaction threshold used to estimate the behavioural reaction threshold equalled 140 dB re 1 μPa^2s SEL.

According to Southall et al. (2007) in none of the surveys there was an observed change of behaviour corresponding to strong effects of avoidance in seals. It is confirmed by the observations that both harbour seals and grey seals do not react to noise during construction in places where they go onshore and are known for their quick adaptation even to relatively high noise levels (Edrén et al., 2010). Russell et al. (2016) studied the impact of construction of an offshore wind farm with piling works on harbour seals *Phoca vitulina* in south-eastern England, an area where wind farms are constructed using pile drivers. Never in the entire construction period in question were seals observed abandoning the area. However, during piling works, the abundance of seals decreased significantly in a radius of 25 km from the piling works location [by 19 to 83% (confidence interval: 95%)], while at average 440 individuals were leaving the region. It equals a significant movement that appears when the expected levels of received noise range from 166 to 178 dB re 1 μPa(p-p). The movement persisted for no longer than two hours from the moment the piling action stopped. Southall et al. (2007) proposed a behavioural criterion based on the criterion of causing TTS; in the study in question this threshold (based on a TTS NOAA threshold) was used to carry out the assessment.

The hearing threshold shift caused in animals may lead to changes of detection threshold temporarily (TTS), or permanently (PTS). PTS caused by noise was documented only during one lab tests and it is probably not too frequent in wild populations, because in the case of most types of anthropogenic noise sources, animals must have had to be very close to the source of noise. Therefore, the hearing loss is only temporary and the animal retains its initial detection capacity after a regeneration period. Prolonged exposure to constant noise when the ear is vulnerable to acoustic pressure levels that cause TTS without any time for regeneration of hearing may cause the PTS to develop. In the case of PTS and TTS the sound intensity is a vital factor in terms of the degree of hearing loss, similarly its frequency, exposure time and the length of regeneration period (Popov et al. 2011).

Southall et al. (2017) proposed a threshold associated with PST for cetaceans such as harbour porpoise, which use echolocations sounds at high frequencies. Their experimental data referred to cetaceans that use medium frequencies (bottlenose dolphins and beluga whale) and are already not considered representative. There were no studies concerning the common porpoise, but in studies carried out in 2009 Lucke et al. (2009) also measured TTS also in this species which was exposed to single sound pulses from an air cannon. The threshold value of TTS equalled 164 dB re 1 $\mu Pa^2 s$ SEL (TTS = 6 dB, hearing regeneration took place after >4 h). At TTS reaching 6 dB the distance from which the animal hears sound with a frequency of TTS is shortened by half. Popov et al. (2011) studied TTS in another porpoise species – finless porpoise (*Neophocaena phocaenoides asiaeorientalis*). At prolonged exposure (30 min) to sound between 32 and 128 kHz, TTS appeared at acoustic pressure levels equal to 140 dB re 1 μPa (Popov et al., 2011). The quoted authors were able to cause very high TTS levels (45 dB) with noise exposure in the octave band with a middle frequency of 45 kHz. Audiograms indicate that porpoises hear much better at frequencies of 45 kHz than at lower frequencies generated during piling works. Therefore, the threshold proposed in the studies above most probably does not take into account the threshold of causing PTS by noise generated by piling works. Therefore the value used by Maxon et al. (2015) was not used in this study.

In the case of the common porpoise, TTS occurs at frequencies close to the main frequency of the noise that has impact both in the case of continuous tones (Kastelein et al. 2013), but also pulse noise with low frequency (Lucke et al., 2009). Noise generated during piling works is a broadband noise, but most of the energy is at low frequencies (that is <1 kHz). Nothing supports theory that TTS at these frequencies impacts the navigation and food seeking capacity of porpoises using echolocation (the frequency of common porpoise clicks have a frequency of approx. 130 kHz) (Villadsgaard et al., 2007). Potentially, the capacity of detecting ships that emit low frequency sounds is lowered in these animals. Most noise generated by ships has a much lower frequency than 1 kHz, at which the porpoise hearing is weak, therefore it is hard to assess the biological significance of TTS at frequencies this low. Results obtained by Lucke et al. (2009) may be referred to piling works because in these studies the TTS caused by exposure to single air cannon pulses were measured. In the latest research carried out using multiple exposures to air cannons, much greater thresholds that initiate TTS were found than the one measured by Lucke et al. (2009) (Lam et al., 2017).

Kastak et al. (2008) caused PTS in harbour seals as a result of an error in research. Correlating this result win the second experiment by Kastak, Maxon et al. (2015) indicates the threshold of PTS occurrence in seals in the region of 200 dB re 1 μPa²s. Southall et al. (2007) suggest that in seals, TTS appears in the presence of noise of a weighted value M (proposed by Southall et al., 2007) which equals 171 dB SEL, while it was not a direct measurement, but only extrapolation from the TTS thresholds for bottlenose dolphins and beluga whales. Kastelein et al. (2012) proposed as a result of direct measurements a TTS threshold for seals as a non-weighted value equal to 169–176 dB SEL. Earlier on Kastak et al. (2005) measured the threshold for a harbour seal and proposed a TTS occurrence threshold to be a non-weighted value equal to 182 dB SEL. Maxon et al. (2015) suggested that all the measurements proposed above are taken into account and proposed the use of an average from these results as an impact criterion (176 dB re 1 μPa²s).

The results presented above indicate that there is a significant uncertainty regarding the criteria of noise exposure for marine mammals. It should be stressed that newer studies are not necessarily more complete, even if they concern relevant species. All TTS studies are carried out in controlled environments (e.g. pools or port pens). It is very likely that in all such conditions animals were exposed to a full spectrum of the test sound, including higher frequencies. In nature, these higher frequencies, which most probably are the cause of impact hearing, are in most cases largely reduced after several kilometres from the sound sources. As a result, sound on similar levels may cause impacts in nature which differ greatly from the impacts in the experiment. To sum up, the exposure criteria must take into account the dependency of hearing sensitivity and sounds of different frequencies.

The results presented above and other arrangements were used in a recently published broad overview compiled by the NOAA agency. Based on this overview, NOAA developed recommendations regarding specification of PTS and TTS thresholds in marine mammals that differ in hearing characteristics [in accordance with the classification from Southall et al. (2007)]. The NOAA criteria are based on weighing functions which were not used so far, that is considering a different loudness perception criterion for various sound frequencies. These criteria will be treated as the most versatile and therefore they were used in this Report.

Table 68. The overview of noise exposure criteria used to calculate impact ranges

Source	**Impact**	**Marine mammal**	**Modelled sound type**	**Noise exposure level (weighted SEL) [dB re 1 μPa²s]**
NOAA (National Marine Fisheries Service, 2016)	PTS	Common porpoise	A single impact and SEL_{cum}	155
	TTS	Common porpoise	A single impact and SEL_{cum}	140
	PTS	Harbour seal	A single impact and SEL_{cum}	185
	TTS	Harbour seal	A single impact and SEL_{cum}	170
Maxon, Thomsen i Schack (2015)	Behaviour	Common porpoise	Single impact	140 (non-weighted SEL)
NOAA (National Marine Fisheries Service, 2016)	Behaviour	Harbour seal	Single impacts	170

PTS – permanent hearing threshold shift, TTS – temporary hearing threshold shift, SEL – noise exposure level, multiple pulses – a series of subsequent pulses
Source: internal data

The impact range of noise generated in the Baltica OWF Area on porpoises

Noise impact ranges that cause behavioural reactions, TTS and PTS in porpoises were modelled taking into account the noise reduction system. As shown in the figure (Figure 48) and also in the table below (Table 69), the range of behavioural reaction equals between ten and twenty kilometres in directions at which the shape of seabed blocks sound propagation, but reaches up to 59.9 km for a sound channel towards north-east. Average range of behavioural reactions equals 29.7 km. The range of TTS for SEL and SEL_{cum} is respectively 1.2 and 23.5 km on average, and the maximum values of 1.8 and 38.5 km. The PTS range is smaller than TTS and does not exceed 28.7 km for SEL_{cum}.

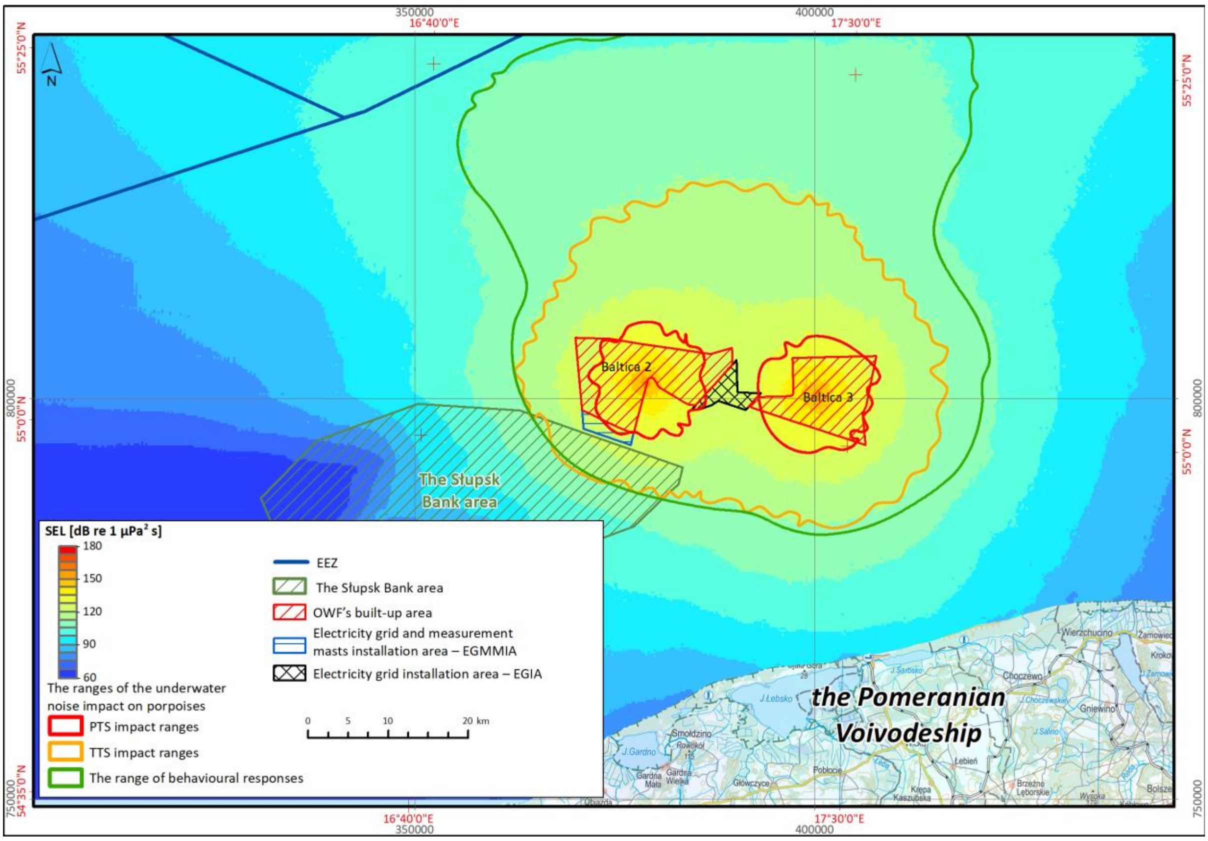


Figure 48. Map of noise propagation for the weighted SEL level of a single impact after the application of the noise reduction system for emissions from the Baltica OWF along with threshold values for porpoises – 2 piling works simultaneously at a distance of 20 km from each other

Impact ranges of TTS and PTS for SEL_{cum}
Source: internal data

Table 69. Noise impact scopes for porpoises in the Baltica OWF

Impact	SEL threshold value [dB re 1 µPa²s]	Average impact range [km]	Maximum impact range [km]
Behavioural reaction	140	29.7	59.9
TTS (single impact)	140	1.2	1.8
TTS (SEL_{cum})	140	23.5	38.5
PTS (single impact)	155	0.1	0.1
PTS (SEL_{cum})	155	10.2	28.7

The threshold SEL value refers to the weighed SEL outside the threshold values for behavioural reaction which refer to non-weighted SEL
Source: internal data

The impact range of noise generated in the Baltica OWF Area on grey seal and harbour seal

The range of behavioural reaction is smaller than 0.1 km in all directions (Figure 49). The range of TTS for SEL and SEL_{cum} is 0.1 and 5.6 km, and the maximum distances are 0.1 and 6.7 km. The PTS range is smaller than the TTS range and shows an almost entirely round shape around the source with a radius no greater than 0.8 km for SEL_{cum}. The table presents the noise impact ranges on seals (Table 70).

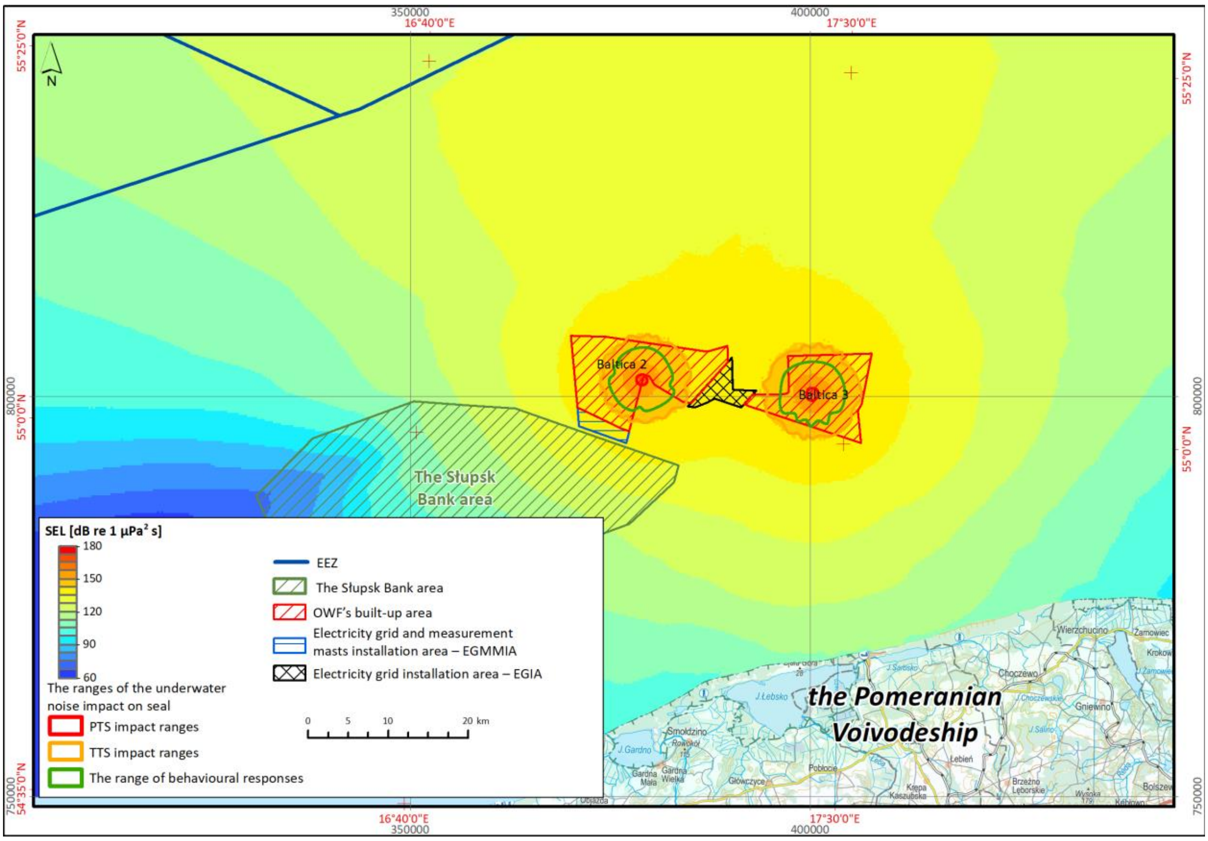


Figure 49. Map of noise propagation for the weighted SEL level of a single impact after the application of the noise reduction system for emissions from the Baltica OWF along with threshold values for harbour seal – 2 piling works simultaneously at a distance of 20 km from each other

Impact ranges of TTS and PTS for SEL_{cum}
Source: internal data

Table 70. The noise ranges on impact on harbour seal and grey seal in the Baltica OWF after applying the noise reduction system

Impact	**Threshold value SEL [dB re 1 µPa²s]**	**Average impact range [km]**	**Maximum impact range [km] (in a north-eastern direction from the OWF Area)**
Behavioural reaction	158	8.0	9.0
TTS (single impact)	170	0.2	0.2
TTS (SEL_{cum})	170	11.2	13.4
PTS (single impact)	185	0.2	0.2
PTS (SEL_{cum})	185	1.4	1.6

Source: internal data

Percentage of marine mammals vulnerable to impact of the noise generated in the Baltica OWF Area

During the entire study period, a total of three seals were observed. One was classified as grey seal, two remained unidentified. Very low density of grey seal in the area indicates that the number of vulnerable animals is very low, except for vulnerability to TTS in the case of accumulation of impacts, which may influence animals at a distance up to 13.4 km from the construction site. In correlation with relatively large abundance of Baltic Sea population – 32,000 individuals (HELCOM, 2013), the impact on these animals will most probably still be very small.

The total number of harbour seal individuals in the area of the Baltic Sea is relatively low and estimates show 1563 individuals on the west Baltic Sea shore (NOVANA population monitoring, commission led by Jonas Teilmann). Most of these animals rest onshore west from the area of the designed OWFs in Falsterbo, Saltholm and Bøgestrømmen and most probably do not move more than 50–100 km from their onshore rest spots (Olsen et al., 2014). Percentage of animals affected by any impact related to construction is therefore very low.

In order to estimate the percentage of population of vulnerable porpoises, modelling of impact areas was used (affected area). Its shape and dimensions were determined by maximum impact ranges. Then the number of animals which may be affected by the impact, based on density estimates in the SAMBAH study. It was not possible to estimate the number of animals on the basis of surveys carried out for the purposes of the project, due to a very low number of observed animals. Due to a very large discrepancy in estimates, the lower confidence level was used (95% CI 80–1091), drafted in the SAMBAH project. The percentage of vulnerable animals was calculated by dividing the number of vulnerable animals (lower and upper confidence level) by the general number of individuals (lower and upper confidence level). Results were presented in table (Table 71), which shows which part of porpoise population may be covered by impact during the construction of the Baltica OWF. The percentage of animals affected by TTS and PTS equals at most 1.7% and 0.36% respectively, which in a worst case scenario may be considered an impact of moderate significance.

Table 71. The estimated number of porpoises affected by the impact of noise generated at the construction phase of the Baltica OWF for two simultaneous piling works at a distance of 20 km from one another

Effect	**Vulnerable area [km^2]**	**Estimated number of animals from the Baltic Sea population (NE) [individuals]**	**Estimated density in the modelled area [individuals/km^2]**	**Number of affected animals in the modelling area**	**Percentage of affected animals in the population**
Behavioural reaction	3460	80-1091	0.00060-0.00823	2.3*; 32.1**	2.9
TTS (single impact)	4.5	80-1091	0.00060-0.00823	0.5*; 7.4×10^{-2}**	6.8×10^{-3}
TTS – accumulated 1 h impacts	1662	80-1091	0.00060-0.00823	1.3*;18.3**	1.7
PTS – single impact	0.1	80-1091	0.00060-0.00823	0.4*; 4.9×10^{-4}**	4.5×10^{-5}
PTS – accumulated 1 h impacts	284	80-1091	0.00060-0.00823	0.3*; 3.9**	0.36

**Lowest estimates*

***Conservative estimates*

Source: internal data

Noise caused by dredging works on the seabed

The noise levels caused by subsea works are much lower than in the case of pile driver operation, but because the dredging noise is continuous to varying extents, and the piling noise is interrupted (pulse length = 50 ms), they cannot be compared. However, it is obvious that if porpoises do not spend too much time in the vicinity of a dredger, there will be no physical harm as a result of noise impact (WODA, 2013).

The latest studies carried out by Diedrichs et al. (2010) shown that porpoises temporarily avoided the sand extraction area at the Sylt island in Germany. Diederichs et al. used C-POD devices in their studies. When a dredging ship was closer than 600 m from a C-POD device, the interval to the nearest porpoise detection was three times longer (compared to the time when there was no sand extraction). After the ship departed, the natural level of clicks was recorder. The results of studies are significant because the level of the noise emitted by the dredger was recorded as well (see: Itap, 2007). Due to differences in sound transfer between locations, the distance of 600 m is vital only for this specific dredging project and may not be applied generally for other projects involving dredging works.

Visual surveys using planes did not document any negative impacts of this process (Diederichs et al., 2010). Other studies on bottlenose dolphins shown that intensive dredging processes caused the dolphins to spend less time in the area or works due to high degree of interference, despite significant meaning of the area as feeding grounds (Pirotta et al., 2015).

Noise generated by ship traffic

One of the analysed issues is an increasing noise level in the surroundings due to increased ship activity in the OWF construction period. It may impact behaviours of marine mammals and mask their communication signals. Ship noise may cause stress, which in turn brings physiological effects, (such as TTS), which may cause deterioration of marine biota health (Tasker et al., 2010). During the construction, ship traffic, both for small and large vessels, will increase. This additional noise will increase the general background noise level.

Large, slowly sailing ships will not cause a significant increase of acoustic noise in frequencies relevant for porpoises and seals, because the main acoustic energy generated from larger ships is generally below 1 kHz (Richardson et al., 1995; McKenna et al. 2012). For small, agile ships, a significant portion of energy may be generated at frequencies ion the scope which can be heard by porpoises and seals (OSPAR, 2009). Compared to piling, the levels of noise generated by any ship are lower. It is also possible, that there will be a behavioural reaction of marine mammals and that they will leave the built-up area for as long as the piling works continue. Most probably, the noise generated during transport will have no significant impact on marine mammals in the Baltica OWF Area.

Increased ship traffic intensity

Increased ship traffic with regard to subsea works potentially increases the risk of collisions of marine mammals with water crafts. Ship collisions take place more often when colliding with large whales. There is data that suggests that it may be a significant mortality factor for small cetaceans in areas with high ship traffic areas (Van Waerebeek et al., 2007). The risk of collision with a water craft increases with the ship speed (Carrillo & Ritter, 2010). Ship collisions with seals are not well documented. The Baltica 2 and Baltica 3 Areas have very low density of marine mammals, therefore their risk of being hit by ships is minimal.

Suspended matter from sediments in sea deep (resuspension)

A significant problem that arises during construction of offshore wind farms is the phenomena of seabed sediments resuspension in the sea deep. Laying cables on the seabed and settlement of foundations of offshore wind power stations increases the turbidity of water and reduces its clarity. Particularly the gravity based foundations generate a large amount of suspended solids because it requires dredging in order to reach the correct basement as well as seabed levelling works (Reach et al., 2012).

Marine mammals inhabit the environment characterized by small water clarity because they do not need sight to produce images of their surroundings or gather food (Au et al., 2000). The increase of the turbidity of water will therefore have a negligible impact on marine mammals. Sometimes, insignificant impacts may be experienced by marine mammals with no echolocation and therefore they may have a hindered capacity to gather food or escape from predators (Nairn et al., 2004); there are no direct proofs of such negative impacts. It was also shown that blind seals feed in the same areas as healthy ones. It demonstrates that they do not use their sight when feeding (McConnell et al., 1999). The increase of water turbidity will have a minimum impact on their capacity to perform daily life functions. Therefore, even though direct impact of suspended solids on porpoises and seals was not yet defined, there may be an intermediate effect via potentially negative effects for species that are eaten by marine mammals (and their habitats). It should be noted that apart from changes in benthos habitats and possible changes in the food chain, there may also be an increase in pollution caused by resuspension of pollutions deposited in the seabed sediments.

It is likely that the sediment resuspension will have a very small impact on marine mammals, both in terms of impact on navigation and increased release of pollutants into sea deep, even more so because, as shown by the sediments examinations for the needs of the project, the sediments are not polluted.

Pollutants

Another environmental issue which may appear during construction is the increase of the contamination level caused by an increased ship traffic or release of pollutions from the seabed sediments. Since the construction should not cause a release of harmful chemicals which could be hazardous for porpoises of seals, the impact in question is not very likely, even more so, because, as shown by the sediments examinations for the needs of the project, the sediments are not polluted. The increased ship traffic during construction may lead to the increase of pollution dump to the water from the exhaust gas system and increase the risk of oil leaks due to ship collision. It may have a negative impact on the marine environment. Because the probability of such event is low and the density of mammals is small, therefore the general hazard for marine mammals related with the increase of pollutions during the construction of the Baltica OWF will probably be very insignificant.

Changes in a habitat

Settlement and construction of foundations, power substations and laying power cable change the seabed in the Baltica OWF Area and along the cable line down to the power substation. Physical damage to the seabed may cause the loss of benthic fauna habitats (soft seabed species) and a temporary loss of benthic biomass.

The results of monitoring for Danish offshore wind farms show that benthic biomass and abundance of fauna within the boundaries of wind farms drop only at the construction phase and then increase.

The main reason is the increased seabed diversity. New habitats will appear on hard seabed around structures and foundations of offshore wind power stations, which causes new habitats to appear, which are a mix of sandy and hard seabed habitats (Bioconsult, 2005). The results show also that recolonisation of soft seabed takes place relatively quickly (within 5 years), but the actual time depends on the benthic fauna structure (species composition, abundance and biomass). Temporary loss of benthic fauna biomass may have an indirect impact on marine mammals which may use this area as feeding grounds, but it does not concern the area of the Baltica OWF. Because general biomass and abundance of benthic fauna undergoes no significant change, the indirect impact is generally considered to be a short-term one.

The obtained results of impact assessment were presented below in the table (Table 72). In the case of porpoises, the possibility of PTS as a result of accumulated noise impact was estimated as medium, because the exposure scale has a local character. Only 0.37% of population may find itself in the impact range, therefore the impact scale has only a local significance, provided it exists at all. The scope of possible presence of TTS is regional, which leads to small scale of the impact. The scale of impacts on harbour and grey seals is also small.

Table 72. Impact on marine mammals at the phase of construction of the Baltica OWF

Species	Impact	Impact range	Duration	Impact long-term character	Reversibility	Impact's scale	Impact's significance
Porpoise Phocoena phocoena	Single PTS	Local	Long-term	Repeatable	Irreversible	Low	Moderate
	Accumulated PTS	Local	Long-term	Repeatable	Irreversible	Low	Moderate
	Single TTS	Local	Short-term	Repeatable	Reversible	Low	Moderate
	Accumulated TTS	Regional	Short-term	Repeatable	Reversible	Low	Moderate
	Behavioural reaction	Regional	Short-term	Repeatable	Reversible	Low	Moderate
	Shipping noise	Local	Short-term	Temporary	Reversible	Low	Moderate
	Sediments resuspension	Local	Instantaneous	Temporary	Reversible	Low	Moderate
	Changes in the environment	Local	Long-term	Constant	Irreversible	Low	Moderate
	Collisions of vessels	Regional	Short-term	Constant	Irreversible	Low	Moderate
Harbour seal Phoca vitulina and grey seal Halichoerus grypus	Single PTS	Local	Long-term	Repeatable	Irreversible	Low	Insignificant
	Accumulated PTS	Local	Long-term	Repeatable	Irreversible	Low	Insignificant
	Single TTS	Local	Short-term	Repeatable	Reversible	Low	Insignificant
	Accumulated TTS	Local	Short-term	Repeatable	Reversible	Low	Insignificant
	Behavioural reaction	Local	Short-term	Repeatable	Reversible	Low	Insignificant
	Shipping noise	Local	Short-term	Temporary	Reversible	Low	Insignificant
	Sediments resuspension	Local	Short-term	Temporary	Reversible	Low	Insignificant
	Changes in the environment	Local	Long-term	Constant	Irreversible	Low	Insignificant
	Collisions of vessels	Regional	Short-term	Constant	Irreversible	Low	Insignificant

Source: internal data

The significance of grey seal and harbour seal is assessed as medium, taking into account their protection status and number. Porpoises are assessed as having a large significance due to their protection status, as well as their critically endangered status, even though their presence in the Baltica OWF Area will be considered small (Table 73).

Table 73. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on marine mammals

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.4.1.5 Seabirds

The description of potential impacts of the OWF on seabirds is based on scientific publications and reports from pre- and post-investment surveys carried out in the region of existing wind farms (Erickson et al., 2001; Christensen et al., 2003; Christensen et al., 2004; Kahlert et al., 2004a, b; Petersen et al., 2004; Desholm & Kahlert, 2005; Fox et al., 2006; Hüppop et al., 2006; Petersen et al., 2006; Everaert & Stienen, 2007; Blew et al., 2008; Drewitt & Langston, 2006; Krijgsveld et al., 2011; Leopold et al., 2011; Cook et al., 2012).

The Environmental Impact Assessment of the Baltica OWF also includes birds which reminded in the surveyed sea area (were sitting on the water) instead of only flying over it. The assessment of impact on birds that fly over was carried out regarding the results of migratory birds. The OWF impact assessment considers the most abundant seabird species, the share of which in the abundance of the entire bird group reached at least 1.0% in at least one phenological phase, in at least one of surveyed sea areas (OWF or the Słupsk Bank area). The analysis also includes one species of waterbird (common gull) for which the percentage share in the bird group was significant (4.2% in the summer period in the OWF Area) and exceeded 1% of the group abundance. The assumed threshold value (1% of bird groups) does not concern the species listed in the Appendix I of the EU Birds Directive (European Parliament and Council Directive 2009/147/WE of 30 November 2009 *on conservation of wild birds*), and the ones with an elevated endangerment category (vulnerable, endangered or critically endangered with extinction) pursuant to the International Union for Conservation of Nature (the IUCN Red List of Threatened Species. Version 2017-2). Such species were taken into account in this assessment regardless of the number of individuals found out.

From 10 species included the Environmental Impact Assessment, both loons species show the greatest vulnerability to the presence of the offshore wind farm. They are characterised by very low manoeuvrability in air (Man = 5), high timidity (Dsc = 4) and are assigned with high protection priority (PP = 5). Relatively high values of vulnerability indicator (higher than the average of 22.74) were also awarded to velvet scoter and long-tailed duck. In the case of velvet scoters it results mainly from high protection priority of Baltic Sea populations (PP = 5), high vulnerability to being scared off (Dsc = 5) and a narrow spectrum of inhabited habitats outside breeding season (Ea = 4). Compared to velvet scoter, long-tailed duck is less vulnerable to being scared off (Dsc = 3), therefore its sensibility to the presence of wind farms is lower. The remaining species demonstrate much smaller degree of sensitivity to the presence of offshore wind farms. Assessment of sensitivity of surveyed species is included in the table below (Table 74). Such sensitivity assessment method was used successfully in order to assess the impact of the BŚII and BŚIII OWFs on seabirds (Meissner, 2015c).

Table 74. The list of seabird species taken into account in the Environmental Impact Assessment along with assessment of their sensitivity (SSI) to the presence of the offshore wind farm

Species	Binomial nomenclature	Man	Hg	ShT	Fn	Dsc	Ea	Pop	Sr	PP	SSI
Long-tailed duck	*Clangula hyemalis*	3	3	2	3	3	4	2	2	5	28.9
Velvet scoter	*Melanitta fusca*	3	1	2	3	5	4	3	2	5	33.8
Razorbill	*Alca torda*	4	1	1	1	3	3	2	5	2	15.8
Common murre	*Uria aalge*	4	1	1	2	3	3	1	4	1	12.0
European herring gull	*Larus argentatus*	2	4	2	3	2	1	2	5	1	11.0
Common gull	*Larus canus*	1	3	2	3	2	2	2	2	4	2.0
Little gull	*Hydrocoloeus minutus*	1	1	3	2	1	3	5	2	4	12.8
Lesser black-backed gull	*Larus fuscus*	1	4	2	3	2	1	4	5	2	13.8
Black-throated loon	*Gavia arctica*	5	2	3	1	4	4	4	3	5	44.0
Red-throated loon	*Gavia stellata*	5	2	2	1	4	4	4	3	5	43.3

Assessment components – all components were assessed in a scale from 1 (smallest sensitivity) to 5 (greatest sensitivity) – vale scales explained in Garthe and Hüppop (2004) and Furness (2013):
Man – Capacity to effectively manoeuvre in air
Hg – Height of movement above the water
ShT – Share of time spent in the air
Fn – Presence of night flights in a typical behaviour
Dsc – Degree of being scared by offshore wind farms and ship traffic related with their operation
Ea – Ecological amplitude for a species
Pop – Size of the biodemographic population
Sr – Yearly survival rate of adult individuals
PP – Protection priority
Source: internal data on the basis of Garthe and Hüppop (2004) and Furness (2013)

Seabirds are primarily vulnerable to three types of impacts related with construction, exploitation or decommissioning of the offshore wind farm: loss/change of habitat, collision risk and presence of a barrier effect. Impacts related with the construction and decommissioning phase are similar.

Apart from the above-mentioned sensitivity index (Table 74), based on the publication by Garthe and Hüppop (2004) and Furness (2013) a sensitivity index for staging birds quoted from Langston (2010) was presented, as well as guidelines of the European Commission “Wind Energy Developments and Natura 2000” (2011) (Table 75).

Table 75. The sensitivity of assessed seabird species to potential OWF impacts

Species	Binomial nomenclature	Index of sensitivity to wind farms (SSI)	General risk index (Langston 2010)*	Sensitivity to offshore wind farms (EC guidelines, 2011)			
				Forcing out of a habitat	Collision	Barrier effect	Change in habitat structure
Long-tailed	*Clangula hyemalis*	28.9	**	XX	X	X	X

Species	Binomial nomenclature	Index of sensitivity to wind farms (SSI)	General risk index (Langston 2010)*	Sensitivity to offshore wind farms (EC guidelines, 2011)			
				Forcing out of a habitat	Collision	Barrier effect	Change in habitat structure
duck							
Velvet scoter	*Melanitta fusca*	33.8	**	XX	X	X	X
Razorbill	*Alca torda*	15.8	**	XX	X	-	X
Common murre	*Uria aalge*	12.0	**	XX	X	-	X
European herring gull	*Larus argentatus*	11.0	**	-	x	x	-
Common gull	*Larus canus*	12.0	**	-	-	-	-
Little gull	*Hydrocoloeus minutus*	12.8	?	-	-	-	-
Lesser black-backed gull	*Larus fuscus*	13.8	***	-	-	-	-
Black-throated loon	*Gavia arctica*	44.0	***	X	X	-	-
Red-throated loon	*Gavia stellata*	43.3	***	XXX	X	-	-

*According to a general risk index by Langston: *small risk, **moderate risk, ***high risk, ? undefined*
In the European Commission guidelines: XXX – proof of significant risk of impact, XX – proof or indication of a proof of impact, X – potential risk of impact, x – small or non-significant risk of impact
Source: internal materials based on Langston (2010) and guidelines of the European Commission "Wind Energy Developments and Natura 2000" (2011)

Based on the calculation of the SSI value, the sensitivity of specific environment resources (seabird species) to OWF impacts was specified and presented in the table above (Table 76). **Resource sensitivity** to OWF impact was classified as low, if the SSI value does not exceed 20, as **medium** for the SSI scope from 20.1 to 40, high for the SSI scope from 40 upwards, which complies with the results of studies in the North Sea (Garthe & Hüppop, 2004). Six species included in the EIA were assigned low sensitivity to the OWF impact, two of them were assigned medium and two – high. The determination of resource sensitivity classified this way was included in the matrix used to determine the significance of the OWF impact on seabirds. It is a deviation from the framework method assumed in this EIA Report used to determine the significance of the OWF impact on specific elements of the environment, because for other elements of the environment, the value of the resource or the significance of the receptor was included in the matrix for determining the impact significance. The significance of each bird species (receptors/resources), which was included into the OWF impact analysis was also specified. The significance of specific bird species was expressed in its protection status (protection priority for species was described on the basis of the current provisions of law and current lists that define the degree of species endangerment), but mainly in its abundance found in the surveyed sea area. Both the protection statuses (priority) of specific bird species as well as their abundance in the surveyed sea area were described in this Report. The key role in the analysis of the OWF impact on the seabird species is their sensitivity to bird species impacts. The significance of specific receptors was taken into account when determining the scale of each impact. The greater the abundance of a specific species found in the surveyed sea area and the greater its protection priority (highest protection priority at strict species-specific protection, presence of the species in the list in Appendix I of the EU Birds Directive, SPEC2 category according to BirdLife International 2004 – the highest category SPEC 1 not among the analysed species, VU category – vulnerable according to the national IUCN list, version 2017-2), the higher the scale of the impact on this receptor. It should be borne in mind that when determining the scale of a given impact of the OWF on seabirds, the characteristics and intensity of this impact were taken into account. With the significance of specific receptors in mind, however, their sensitivity to OWF impacts had to be considered because even seabird species which are abundant in the surveyed sea area (e.g. European herring gull) may however not be exposed to the OWF impacts to a large extent due to their small sensitivity to it. On the other hand, bird species sparse in the surveyed sea area (e.g. black-throated loon, red-throated loon) may indicate large sensitivity to OWF impacts. Therefore, the assessment of OWF impact on seabirds included their sensitivity to these impacts.

Table 76. Determination (based on the SSI factor) of the sensibility of specific seabird species to OWF impacts

Species	Binomial nomenclature	Index of sensitivity to wind farms (SSI)	Sensitivity of the resource
Long-tailed duck	*Clangula hyemalis*	28.9	Average
Velvet scoter	*Melanitta fusca*	33.8	Average
Razorbill	*Alca torda*	15.8	Low
Common murre	*Uria aalge*	12	Low
European herring gull	*Larus argentatus*	11	Low
Common gull	*Larus canus*	12	Low
Little gull	*Hydrocoloeus minutus*	12.8	Low
Lesser black-backed gull	*Larus fuscus*	13.8	Low
Black-throated loon	*Gavai arctica*	44	High
Red-throated loon	*Gavia stellata*	43.3	High

Source: internal data

For the purposes of determination of the scale for the given impact on seabirds the so-called exposure scale was defined, which expresses the impact range. **The impact scale is determined as local**, in case of forecasting that the impact of the planned OWF will concern a sufficiently small number of individuals of the given seabird species that it is not significant against the background of broader (than the one present in the OWF Area and in its immediate vicinity) biogeographic population of this species. **The impact scale was defined as regional** in the case where a given OWF impact may concern a significant part of the biogeographic population of the given seabird species, due to its numerous presence in the region of the investment.

It should also be noted, that apart from emissions and environment disturbances typical for OWF (which can be predicted), at each phase of the investment, unplanned emissions may occur such as contamination of sea deep and seabed sediments with petroleum substances (during a normal and emergency operation), anti-fouling agents, accidentally released municipal waste or domestic sewage, chemicals and waste originating from the farm construction, operation or decommissioning. They will indirectly affect living organisms, including seabirds.

At the construction phase, it may be expected that the birds will be scared away from the works site. The radius of this impact depends both from the bird species and the noise level and the frequency of traffic of water crafts and helicopters. The impact of the wind power station at the construction phase will change with the construction of subsequent structures. Initially, it will be small, with a local character, and then the area from which birds are scared off will gradually increase. There are exceptions regarding seagulls, including a very numerous species – European herring gull – which are present on often in the area of the offshore wind farm at the phase of construction than they were previously present there. They use the structures above water, also non-operational offshore wind power stations, as their resting place.

Table 77. Potential impacts of the Baltica OWF in the construction phase on seabirds

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
Traffic of water crafts and helicopters	Traffic of water crafts and helicopters at the construction phase will scare off birds. The most important parameters that impact the impact scale are the number of constructed power stations, the length of laid cables and related number of used water crafts and helicopters, construction duration and the period in which it is carried out.
Noise and vibrations emission	Emission of noise and vibrations in the sea area covered with construction works will scare away birds and force them out of the sea area of the investment. The most important parameters that impact the impact scale are the number of constructed power stations, the length of laid cables and related number of used water crafts and helicopters, construction duration and the period in which it is carried out.
Lighting of the investment site	Lighting the construction site using a strong light source may draw in nocturnal birds. It concerns mainly Procellariiformes, which are not present in the Baltic Sea. No data about the impact of strong lighting on the remaining species remaining in the investment site. The most important parameters that impact the impact scale are the number of constructed power stations, the length of laid cables and related construction site lighting intensity, construction duration and the period in which it is carried out.
Creation of a mechanical barrier	Power station and power substation structures that gradually emerge in the construction phase will scare away the birds. The influence of this impact on birds depends on the wind farm construction pace. Initially, single power stations will have little impact, but gradually the scaring effect will increase (Stewart et al. 2004). The most important parameters affecting the impact scale are the number of constructed power stations and the associated infrastructure.
Barrier caused by the presence of ships	Presence of a large number of ships used in construction of the wind farm may result in a barrier effect, thereby reducing the possibility of bird movement between stop areas during migration. The impact scale will depend on the number of water crafts involved in the construction phase, their size, construction phase duration and the season when the works are carried out.
Collisions with ships	Collisions of birds with water crafts used for construction of wind farms may take place, mainly in the night, when the birds are lured by the light they emit. The impact scale will depend on the number of water crafts involved in the construction phase, their size, lights configuration and intensity, construction phase duration and the season when the works are carried out.
Destruction of benthos habitats	Benthos communities will be destroyed in the construction phase. It is expected that this periodic loss of food supply will have no impact on birds because the majority of them will have been scared away from the construction site. The most important factors influencing the level of impact are: • type, size and number of built foundations and the length of laid cables; • type of rock material that make up the seabed, determining the species

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
	composition of zoobenthos communities used as food by the birds.
Increase in concentration of suspended solids in the water column	Direct propagation of sediments and resuspension of agitated sediments will decrease water clarity. When the reduction of water clarity exceeds the initial state, it may result in impairment of the predatory capacity of birds that use sight for that purpose and consequently lead to the movement of birds that prefer clear waters. The impact scale will depend on the amount of transferred sediment, composition of sediments and the season when the main construction works that agitate seabed sediments take place.
Re-deposition of disrupted sediments	Deposition of sediments related with preparation of the farm seabed for settlement of the wind power station foundations may impact the benthos environment present in the OWF Area and in its vicinity. A layer of agitated sediments will deposit on benthic organisms, which in turn may inhibit their gas exchange and feeding capacity. This phenomenon may lead to the impairment of benthos and fish which feed there (reduction of biomass, growth and productiveness), which in turn impacts the food supply of seabirds in this area. The impact scale will depend on the season when the main works related with transferring sediments will take place.
Contamination of the sea deep and seabed sediments with oil-derivative substances	Sailing vessels (ships, barges etc.) will be used at every phase of the investment. Small spillages of oil substances (lubricating grease, diesel fuel, fuels) into the water deep may occur during normal vessels operation. Contaminations released into the water deep during normal vessels operation are the second largest source of oil pollution in the sea. Approximately 33% of oil is released from this type of source into the environment (mainly due to increased vessel traffic in the Baltic Sea region (Kaptur, 1999). In comparison, approx. 37% of oil substance released into the sea comes from rivers as a runoff from land. Tanker disasters are as far as in the third place (12%). The release of oil substances mat also occur in emergency situations (failure or vessel collision, construction disaster). The heavier oil fractions are subjected to sorption on the surface of organic and mineral suspensions, which will result in an increase of their specific gravity, and their gradual sinking to the bottom. Water and bottom sediments contamination may adversely affect the seabirds. The most important factors influencing the level of impact are: • the type and amount of released oil substances; • weather conditions; • type of rock material that makes up the seabed, determining the species composition of zoobenthos communities which will be destroyed and the degree of accumulation of the heavier oil fractions in the seabed.
Water column and seabed sediments contamination with antifouling agents	Sailing vessels (ships, barges etc.) will be used at every phase of the investment. A certain amount of anti-fouling substances can be released into the sea deep from the hulls of sailing vessels during normal operation. Water and bottom sediments contamination may adversely affect the seabirds. The most important factors influencing the level of impact are: • the type and amount of released oil anti-fouling substances; • type of rock material that makes up the seabed, determining the species composition of zoobenthos communities which will be destroyed and the degree of accumulation of harmful substances in the seabed.
Water column and seabed sediments contamination with accidentally released municipal waste and domestic waste water	At each phase of the investment, both aboard vessels and at a construction facility situated on land (in the port serving the investment realisation) waste, mainly municipal and other, not directly connected with the building process, as well as domestic sewage will be produced. Waste and sewage may be accidentally released to the sea during the collection from ships or in the event of failure. Water and bottom sediments contamination may adversely affect the seabirds.

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
	The most important factors influencing the level of impact are: • the type and amount of released waste and wastewater; • weather conditions; • type of rock material that makes up the seabed, determining the species composition of zoobenthos communities which will be destroyed and the degree of accumulation of harmful substances in the seabed.
Contamination of the water deep and bottom sediments with accidentally released chemical agents and waste from the farm construction	During the construction of a wind farm, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the investments) and on the project's site, the generated waste will be directly related to the process of construction. These can include, among others, damaged parts of the farm elements, cement, grout, mortar, adhesives used to connect elements of the foundation and power stations and other chemical substances used during the construction. These can be accidentally released into the sea. Water and bottom sediments contamination may adversely affect the seabirds. The most important factors influencing the level of impact are: • type and quantity of released chemicals; • weather conditions; • type of rock material that makes up the seabed, determining the species composition of zoobenthos communities which will be destroyed and the degree of accumulation of harmful substances in the seabed.

Source: internal data based on Meissner, 2015b, 2015c

Among the potential impacts listed above, it is expected that the following causes or sources of impact may occur, which will impact on avifauna at the construction phase of the Baltica OWF:

- traffic of water crafts and helicopters;
- emission of noise and vibrations;
- lighting of the investment site;
- creation of a mechanical barrier;
- barrier caused by the presence of ships;
- collision with vessels;
- destruction of benthos habitats;
- increase of suspended matter concentration in the water;
- deposition of agitated sediment.

In the wind farm construction phase, expect increase traffic of water crafts and helicopters as well as periodically increased noise level. Both factors should have no impact on the flight paths of these waterbird species which use the OWF Area in small numbers or not at all, just fly above it. It cannot be ruled out that such an impact is pronounced at night, particularly if the construction site is strongly illuminated.

Species that are scared away easily, characterized by large distance of escape (loons, velvet scoter) will be scared away, particularly at a distance of approx. 2 km from the place the works are carried out. The distance of reaction for the constructed wind farm will be smaller in the case of species with a smaller ease of being scared away (long-tailed duck, razorbill, common murre). The presence of ships and immobile structures protruding from the water will bring about more abundant presence of seagulls (mainly European herring gull) that use these elements as their resting places and seek food in the vicinity of ships.

Traffic of water crafts and helicopters

Due to the fact that it is hard to differentiate the impacts of the increased traffic of water crafts and helicopters, these impacts are assessed jointly.

Construction works will require the presence of various water crafts and helicopters which will disturb seabirds by their physical presence, noise (along with the noise generated by driving piles if the selected foundation type requires it) and emission of light. The scale of impact will depend on the number of water craft and helicopters involved, their sizes, duration of the construction phase, the part of the OWF Area where the increased traffic of water craft will take place (due to abundance of seabirds found in given parts of the OWF Area) and the season when the works will take place, because many seabirds may appear in the sea area of the Baltica OWF only seasonally.

The effect of scaring away will increase along with progressing construction of the farm area. Initially, it will have a local character and birds would be able to find feeding grounds in the vicinity, but at the final phase of construction the scope of its impact will increase significantly, largely limiting the possibility of birds feeding and rest in this area.

Since the detailed schedule of construction activities is not yet known, the level of bird disturbance was assessed based on their abundance found in the period of their greatest density in a year, assuming that the works will take place at the entire wind farm area simultaneously. In spatial view, it was assumed that the movement of sensitive species will be the same as for the exploitation phase of the wind farm: higher degree of forcing out sensitive species from the relevant area of the wind farm and smaller degrees from the 4 km buffer zone around the investment (it must be noticed, however, that the degree of forcing out the birds will be over twice as large within the distance from 0 km to 2 km from the Baltica OWF Area than within the distance from 2 km to 4 km to the outer boundary of the Baltica OWF Area, while for the forcing out from the 2–4 km buffer zone there was no found statistical relevancy – Petersen et al., 2006).

Construction ships presence and traffic will be the main source of interference for birds sensitive to this type of impacts. These impacts will mask the results of associated pressures, such as subsea noise. Species that are scared away easily, characterized by large distance of escape (loons, velvet scoter) will be scared away, particularly at a distance of approx. 2 km from the place the works are carried out. The distance of reaction for the constructed wind farm will be smaller in the case of species with a smaller ease of being scared away (long-tailed duck, razorbill, common murre). Bird monitoring during construction works for an offshore wind farm Egmond aan Zee in the Netherlands displayed no noticeable reaction of non-sensitive bird species to disturbance related with the ship presence during piling works, mainly seagulls and terns. The presence of ships and immobile structures protruding from the water will bring about more abundant presence of seagulls that use these elements as their resting places and seek food in the vicinity of ships (e.g. European herring gull, lesser black-backed gull, to a smaller extent common gull).

The analysis of forcing out was carried out for the species most often observed in the surveyed sea area – long-tailed duck *Clangula hyemalis.* It was based on average long-tailed duck abundances found in the period when they are the most abundant, that is in the winter period (December–February). The results of the analysis are presented below.

Traffic of water craft and helicopters in the construction phase is a direct, negative impact on seabirds with a local range (except for the long-tailed duck, where the range is regional due to is abundant presence in the OWF Area and possible consequences of disturbance of the long-tailed duck population in the OWF Area for a greater – biogeographic population of this species), mid-term, repeatable in the construction period, with intensity dependent on the species. Similar impacts on seabirds are present during possible decommissioning of the wind farm.

Parameters of the Baltica OWF will have impact on the length of the farm construction length, which correlates with the length of the period of presence of increased intensity of water craft and helicopter traffic.

Long-tailed duck *Clangula hyemalis*

Long-tailed duck was the seabird species that was most often found in the Baltica OWF Area. This species was observed during the wintering period between October and April. In the OWF Area, the highest abundance of long-tailed ducks was found between January and April, and on the Słupsk Bank starting from November.

The selection of the habitat by seabirds that move due to disturbance is not known, but most probably the long-tailed ducks from the Baltica OWF Area will move to the Słupsk Bank region or adjacent regions, because they are the nearest suitable environment used by this bird species. In theory, greater density of birds in the relocation areas may impact their condition, and thereby their survival rate and reproduction due to increased competition for food, excessive exploitation of food supply, behavioural interactions etc. The dependency between the density of sea ducks and other seabird species and capacity of their habitats is very rarely studied, so its area is not well studied. Applying the principle of caution in Environmental Impact Assessment it is often assumed that the habitats are used fully in the context of their capacity and a loss of habitat for a species is equivalent to the removal of birds that use this habitat from the number of birds that use this habitat from the number of birds that belong to the given population.

As indicated by the publication by Petersen et al. (2006), many years of pre- and post-investment surveys carried out on offshore wind farm Nysted in Denmark prove that long-tailed duck avoids presence in the area of the constructed offshore wind farm. It is also largely forced out from the 2 km zone around the boundaries of the zone where power stations are constructed, and to a lesser extent also from the zone from 2 to 4 km from the farm. Based on the survey results in the area of the offshore wind farm Nysted in Denmark the extent of long-tailed duck being forced out from the OWF Area, from the zone from 0 km to 2 km and from the zone from 2 km to 4 km from outermost wind power stations located in the constructed area of the OWF (Petersen et al., 2006). The degree of long-tailed duck being forced out of the Nysted farm equalled approx. 73%, from the buffer zone 0–2 km – approx. 58%, from the buffer zone 2–4 km – approx. 25%, while no statistical relevance was found for forcing out of the buffer zone 2–4 km.

Average expected density of long-tailed ducks in the winter period inside the Baltica OWF Area equalled 5.27 indiv.·km^{-2}. In the 2 NM buffer zone it was greater, ranging to over 20 indiv.·km^{-2}, which involved partial overlapping of the buffer zone in the south-western edge of the Baltica 2 area (according to the construction site area in PSZW) with the Słupsk Bank area and its direct surroundings. In turn, the maximum density of long-tailed ducks for individual research cruises in the OWF Area in winter reached approx. 290 indiv.·km^{-2}, and in spring 2016 they were even higher, approx. 320 indiv.·km^{-2}. In the buffer zone 2 NM the maximum long-tailed duck densities were high, while in the spring they were close to the values observed for the OWF, and in the winter they exceeded them, reaching the value of approx. 1500 indiv.·km^{-2}. It should be noted that the distribution of densities in the OWF Area and in the buffer zone was varied (various densities in various area parts) with the highest values in the belt adjacent to the Słupsk Bank.

Based on the expected density (average density) the size of the wind farm sea area and the buffer zone and the assumed values of bird movement outside the boundary of the wind farm (72.83%) and outside the buffer zone area [57.76% for zone 0–2 km and 25.06% for zone 2–4 km from the boundary of the OWF construction site according to Petersen et al. (2006)] it was estimated that from the wind farm area due to disturbance caused by construction works (mainly ship traffic) in the winter period a total of 1880 long-tailed duck individuals will move (680 indiv. from the OWF, 759 from the zone 0–2 km and 441 indiv. from the 2–4 km zone from the boundary of the OWF construction site).

The value of 1880 individuals constitutes 0.12% of regional population for this species (N=1,600,000, Wetlands International 2017). There are no accurate estimates of abundance of long-tailed ducks wintering in the Polish zone of the Baltic Sea, but based on the results of counts involving the entire Baltic Sea (Skov et al., 2011) it can be assumed that the national population of long-tailed ducks is approx. 210 thousands individuals. In such a case, 1880 individuals would constitute 0.90% of national long-tailed duck population. This value is close to the value of 1% of national population, which is a threshold value for considering the significance of the area for population of a given species (GDEP: Instruction for filling a Standard Data Form of a Natura 2000 area), but is smaller than this value. It indicates the significant of the significance of the Słupsk Bank area and its direct vicinity as wintering grounds of long-tailed duck, but does not involve a significant impact on its winter population. Moreover, it should be underlined that this species feeds in sea areas with the depth of up to 30 m, particularly up to 25 m. In accordance with the Applicant's decision to limit the OZ MFW – the site of the OWF construction, this area no longer includes sea areas with depth up to 25 m, and sea areas with depth up to 25–30 are located only in the south-western part of the Baltica 2 Area. In accordance with the analysis of long-tailed duck use of sea areas of varying depth (on the basis of pre-implementation surveys), the density of long-tailed ducks in areas with depth of 20–25 m equalled 46.30 indiv. km^{-2}, while in areas with depth of 25–30 m it was over ten times smaller and equalled 4.11 indiv. km^{-2}. Therefore, it will be considered that the magnitude of long-tailed ducks being forced out from the investment area will have a moderate but insignificant impact on its national population.

During the surveys of the OWF BŚII area, various average densities of long-tailed ducks were found in winter periods of 2012/2013 and 2013/2014 (Meissner, 2015c). In the winter period of 2012/2013 it equalled 87.9 indiv.·km^{-2}, while in the winter of 2013 and 2014 it equalled 3.8 indiv.·km^{-2}. Therefore the average long-tailed duck density in the winter in the Baltica OWF Area is close to the one calculated for the winter period of 2013/2014 for the BŚII area. Due to differences in long-tailed ducks density in various winter seasons in the BŚII area (average value of individuals forces off equals 6038 for two subsequent winter season assuming the degree of forcing out of OWF Area equal 75% and out of the buffer zone 0 to 2 km equal 50%) and differences in density of long-tailed ducks in parts of OWF Area with varying depth, even though the Baltica OWF Area is larger than the BŚII area, the number of long-tailed duck individual forced out of the Baltica OWF Area will be smaller than in the case of BŚII. When assuming the same degree of forcing out of the OWF's built-up area (75%) and the zone 0–2 km from the OWF's built-up area (50%) for the Baltica OWF, as it was specified for BŚII, the value of long-tailed ducks forced out due to the operation of the Baltica OWF would equal 1358 individuals.

In turn, during surveys of BŚIII OWF in the winter period, the recorded density of long-tailed duck ranged from 1.02 indiv.·km^{-2} in December to 17.55 indiv.·km^{-2} in February, and the total number of long-tailed duck individuals forced out of the investment, including the 2 km buffer zone in the winter was estimated as 2443 individuals. For this wind farm as well, the estimated value of winter long-tailed duck population being forced out is greater than in the case of Baltica OWF (Meissner, 2015b).

Remaining species

During surveys in the Baltica OWF Area velvet scoters were observed in great numbers in the Słupsk Bank area. In the Baltica OWF Area and in its 2 NM buffer zone, velvet scoters were present, but were very scarce (average density for specific phenological phases close to zero indiv.·km^{-2}). In the entire period of surveys in the Baltica OWF Area only seven velvet scoter individuals were found sitting in water at the transect belt. Even forcing out all velvet scoter individuals form the Baltica OWF Area will have no impact on velvet scoter population. Velvet scoters were also observed in small numbers during pre-implementation monitoring for the entire BŚII OWF area (a total of 46 individuals during the entire survey period). Average expected velvet scoter density in the BŚII OWF area in the winter period (0.07–0.09 indiv.·km^{-2} in the BŚII OWF; up to 0.13 indiv.·km^{-2} in the buffer zone of the BŚII OWF) were close to the ones found in the planned investment area. It was estimated that from the BŚII wind farm area, along with a 2 km buffer zone, only from 9 to 16 velvet scoter individuals will move due to being scared off during construction works, which has no impact on the population of this species. Similarly to the BŚIII OWF, the average expected densities of velvet scoters in the OWF Area were close to zero (0.15–0.33 indiv.·km^{-2} in the BŚIII OWF area and up to 0.39 indiv.·km^{-2} in the buffer zone of the BŚIII OWF). It was estimated that due to scaring of birds during construction works from the BŚIII OWF area and its 2 km buffer zone, 23 to 51 velvet scoter individuals will move, which equalled approx. 0.01% of biogeographic population of this species (N = 450,000) (Wetlands International, 2017).

Razorbill was the second bird observed in the Baltica OWF Area in terms of abundance, but the average density of razorbill calculated for the Baltica OWF Area and its 2 NM buffer zone was never high (up to 3 indiv.·km^{-2}). Its maximum densities found for specific research cruises were much greater and in spring 2016 (March and the first half of April) they equalled 64.35 indiv.·km^{-2} in the Baltica OWF Area and 46.71 indiv.·km^{-2} in the 2 NM buffer zone. In the spring of 2017 (March) these values equalled 6.11 and 11.99 indiv.·km^{-2}, respectively, in the autumn of 2016 r. 8.52 and 11.80 indiv.·km^{-2} respectively, and in the winter 6.37 and 4.24 indiv.·km^{-2}. In the summer of 2016, no razorbills remaining in the in the investment area were found. Average densities of razorbills in the surveys for the purposes of BŚII OWF, the average densities of razorbills in the surveyed sea area were not high and equalled from 0.5 to 1.0 indiv.·km^{-2}. Average density of razorbills looked similarly in the BŚIII OWF area (0.5–1.0 indiv.·km^{-2}), for which the number of individuals forced out of the investment area in the winter period was estimated at 477 individuals (Meissner, 2015b). In the Baltica OWF Area 608 razorbills were observed (11.9% of a bird group) sitting on the water and 465 individuals from this species in flight. The world population of razorbills is estimated at approx. 430–770 thousands of breeding pairs. The European population of this species is estimated at about 0.9–1.5 million adults (BirdLife International, 2004). In the Baltic Sea region, there are 15 thousands razorbill pairs, in years 1988–1993 approx. 156 thousands of individuals were wintering there (Durinck et al., 1994; BirdLife International, 2004). It results from the fact that 608 razorbills observed along the survey transect within the boundaries of the Baltica OWF do not constitute a large percentage of global or European population of this species.

Common murre was the third species in terms of abundance that remain in the Baltica OWF Area. In the OWF Area, at the transect belt, the presence of 439 common murres sitting on water was found, as well as 69 individuals identified as a razorbill or a common murre. The largest common murre concentrations in the Baltica OWF Area were observed in summer – in July and August. In the BŚII

OWF area common murres were less abundant. In the EIA Report for the BŚII it was found out that due to low abundance of observed common murres, even if all recorded individuals are forced out of the investment area, it will have no significant impact on the population of this species (Meissner, 2015c). During surveys carried out as part of pre-investment monitoring in the OWF BŚIII, a relatively low number of common murres was found – a total of 97 individuals (Meissner, 2015b). Small abundance of the species indicates very small common murre density in the BŚIII OWF area, therefore only single common murre individuals can move to another region due to disturbance related with the presence of water crafts and helicopters used during construction of the wind farm. Movement of a very small number of individuals will have a negligible impact on the population of this species (>2,000,000 of breeding pairs) (BirdLife International, 2004).

European herring gull was the third most often observed seabird species, after long-tailed duck and velvet scoter during transect surveys (total number of birds sitting in the water and in flight) and fourth species in terms of abundance remaining in the Baltica OWF Area (birds sitting on water). Changes in the abundance of European herring gulls showed no regularities. The average density of this species in the OWF Area and in the 2 NM buffer zone equalled below 1 indiv.·km^{-2}, regardless of the phenological phase. The most individuals were observed in spring 2016 (March and the first half of April), when the maximum density of European herring gull was recorded in the OWF Area exceeding 20 indiv.·km^{-2}. Most of the herring gulls were observed while flying, which is associated with the fact that these birds penetrate big areas in search for food, which includes also the scraps released or lost during the fish hauling or fish processing done aboard cutters. This species is not prone to be scared away by traffic of water crafts or helicopters and it will not be forced out of the Baltica OWF Area due to this impact (Garthe & Hüppop, 2004; Furness et al., 2013). Construction works-related partial or total exclusion of fishing hauls and traffic of fishing cutters followed by seagulls may have impact on the partial forcing out of European herring gulls form the area of planned investment. A similar conclusion was presented for the possible movement of European herring gulls from the BŚII OWF area, where fishing catches were limited. In the OWF BŚIII area the average density of this species was higher than in the Baltica OWF Area, equalling 5 indiv.·km^{-2}. Due to greater area of the Baltica OWF compared to the BŚIII, the number of European herring gulls that use the areas of both farms did not differ greatly (respectively 659 indiv. vs. 500 indiv.).

The remaining seagull species (common gull, little gull, lesser black-backed gull) were not recorded in the Baltica OWF Area as often as the European herring gull. Similarly to the European herring gull, the lesser black-backed gull follows fishing cutters in search of food. The little gull was observed very scarcely in the OWF Area, mainly in flight. The common gull is a waterbird rarely met in the open sea. All the seagull species have low sensitivity of OWF impact, including being scared away (Garthe & Hüppop, 2004).

The black-throated loon and red-throated loon were present very scarcely in the surveyed sea area, which did not make it possible to estimate their density. Despite high protection priority of both these species of loons and their high sensitivity of OWF impact, including water craft traffic (Garthe & Hüppop, 2004; Furness et al., 2013), forcing several tens of observed loons out of their habitats will have no significant impact on the population of these species. Impact will concern a minimum part of the regional population of these birds (red-throated loon population abundance – 150,000, black-throated loon – 250,000) (Wetlands International, 2017). Also during pre-implementation monitoring for BŚII OWF very low abundances of these two loon species (a total of 86 indiv. from both species, including 28 indiv. sitting on water) and it was found out that even forcing out all the observed individuals from habitats located in the BŚII OWF sea area will have no impact on their populations (Meissner, 2015c). A similar conclusion was drawn for the black-throated loon and red-throated loon remaining in the BŚIII OWF area, where very low abundances of these species were also found (a total of 35 individuals, including 11 sitting on water).

The analyses of significance of individual impacts of seabirds take into account the application of actions to optimise the manner or organisation of construction works, introduction of prevention of entry to the Słupsk Bank area for ships that participate in the construction of the Baltica OWF in the period of numerous presence of long-tailed duck, that is from November to April, and allowing for foundation works in the period between November and April on the condition that the noise generated by construction works is maintained on a level that does not cause birds to be scared in the Słupsk Bank area. On the basis of the literature available at the moment the application for a decision on environmental conditions it is 117 dB for positive bird reactions (Crowell, 2014) – the level is determined in accordance with the principle of caution due to lack of scientific studies regarding the noise level that scares the birds away. In case new study results appear which define the noise level that scares birds away it is proposed to present information about such results to RDEP in order to define the maximum permissible noise level. Optimisation actions include particularly the limitation of sources of strong light directed upwards at night to only the essential illumination, which is a good practice generally used in offshore works.

The impact analysis of water craft and helicopter traffic related with the construction of the Baltica OWF to specific seabird species is presented in table (Table 78).

Table 78. Water craft traffic – analysis of impact on individual seabird species at the construction phase

Species	**Binomial nomenclature**	**Sensitivity of the resource (acc. to the SSI)**	**Impact susceptibility**	**Importance of the resource**	**Justification for the impact assessment**	**Impact's scale**	**Impact's significance**
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity. Large densities of the species at the site of the planned investment A part of this sea area to the depth of 30 m is a potential feeding ground adjacent to the Słupsk Bank, which is one of the most important wintering grounds for this species in the Baltic Sea.	Average (scale of exposure– regional, duration – mid-term, intensity – high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, but rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	Species is not endangered, has no high protection priority, low abundance in the region of the planned investment.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate

Source: internal data

Noise and vibrations emission

Presence and movement of construction ships will be the main cause of disturbance of seabirds in the sea area covered by the construction of the OWF. This impact will be much greater than other pressures related with the construction phase, such as emission of subsea noise.

Bird monitoring during construction works for an offshore wind farm Egmond aan Zee in the Netherlands displayed no noticeable reaction of non-sensitive bird species to disturbance related with the ship presence to the piling works (i.e. mainly seagulls and terns).

Noise and vibrations in the construction phase is a direct, negative impact on seabirds with a local range (except for the long-tailed duck, where the range is regional due to is abundant presence in the OWF Area and possible consequences of disturbance of the long-tailed duck population in the OWF Area for a greater – biogeographic population of this species), mid-term, repeatable in the construction period, with intensity dependent on the species. Similar impacts on seabirds are present during possible decommissioning of the wind farm.

Table 79. Noise and vibration emission – analysis of impact on individual seabird species at construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity, no data regarding sensibility to noise)	High	High protection priority. Moderate timidity. Large densities of the species at the site of the planned investment A part of sea area to the depth of 30 m is a potential feeding ground adjacent to the Słupsk Bank.	Average (scale of exposure – regional); duration – mid-term; intensity – high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity, no data regarding sensibility to noise)	High	High protection priority. High timidity, but small abundance at the investment site.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity, no data regarding sensibility to noise)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
Common murre	*Uria aalge*	Low	Average (moderate timidity, no data regarding sensibility to noise)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
European herring gull	*Larus argentatus*	Low	Average (low timidity – significant resistance to noise which does not accompany an actual hazard)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant

Species	**Binomial nomenclature**	**Sensitivity of the resource (acc. to the SSI)**	**Impact susceptibility**	**Importance of the resource**	**Justification for the impact assessment**	**Impact's scale**	**Impact's significance**
Common gull	*Larus canus*	Low	Average (low timidity – significant resistance to noise which does not accompany an actual hazard)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity, no data regarding sensibility to noise)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity – significant resistance to noise which does not accompany an actual hazard)	Low	Species is not endangered, has no high protection priority, low abundance in the region of the planned investment.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity, no data regarding sensibility to noise)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity, no data regarding sensibility to noise)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate

Source: internal data

Lighting of the investment site

Birds navigate during migration in reference to natural light sources, such as stars and sun. It was found out that at night they come to lighthouses, drilling towers and other structures with artificial illumination (Wiese et al., 2001). During surveys on bird behaviour at drilling rigs it was found out that illumination causes seabirds to gather around these structures, not only in the migration period. It mainly concerned *Procellariformes* birds which are most often nocturnal, but also concentrations of auks (*Alle alle*) containing several thousands of individuals (Wiese et al., 2001), which are closely related with razorbills and common murres found in the area of the planned investment. In the case of most typically sea bird species (sea ducks, loons), the impact of artificial illumination on birds that remain at a closer or further distance from the light sources remains mostly unknown.

Illumination of the investment site in the construction phase will cause a direct, negative impact on seabirds with a local range (except for the long-tailed duck, where the range is regional due to is abundant presence in the OWF Area and possible consequences of disturbance of the long-tailed duck population in the OWF Area for a greater – biogeographic population of this species), mid-term, repeatable in the construction period, with intensity dependent on the species. Similar impacts are present during possible decommissioning of the wind farm.

Table 80. Illumination of the investment site – analysis of impact on individual seabird species at construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity, no data regarding sensibility to artificial lighting)	High	High protection priority. Moderate timidity of the species Large densities of the species at the site of the planned investment A part of sea area to the depth of 30 m is a potential feeding ground adjacent to the Słupsk Bank.	Average (scale of exposure – regional); duration – mid-term; intensity – high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity, no data regarding sensibility to artificial lighting)	High	High protection priority. High timidity, but small abundance at the investment site.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity, no data regarding sensibility to artificial lighting)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
Common murre	*Uria aalge*	Low	Average (moderate timidity, no data regarding sensibility to artificial lighting)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
European herring gull	*Larus argentatus*	Low	Average (low timidity, artificial lighting may make it easier for this seagull to find food at night)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	Average (low timidity, artificial lighting may make it easier for this seagull to find food at night)	Low	Waterbirds rarely encountered at sea away from the coast. A moderately abundant species flying above the surveyed basin. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity, no data regarding sensibility to artificial lighting)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity, artificial lighting may make it easier for this seagull to find food at night)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity, no data regarding sensibility to artificial lighting)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity, no data regarding sensibility to artificial lighting)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate

Source: internal data

Generated barriers for birds (caused by the presence of power stations)

The appearance of subsequent wind power stations and power substations at the construction phase will gradually occupy an increasingly large part of the wind farm sea area, thereby creating a mechanical barrier for seabirds that move in a local scale between the feeding areas and/or rest areas and are not bound to fly over obstacles. The scale of the barrier effect will depend mainly from the number of constructed offshore wind power stations, their size, distribution as well as the emitted light and noise. The predominant behaviour is that birds avoid the area occupied by wind power stations which results in their drop of abundance in radius up to 2 and sometimes even to 4 km from the OWF (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011). It should also be noted that the Applicant decided to limit the OWF built-up area in comparison with the area determined in the PSZW permit. The purpose of this limitation was to decrease the barrier effect for birds caused by the presence of wind power stations. As a result of the OWF built-up area limitation, a 5 km wide migration corridor will be created on the line in the migration direction of most seabird species (north east – south west), which facilitates their flight to wintering grounds in the Słupsk Bank area and leaving them in spring for nesting grounds.

New structures created in the sea at the construction phase will be a source of direct, negative impacts on seabirds with a local range, mid-term, reversible, repeatable in the construction periods (for each cycle of construction of a single wind power station), intensity depending on the species.

Table 81. Creation of a barrier for birds (caused by the presence of power stations) – analysis of impact on individual seabird species at construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity of the species With the installation of subsequent power stations, the impact will gradually increase.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site. With the installation of subsequent power stations, the impact will gradually increase.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species With the installation of subsequent power stations, the impact will gradually increase.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species With the installation of subsequent power stations, the impact will gradually increase.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Insignificant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority. Rare appearances (mainly birds flying through) in the investment region, but the presence of water crafts during the OWF construction may cause more numerous presence of birds in this region.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area. With the installation of subsequent power stations, the impact will gradually increase.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area. With the installation of subsequent power stations, the impact will gradually increase.	Low (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate

Source: internal data

Creation of barriers for birds (caused by the presence of ships)

Presence of a large number of ships used in construction of the wind farm may result in a barrier effect, thereby reducing the possibility of bird movement between the areas where they stay. The impact scale will depend on the number of water crafts involved in the construction phase, their size, construction phase duration and the season when the works are carried out.

During construction phase the ships will carry out tasks in the specified wind farm areas, and consequently, the barrier created this way will be smaller than the entire OWF Area. Seabirds moving locally most often react to the encountered obstacles by increasing the flight altitude or deviation from the initial flight direction. Therefore it may be expected that they will change their flight path in order to avoid the ships. Avoidance will increase the energy cost of the flight, but the increase is not expected to be excessively large, because energy cost of daily flights, even when doubling their distance, will constitute only a small portion of daily activity of birds.

It was concluded that outside migration period common eiders carry out only 10 minutes of flight during the day (Pelletier et al., 2008). Similar results may be expected for other species of sea ducks, loons and razorbills. Pelagic birds, such as seagulls spend most of their day on flights, and additional avoidance of an obstacle in the case of wind farm construction works will not cause any measurable effect in their energy balance.

Presence of ships at the construction phase creates a barrier for the movement of birds which causes a direct, negative impact on seabirds with a local range, short-term, reversible, recurrent during the construction period, with low intensity. Similar impacts are present during possible decommissioning phase of the wind farm.

Table 82. Creation of a barrier for birds (caused by the presence of ships) – analysis of impact on individual seabird species at construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Large abundance of the species at the investment site. Moderate timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant

Species	**Binomial nomenclature**	**Sensitivity of the resource (acc. to the SSI)**	**Impact susceptibility**	**Importance of the resource**	**Justification for the impact assessment**	**Impact's scale**	**Impact's significance**
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the investment area. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant

Source: internal data

Collisions with ships

During night hours in the time of bad visibility caused by adverse atmospheric conditions (e.g. precipitation, fog), birds, particularly ones belonging to less timid species, may be drawn by the lights emitted by the ships. Collisions of waterbirds with ships during the night were documented in the south-western Greenland, they were strictly related with bad visibility (Merkel & Johansen, 2011). In the case of birds being drawn in due to light emission it is expected that the degree of collisions will not be related with the water craft heights. The existing knowledge on this subject does not indicate that it should be a significant issue. Therefore it is assessed that the impacts of construction ships will be limited to a relatively low area in the OWF construction phase (for individual offshore wind power stations) and the expected number of such collision will be low, therefore the significance of this impact is assessed as negligible to of little importance dependency of the sensitivity of a given species.

Collisions of birds with construction ships is a direct, negative impact of local range, mid-term, irreversible, repeatable in the period of construction, with medium intensity. Similar impacts are present during possible decommissioning phase of the wind farm.

Table 83. Collisions of birds with ships related with construction of the Baltica OWF – impact analysis for specific seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity of the species	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls. Therefore, this species is used to the presence of ships which can, however, undergo a collision due to the presence of low visibility (fogging, precipitation).	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the investment area. Low timidity of the species	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. The species is rarely seen. Presence of ships may cause more abundant presence of birds in this area. Therefore, this species is used to the presence of ships which can, however, undergo a collision due to the presence of low visibility (fogging, precipitation).	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls. Therefore, this species is used to the presence of ships which can, however, undergo a collision due to the presence of low visibility (fogging, precipitation).	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant

Source: internal data

Destruction of benthos habitats

Construction of wind power station foundations and power substation (particularly if gravity based foundations are selected) as well as placing external power cables cause disturbance of benthic communities in the place of implementation of the investment, which were broadly describes in the section on the assessment of the investment's impact on zoobenthos.

Some habitats used by seabirds where they stop during migrations will be lost due to settlement of foundations. This process will have a direct impact on the seabed and will impact the sea deep. Natural benthic environments will be lost, but most probably new ones will be created in their place an artificial reef effect. Benthos habitats will also be destroyed in the locations of trenches dug for laying subsea cables, but the will most probably rebuild after several years after the construction works are finished. The scale of impact will largely depend on the number of seabed foundations of wind power stations, their type sand size as well as the scale of dredging works needed to lay a network of cables.

Bird species vulnerable to impacts related with loss of seabed habitats due to occupation of space due to occupation of space are mainly sea ducks that feed on benthos. However, these species are very vulnerable to disturbance by human sea activities, therefore it is estimated that the impact as a result of disturbance due to the presence of construction ships will be the main source of impact in the area, thereby resulting in the same movement of sensible species. With regard to the above, these birds will not additionally experience any impact due to occupied space in the construction phase. Additionally, the loss of habitat due to space occupation by offshore wind power stations will be low, equalling approximately 0.1% of the Baltica OWF Area.

When the benthos density on the Słupsk Bank decreases as a result exploitation of these resources by a very large number of benthivorous organisms, the birds may move to deeper waters with more developed benthos communities, including to parts of the Baltica OWF Area. The results of zoobenthos studies indicate that in the area of the Baltica OWF, the areas with the highest Ecological Quality Ratio (EQR) are parts of boulder areas (hard seabed with mussels) in the western part of the Baltica 2 Area and in the central part of the surveyed sea area (at a contact of buffer zones of Baltica 2 Area and Baltica 3 Area). Presence of macrozoobenthos in this area in a very good and good quality condition (Osowiecki, 2017) partially overlaps with the presence of the greatest densities of long-tailed ducks (diving benthivorous species) in the winter period of 2016 and in March 2017. After bringing the farm boundary specified in PSZW document further from the Słupsk Bank, as proposed by the Applicant, the farm will be constructed in the area of feeding grounds of a lower significance located in large depth zone where feeding is less energetically efficient for long-tailed ducks. 94% of the Baltica OWF Area is located at the depth of more than 30 m. The argument about decreased attractiveness of the Baltica OWF Area is shown by inventory results, where 95% of long-tailed ducks were observed in sea areas with depths lower than 30 m.

Destruction of benthos habitats during construction works is an indirect, negative impact on some seabirds (mainly benthivorous ones) with a local impact, mid-term, reversible, repeatable in the construction period (for each wind power station of infrastructure element, with intensiveness depending on the species. Similar impacts are present during possible decommissioning of the wind farm. No impact on birds feeding on fish was found.

Table 84. Destruction of benthos communities – analysis of impact on individual seabird species at the Baltica OWF construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	High (species feeding on benthic organisms)	High	High protection priority. High sensibility of the species on food supply restrictions.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (species feeding on benthic organisms)	High	High protection priority. High sensibility of the species on food supply restrictions. Small abundance of the species at the investment site.	Average (scale of exposure – local; duration – mid-term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Very low (indirectly via food supply – fish)	Average	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on ichthyophagous species.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Irrelevant
Common murre	*Uria aalge*	Low	Very low (indirectly via food supply – fish)	Average	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on ichthyophagous species.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Irrelevant
European herring gull	*Larus argentatus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish swimming near the surface. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish and invertebrates swimming near the surface (e.g. planktonic crustaceans). Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None
Little gull	*Hydrocoloeus minutus*	Low	None (the species does not feed on benthos)	High	The species does not feed on benthic organisms but small fish caught from the water surface and invertebrates. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None
Lesser black-backed gull	*Larus fuscus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish swimming near the surface. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None
Black-throated loon	*Gavia arctica*	High	Very low (indirectly via food supply – fish)	High	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on ichthyophagous species.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Insignificant
Red-throated loon	*Gavia stellata*	High	Very low (indirectly via food supply – fish)	High	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on ichthyophagous species.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Insignificant

Source: internal data

Increase in concentration of suspended solids in the water column

During the construction phase resuspension of seabed sediments will take place resulting in the increase in suspended matter concentration in water. This phenomenon will be the most intensive in the case of using gravity based foundations which require prior preparation of seabed.

The increase of suspended matter concentration in water during construction works is an indirect, negative impact on certain seabirds (birds that dive in water when seeing food) with a local range, mid-term, reversible, repeatable in the construction period, with low intensity. Similar impact will take place during possible decommissioning phase of the wind farm. No impact on seagulls was found.

Direct propagation of sediments and their resuspension will result in decreased water clarity. If it exceeds the level present naturally, then it may cause difficulties in hunting for diving birds that use sight when seeking food, and consequently, result in movement of birds that prefer waters with higher clarity. Local drop in water clarity within the farm will be, however, short-term and its impact will be masked by birds leaving the area due to other, more intensive disturbances.

Table 85. Increase of suspended matter concentration in water – analysis of impact on individual seabird species at the Baltica OWF construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	High (species feeding on benthic organisms)	High	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Velvet scoter	*Melanitta fusca*	Average	High (species feeding on benthic organisms)	High	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Razorbill	*Alca torda*	Low	Very low (indirectly via food supply – fish)	Average	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	Very low (indirectly via food supply – fish)	Average	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
European herring gull	*Larus argentatus*	Low	None (the species does not dive in search for food)	Low	The species does not dive in search for food, which is why rise in suspended solids concentration in water will not hinder its access to food or its other activities.	Not applicable	None
Common gull	*Larus canus*	Low	None (the species does not dive in search for food)	Low	The species does not dive in search for food, which is why rise in suspended solids concentration in water will not hinder its access to food or its other activities.	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Little gull	*Hydrocoloeus minutus*	Low	None (the species does not dive in search for food)	High	The species does not dive in search for food, which is why rise in suspended solids concentration in water will not hinder its access to food or its other activities.	Not applicable	None
Lesser black-backed gull	*Larus fuscus*	Low	None (the species does not dive in search for food)	Low	The species does not dive in search for food, which is why rise in suspended solids concentration in water will not hinder its access to food or its other activities.	Not applicable	None
Black-throated loon	*Gavia arctica*	High	Very low (indirectly via food supply – fish)	High	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant
Red-throated loon	*Gavia stellata*	High	Very low (indirectly via food supply – fish)	High	Increase of suspended matter concentration in water may hinder diving birds that use sight when seeking food.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant

Source: internal data

Re-deposition of disrupted sediments

After the period of increased concentration of suspended matter in water the deposition (sediment descending) on the seabed will take place. It is not expected that this phenomenon should have a significant impact on benthic organisms, or an indirect impact on birds that feed on them, because they will be scared away earlier from the works site.

Deposition of agitated sediment during construction works is an indirect, negative impact on certain seabirds (most importantly benthivorous, but indirectly also ichthyphaga) with a local range, mid-term, reversible, repeatable in the construction period, with low intensity. Similar impact may be present during decommissioning of the wind farm. No impact on seagulls was found.

Table 86. Deposition of agitated sediments – analysis of impact on individual seabird species at construction phase

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	High (species feeding on benthic organisms)	High	Deposition of agitated sediment will destroy zoobenthos communities used as food by the described bird species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Velvet scoter	*Melanitta fusca*	Average	High (species feeding on benthic organisms)	High	Deposition of agitated sediment will destroy zoobenthos communities used as food by the described bird species.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Razorbill	*Alca torda*	Low	Very low (indirectly via food supply – fish)	Average	Deposition of agitated sediment will destroy zoobenthos communities on seabed used as food by the described fish species. It will indirectly impact the deterioration of ichthyophagae food supply, the described bird species belong to that group.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	Very low (indirectly via food supply – fish)	Average	Deposition of agitated sediment will destroy zoobenthos communities on seabed used as food by the described fish species. It will indirectly impact the deterioration of ichthyophagae food supply, the described bird species belong to that group.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Irrelevant
European herring gull	*Larus argentatus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish swimming near the surface. Disturbances in benthos communities (resulting from resedimentation of disturbed sediment)	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
					may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.		
Common gull	*Larus canus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish and invertebrates swimming near the surface (e.g. planktonic crustaceans). Disturbances in benthos communities (resulting from resedimentation of disturbed sediment) may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None
Little gull	*Hydrocoloeus minutus*	Low	None (the species does not feed on benthos)	High	The species does not feed on benthic organisms but small fish caught from the water surface and invertebrates. Disturbances in benthos communities (resulting from resedimentation of disturbed sediment) may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None
Lesser black-backed gull	*Larus fuscus*	Low	None (the species does not feed on benthos)	Low	The species does not feed on benthic organisms but on fish scraps thrown from fishing vessels and on fish swimming near the surface. Disturbances in benthos communities (resulting from resedimentation of disturbed sediment) may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on seagulls.	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Black-throated loon	*Gavia arctica*	High	Very low (indirectly via food supply – fish)	High	Deposition of agitated sediment will destroy zoobenthos communities on seabed used as food by the described fish species. It will indirectly impact the deterioration of ichthyophagae food supply, the described bird species belong to that group.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant
Red-throated loon	*Gavia stellata*	High	Very low (indirectly via food supply – fish)	High	Deposition of agitated sediment will destroy zoobenthos communities on seabed used as food by the described fish species. It will indirectly impact the deterioration of ichthyophagae food supply, the described bird species belong to that group.	Negligible (scale of exposure – local; duration – mid-term; intensity – low)	Insignificant

Source: internal data

Summary

Significance of the Baltica OWF's impact at the construction phase on seabirds reflects the significance of such an impact for long-tailed duck *Clangula hyemalis*, which was the most often observed species in the OWF Area and which suffers the highest impact of the OWF at the construction phase among seabird species analysed in this Report. Long-tailed duck has an average sensitivity for the OWF impacts. The scale of impact of water crafts and helicopters related with forcing birds out of their habitats for the Applicant's variant was assessed as average. With regard to the above and in accordance with the method of assessment for seabirds assumed in this Report, the significance of the Baltica OWF in the Applicant's variant at construction phase was assessed as moderate with relation to these birds.

In the case of a black-throated loon and red-throated loon, certain types of impacts were awarded the same significance as in the case of long-tailed duck. However, these species (loons) were not very numerous in the surveyed sea area, and a relatively high significance of certain impacts in relation to them results from high vulnerability of loons to offshore wind farms. The Investment will have no significant negative impact on both found loon species. The impact of the construction of the Baltica OWF on species of seabirds other than the most abundant long-tailed duck will be lower than in its case.

The scale of impacts discussed here will depend on the time when the structures will be created. In case of a short construction phase their scale quickly reaches average level for certain resources, in case of a long-term construction process in the initial phase the impact scale will be negligible or small and will later enter average for certain resources. Initially, single wind power stations will have little impact on birds, but gradually the scaring effect will increase. In the case of concurrent construction of power stations in distant locations, scaring birds away will concern a large sea area from the start. However, installation of power stations in a systematic manner, which gradually fills the sea area with neighbouring structures will cause a gradual increase of this effect and gradual forcing out of birds from the sea area intended for the investment. However, adopting the second type of area development will delay, albeit to a very small degree depending on the pace of works, the forcing out of birds from the sea area occupied by power stations.

The emerging structures and increased traffic of water crafts and helicopters involves primarily scaring of birds from the investment area, will have moderate significance in relation of long-tailed duck. Moderate significance of impact with regard to long-tailed duck will also be assigned to noise and vibration emission, ligating of the investment location, creation of a barrier for birds caused by the presence of power stations and destruction of benthos communities, which will, however, be reversible and mid-term. The impact significance in turn is however determined as negligible for long-tailed duck in the case of barrier for birds caused by the presence of ships, collisions with ships, increase of suspended matter concentration in water and deposition of agitated sediment.

With the regard to the above, the total significance of the Baltica OWF impact at the construction phase on seabirds was characterised as moderate.

6.1.1.4.1.6 Migratory birds

The impact of the Baltica OWF on migratory birds was determined based on data gathered during the measurement campaigns carried out in 2016 in the spring and autumn migration seasons and in March 2017, on experience and knowledge gathered during similar projects as well as on literature, including Environmental Impact Assessment Reports for offshore wind farms.

In case of construction, the following potential impacts on migratory birds were found:

- barrier effect caused by ships;
- collision with construction ships.

Presence of numerous ships will cause a barrier to be created, which may cause force the change of migration routes, particularly for waterbirds flying at low altitudes. The majority of impact will depend on the number of units involved in the construction phase, their size, season and duration of the construction phase. Migratory waterbirds which are sensitive to disturbances generated by ships will avoid the barrier by changing their flight direction, which may make the route of a specific bird slightly longer, which will in turn increase the energetic cost related with the trip. The change of route will concern only a small part of route and the increased energetic cost will be negligible, as it was estimated for the case of common eider (Masden et al., 2009) and for several other species for which the modelling was carried (Appendix 4). Therefore, the significance of the barrier effect at the construction phase in the Baltica OWF Area was considered negligible (for species with low and average significance) and of little importance (for species with high significance).

Collisions between birds and ships are not ruled out, particularly at night when birds are drawn to the lighting of the construction site and of units involved in construction. The collision risk will depend on the number of units involved in the construction phase, their size, lighting, season and duration of this phase. In poor weather conditions or at night, migratory birds, especially terrestrial birds, may be attracted by the lights mounted on the construction vessels. The probability of collision with ships is not researched well and currently it is not possible to present this phenomenon in a quantitative manner, but it was documented that similarly to onshore elements, phenomena occasionally collide with structures erected offshore (Blew, 2013). Additionally, at nights when the weather is unfavourable migratory birds may be attracted by lights installed on the vessels. Collisions of waterbirds with construction ships at night were documented at the south-western shores of Greenland and were indeed related with bad visibility (Merkel & Johansen, 2011). In the case of birds being drawn to light it seems that the degree of collisions is be related with the water craft sizes. Nevertheless, the knowledge obtained so far on the subject does not suggest that collisions with construction ships are a serious problem and are a source of a large impact. Therefore, the impacts of collisions with ships will concern only single cases during bad weather with low visibility, on a small area. Therefore, the impact significance of collisions with ships will be considered negligible (for species with low and average significance) and of little importance (for species with high significance) (Table 87).

Table 87. The significance of impacts related with the offshore wind farm construction phase on migratory birds travelling via the Baltica 2 and Baltica 3 Areas

Species	Impact	Spatial scale of impact	Duration	Intensity	Impact frequency	Impact reversibility	Impact's scale	Impact's significance
All significant migratory bird species of high significance listed in the section 3.7.1.5.1 (Table 27)	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Insignificant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Insignificant
All significant migratory bird species of medium significance listed in the section 3.7.1.5.1 (Table 27)	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Irrelevant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Irrelevant
All significant migratory bird species of low significance listed in the section 3.7.1.5.1 (Table 27)	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Irrelevant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Irrelevant

Source: internal data

The table below (Table 88) summarises potential impacts of the Baltica OWF in the construction phase on migratory birds.

Table 88. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on migratory birds

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.4.1.7 Bats

The construction phase includes the following actions:

- movement of installation vessels from the port to the investment location and transportation of the construction elements;
- preparation of the seabed for foundations;
- construction of foundations;
- installation of wind turbine elements (towers, nacelles, rotor);
- burial of the cables (embedding the cables into the seabed or laying the cable on the bottom).

Activities such as laying cables, the preparation of the seabed and the construction of foundations regard works carried out under the surface of water. The possible impact exerted on the environment as a result of these works will not influence bats. In the case of movement of installation units or the installation itself, however, there may appear an impact on bats due to an increased risk of collision resulting from obstacles and organisms being bat food supply that emerge around the built elements on the sea surface as well as vessel units, which may give the possibility of feeding.

Transportation of installation elements is connected to an increased traffic of sailing vessels in the area of the planned investment, while installation is a construction activity, in result of which new elements of the landscape form. The increased traffic of vessels and the constructed wind power stations, with adequate weather conditions (lack of rain, calm sea conditions) can be factors attracting insects into the area of the investment (Poerink et al., 2013; Ahlén, 2003). In the years 2005, 2006 and 2008, surveys regarding the behaviour of migrating and feeding bats were conducted off the coasts of Sweden and Denmark, within the maximum distance of approx. 19 km from the coast. The following islands were surveyed: Gotland, Oland, Bornholm, Faster, Lollandia, Saltholm and artificial island Peberholm as well as waters of Sund, Kattegat and Kalmar Straits and the Baltic Sea (Ahlén et al., 2009). The surveys allowed to identify 11 bat species, with 8 of them being regarded migratory species. It should be emphasized that surveys were conducted within an insignificant distance from the coast, whereas the activity monitoring in the OWF Area took place within over 25 km from the coast. Moreover, during the surveys off the coasts of Sweden and Denmark, altogether as many as 4051 observations were made, while in the OWF Area it was only 79.

On the basis of the discussed surveys (Ahlén et al., 2009), the presence of migratory and non-migratory bats was confirmed – within 14 km from the coast. Both bat groups had been feeding actively within offshore wind power stations and above the surface of the water thanks to food supply concentration. Moreover, the authors proved that there were numerous groups of crustaceans on the water surface, which most probably constituted food supply for hunting within the surveyed area: Daubenton's bat (*Myotis daubentonii*) and mouse-eared bat (*Myotis dasyceme*). No correlation between food supply concentration and distance from the coast was found. Food supply abundance most probably results from the weather conditions. According to the pieces of information in the literature (Rydell et al., 2010; Boshamer & Bekker, 2008; Ahlén et al., 2009), insects probably move actively or passively or are extracted towards deep sea as a result of the wind operation. Boshamer and Bekker (2008) point to the presence of insects (mainly hoverflies, butterflies and beetles) on the light-vessel located in the North Sea within the distance of 30 km from the coast. The biggest concentrations of actively moving insect species could be observed at a low wind speed, but in the case of its increase, food supply was still present in the form of passively moving aeroplankton (a group formed by insects, arachnids and other organisms). On the basis of the surveys conducted off the coasts of Sweden and Denmark, Ahlén et al. (2009) pointed to the need of further and more quantitative surveys in order to comprehend the bat feeding dynamics and the availability of victims in offshore areas, as well as the need to analyse how far from the coast, how often and in what periods the phenomenon of feeding occurs. The created constructions and the vessels used during the construction may serve as new hideaways or stopovers during migrations (Ahlén et al., 2007, 2009; Rydell et al., 2012), and can become even more attractive given the concentrating food supply. The newly formed structures can also involve the first collisions of bats resulting from their cross-cutting the routes of daily or periodic migration.

The presented activities related with the construction of the offshore wind farm may generate a large increase of noise, which can disorient the bats during flight and can act as a barrier effect. This way, the conducted works within the OWF Area can result in a change of migration routes, which involves an additional input of energy (European Commission, 2011).

Given that the majority of actions will take place below the water surface, the potential impact of OWF on chiropterofauna in the OWF construction phase is regarded negligible. However, intensified vessel traffic and built constructions may exert an impact on bats. At favourable weather conditions, these factors may involve an increase in food supply concentration in the OWF Area. Additionally, vessels and new constructional elements may be adapted by bats as potential hideaways or stopovers at the route of season migrations. Bats attracted this way may be vulnerable to collisions resulting from hitting with vessels or newly-built OWF construction elements that will be obstacles on possible migration routes.

Impacts of the presented factors on chiropterofauna in the OWF construction phase in the variant proposed by the Applicant will be negative, direct, simple, instantaneous, reversible and local. Impacts resulting from OWF construction will be limited in time and space and installation units will not reach considerable speed, which is why feeding and migrating bats are not to experience any problems when it comes to omitting possible obstacles while flying. Additionally, it should be emphasized that on the basis of the results received within the conducted chiropterofauna monitoring, bat activity in the OWF Area was found out to be low and species did not seem to migrate in the surveyed area.

Due to the above and on the basis of the current state of knowledge, as well as taking into consideration the protection status of bats, the impact scale of the Baltica OWF is regarded as negligible and its importance as insignificant (Table 89).

Table 89. The matrix determining the greatest significance of the impact of the Baltica OWF in the construction phase on avifauna

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.4.2 Impact on protected areas

6.1.1.4.2.1 Impact on protected areas other than Natura 2000

Due to significant distance of the Baltica OWF from the protected area of the Słowiński National Park, there are no significant impacts on this area, including any element for which it was established to protect, that is biodiversity, resources, creations and components of inanimate nature as well as landscape values of the Park.

Attachment to the Regulation of the Minister of Environment no 31 of 16 February 2017 on protective tasks for the Słowiński National Park (Journal of Laws MoE 2017.10, item 31), where the existing and potential internal and external hazards were identified and assessed as well as methods of elimination or limitation of these hazards and their results, also indicated the hazard resulting from increasing areas for wind farms in communes adjacent to the Park in the category of existing external hazards. In the category of potential external hazards it was indicated that only the creation of wind farms in the Park prospective is a potential external hazard, therefore it should be decided that the Baltica OWF will not be a hazard to the Słowiński National Park.

6.1.1.4.2.2 Impact on the Natura 2000 protected areas

Identification and assessment of impact on protected areas within the framework of the Natura 2000 ecological network was presented in the section 6.3.

6.1.1.4.3 Impact on ecological corridors

An ecological corridor is, according to The Nature Conservation Act of 16 April 2004 (Journal of Laws 2016, item 2134 as amended), is an area that makes it possible for plants, animals or fungi to migrate. The network of ecological corridors connecting the European ecological network Natura 2000 in Poland was developed in 2011 (Jędrzejewski et al., 2011). In this study, no ecological corridors have been indicated in the PMA. In the Baltic Sea area there are regular bird migrations in the spring and autumn period, however the tactics of migrations and their routes are very weakly researched.

In the case of long-tailed duck, velvet scoter and razorbill, the increase of the number of individuals flying above in the spring season took place at the same time as the increase of these species in the region of the planned Baltica OWF. Also the increase of the number of these individuals flying above in the autumn took place at the same time as the increase of their abundance on water. Therefore it can be assumed that part of the observed flights of long-tailed ducks, velvet scoters and razorbills, even in the period of spring and autumn migrations, only considered local movements between feeding grounds (Meissner, 2017).

Bearing in mind the lack of information about the presence, function and significance of ecological corridors in sea areas, it was conservatively assumed that the value of this resource is average.

Taking into account the spatial scale of the Baltica OWF Area with regard to the size of the Baltic Sea sea area, including the increasing effect of space development and taking into account the space free from buildings between Baltica 2 OWF Area and the Baltica 3 OWF Area, it was assessed that the impact of the Baltica OWF Area at the phase of construction on the migration routes of migratory species will be negligible (Table 90).

Table 90. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on ecological corridors

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.4.4 Impact on biological diversity

Due to lack of specific organisms found exclusively in the Baltica OWF Area it was assumed with regard to organisms present in POM that any significance of biological diversity in POM is high and in the OWF Area the significance of this resource is average.

The analysis of possible impacts resulting from carried out construction activities in the construction phase of OWF indicates that their impacts in most cases will have a short-term and local character. It concerns all types of emissions (noise, suspended matter, release of nutrients from seabed sediments). The impact intensity in the environment will decrease as the distance from their source increases. Mobile species (fish, marine mammals, birds) will avoid the space where they encounter deterioration of conditions which are optimal to them. Due to time limitation of the effect of scaring away these species and a large capacity of marine environment space after the emissions stop and the return of the previous life space conditions, the species (fish, marine mammals) return to the area from which they were scared away, of will use the neighbouring areas. The seabirds remaining in the Baltica OWF Area before the construction works start, they may permanently leave this area in order to move to the neighbouring regions, e.g. the Słupsk Bank area.

In the case of species related permanently with the seabed in the Baltica OWF Area (zoobenthos), the construction works will cause the destruction of parts of zoobenthos communities, directly in the places of foundations for wind power station towers and in places where the seabed is disturbed. However, due to common character of benthic organisms their resources will not be significantly diminished. However, the qualitative structure of zoobenthos will not be changed.

As a result of carried out construction works there may be a temporary qualitative change in the species structure in the Baltica OWF Area and in the area directly around it. After the works are stopped, the biological diversity on the species level will not be changed, that is the OWF structures will not create conditions for stable migration of new species from other sea areas with a different species structure (e.g. from the North Sea) and will not lead to permanent destruction of the population of species remaining currently in the OWF Area or in the neighbouring sea areas. However, after finishing the OWF construction phase and starting the operation of wind power stations, part of bird individuals more sensitive to the impact of wind farms may leave the OWF Area and move to adjacent feeding grounds. Loss of zoobenthos in quantities which are negligible from the point of view of bird and fish food supply, and consequently for marine mammals, does not cause disturbance in food dependencies, which does not disturb the existing equilibrium and does not lead to permanent elimination of weaker competition.

The character of the OWF Area structures will not lead to a speciation process, that is creation of conditions favourable to emergence of new species. There will be no marine habitat fragmentation, wherein it would be possible to isolate populations permanently or temporarily related with the Baltica OWF Area as well as adjacent sea areas.

As a result of construction works carried out there will also be no direct or indirect destruction of benthic and pelagic habitats which may consequently lead to extinction of species that live therein. As a result of works carried out there will also be no physical barriers which could not be overcame by marine biota.

Therefore, it can be decided that the phase of construction of the OWF may lead to a short-term change in the number of species staying within the structure area. Specific species may be temporarily scared away to the neighbouring regions, where they will not be vulnerable to disturbance. Such movements of individuals are not, however, a factor that changes biodiversity on the species level. The works carried out will also not lead to changes at the level of ecosystem or genetic diversity.

The impact of the investment in question to biodiversity may be considered of little importance (Table 91).

Table 91. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on biodiversity

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.5 The impact on cultural amenities, monuments and archaeological objects and sites

The assessment conducted based on the geological scouting results and geophysical surveys of the seabed (Appendix 1) in the area of the OWF implementation and the area impacted by the investment.

Assessment of probability of Stone Age settlement relic's occurrence in the area of the planned investment. The implementation of the Baltica OWF investment may cause the following types of impacts on objects with potential significance for protection of cultural heritage (archaeological relics, dated to Stone Age) unidentified so far, which may be discovered and identified later on:

- destruction or permanent damage of archaeological relics by ship anchors;
- damaging or total destruction of archaeological relics when settling gravity based foundations and cable laying;
- damaging of archaeological relics during installation of pile foundations;

- ground subsidence;
- uncovering of archaeological objects;
- redeposition of disrupted sediments;
- discovery of new objects (positive character).

During construction works new, previously unidentified archaeological stations, objects or artefacts may be discovered, which were not taken into account in the impact assessment presented in this Report because there was no knowledge of their existence at the current stage.

Based on the analysis carried it was considered that the significance of the impact on prehistoric archaeological relics from the Stone Age will range from negligible to of little importance.

It was concluded that all the potential impacts of the Baltica OWF on the possible Stone Age relics will be insignificant with an exception of the impact associated with installation of pile foundations, the impact of which has been assessed as of little importance. The results of the conducted assessment indicated that the investment consisting in construction of the Baltica OWF will not have a significant negative impact on preservation of the cultural heritage in the Applicant's variant at the construction stage.

Considering the issue of presence of relics from the Stone Age (mainly remnants of late Palaeolithic and Mesolithic settlements) in the area of the planned investment, it must be taken into account that the actual area with potential settlements of Stone Age communities underwent irreversible transformations of destruction due to activity of natural factors. It is not only impossible to recognise it from the perspective of conventional land archaeology, but it is also a very complex issue from the perspective of underwater archaeology.

The scale of transformations of Palaeolithic landscape at the turn of Pleistocene and Holocene is confirmed by the results of geological surveys carried out in the Baltica OWF Area. Their dynamics led to total erosion of rafting which could include relics related with human settlements in this area in the period in question e.g. at the turn of Pleistocene and Holocene. Consequently, the chance of accidental finding o remnants of relics from the Stone Age during the construction phase will be considered as close to zero in this area.

Even though the current state of knowledge on the Pomeranian region settlement history does not exclude the possibility of settlements in late Palaeolithic age and in Mesolithic age in the areas overlapping the investment area, the possibilities of observation and identification of its relics are much more complex, e.g. in the form of:

- archaeological sites from the Stone Age;
- anthropogenic ground-embedded objects;
- single stone and organic artefacts.

Even if the listed relics potentially exist as a component of seabed raftings in the Baltica OWF Area, the possibilities of their collection and location are extremely small. Moreover, the Inventory of Underwater Archaeological Sites does not include data on any subsea archaeological sites dated to the Stone Age epoch located in the area of the planned investment.

The cause of such a state of affairs is strong erosion of areas located this to the north from the current shoreline of the Southern Baltic (Uścinowicz, 2003) and the sedimentation processes which obliterated the relics of paleological landscape, which was confirmed as a result of geological and geophysical surveys (Appendix 1).

In the context of the most important conclusions of geophysical surveys with the purpose of identification of anthropogenic relics in the Baltica OWF Area, it should be mentioned that:

- seismoacoustic, geologic and ROV surveys were carried out and did not confirm the presence of settlement relics from the Stone Age;
- geophysical surveys carried out in order to recognise the character of the seabed shape and composition, as well as the reconstruction of palaeolithic landscape did not confirm the presence of anthropogenic objects related with prehistoric settlements;
- the overview of geological cores carried out for the presence of archaeological relics (e.g. elements of cultural heritage from the prehistoric periods) did not confirm a possibility of finding them in the area of the investment.

To sum up, the planned Baltica OWF investment at the construction phase will not have a negative impact on potential objects with large significance on the protection of cultural heritage from the Stone Age. Surveys carried out in the area in question did not show any archaeological objects or raftings related with settlement in the Stone Age.

6.1.1.6 Impact on use and development of sea area as well as tangible goods

During the construction phase of the Baltica OWF, this area will, for safety reasons, be excluded from sailing, fishery, research cruises and tourist cruises. Only the presence of service ships will be allowed. The construction of the Baltica OWF will not interrupt the use of the MW P-19 area. The elements of cultural heritage identified during the surveys should be granted protection by means of delineating zones excluded from construction works within the range of up to 100 m. More intensive traffic of vessels employed for the purposes of the OWF construction may translate into hindered vessel traffic along the route to the south of the OWF.

It is assumed that the moment the construction starts, the investment area is excluded from the possibility of carrying out fishing catches, which means predominantly:

- limitation or no possibility of catches in this area;
- in correlation with construction of other offshore wind farms planned in this area, the accumulation of areas excluded from fishing use and lengthening routes of access to other fishing areas.

It means a negative, direct and long-term impact on fishery.

The estimated amount and value of catches in the Baltica OWF Area, calculated proportionally to the size of the area which will be occupied by the farm (along with the 500 m buffer zone) in the given square in relation to the total amount and value of the Baltic Sea catches in 2012–2016 equalled 0.2% and 0.4% respectively (212 Mg and 780 thousands PLN). In the Baltica OWF Area mostly cod and flounder is caught, that is species caught commonly also outside the Baltica OWF Area. Therefore, the value of the resource will be considered average.

Resistance to impact is average – fishing vessels have a possibility of changing fishing areas, but it will involve the risk of lowering fish catch efficiencies and lengthening the way to the fishing areas.

Table 92. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on use and development of the sea area

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Note: Due to the location of the Baltica OWF in close distance from ports in Łeba, Ustka and Darłowo and on the route of sailing ships (mainly registered in Łeba) to the Słupsk Furrow fishing areas, the impact will be local and negligible. I concerns mainly ships that station in Łeba, in the case of which, due to the need to go avoid the farms, the road is exceeded and the time needed to reach the fishing area is increased

Source: internal data

6.1.1.7 Impact on the landscape, including the cultural landscape

At the construction phase of OWF, the following potential impacts of the investment on the landscape, including the cultural landscape, were identified:

- movement of sailing vessels, first of all the ones of contractors of the construction works, but also surveys, supervision and other works;
- transportation of OWF structural components, including the large-size ones;
- subsequently built offshore structures, such as offshore wind power stations, substations and platforms.

The impact on the landscape will be objective, as it changes its character from a natural to an industrial one, but also subjective, depending on the individual character of the viewer, and as such may be perceived as negative, positive or neutral.

Offshore structures will be carried out gradually, in phases. It is expected that the construction phase of OWF may last 8 years. Offshore structures will be painted and marked, including the fact that they will be lit in order to provide marine and aerial safety.

OWF impact on the landscape in the construction phase depends on:

- ship traffic related with the construction, the size of the transported structures;
- size of the structures, rotor diameter and its position with respect to the viewer;
- number and location of offshore wind power stations and objects;
- meteorological conditions and sea state;
- the place the landscape observer is.

People stay in the OWF Area for a short time, up to a couple of hours. These are vessel staff, passengers of tourist ferries and fisherman and deep-sea anglers, tourists on pleasure crafts, participants of search and rescue missions, people who fly over the sea using planes, scientists and other. For this group the planned OWF will be the most visible, while more people will be able to watch the OWF at day rather than at night, e.g. some, e.g. part of ferry crew and passengers will be sleeping. During the construction this group will expand by employees of OWF construction vessels. Impacts on the landscape will be short-term, temporary, depending on how long the observer will be exposed to the construction of OWF or transported elements.

During the construction phase, it is not only offshore landscape that will become affected, but also ports where marine constructions are built. Impacts on the landscape in this scope will be short-term, temporary and will take place primarily in industrial and port territories, depending on the location of the production area more or less visible for a casual observer; these will be medium and big ports. The landscape of the port and industrial areas is transformed, with many objects and structures changing the landscape to an industrial, anthropogenic one; they may partially or even fully obscure the observer's view on the structures undertaken for the purposes of OWF.

The impact was assessed as negligible (Table 93), though it varies with respect to the observer's distance from OWF and the type of the impacted landscape. The open-see landscape is not resistant to disturbance, but its value is not high as not many people for a short time will suffer from the landscape change, and some of them (e.g. tourists) may perceive it to be beneficial or interesting. The spatial scope of the impact will be big, decreasing with the distance from OWF, and will involve a periodically higher ship traffic; the impact scope in ports will be local.

Table 93. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on the landscape, including the cultural landscape

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.1.8 Impact on population, health and living conditions of humans

In the construction phase of the OWF, the impact on the population will vary in intensity on onshore and offshore areas. In port and shipbuilding areas, basic elements of wind power station will be manufactured: foundations, towers, rotors. Substations as well as platforms for infrastructure conditioning the proper functioning of the OWF will be manufactured in other plants. Throughout many years, they will be manufactured with the use of multiple technologies and subsequently transported to their designated location in the OWF. The planned number of wind power stations will require a couple of years before manufacturing and installing them offshore, which will provide workplaces for many people in shipbuilding industry, power industry, mechanical engineering and marine transportation. The construction of the OWF will potentially involve big plants and ports from the Tricity region and localities such as Władysławowo, Łeba, Ustka or Darłowo. Impacts on health and living conditions of the employees related with noise emission, air pollution, sewage and waste are to be expected in the plants where OWF constructions and devices will be manufactured.

In offshore areas, the long-time period of the OWF construction will result in significant changes of routes in the area surrounding the OWF as well as significant disruption in sailing of all marine vessels due to the crossing with main sailing paths of the Southern Baltic. This will result in an increase of hazard when it comes to sailing of all vessel types, including recreational crafts, as well as functioning of fishery in this region of the sea. The construction of an offshore farm of the size of Baltica may require approximately 800 cruises annually by vessels of various sizes at the routes between the OWF and the Gdańsk Bay ports as well as ports in Ustka and Łeba. This will contribute to the safety of sailing. In the construction phase, the fishery sector will need to resign from catching in some of the fishing squares, namely: L8, M8, N8, M7 and N7 in sea areas covered by the construction work.

The currently conducted exploitation of oil and natural gas in B3 and B8 deposits as well as the planned exploitation of B4 and B6 subsea natural gas deposits will not be disrupted thanks to a significant distance of a couple of dozens of kilometres between the given deposits and the Baltica OWF.

The process of the Baltica OWF construction will restrict actions related with offshore crisis management and emergency response. This regards various types of emergency events and accidents involving vessels, emergency rescue, salvage of property or combating oil pollution.

The potential impact on health conditions and human life in offshore areas will be related with transportation and assembly of particular wind power station constructions as well as possible collisions of vessels with constructions of offshore wind power stations.

Table 94. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on population, health and living conditions of humans

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.2 Exploitation phase

6.1.2.1 Impact on geological structure, seabed sediments, access to resources and deposits

The following impacts on geological structure, seabed sediments, access to resources and deposits in the exploitation phase are expected to take place:

- disturbance of the sediment structure;
- change of the seabed morphology;
- ground subsidence;
- suspended matter agitation and sedimentation;
- sediment heating;
- hindered access to the deposits.

Disturbance of the seabed structure

During exploitation of the OWF, there will be carried out works which disrupt the structure of bottom sediments i.e. change of damaged fragments of power cable. Agitation of sediment associated with anchoring of vessels during inspection, maintenance and sudden emergency repairs will also be observed. The process of anchoring is brief, occurs in a small area (spot), to a depth of approx. 3 m. Amount of sediment that can be agitated through anchoring is small.

Moreover, bottom sediments in direct vicinity of foundation structures will be subjected to washing out. Simulations carried out for typical conditions prevailing in the North Sea showed that the average value of scouring equals to 0.3 of a foundation's diameter in periods of occurrence of big waves (Nielsen & Hansen, 2007). Considering the hydrodynamic conditions prevailing in the Baltic Sea, it is expected that the value of scouring depths will be smaller than in the North Sea. Moreover, at the phase of the construction project, types of foundations will be selected which are adequate for the installation conditions and – if necessary – a protective layer against washing out, which will significantly decrease this impact in the period of exploitation.

The scale of impact may be reduced by the protective layer (e.g. against scouring or trawling) placed around the foundations or possibly along cable routes.

Disturbance of seabed sediment structure in the exploitation phase was evaluated as negligible and of a local range (Table 95). Minimizing actions are not required.

Table 95. The assessment of the impact of wind power stations in the OWF Area on the seabed in the exploitation phase – disruption of the sediment structure

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Disturbance of the seabed structure	The carried out works will disrupt the structure of bottom sediments, i.e. change of damaged fragments of power cable. Disruptions will be also caused due to anchoring of sailing vessels. Moreover, bottom sediments in direct vicinity of foundation structures will be subjected to washing out. In order to avoid that, protection against washing out will be used.	Negligible impact, local scope

Source: internal data

Change of the seabed morphology

In places of settling wind farms changes may occur in the morphology of the seabed. Locally, erosion can occur – scouring of foundations or accumulation of sediments in the vicinity of a foundation.

Small washing out is expected, which does not endanger any elements of the infrastructure, on the upstream side of the structures settled on the bottom and the formation of sand drifts on the downstream side. The resulting seabed forms should not be larger than the existing and moving ones. The uncovering or covering up of the elements of internal cable infrastructure of the farm (cables connecting the individual plants within a field) can occur in places.

A small change of seabed structure can also occur during maintenance works, such as replacement of power cables. Bottom sediments agitated during these works can be washed out. Thereby, the hollow formed along the cable can be temporarily uncovered.

The change in seabed morphology in the exploitation phase was evaluated as a negligible impact of a local range (Table 96). In the phase of exploitation, no actions minimizing this impact are necessary.

Table 96. The assessment of the impact of wind power stations in the OWF Area on the seabed in the exploitation phase – change of the seabed morphology

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Change of the seabed morphology	Settling elements of the wind farm involves a change in morphology (shape) of the seabed. In places of settling wind farms changes may occur in the geological processes of the seabed. Locally, erosion can occur – scouring of foundations or accumulation of sediments in the vicinity of a foundation.	Negligible impact, local scope

Source: internal data

Ground subsidence

Foundations of an individual wind farm structures settled on the seabed, depending on their mass, can cause compaction of the ground, that is, its intensification in result of decreasing the amount of empty spaces between the sediment grains. As a result, the foundation will subside.

In the exploitation phase, the process of ground subsidence under the weight of the foundation will be slower than during construction, but it will remain noticeable. This concerns mainly the use of heavy gravity foundation. The impact will be more noticeable in areas with mud-loam and loosely packed sand as well as sand and gravel sediments. Areas with clay seabed are also exposed to ground subsidence, but to a lesser extent. Subsidence will be more intensive in the case of gravity based structures rather than all remaining foundation types.

Ground subsidence in the exploitation phase was evaluated as a negligible impact of a local range (Table 97). No actions minimizing this impact are expected.

Table 97. The assessment of the impact of wind power stations in the OWF Area on the seabed in the exploitation phase – ground subsidence

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Ground subsidence	Depending on the mass, ground subsidence will take place, the foundation may cause soil compaction and its subsequent subsidence. This phenomenon can occur also in the phase of exploitation, especially in the case of using heavy gravity foundations.	Negligible impact, local scope

Source: internal data

Suspended matter agitation and sedimentation

Minor damages to the structure of sediments that will occur in the exploitation phase, related primarily to anchoring of vessels and replacing sections of energy cables (e.g. damages repair) will cause the impact of reducing water transparency, caused by the rise of suspension in the water deep (turbidity of water), but not affecting the structure of the seabed.

Increase of suspended matter in water in the phase of exploitation of the Baltica OWF was evaluated as negligible and of a local range (Table 98). No actions minimizing this impact are necessary.

Table 98. The assessment of the impact of wind power stations in the OWF Area on the seabed in the exploitation phase – increase of suspended matter concentration

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Increase of suspended matter concentration in the sea deep and suspended matter sedimentation	Some service works (i.e. replacing a section of a damaged cable), as well as anchoring of vessels will cause disruption of the bottom sediment structure and rising of suspension, which will cause water turbidity. Suspended matter was created as a result of resuspension of sediments during dredging works descends to the seabed in accordance with the regional water dynamics.	Negligible impact, local scope

Source: internal data

Sediment heating

The electric current flowing through the cable causes it to heat up, due to power losses in the electrical resistance as according to Joule's law. As the temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment. According to the OSPAR's guide from 2012 on the best environmental practices in the laying and use of subsea cables, the burial of the cable at a depth of 1 m to 3 m under the seabed is sufficient to allow within 0.2 m below the seabed surface the rise of the sediment temperature associated with heat emission through the power cables under load to be not greater than the recommended 2°K. The minimum burial depth will be determined on the basis of the type of sediments (their thermal conductivity) and the type of electricity grid (size and type of loads, thermal characteristics). Emission of heat by the cables is a negative, long-term, irreversible, impact constant at the exploitation phase and of local range. The scale of the impact was evaluated as small.

Given its universality, significance and role (especially the habitat-forming one), the value of the seabed sediment resource was evaluated as high.

Sediment heating in the Baltica OWF exploitation phase was evaluated as a negligible impact of a local range (Table 99) despite the significance of the resource and small scale of impact, since given the sea thermal capacity the level of sediment heating is expected to be negligible and limited to its direct neighbourhood (at the distance up to 10 m). Therefore, no changes in the habitats are expected to occur as a result of this impact. No actions minimizing this impact are necessary.

Table 99. The assessment of the impact of wind power stations in the OWF Area on the seabed in the exploitation phase

Type of potential impact (factor)	**Description of the impact (based on data from the literature)**	**The evaluation of the impact on the seabed in the OWF Area**
Sediment heating.	The electric current flowing through the cable causes it to heat up, due to power losses in the electrical resistance as according to Joule's law. As the temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment. This way, sediment may change its habitat-forming parameters.	Negligible impact, local scope

Source: internal data

Hindered access to deposits

In the exploitation phase, one of the impacts on mineral resources will be the presence of obstacles that would hinder their mining and prospect. It regards both detrital resources and hydrocarbons deposited at significant depths below the seabed. The processes of washing out sediments will take place in the direct neighbourhood of the foundations, which may lead to the diffusion of resource deposits.

No mineral resources were found out in the Baltica OWF Area. It cannot be excluded, though, that deeply lying mineral resources (e.g. hydrocarbons) will be discovered in the future in the Baltica OWF Area. The construction of the Baltica OWF will not block access to these resources, it will simply impose restrictions related with the necessity of taking into account the structures and installations of the Baltica OWF when planning explorations and exploiting mineral resources.

Table 100. Impact on resources

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Hindering access to mineral resource deposits	The existence of obstacles on the seabed that make it impossible to mine and prospect for mineral resources. It regards both detrital resources and hydrocarbons deposited at significant depths below the seabed.	No impact No mineral resources accumulations in the OWF Area
Washing out or covering deposits of mineral resources	The processes of washing out sediments will take place in the direct neighbourhood of the foundations.	No impact No mineral resources accumulations in the OWF Area

Source: internal data

Despite a significant habitat-forming and prospective industrial impact, the significance of the impact of the Baltica OWF on the geological structure, seabed sediments and mineral resources was evaluated as negligible.

6.1.2.2 Impact on marine waters and the quality of marine waters and seabed sediments

In the exploitation phase, the following impacts of the OWF on marine waters and their quality are anticipated:

- impact on wave motion and sea currents;
- release of contaminants and nutrients from the sediment into the sea deep;
- polluting the water deep and bottom sediments with anti-fouling agents;
- contamination with accidentally released waste water.

6.1.2.2.1 Impact on marine water dynamics

As part of the evaluation of the investment impact on marine waters, wave motion and ocean currents were analysed. What follows from the measurements conducted by the Maritime Institute in Gdańsk is that in the Baltica OWF Area the velocity and directions of water flows are subject to constant changes. As a result of the construction of wind power stations in this region, these water flows may undergo modifications. This phenomenon may be influenced by the following factors:

- the number of wind power stations, the distance between them and method of distribution;
- the size and shape of individual towers of wind power stations;
- the type and size of foundations;
- specification of water flow field (velocities, dominant directions, etc.);
- the shape of seabed with particular emphasis on surface gradients and natural barriers.

As a result, velocities and directions of water flow as well as water pressure in the direct neighbourhood of each construction may undergo modifications, which will result in a local increase of velocity of water flow due to the narrowing of the flow stream and swirling around the structure. Vortices may arise both from the downstream side and directly in front of an obstacle. The range of impact of the supporting structure on water flows in the water deep is equal to only a few times the diameter of the structure, so no more than several dozen meters. Distances between particular wind power stations will equal at least 4 times rotor diameters, thus being a couple of times higher than the range of this impact. This means that a mutual overlapping of these interactions is not to be expected and the disturbance will be solely of a local character.

The introduced modifications of the wave motion may be visible only in the immediate vicinity of particular offshore wind power station. They are of a local character and should not occur outside the Baltica OWF Area.

Having encountered obstacles in the form of towers of wind power stations, wind waves on the free surface of the sea omit them, thus losing some of their energy. If diameters of the offshore wind power stations are smaller than one fifth of the length of the waves propagating in their direction (Massel, 1992), such towers can be treated as streamline structures. That means that they will not cause any significant disturbances of the wave field. Otherwise, waves approaching the structures windward will be partially subjected to reflection and the ones approaching the structures windward to deflection of the wave beam after encountering an obstacle. In the area of the shadow, that is directly behind the obstacle encountered by the waves there is no wave motion, although swirling water may occur there. However, in front of the structure the reflected waves interfere with the approaching waves resulting in formation of standing waves. As a result, using the linear theory for simplification, directly in front of the vertical structure, the orbital velocities rise twofold. If the waves are long enough to affect the bottom, in cooperation with the sea currents, they can contribute to picking up of the sediment and consequently, lead to the erosion in the immediate vicinity of the foundation structure. The disturbances of the wave motion may be noticeable only leeward. They are of a local character and should not occur outside the Baltica OWF Area. The impact of wind power stations on the wave field and ocean current field will be of a local character and will not play a key role when it comes to these elements.

The Baltica OWF is outside the Słupsk Furrow, which is responsible for the transportation of oxygenated and more saline waters from the North Sea, which after rare, although very important for the Baltic ecology, intakes migrate through the Słupsk Furrow to the Gdańsk Deep and the Gotland Deep. The Baltica OWF will not impact these processes.

The value of the water resource is big, and it is related with the habitat forming nature of both components of the environment. The scale of impact on marine water dynamics is negligible and given its local range, the significance of impact of the Baltica OWF on marine water dynamics in the exploitation phase of the Applicant’s variant will be evaluated as insignificant.

6.1.2.2.2 Impact on the quality of marine waters and seabed sediments

Contamination with accidentally released wastewater

Wastewater may be generated in the exploitation phase by people present on vessels and platforms, as well as during the maintenance of wind power stations, substations and electricity grid.

A detailed description of this impact is described in section 6.1.1.2.

The impact significance of marine water pollution with waste in the Applicant’s variant in the exploitation phase is the same as in the construction phase (vide section 6.1.1.2.2). It will differ only in the size of the potential impact depending on the number of the conducted operations in the Baltica OWF Area (ship traffic, accepted solutions – the presence of people in substation etc.).

Release of contaminants and nutrients from the sediment into the water deep related with agitation of seabed sediment

During the exploitation of the OWF, there will be carried out works which cause agitation of bottom sediments i.e. maintenance of foundations, cables or anchoring of vessels. This will favour transition of contaminants and nutrients from sediments into the water deep.

The following will pass into the water: labile forms of metals, organic pollutants, i.e. polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), nutrients (nitrogen and phosphorus). Release of contaminants and nutrients from the sediment into the water deep was described in detail in section 6.1.1.2.1.

Since the sediment in the area of research is characterized by a low content of harmful substances (metals, PAHs, PCBs, TBT) and nutrients, the risk of their passing into the water deep is small (it will cause deterioration of water quality to a small extent).

The impact significance of the release of contaminants and nutrients from the sediment into the water deep in the Applicant's variant in the exploitation phase is the same as in the construction phase (vide section 6.1.1.2.2). It will differ only in the size of potential impact depending on the number of operations performed in the Baltica OWF Area associated with disturbance of the seabed. As in most cases, it will be associated solely with emergency situations at the exploitation phase, and so the impact will occur occasionally or not at all.

Contamination with compounds from anticorrosion protection agents

Cathodic protection is the most common method used in protection of steel elements against corrosion in the marine environment. It can be implemented as a galvanic or electrolytic protection. The galvanic cathodic method involves using zinc or aluminium anodes. The foundation elements are usually additionally covered with insulating protection layers. In the initial period of operation, emissions of zinc or aluminium from the anode are not observed. This process develops (progresses) over the years and along with the degree of damage of the protective coating on parts subjected to corrosion protection. It is assumed that complete dissolution of anodes takes about 20 years.

The discussed metals are first of all transmitted into the water deep. Leaving them in a dissolved form (in the sea deep) depends on the concentration of anions and ligands that chelate currently in water, pH and redox properties as well as in the presence of absorbing sediments (Alloway & Ayres, 1999). Aluminium will be precipitated to a large extent and accumulated in the sediment, because its solubility in natural waters (pH approx. 8) is very small. It will be to a large extent sorbed by the sediments in the form of metastable compounds. It may be released again to the sea deep as the water acidification increases (Kabata-Pendias & Pendias, 1993). The zinc compounds can remain in the water longer than aluminium, because most of them are soluble in water. Zinc can undergo adsorption and co-precipitation with hydrous oxides of Fe, Mn and Al, occurring in sediments, Co-precipitation and adsorption of zinc is furthered by presence of clayey minerals (loamy, with a high content of fine fractions and organic soil material) (Alloway & Ayres, 1999).

Ecotoxicological tests showed significant aluminium toxicity to aquatic organisms such as algae, fish and first order consumers (Klöppel et al., 1997; Migaszewski & Gałuszka, 2007). Excess aluminium causes decalcification and deformation of bones, and anaemia and hardening of cell membranes (Migaszewski & Gałuszka, 2007). Harmful effects on fish appear to be associated with the process of precipitation of the metal on gills, in result of defence mechanisms (e.g. emitting neutralizing compounds of Al+3) (Kabat-Pendias & Pendias, 1993).

Zinc is one of the more mobile metals in sediments, which affect its replaceable forms, as well as the binding to organic substance (Kabat-Pendias & Pendias, 1993). It regulates metabolism of carbohydrates and proteins in plants. Its excess (100–400 $mg \cdot kg^{-1}$ depending on the species) causes a development of chlorosis and necrosis. This phenomenon is associated with iron deficiency, and inhibition of photosynthesis. In vertebrate organisms, zinc is also involved in metabolism of proteins and carbohydrates, in detoxification of heavy metals in cells, and it also increases activity of enzymes and hormones (Migaszewski & Gałuszka, 2007).

The table (Table 101) presents the amounts (loads) of zinc and aluminium which may enter the environment as a result of using cathodic protection against corrosion. Calculations consider the Applicant's variant, that is 209 foundations and 25 other structures.

Table 101. Amounts of zinc (Zn) or aluminium (Al), which can be released into the environment during about 20 years in result of using cathodic protection against corrosion

Type of foundation	**Amount of Zn or Al**	
	1 foundation, the amount of element released during exploitation of the farm (20 years)	**Applicant's variant (209 foundations), amount of the element released by the entire farm**
Large-diameter pile	1 Mg Zn	209 Mg Zn
Gravity based	0.25 Mg of Zn or Al	52.2 Mg of Zn or Al

Source: internal data

Contamination of waters and seabed sediments with Al or Zn released during exploitation is a negative input, direct, long-term, irreversible, constant in the exploitation period, with a local range. The scale of impacts for waters and sediments is small.

The alternative for the presented method is electrolytic cathode protection. In this method, the protected object becomes the cathode of an electrolytic cell powered by direct current from an external source. The anode used in this circuit is usually insoluble. The most durable anode materials in this method include platinum and titanium electrodes coated with a platinum layer measuring 2–3 µm. With the use of electrolytic cathodic protection no impact is observed on quality of water and sediments.

The value of the water resource is big, and it is related with the habitat forming nature of both components of the environment. The scale of impacts for anti-corrosion protection on the quality of marine waters and sediments is negligible and the significance of the impact of the Baltica OWF with regard to anti-corrosion protection on the quality of marine water and sediments in the Applicant's variant at the exploitation phase will be assessed as of little importance. In the case of using electrolytic cathode protection, the impact will be non-existent.

Summary of the assessment of the impact on the Baltica OWF in the exploitation phase on the quality of marine water and sediments

The significance of the Baltica OWF impact in the Applicant's variant in the exploitation phase will be assessed as the highest significance from the ones listed above, that is of little significance on marine water and sediment quality.

6.1.2.3 The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

The wind power stations will locally lower the wind energy and disrupt atmospheric pressure directly within the range of rotating blades. The power stations may locally disrupt the speeds and direction of water flow as well as locally dampen sea wave energy, which is demonstrated in the loss of their height.

Given the significant distance of the Baltica OWF Area from the coast and other potential sources of pollution emissions it will be assumed that the air purity class within the area will correspond to the purity class A. Given that the emission in the OWF exploitation phase is minimal (mainly from Diesel generators from the objects installed in substations and air conditioning devices as well as maintenance units), practically no emission of dust pollution and only insignificant emission of gas pollution will be assumed, including carbon dioxide, which is a greenhouse gas. Thus there is no need to assume air purity deterioration or the lowering of its purity class. No emissions of any other gases responsible for the greenhouse effect are to be expected.

The planned investment in the exploitation phase will have both a negative and positive impact on the climate. Negative impacts are related with emission of greenhouse gases caused by combustion of fuels by servicing ships. A positive impact on climate will be the generation of electricity from a renewable source by the OWF on a level of 2550 MW, which, at carbon dioxide emission at a level of 900–960 kg CO_2 for 1 MWh will noticeably reduce the emission of this gas on a national scale.

According to arrangements of the GP WIND project (GP WIND, 2012) generation of electricity from offshore wind power stations involves emission from 6 to 34 kg CO_2 per 1 MWh, which at expected generation of 223.38 TWh during 25 years of exploitation means emission from 1.3 to 7.6 m Mg CO_2. The higher value from the ones quoted concerns the case then a gravity foundation is used with a large share of cement in the structure. Even in such case, emissions will be at least 10 times lower than the ones related with generation of electricity in other sources based on bituminous coal or lignite (expected reductions of emissions are above 80 m Mg CO_2 – without the emission associated with construction of these sources taken into account).

In the exploitation phase there will be an insignificant increase of local greenhouse gases emissions due to combustion of fuels by service ships for the wind farm.

Climate conditions in the Southern Baltic area related with shaping of weather phenomena (mainly temperature, precipitation and wind) in a perennial period undergo constant changes which, even though they are related with global climate changes, basically have a character of regional changes. Due to the fact that the expected scope and scale of these changes in the period of several tens of years, for which the exploitation of the OWF is expected to take place is relatively small, the forecast climate changes in the Baltic Sea region will have a slight impact on the area of the designed farm and will also have a small impact on exploitation conditions and safety of wind power stations. It should be borne in mind, however, that in order to ensure correct functioning of a wind farm, it is necessary to take into account the possibility of extreme weather conditions at a scale greater than it is observed currently, as well as the fact that the scope of its variability throughout the year and in specific years will be increased, taking into account the expected change trends in the period of several decades.

The observed increase of farm productivity and frequency of storm phenomena should cause a certain increase of the Baltica OWF productivity. On the other hand, however, it may result in greater failure rate of offshore wind power stations and periodic deterioration of navigation conditions in the farm region. Therefore, there should be an expected risk of more frequent presence of wins stronger than force 10 on Beaufort's scale than it is the case now. Possible impact of average sea level, as well as changes of thermal conditions and water salinity will not have a noticeable impact on operation, exploitation conditions and safety of the Baltica OWF equipment. The forecast increase in sea surface temperature practically excludes risks related with the presence of ice phenomena. However, the forecast increase of the amount of precipitation and humidity of the lower atmosphere layer increases the risk of icing for windmills (in the case of negative air temperatures – in this scope, however, a decrease of frosty and very frosty days is expected), as well as increase of frequency of occurrence of situations with a limited visibility.

For open sea areas, shortening and increasingly mild character of ice seasons will have a positive impact on sailing conditions and exploitation of devices at sea.

The progressing eutrophication of marine waters may cause certain hindrances in exploitation of the designed OWF, particularly in the summer period. The increase of temperature in the winter period may cause disappearance of species typical for cold water and appearance of species present in warmer waters.

In the exploitation phase the direct and local impact of the planned investment (related with the use of water crafts and their use of fuel) will have no significant impact on the change of climate conditions. Despite long-term impact, its range will be local. However, indirectly the exploitation of the wind farm causes reduction of greenhouse gas emissions to the atmosphere by other sources, e.g. coal-based power stations located in other regions of the country. Therefore, despite large significance of climate and air quality as well as a smaller scale of impact of the Baltica OWF in the Applicant's variant in the exploitation phase it can be considered that in the scope of emissions of greenhouse gases from vessels to the atmosphere, the significance of the impact will be negligible. The impact of reduction of greenhouse gases is positive, but hard to assess. It results from the fact that reduction of emission will be assigned to an entirely another space (location of an equivalent power station using fossil fuels).

6.1.2.4 Impact on systems that use PEM

The exploitation of offshore wind farm active so far indicates that operation of wind power stations and certain types of tower structures may have a negative impact on the operation of shipboard and onshore navigation support devices and other applications. It regards particularly radars, communication systems and radiolocation devices, such as AIS, which is fitted on each ship with gross capacity above 300 Mg.

Experiences from Great Britain show that OWF may in particular situations:

- interfere with operation of shipboard radars;
- lower the radar operation effectiveness;
- impact radio communication;
- cause interference of waves emitted from ships, shore systems and OWF devices;
- deflect and distort signals due to the structure of towers and blades of offshore wind power stations.

Systems which may be interfered by the Baltica OWF include:

- NMSS components – shore radar systems, stations that record AIS system signals, radio communication;
- GMDSS system of emergency communication;
- SAR communication systems;
- the Border Guard and Navy systems – communication systems and radar systems;
- navigation systems in ships that sail near the Baltica OWF – radio communication, navigational radar systems and transceivers of the AIS system;
- radio and television signal.

Impact on radar systems was shown in the example of the Triton Knoll farm. For the purposes of assessment of the impact of OWF Triton Knoll (Great Britain) on navigation radars and other navigation support structures (navigation buoys, RACON type marking) QinetiQ[2] carried out surveys in 2010. The following scenario has been accepted for implementation in the OWF area:

- 240 wind power stations, each with power of 8 MW (maximum number and size of the power stations);
- a certain number of ships (trade ships which are 100 m long and fishing cutters which are 20 m;
- navigation radars operating in the X and S band.

The study took into consideration the impact of the presence of wind power stations on the capacity of radars of various objects (ships, drilling rigs, navigation buoys) for various locations of these radars, as well as the possibility of using a so-called Sensitivity Time Control (STC) – a tool that allows regulation of radars and improving visibility of images.

For each location, the radar capacity to detect target was analysed in the following aspects:

- probability of target detection;
- image saturation;
- physical shadow effect;
- capacity of detection in the area of side leaves of the radar antenna;
- false images and false image areas.

Probability of object detection

The study assumed that objects assumed in the maximum scenario will be detected by radars operating in X and S bands, regardless of the type of ship on which they are installed. A 90 m blade will be detectable from the distance of 35 NM (64.8 km) and the nacelle located at height of 130 m will be visible from the distance of 25 NM (46.3 km). It means that the target that includes both the wind power station towers and rotor blades appear separately if the radar range of operation is smaller than 24 NM (44.4 km). It should be assumed that a clear image of objects is detected at extended range of radars will constitute additional navigational support apart from the marking that already exists.

The application of STC may reduce the signal strength (reception) as a function of range. STC lowers reception in the X and S bands in the following scope:

- for trade ships:
  - range of 0 NM – maximum reduction,
  - range of 11 NM – minimum reduction;
- for fishing ships:
  - range of 0 NM – maximum reduction,
  - range of 4 NM – minimum reduction.

[2] QinetiQ's study 'Triton Knoll Wind Farm Impact Assessment' (Appendix 7a and 7b).

Image saturation

The radar signal received the moment the radar's dynamic range is exceeded causes the image to be oversaturated and blurred. The study shown that for trade ships such an effect may take place within a distance of 1.3 NM (2.4 km) from wind power stations for radars working in the S band and at a distance of 1 NM (1.8 km) from wind power stations for radars working in the X band. X band radars working on fishing ships may undergo interference at a distance smaller than 0.5 NM (0.9 km).

At the same time it was found out that image oversaturation effects are entirely eliminated thanks to the use of STC.

Physical shadow effect

The potential shadow effect is the most significant phenomenon for sailing. For large objects, such as the OWF structures, it increases as it gets closer to these objects. In this case, interference depends on the radar cross section (RCS), shadow depths and signal strength.

The study shown that radars operating in the S band may suffer from interference (shadow effect becomes predominant) in a distance of 5 NM (9.3 km) and cause emergence of a shadowed sector with the length of 200 m. X band radars work much better in the same conditions – the width of the sector in the shadow equals approx. 100 m. For the scenario assumed for the Triton Knoll farm (240 power stations) the interference level may cause reduction of detection capacity by approx. 29%. It should be expected that for the Baltica OWF this level will be similar.

The shadow effect may additionally be reduced by applying corrective measures – radar stations located in the vicinity of OWF. Selection of equipment and its parameters will depend on the OWF technical specification and other investments located nearby. Application of mitigation measures may concern particularly the systems that utilise operation of shore stations (e.g. national defence radar systems).

Interference resulting from radar waves coming from the side leaves of the antenna

Apart from the main, narrow stream of radio waves generated by the antenna there are numerous side streams (side leaves), which causes the creation of undesired (false) images. The presence of a wind power station at a distance smaller than 0.5 NM from a trade ship decreases probability of detection in the area with an angle of approx. 100°, but application of STC eliminates this interference reducing this angle to approx. 10°.

False images

Presence of multiple objects with a significant refraction capacity and focused at a small distance from one another may cause the creation of false images on radar screens. Offshore wind farm power stations may therefore create a possibility of occurrence of this phenomenon. It concerns particularly the situation where an object present in the OWF Area has to be detected. In the case of objects present outside the offshore wind farm area, this event has a much smaller significance.

In a direct vicinity of the OWF there may be additional reflections of images of ships present there. Presence of this phenomenon depends on the radar type and the relative location of the object where the radar is located and the detected object, which possible false image may be generated. Generally, the additional reflection and generation of a false image for radars operating in the S band will appear in a situation when the radar antenna is present within the presence of 0.5 NM and the detected object is located on the other side of the farm at a distance of 10–15 NM. The application of STC largely reduces the interference of this type. However, the effects of creation of false images will be researched in reference to specific technical solutions of the OWF and relative location of navigational routes.

Interference in vessel radio communication and the AIS system

In the scope of radio communication and AIS system communication, the basic phenomenon that results from the quality level of communication is placing physical obstacles on the radio signal transmission path. It results from the fact that the significance of these interferences is large in the case the receivers and transmitters (regardless of whether they are mobile or immobile) are located on the opposite sides of the OWF or between them.

It may for example concern the communication of ships sailing north from the OWF and the onshore AIS stations. In the case of an immobile onshore station and a ship sailing north from the Baltica OWF, periodic losses of communication may occur and/or deterioration of the communication quality.

In accordance with the conditions included in the PSZW document, the Applicant at the phase of drafting the construction design will be obliged to arrange with the relevant users (the Border Guard, the Ministry of National Defence and the maritime administration), in order to introduce prevention measures, which will allow the users to accept the impact of the Baltica OWF on communication and radiolocation systems. With regard to this, despite the importance of these systems for the society and the national interests, it will be assumed that the significance of the Baltica OWF impact on these systems shell be **negligible**. In order to achieve the requirements above, it may be expected that it would be necessary to carry out corrective measures, such as installation of communication and radar systems at the north boundary of the Baltica OWF which would support the operation of systems of the maritime administration, the Border Guard and the Navy, particularly ones based on systems of stations placed onshore. The installed devices will have to be communicated in real time with the relevant organs using dedicated teletechnical links. Determining the specific solutions will be possible only at the phase of construction permit, when the power station parameters (shapes of blades, tower, nacelle of wind power stations and their number and distribution).

6.1.2.5 Impact on nature and protected areas

6.1.2.5.1 Impact on biotic elements in the sea area

6.1.2.5.1.1 Phytobenthos

Due to the fact that no offshore wind power station was built in the PMA, in order to assess the impact of the Baltica OWF on phytobenthos, the authors based on data from the literature regarding other marine areas, mainly the Baltic Sea. Analysis of subject matter literature shown that potentially there are two factors that impact phytobenthos during the investment exploitation phase (Table 102, Table 103).

Due to trace amount of phytobenthos present outside the Baltica OWF Area, it was assumed that even though the significance of phytobenthos generally in the PMA is large due to the uniqueness of this resource in the PMA, in the OWF Area the significance of this resource is low.

The first impact factor is construction works in the seabed (Table 102), involving settlement of support structures on the seabed. Irreversible destruction of phytobenthos communities will take place – a so-called loss of habitat part (Köller et al., 2006; Zucco et al., 2006). According to these authors the seabed construction impact result will be long-term. Habitat destruction may also take place during routing repairs or maintenance of the structure using jack-up type ships (Köller et al., 2006; Zucco et al., 2006). After the servicing unit sails away the structure most often returns to the initial condition in the next vegetation season. The scale of destruction of phytobenthos communities depends on the seabed surface occupied by the structure along with the scour protection layer as well as the intensity of use of servicing units which have contact with the seabed. In the case of exploitation of an offshore wind farm in the Baltica OWF Area there will be no loss of habitat part, because trace amounts of phytobenthos are present outside the construction site.

Table 102. The assessment of the impact of wind power stations in the OWF Area on phytobenthos, during the investment exploitation phase – construction over the seabed

Description of the impact (based on data from the literature)	**Phytobenthos impact assessment in the OWF Area (based on the results of the Inventory Report)**
Loss of habitat part – the seabed under the foundation of the support structure and the scour prevention layer will be devoid of biological life; seabed destruction will take place also during structure inspections and repairs using jack-up units that anchor in the seabed	There will be no loss of phytobenthos habitat, because no habitat exists in the area of construction. Trace amounts of plants are only present outside the area of construction and therefore outside the area of inspections and repairs of structures by jack-up ships. No impact

Source: internal data

The second factor which has a strong impact is the presence of hard substrates in the environment, that is support structures and scour prevention layers (Table 103), the impact of which is documented in the broadest manner, and is most controversial (e.g. SEAS Wind Energy Centre, 2002; Birklund & Petersen, 2004; Bruns & Steinhauer, 2005; Horns Rev. 2005; Leonhard & Pedersen, 2005; Nielsen, 2006; Birklund, 2006; Petersen & Malm, 2006; Köller et al., 2006; Zucco et al., 2006; Wilhelmsson & Malm, 2008; Kerckhof et al., 2010; Bouma & Langkeek, 2012; Rostin et al., 2013). Submerged parts of constructions newly introduced into the environment (hard substratum) are overgrown during the wind farm exploitation phase by periphyton organism colonies: invertebrates and macrophage which create a so-called artificial reef. The process of macroalgae overgrowing the support structures starts as early as in the first vegetation season from the moment the structure is settled. Surveys carried out in the Baltic Sea indicate that structures are overgrown most abundantly by one-year filamentous chlorophytes in the zone up to 2 m of length (Mańkowski & Rumek, 1975; Nielsen, 2006). The remaining, deeper parts of structures are primarily overgrown with brown algae and red algae (Nielsen, 2006; Zucco et al., 2006), later driven off by mussels and barnacles. Therefore there is a possibility that support structures constructed in the OWF Area, if they are overgrown by macroalgae, then it takes place to a small degree and for a short time.

Table 103. The assessment of the impact of wind power stations in the OWF Area on phytobenthos, during the investment construction phase – presence of artificial hard substrates

Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Inventory Report)
The effect of an artificial reef – supporting structure and scour protection layer on the seabed are potential substrates for the formation of the periphyton flora	Appearance of allochtonic species in the region, that is ones that previously were not present in the region of offshore wind farm, for instance due to lack of stony seabed or depths too large for development of plants. An increase of biomass of autochtonic species, that is present in the offshore wind farm area on cobbles and boulders. Increase of biological productivity in the region, which results in the increase of the feeding supply for fish and birds (negative/positive results)	Possible overgrowth of support structures by: allochtonic species – not present earlier in the OWF Area due to the seabed depths greater than 20 m and sporadic presence of stony seabed autochtonic species -present on cobbles and boulders distributed on the seabed outside the line of construction in the OWF Area Impact: direct simple short-term temporary reversible local negative/positive Scale of impact: negligible Significance of a resource in the Baltica OWF Area: small Significance of impact: negligible

Source: internal data

Results of monitoring surveys carried out mainly in the Danish straits and the North Sea (Zucco et al., 2006; Wilhelmsson & Malm, 2008) indicate that periphyton communities have an immense impact on the environment on the ecosystem level. They locally change biocenosis species diversity and biological production in the farm region. They increase the food supply for birds and fish and create new hiding places for juveniles and phytophylic fauna. Therefore, the creation of artificial reef on structures in the OWF Area may be considered twofold, as a positive and negative phenomenon at the same time. An artificial reef on the one hand may impact local increase of biodiversity and increase of the phytobenthos biomass in the OWF Area (positive impact) and on the other hand it may cause modifications of initial environment conditions prevailing before the structure settlement – e.g. there may be species previously absent in the region (negative impact) (Wilding et al., 2017). Currently, the scientific community is divided in the issue of assessment of the impact of artificial reefs on the environment, including phytobenthos. Until now there were no studies in the PMA regarding similar investments, therefore no far-reaching conclusions may be drawn, and the aspects of reef impact will be treated generally, only signalling the possible impacts.

In the assessment of potential impacts of the decommissioning of an offshore wind farm in the Baltica OWF Area on phytobenthos, particular attention should be paid to protected species in accordance with the Regulation of the Minister of the Environment of 9 October 2014 on plant species protection (Journal of Laws no. 2014, item 1409) During the surveys from 2016 (Appendix 1), the presence of a single individual of a strictly protected species – red algae *Furcellaria lumbricalis* (formerly *F. fastigiata*) in the zone outside the OWF Area intended for construction. Trace amounts of this species indicates that its presence in the region was incidental. The place in Poland where it is most abundant was identified in the boulder area of the Słupsk Bank (Kruk-Dowgiałło et al., 2011), located approx. 20 km from the south-western boundary of the OWF Area.

Therefore, in accordance with the above description of pressure factors on phytobenthos, it will be concluded that the exploitation of the wind farm will have no impact on the protected species of the red algae *F. lumbricalis*, because it is located outside the construction line, and the impact of the factors above is unlikely. Possible destruction of single individuals of this species as a result of actions related with the exploitation of the planned investment will not have impact on the population of this species in the PMA.

Table 104. The matrix determining the greatest significance of the impact of the Baltica OWF in the exploitation phase on phytobenthos

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

From the two analysed pressure factors on phytobenthos, in the exploitation phase, only the structure overgrowth was taken into account during impact assessment on this element of the environment. There will be no loss of phytobenthos habitat, because no habitat exists in the area of construction. Possible overgrowth of support structures by allochtonic species – not present earlier in the OWF Area due to the seabed depths greater than 20 m and sporadic presence of stony seabeds – as well as autochtonic species – present on cobbles and boulders distributed on seabed outside the line of construction in the OWF Area will be insignificant and its scale will be negligible (Table 104)

The exploitation of the wind farm will have no impact on the protected species of the red algae *F. lumbricalis*, because it is located outside the construction site, and the impact of the factors above is unlikely.

6.1.2.5.1.2 Zoobenthos

On the basis of analysis of the literature on the subject matter, two basic potential factors were identified which may impact zoobenthos in the exploitation phase:

- construction in the seabed;
- emergence of artificial hard substrate in the environment, i.e. supporting structure and scour protection layer.

Construction over the seabed eliminates the sediment surface occupied by the foundation and the scour protection layer from biological life. Loss of habitat part in will take place in the construction and exploitation phases of the OWF (Köller et al., 2006; Zucco et al., 2006). Due to a relatively small scale of the investment, qualitative and quantitative zoobenthos composition which is typical and non-divergent from the remaining part of the PMA (small value of the resource) and a large rebuilding capacity of zoobenthos resources (which will take place after the decommissioning phase) this impact will be negligible (Table 105).

Table 105. The assessment of the impact of wind power stations in the OWF Area on zoobenthos in exploitation phase – construction over the seabed

Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Assessment of impact on zoobenthos
Loss of habitat part – the seabed under the foundation of the support structure (for wind power stations and power substations) and the scour prevention layer will be devoid of biological life; short-term seabed destruction will take place also during structure inspections and repairs using jack-up units that anchor in the seabed	Elimination of natural zoobenthos communities in the area occupied by the support structure and the scour prevention layer; periodic seabed destruction will take place also during structure inspections and repairs using jack-up vessels	Impact: direct simple long-term constant lasting local negative Impact scale: negligible Importance of the resource: low Importance of the impact: irrelevant

Source: internal data

Emergence of artificial hard substrate in the environment, i.e. supporting structure and scour protection layers will be considered factors that have a significant local impact on zoobenthos. It results in alteration of the qualitative and quantitative structure of a natural zoobenthos community, particularly in places where hard substrate was not previously present (Table 106).

Table 106. Assessment of impact of wind power stations in the OWF Area on zoobenthos in the exploitation phase – the emergence of artificial hard substrate (negative impact)

Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Assessment of impact on zoobenthos
The effect of an artificial reef – supporting structure and scour protection layer on the seabed are optimal substrates for the formation of a periphyton community	Emergence of hard substrate in regions with natural presence of fragments of sandy seabed habitats Creation of microcommunities that are beneficial to spreading zoobenthos species alien to this habitat	Impact: direct simple long-term constant lasting local negative Impact scale: average Importance of the resource: low Importance of the impact: insignificant

Source: internal data

Submerged parts of wind power stations are overgrown during the exploitation phase by periphyton organism colonies: invertebrates and macrophage which create a so-called artificial reef. The process of zoobenthos periphyton species overgrowing the support structures starts after reproduction of periphyton species and larvae attaching to the hard surface of the structure. Periphyton communities have a significant impact on marine environment on the ecosystem level. The emergence of artificial hard substrate in the environment is the best documented impact (SEAS Wind Energy Centre, 2002; Birklund & Petersen, 2004; Bruns & Steinhauer, 2005; Horns Rev… 2005; Leonhard & Pedersen, 2005; Birklund, 2006; Köller et al., 2006; Nielsen, 2006; Petersen & Malm, 2006; Zucco et al., 2006;

Wilhelmsson & Malm, 2008; Kerckhof et al., 2010; Bouma & Lengkeek, 2012; Rostin et al., 2013; Janßen et al., 2013; Wilding et al., 2017) (Table 107).

Table 107. Assessment of impact of wind power stations in the OWF Area on zoobenthos in the exploitation phase – the emergence of artificial hard substrate (positive impact)

Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Assessment of impact on zoobenthos
The effect of an artificial reef – supporting structure and scour protection layer on the seabed are optimal substrates for the formation of a periphyton community	Intensification of biological productivity in the OWF Area (increase of zoobenthos abundance and biomass)	Impact: direct simple long-term constant lasting local positive Impact scale: average Importance of the resource: low Importance of the impact: insignificant

Source: internal materials, taking into account the results of impact analyses in paper by Dziaduch (2015)

Assessment of impact of newly created artificial reefs on the environment is ambiguous in the opinion of authors of studies. On the one hand, the increase of biodiversity (habitat and taxonomy) as well as the increase of zoobenthos resources which is a food supply for fish and seabirds may be considered a positive phenomenon. Negative impacts include the loss of previous neutral character of the seabed part habitat and a group of factors with impact that expands outside the OWF Area, e.g. changes in resources and the zooplankton structure resulting from filtering it out by periphyton organisms (Wilding et al., 2017) as well as the increase of the mass of gelatinous zooplankton (jellyfish) which when in a settled state – polyps – are attached to hard surfaces of structures (Janßen et al., 2013). Artificial reefs, as confirmed by various authors, may also facilitate spreading species alien to the areas (Helfman et al., 2017).

Analysis of pressure factors on zoobenthos at the exploitation phase shown that the "Construction over the seabed" impact will be negligible due to negligible scale of impact as well as the small significance of the resource. In turn, the impact resulting from the presence of artificial hard substrates in the environment will have a twofold character: positive – because it will increase zoobenthos resources locally, and negative – because it will cause the appearance of an alien hard substrate in the regions with naturally present fragments of sandy seabed habitats. At the same time this artificial reef may be a micro-habitat which is favourable to spreading of zoobenthos species alien to the area. Due to average impact scale and low significance of the resource, both impacts were considered of little importance (Table 108).

Table 108. The matrix determining the greatest significance of the impact of the Baltica OWF at the exploitation phase on ichthyofauna

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	**Insignificant**	Moderate	Significant

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
	High	Moderate	Significant	Significant

Source: internal data

6.1.2.5.1.3 Marine ichthyofauna

Noise and vibrations emission

The source of noise in the Baltica OWF exploitation phase will be the operating offshore wind power stations and ships that move around due to servicing works at the OWF. They may cause effect of avoidance and masking effect. Sounds generated by operating offshore wind power stations or ship traffic in the farm region may lead to disturbance of the receipt of natural sound stimuli of the environment by fish, including communication between individuals (so-called masking effect), e.g. in cods. The frequency of cod noises was recorded at the level of 50 and 95 Hz (Hawkins & Rasmussen, 1978; Brawn, 1961). Moreover, Wahlberg and Westerberg (2005) suggest that operation of wind power stations at wind speed 8–13 $m \cdot s^{-1}$ is detectable for Atlantic salmon *S. salar* and cod *G. morhua* within a distance from 0.4 to 25 km. The species above may avoid the zone in the range up to 4 m from the offshore wind power stations at wind speed of 13 $m \cdot s^{-1}$, while within several tens of kilometres the noise generated by the offshore wind power stations may impact their communication. In the case of some species, the effect of avoiding the OWF region due to the stress caused by a constant vibration of wind turbines may be observed (Thomsen et al., 2006).

Reactions involving avoidance of passing vessels were observed in case of studies conducted on the Baltic populations of cod, herring and sprat which demonstrate the best ability to receive sounds among the primary species exploited by fishery (Mitson 1995). The reaction of fish to noise depends also on their physiological state. In case of herring, which has very good hearing, the avoidance of sound sources associated with the vessel traffic and fishing gear is observed usually outside the spawning period (Olsen et al., 1983; Vabø et al., 2002), and this behaviour changes in the herring spawning period (Nøttestad et al., 1996; Axelsen et al., 2000). The range of this impact is, however, relatively small.

Fish are able to adapt to the changing environment conditions. During experiments carried out on sole and cod it was found out that during first attempts of exposure to the sound, the swimming speed of fish was much greater than in during later attempts. Most probably this effect is the fish getting used to the noise (Mueller-Blenkle et al., 2010). However, in the case of sounds made by fish in order to communicate, one of the ways of adaptation is temporary modification. Usually, the length, amplitude, of frequency of sound is changed (Radford et al., 2014). Moreover adult individuals are able to actively avoid the impact of hazardous factors.

Noise and vibrations emissions generated during OWF exploitation may directly and negatively affect ichthyofauna. These impacts will have a negative, direct, local and simple character. The impact will be long-term, reversible.

For all analysed species their resistance to noise and vibration at the exploitation phase is high.

Table 109. Impact of noise and vibrations at the phase of exploitation of the Baltica OWF on ichthyofauna

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant

Species	Importance of the resource	Impact's scale	Impact's significance
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Change of habitat

Introduction of foundations and scour protection structures is favourable to appearance of a new habitat characterised by hard basement. Depends on the area surface, number of artificial reefs. Offers shelter (e.g. for cods 2–3 years old) (Reubens et al., 2014), increased food supply (as a result of colonisation of structures by periphyton organisms, macrophytes, invertebrates). It usually results in creation of aggregations of some fish species, which may draw in predatory fish. Harder basement create spawning conditions for instance for herring, pogge, garfish, lumpfish, rock gunnel, viviparous eelpout, turbot, gobies (Zucco et al., 2006; Norsker, 1997). A refuge for adult fish and early developmental stages may result in a rapid increase in biomass, frequency of occurrence and larger sizes of representatives of fish species previously exploited as well as increase in biodiversity.

Considering the great share of mussels in the abundance and biomass of benthos, relatively fast colonisation of offshore wind power stations foundations by this organism and other periphyton organisms should be expected. It will create favourable feeding conditions for a part of flat fish and several gobies, as well as a shelter for juvenile individuals. It can also be expected that a new additional substrate for demersal fish eggs will appear, the occurrence of which was found during the research (herring, gobies, common sea snail, rock gunnel).

Positive impact of the Baltica OWF is confirmed by observations carried out in the area of already exploited farm. They indicate the attractiveness of these areas for ichthyofauna. Aggregations of small demersal and semi-pelagic fish in the vicinity of large-diameter piles of offshore wind power stations were found in the south-western Baltic Sea (Wilson et al., 2010). An increased concentration of several species takes place within a 20 to 160 m radius around wind farms off the coasts of Sweden. Observations carried out in the areas of Danish and Belgian offshore wind farms in the Northern Sea (Thornton Bank and Bligh Bank) indicate a significant attractiveness of these regions for Gadidae, particularly in reference to younger age groups and flatfish order.

It should be added, however, that not all studies conducted in the OWF Areas clearly indicate their role as a factor increasing the number and diversity of ichthyofauna in these areas. Hydroacoustic surveys conducted in the region of the Nysted OWF (Baltic Sea) and Horns Reef (North Sea) showed no statistically significant impact of new elements of the habitat on distribution of fish both locally and regionally (Hvidt et al., 2004; Hvidt et al., 2005a; Hvidt et al., 2005b).

The magnitude of this impact depends on the surface occupied by structures of the OWF infrastructure, their number and degree of spatial complexity.

The scale of this impact in the Baltica OWF Area is measured with the share of newly created structures at the surface of currently present boulder areas, ensuring similar habitat conditions will be relatively small. The total seabed surface occupied by foundations in the Applicant's variant equals approx. 0.26 km^2. Assuming the spatial structure of these structures increases the available area by 50%, the respective area of new hard soil equals 0.4 km^2.

For both variants, this surface constitutes below 0.5% of the surface of seabed covered with boulder areas equal to 284 km^2 determined on the basis of sonar photographs.

However, a comparison of these surfaces can be misleading due to the fact that in case of boulder sites, the actual surface of objects constituting a hard surface favouring formation of appropriate conditions for spawning is much smaller than the entire area differentiated based on the sonar images. Thus, it is difficult to accurately specify the relative increase in the surface of a hard substrate favouring reproduction of certain types of fish such as gobies, herring or common sea snail. However, it ought to be assumed that it may be an important factor contributing positively to spawning of these fish.

According to Wilhelmsson et al. (2010), the artificial reef effect is a positive impact with a long-term character, local range and average degree of impact. Bergström et al. (2014) assess the impact of creation of new habitats on fish as moderate due to medium spatial range, long-term character and average sensitivity of fish to this factor (positive result).

A new habitat, created as a result of the OWF construction, with its hard substrate and a relatively rich food base for benthivorous fish, may constitute a favourable environment for round goby – an invasive species.

Since the first reports in 1990 on introduction of round goby Neogobius melanostomus with the ships' ballast water to the Gulf of Gdansk, the presence of this species has been noted in the Polish zone of the Baltic Sea, both in deeper waters (up to 40–60 m), as well as in the shallow coastal waters, in the Pomeranian Bay and in the Vistula Lagoon and its tributaries.

Round goby spreads in new habitats also due to the tolerance to a wide range of changing environmental conditions: depth, substrate nature, salinity, oxygen deficiency and diversified food base. The spawning of round goby takes place repeatedly in several portions during the season, at a depth of 0.2 to 1.5 m on different substrates (Wandzel 2003). It can live in the marine, brackish and freshwater environment (Charlebois et al., 1997). Greater depth of the OWF Area will therefore not be favourable to reproductive processes of this species.

The colonisation of the Baltica OWF Area by the round goby migrating from the coastal zone is unlikely due to lack of planktonic larval stages and a limited range of adult fish migrations. This species rarely migrates longer distances. The range of trips is short and usually does not exceed 100 m (Skóra & Stolarski, 1996). The longest migrations occur in late autumn and early spring, when the fish move between shoals and deep waters (Berg, 1949).

The above information indicates that the effective settling of the Baltica OWF Area by this species should not be expected.

Impact related with change of habitat will be an impact with a positive, direct, local, simple, stable, long-term and permanent character.

Table 110. Resistance of specific ichthyofauna species to impacts related with change of habitat

Species	Impact resistance
Cod	Average (demersal fish)
Flounder, plaice	Average (demersal fish)

Species	Impact resistance
Turbot	Average (demersal fish)
Herring	Average (pelagic fish, laying eggs on the seabed)
Sprat	High (pelagic fish)
Protected species (gobies, common seasnail)	Average (demersal fish)
Salmonids (salmon, sea trout)	High (pelagic fish)

Source: internal data

Table 111. Impact of change of habitat at the phase of exploitation of the Baltica OWF on ichthyofauna

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Low	Insignificant
Flounder, plaice	Low	Low	Irrelevant
Turbot	Average	Low	Insignificant
Herring	Average	Low	Insignificant
Sprat	Average	Low	Insignificant
Protected species (gobies, common seasnail)	High	Low	Moderate
Salmonids (salmon, sea trout)	Average	Low	Insignificant

Source: internal data

Creation of a mechanical barrier

Construction of subsea structures may be a migration barrier for fish which have an economic significance with routes that pass in this location. Observations carried out in the areas of Danish OWFs show that due to the possibility of active movement of fish, the above-mentioned factors do not significantly disturb the migration processes (Leonhard et al., 2011).

Impact related with creation of a mechanical barrier is negative, direct, local, simple, long-term, stable and reversible in character. Resistance of all analysed ichthyofauna species to impacts related with appearance of a mechanical barrier is high.

Table 112. Impact related to the creation of a mechanical barrier at the phase of exploitation of the Baltica OWF on ichthyofauna

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Emission of electromagnetic field

Cables transferring electricity create electromagnetic field. Its strength depends on the type and intensity of the current flow. Sensitivity of ichthyofauna on the impact of electromagnetic field depends on:

- detection threshold specific for the given species;
- type of sensor the fish has (magnetic, electric);
- lifestyle (demersal, pelagic – it is expected that demersal organisms are vulnerable to exposure of a greater strength of electromagnetic field) (Normandeau, 2011; Engell-Sørensen, 2002).

Interference of the natural magnetic field caused by electromagnetic field emissions lead to changes of the migration paths and difficulties in finding feeding and spawning grounds for migratory fish (short- and long-distance, e.g. eel, allis shad, twaite shad, herring, sprat, plaice, salmonids and lampreys). The lower detection threshold for magnetosensoric organisms ranges from 0.01 µT to 0.05 µT for various species. Magnetic field generated by cables 145 kV and 100 A will be detected by fish within a distance up to 13 m, while in the case of 500 A cables, the impact range increases to 30 m. The increase of current voltage and intensity will generate a field detected from greater distances (up to several hundred of metres).

Some species (electrosensoric) use electroreception in order to find food, find individuals from the same species, find a mate, in certain cases also for navigation purposes. In the case of these organisms there may be a negative impact of electric field interference. Spatial range of this impact usually ranges up to several metres from its source (Orbicon, 2014; Engell-Sørensen, 2002). Therefore it seems that the impact of this factor on ichthyofauna will have a rather local character. Such an assumption was made for instance in the EIA for offshore wind farms Horns Rev 3 and Vindeby.

Impact related with the electromagnetic field emission is negative, direct, local, simple, short-term and reversible.

All analysed species are characterised by high resistance to PEM impacts in the exploitation phase.

Table 113. Impact related with electromagnetic field at the phase of exploitation of the Baltica OWF on ichthyofauna

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Ichthyofauna undergoes moderate positive impact caused by a beneficial change of habitat and a negative impact of little importance caused by the remaining factors at the exploitation phase in the OWF Area. The awarded assessment results from high significance of the receptor justified by presence of protected species (common seasnail and gobies) and impact scale which is small, in case of positive impact, or negligible in the case of negative impact (Table 114).

Table 114. The matrix determining the greatest significance of the impact of the Baltica OWF at the exploitation phase on ichthyofauna

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.2.5.1.4 Marine mammals

The exploitation phase may cause certain disturbances that impact porpoises in the Baltica OWF Area, but it is expected that the extent of these disturbances will be very limited both temporary and spatially. Sensitivity of porpoise to factors present during wind farm exploitation is generally very low, and effects caused by these factors are largely negligible. Effects of avoidance may take place with a very good probability, only with regard to service and maintenance related traffic, therefore it will be a short-term impact. There is a possibility of a reef effect taking place, which may have a positive impact on porpoises thanks to the improvement in feeding options.

Sensitivity of grey and harbour seals to multiple impacts is very similar to the sensitivity of porpoises. There is an additional possibility of masking, because seals generate vibrations with a small frequency in the scope where offshore wind farms generate noise (see Thomsen et al., 2006b). This impact will be low on the one hand from a relatively small noise level and on the other hand due to a very low number of seals in the survey area Visual effects may be more important of seals compared to porpoises (see Bach, 1991; Vogel, 2000).

Noise generated during exploitation

The noise during exploitation of offshore wind power stations is much lower that at the construction phase and consequently, its impact is much lower (Thomsen et al., 2015). The impact of underwater noise on marine mammals in the phase of exploitation of the Baltica OWF was assessed on the basis of the available relevant literature.

Measurement of noise generated by small wind power stations (up to 2 MW) suggests that noise from the exploited wind power stations is relatively low and intensive, partially with frequencies below 1 kHz (Wahlberg & Westerberg, 2005; Madsen et al. 2009, Thomsen et al., 2006b). It was concluded that porpoises may detect noise from wind power stations at a distance of several tens of metres, while seals could detect sound form a distance of several hundreds of metres (Tougaard & Henriksen, 2009). It is compliant with earlier model calculations which confirmed that the noise of operation of small wind power stations should have a small impact on marine mammals (Thomsen et al., 2006b).

In Germany, Denmark and the Netherlands analyses were carried out regarding distribution of porpoises due to construction and exploitation of wind farms. Types of offshore wind power stations ranged from 2 to 5 MW. No negative impact was found in two studies (Tougaard et al., 2006; Thompson, 2010). Studies on OWFs in coastal waters of Nysted (Danish part of the Baltic Sea) indicate that two years after finishing construction (Carstensen et al., 2006) there is a large abundance of porpoises in this area (Teilmann & Carstensen, 2012). In the case of studies carried out in the Netherlands is was also shown that the abundance of porpoises within the boundaries of OWF increased significantly (Thomsen et al., 2006a). It follows that the observations carried out are not related with any specific wind farm, but only reflect the general trend.

A completed numeric noise modelling (Marmo et al., 2013) has shown that noise generated during exploitation of an OWF settled on large diameter piles (6 MW) was audible by porpoises and seals within a distance up to 18 km (Figure 50). In the case of seals no behavioural reactions were found. In the case of porpoises, there may be a reaction at large wind speeds (15 $m \cdot s^{-1}$) within a distance of 18 km from the source of noise. Due to specified criteria, only 10% of animals exposed to noise will react. Therefore, it is expected that 90% of porpoises in modelling does not react to the sound of exploitation of an offshore wind power station on a foundation in the form of a large diameter pile. The cited studies used conservative data regarding noise in the surroundings (= smallest possible sound levels). The impact ranges are therefore based on the worst case scenario. There are, although no scientific data on animal adaptation of the generated noise (Marmo et al., 2013). So far, the opinion of the scientific community is that even the accumulated influence of operation of more than one wind farm on the noise level are very low (Thomsen et al., 2015).

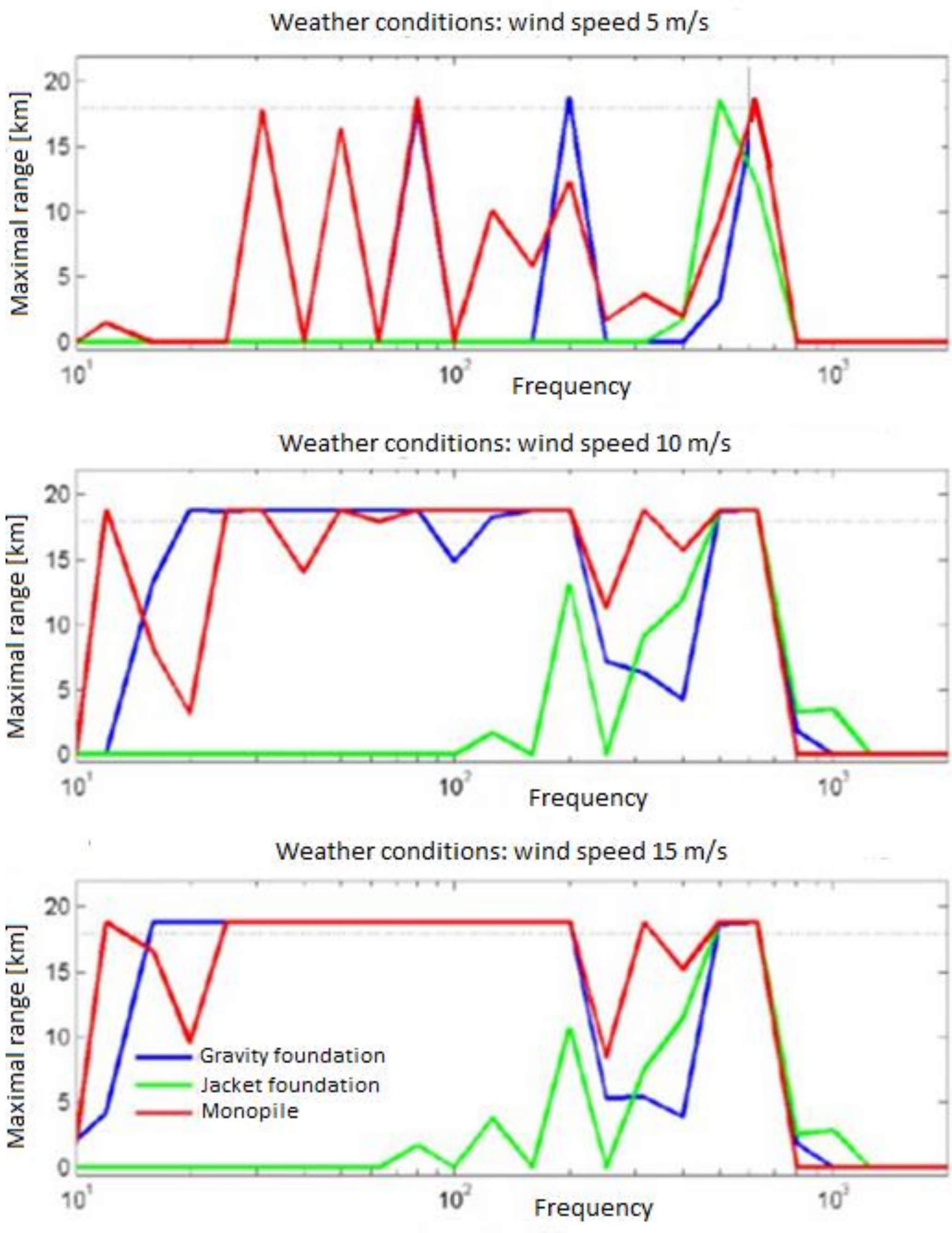


Figure 50. Maximum distance from the centre of the OWF, where the farm emitted noise is audible above the noise in the surroundings, as a frequency function in Hz

Dotted lines = the boarder of the modelling area; noise level of the surrounding (Wenz, 1962) wind speed 5, 10 and 15 $m \cdot s^{-1}$, respectively; number of offshore wind power stations = 16, water depth = 30 m
Source: sec. Marmo et al., 2013

Artificial reef effect

Foundations of offshore wind power stations may fulfil the role of artificial reefs, providing area to be colonized by marine fauna and flora. There may be created new habitats related with its hard substrate, protecting organisms against washing out and contributing to diversity of the sandy seabed (Energy/E2, 2006; Bioconsult, 2005). The surveys also demonstrate that such habitats are colonized relatively fast (up to 5 years), although it depends on the structure of benthos fauna (species composition, abundance, biomass). This may lead to the enrichment of the food supply of fish, which in turn may increase the feeding possibilities of marine mammals (Scheidat et al., 2011; Reach et al., 2012).

Harbour and grey seals could use the same artificial reef effects, and as long as the wind farm is not located next to onshore resting areas, the changes in habitats probably will not be significant.

Shelter effect

If water craft traffic is excluded from the evaluation, it can be stated that the OWF are may become a sort of “marine nature reserve”. Closing this area for some or all types of catches could locally result in marine mammals increase (predators), with a simultaneous decrease of a possible by-catch in tools used in commercial fisheries (Lindeboom et al., 2011).

Visual effects

The presence of underwater support structures and the remaining wind power station elements above the water surface may change the area visually. This may exert impact on marine mammals, particularly seals, which orient in the area thanks to the sight. Underwater foundations, after colonization and overgrowing by marine flora and fauna, will resemble a natural seabed. Spinning rotors of wind power stations may introduce certain interference, e.g. shimmering and moving shadows, which can be seen by seals and possibly by porpoises (Riedmann, 1990). It is assumed that this should not involve any disturbance, as both species remain for most of the time under water and are rarely subject to such potential interference.

According to the modelling results with respect to behavioural reactions, the expected effects are negligible for seals. The impact on porpoises was determined as local (negligible impact scale), of an insignificant importance.

Noise related with the service of the Baltica OWF

Small and medium water crafts will be used to handle the Baltica OWF. These vessels will mainly emit sounds in the range from 160 to 180 dB of 1 μPa at 1 m and will fall in the range from <1 kHz to >10 kHz. It is probable that during the exploitation they will lead to an increase of subsea noise with respect to the frequency, which is partially important for marine mammals. The overall number of maintenance visits for the wind farm is not known. It is probable that it will involve one water craft at once. Noise and other impacts will thus be local (negligible scale of impact), and their importance will be either insignificant of little importance as regarding marine mammals.

Electromagnetic fields

One of dolphin species (Czech-Damal et al., 2011), was found out to possess a sense of electricity, but the same cannot be told about porpoises. None of cetaceans was reported to have a magnetic sense, even though there had been speculations as to using by cetaceans electromagnetic field to navigate (Klinowska, 1986). Possible impacts of the electromagnetic field from wind power station cables are not known, but it is pretty improbable that they could exert a significant impact on porpoise and seals in the OWF Area.

Collisions of vessels

Collisions of vessels, resulting in oil-derivative substances leakage in the Baltica OWF Area may exert a negative impact on marine mammals in the neighbouring waters, however, such situations are very unlikely. Additionally, for investments such as offshore wind farm it is necessary to elaborate the

Action Plan on Counteracting Threats and Contamination from Oil Spills (described in subsection 2.5.6). Taking the above into consideration, the impact of the intake was evaluated as negligible for porpoises and insignificant for seals.

Impact assessment in the course of exploitation

The assessment of the impact of the assessment of the Baltica OWF in the exploitation phase is described in the following tables (Table 115 and Table 116). Generally, the impact on porpoises and seals is small. In some cases, it may turn out to be positive given the effect of artificial reefs, which may increase the feeding possibilities of marine mammals (vide e.g. Leonhard et al., 2013).

Table 115. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on marine mammals

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Table 116. A summative collation of impacts on marine mammals related with the exploitation phase of the investment in the Applicant's variant

Species	Impact	Survey area	Duration	Intensity	Impact frequency	Reversibility	Impact's scale	Impact's significance
Porpoise Phocoena phocoena	Noise from working wind power stations	Local	Long-term	Low	Constant	Irreversible	Negligible	Insignificant
	Noise related with service and maintenance	Local	Short-term	Low	Constant	Reversible	Negligible	Insignificant
	Electromagnetic fields	Local	Long-term	Low	Constant	Irreversible	Negligible	Insignificant
	Visual effects	Local	Long-term	Low	Constant	Irreversible	Negligible	Insignificant
	Reef effect	Local	Long-term	Low	Constant	Irreversible	Negligible	Of little importance, positive
	Shelter effect	Local	Long-term	Low	Constant	Irreversible	Negligible	Of little importance, positive
	Collisions of vessels	Regional	Short-term	Average	Single	Irreversible	Negligible	Insignificant
Harbour seal Phoca vitulina and grey seal Halichoerus grypus	Noise from working wind power stations	Local	Long-term	Low	Constant	Irreversible	Negligible	Irrelevant
	Noise related with service and maintenance	Local	Short-term	Low	Constant	Reversible	Negligible	Irrelevant
	Electromagnetic fields	Local	Long-term	Low	Constant	Irreversible	Negligible	Irrelevant
	Visual effects	Local	Long-term	Low	Constant	Irreversible	Negligible	Irrelevant
	Reef effect	Local	Long-term	Low	Constant	Irreversible	Negligible	Negligible, positive
	Shelter effect	Local	Long-term	Low	Constant	Irreversible	Negligible	Negligible, positive
	Collisions of vessels	Regional	Short-term	Average	Single	Irreversible	Negligible	Irrelevant

Source: internal data

6.1.2.5.1.5 Seabirds

A majority of impacts of offshore wind farm in the exploitation phase on seabirds are of a negative character due to disturbing birds and limiting their access to food supply. A strong scaring effect significantly reduces the risk of collision with power stations. The avoidance of the area taken up by a working farm by seabirds accounts for the fact that positive impacts in the exploitation phase will be of little significance. Only after power station decommissioning, this sea area will be fully accessible for birds.

A potential impact of wind power stations located in high sea areas on seabirds regards an increased mortality as a result of collisions with offshore wind power stations as well as distribution and behavioural changes. The highest mortality is observed in the case of OWFs located on feeding areas and regular flight routes.

Wind power stations cause changes in the manner space is used by birds, which also refers to sea areas. In vast majority of cases offshore wind power stations scare birds away and waterbirds flying above avoid the areas of wind power stations by 100, or even 3000–4000 m. Consequently, the sea areas occupied by wind power stations and areas directly adjacent are much less used by birds for feeding and rest. In some cases the visibly lower of bird density is observed within a radius of 2 km, to a lesser extent even of 4 km from the power station (Petersen et al., 2004). Surveys carried out in sea areas occupied by offshore wind farms show that most bird species avoid areas occupied by wind farms and the neighbouring areas. The only exception are gulls, which use constructions protruding from water (also not working wind power stations) to rest on (Petersen et al., 2006) and at the beginning, in the construction phase of the offshore wind farm implementation, they are encountered more frequently within its boundaries than it could be noticed before (Christensen et al., 2003). In the exploitation phase the interest of gulls in the offshore wind farm decreases clearly (Petersen et al., 2006; Petersen & Fox, 2007).

The fact that a larger part of waterbirds avoid the area where the offshore wind power stations are located, and that low flight altitude between the power stations leads to the decrease of collision risk, therefore bird mortality rate due to collisions with power station structures in sea areas is low. However, in the case of low visibility caused by mist or rain, the collision risk is increased. The number of collisions with wind power stations visibly increases when they are located in areas attractive to bids, where their density is large and when power stations are located on the routes of regular flights related with migrations or local movements. Risk of collision also depends on the bird species. Large waterbird species, such as swans, are more vulnerable to impacts with offshore wind power stations due to difficulties in performing rapid aerial manoeuvres (Brown et al., 1992).

Due to the fact that the majority of seabirds travel at low altitudes above water, and when they are present between power stations they decrease their altitude and maintain even spacing from obstacles (Desholm & Kahlert, 2005; Hüppop et al., 2006; Petersen et al., 2006), the collision risk is influenced by the clearance between the bottom position of the blade and the sea surface. The smaller it is, the greater the change of bird collision with an operational rotor.

Potential impacts of offshore wind farms in the **exploitation phase** on **seabirds** are presented in table (Table 117).

Table 117. Potential impacts of OWF in the exploitation phase on seabirds

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
Traffic of water crafts and helicopters	Traffic of water crafts and helicopters at the exploitation phase will scare off birds. The most important parameters that influence the impact scale are the number of constructed power stations, power substations, the length of laid cables and the related number of the used water crafts and helicopters.
Scaring off and forcing out birds of the habitats	The physical structure of OWF, light and noise emission may be sources of interference for certain sensitive bird species and cause their total or partial movement outside the farm sea area. The scale of interference will depend on the number of offshore wind power stations and the emitted light and noise.
Creation of a mechanical barrier	Operational wind power stations and the associated infrastructure will constitute a physical barrier which, on the one hand causes collision risk and on the other – scares birds away and causes loss of feeding grounds. The effect of scaring birds away by wind farms decreases the collision risk. However, to a larger extent it concerns migrants that fly in the night and in conditions of limited visibility than birds than remain in the investment region. After construction of the farm, most bird species will to a large extent avoid staying in its vicinity, thereby losing access to feeding grounds. The most important factors influencing the level of impact are: • number of power stations; • density of power stations; • clearance between the surface of the sea and the bottom level of a rotor blade; • rotor diameter.
Collisions with power stations	Birds that migrate through the Baltic Sea and local birds that remain in the Baltica OWF sea area during their daily flight may experience collisions with structures of offshore wind power stations (rotors and towers) when they do not notice the obstacle during difficult atmospheric conditions (e.g. precipitation, fog) as well as in the night when they are drawn in their vicinity by the lights of the OWF. The scale of the collision risk depends on the number of offshore wind power stations, their size, rotational surface of the rotor, the rotor rotational speed range, proportion of operational time, night lighting system.
The creation of artificial reef	Changes of habitats caused by appearance of an artificial reef may have a certain positive impact on seabirds that feed on zoobenthos, due to expansion of food supply. It may also have a small indirect impact on diving ichthyophaga feeding on fish that feed on zoobenthos. In underwater parts of structures and at the seabed of the sea area occupied by the farm, rich benthos communities develop which, however, will be used by birds to a small degree, of even not at all. The effect of scaring birds away by structures protruding high from the water will prevail here. The most important parameters affecting the impact scale are the shape, base diameter and number of foundations.
The creation of a closed sea area	The Baltica OWF may be fully or partially closed for the fishery sector. It such a case, it could be expected that in the farm area fish would find very good residence conditions (lack of catches, abundant benthos communities). Birds, however will use the food supply created this way only to a small extent due to the effect of scaring birds away by structures protruding high from the water. The most important parameters affecting the impact scale are the surface of the sea area occupied by the farm, the number of wind power stations and their distribution.
Changes in the regime of sea currents	Underground structures of wind farm structures may impact hydrological conditions in the investment region, particularly cause changes in marine current regime. Marine current vortexes at wind power stations may make it harder to find food for birds that dive in search of food and benthos. The most important parameters affecting the impact scale are the number of foundations, their surface below ground and their density.

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
Contamination of the sea deep and seabed sediments with oil-derivative substances	See the explanation for the construction phase
Water column and seabed sediments contamination with accidentally released municipal waste and domestic waste water	See the explanation for the construction phase
Contamination of the sea deep and seabed sediments with accidentally released chemical agents and waste from the farm exploitation	During the exploitation phase of the wind farm, waste directly related to the farm exploitation process will be generated in on-shore service facilities (in the port that handles the implementation of the investment) and at the project site. They can be, among others, damaged parts of farm elements, cement, grout, mortar and adhesives used in connecting elements of the foundation and power stations and chemical substances used or replaced during service work. These can be accidentally released into the sea. The most important factors influencing the level of impact are: • the type and amount of released waste and wastewater; • weather conditions; • type of rock material that make up the seabed, determining the species composition of zoobenthos communities used as food by the birds.

Source: internal data based on Meissner, 2015b, 2015c

Impact assessment of OWF on seabirds in the phase of exploitation

It is expected that the following causes or sources of impact may occur, which will impact on avifauna at the exploitation phase of the Baltica OWF:

- traffic of water crafts and helicopters;
- scaring off and forcing out of habitats;
- creation of a mechanical barrier;
- collisions with power stations;
- the reef effect;
- creation of a closed sea area.

Some authors expect that along with time overwintering birds get used to the presence of an offshore wind power station (Drewitt & Langston, 2006). This regards i.a. the noise generated by working offshore wind power stations. However, there is still no sufficient evidence to prove this hypothesis. The existing data regard small farms from 10 to 80 offshore wind power stations (Tunø Knob, Horns Rev), and that is why there appear doubts as to whether the result of the surveys can be applied to areas a couple of times bigger (such as the Baltica OWF), the number of power stations of which is far greater (Drewitt & Langston, 2006). A joined analysis of 19 surveys (including 2 regarding offshore wind farms and 7 farms located at the coast) demonstrated, though, that the longer the exploitation of the given farm, the greater the decrease of the number of birds in its vicinity (Stewart et al., 2004). These ambiguous results do not allow for forecasting a long-term impact of the Baltica OWF on seabirds. The present forecast regards the impact within the maximum of a couple of years, since surveys oriented towards the size of the area seabirds are scared away were conducted in the region of wind farm only for a couple of years after the entrance into the exploitation phase.

The impact scale is determined as local when the impact of the planned OWF will concern a sufficiently small number of individuals of the given seabird species that it is not significant against the background of broader (than the one present in the OWF Area and in its immediate vicinity), biogeographic population of this species. **The impact scale was defined as regional** when the given OWF impact may concern a significant part of the biogeographic population of the given seabird species, due to its numerous presence in the region of the investment.

Traffic of water crafts and helicopters

Exploitation of the Baltica OWF will involve traffic of various water crafts, as well as helicopters and construct the farm which will cause birds to be scared off. However, this traffic will not be as intensive as in the construction of decommissioning phase of the OWF, and consequently, will cause bird to be scared to a lesser degree. Due to the fact that it is hard to differentiate the impacts of water crafts and helicopters, these impacts are assessed jointly.

Water craft and helicopter traffic in the exploitation phase will cause a direct, negative impact on seabirds of a local range (except for long-tailed duck, in whose case the range is regional), long-term, reversible, repeatable in the exploitation phase, the intensity of which depends on the species.

Table 118. Water craft and helicopter traffic related with exploitation of the wind farm – impact analysis for specific seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity of the species Large densities of the species at the site of the planned investment A part of this sea area to the depth of 30 m is a potential feeding ground adjacent to the Słupsk Bank, which is one of the most important wintering grounds for this species in the Baltic Sea.	Average (scale of exposure – regional); duration – long-term; intensity – medium)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Insignificant
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water,	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant

Species	**Binomial nomenclature**	**Sensitivity of the resource (acc. to the SSI)**	**Impact susceptibility**	**Importance of the resource**	**Justification for the impact assessment**	**Impact's scale**	**Impact's significance**
					which provide a resting place for seagulls.		
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	A widespread species with a low protection priority. Accompanies fishing cutters in sea areas.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – long-term; intensity – medium)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – long-term; intensity – medium)	Moderate

Source: internal data

Scaring off and forcing out birds of the habitats

Scaring off and forcing out of habitats in the exploitation phase is far less driven by the movement of vessels and helicopters (as compared with the construction and decommissioning phase), and more by disturbing birds through working wind power stations. The impact was diminished as a result of the Applicant's decision regarding limiting the area of the OWF with respect to the area in the PSZW document. According to the Applicant's decision, wind power stations will be located further from the region of Natura 2000 Słupsk Bank than in the PSZW document and thus to a smaller extent cause the disturbance of birds and force them out of their precious habitats (the Słupsk Bank region at the OWF boarder and waters of the depth of 30 m, and especially up to 25 m at the north-eastern boarder of the Słupsk Bank area). Thanks to edging away from the Słupsk Bank, from over 32 km^2 of areas of the depth lower than 30 m in the area compliant with PSZW document, 11.55 km^2 remained in the OWF's built-up area (which constitutes 6% of the whole OWF).

Scaring off birds and forcing them out of habitats in the exploitation phase is a direct, negative impact on seabirds of a local range, long-term, reversible, constant in the exploitation phase, the intensity of which depends on the species.

Table 119. Scaring out birds and forcing them out of their habitats in the exploitation phase – analysis of impacts on particular seabird species

Species	Binomial nomen-clature	Sensitivity of the resource (acc. to SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity of the species Large densities of the species at the site of the planned investment A part of this sea area to the depth of 30 m is a potential feeding ground adjacent to the Słupsk Bank, which is one of the most important wintering grounds for this species in the Baltic Sea.	Average (scale of exposure – regional); duration – long-term; intensity – medium)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Average (scale of exposure – local; duration – long term; intensity – very high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant

Species	Binomial nomen-clature	Sensitivity of the resource (acc. to SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, but rarely seen (most often birds in flight) at the investment site. Presence of water craft may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	Species is not endangered, low abundance in the region of the planned investment.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – long-term; intensity – medium)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Moderate

Source: internal data

Creation of a mechanical barrier

Wind farm objects present above ground may create a barrier for seabirds that move in a local scale between the feeding areas and/or rest areas and are not bound to fly over obstacles. The scale of the barrier effect will depend on the number of offshore wind power stations, their size as well as the emitted light and noise.

During local flights, sensitive seabird species react to the presence of an obstacle in their route by changing the route in a vertical or horizontal direction, thus it may be expected that they will omit the area of the wind power station. The length of the route necessary to omit such an obstacle will increase the energetic cost of the given flight, but the change will not be significant and the energetic cost of a daily flight, even if doubled, still constitute a small fraction of their activity and consumed energy. For example, with the use of the loggers of heart rates it was calculated that outside the migration period common eiders carry out only 10 minutes of flight during the day (Pelletier et al., 2008). Similar results may be expected for other species of sea ducks, as well as loons and razorbills. Pelagic birds, such as seagulls, spend most of the day on flights in natural conditions, therefore an additional omission of an obstacle, in this particular case a wind power station, will not bring any measurable effect as to their daily activity or energy balance.

It should be emphasized that according to the recommendations by the ornithologists preparing this EIA Report, the Applicant took into account the proposal of creating between the Baltica 2 and Baltica 3 Areas an area free from wind farm structures of a minimum width of 5 km, compliant with the direction of bird migrations on the line north east – south west (the migration direction after Keslinka et al., 2017). The value of 5 km of width results from doubling the distance of 2,5 km (2,5 km from each of the side of the flight), slightly higher than the distance of 2 km from the wind power stations where birds are still pretty much disturbed. The majority of seabirds, including the most abundant in the surveyed sea long-tailed duck, omit working power stations within the distance of up to 2 km (Petersen et al., 2006). Long-tailed ducks avoid OWF also in the zone of 2 up to 4 km from OWF, but to a much lesser extent. These birds thus need to have an ensured distance of 2–2,5 km (free from offshore wind power stations) from each side of the flight route (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011), which is fulfilled by the OWF's built-up area in the shape proposed by the Applicant. The creation of the above described area which is free from wind power station constructions and is located between the Baltica 2 and the Baltica 3 Areas diminishes the scale of OWF impact on seabirds.

Setting out the area free from wind power stations in this location will result in that the corridor in which the distance between the external wind power stations of particular investments is the smallest and equals 5 km, is optimal from the perspective of birds, that is ensuring the shortest stay in the direct vicinity of wind power stations and what follows, results in the shortest stress duration for birds during the flight. The spatial orientation of the migration corridor was determined in accordance with the main axis of the bird migration, set on the basis of the results of the surveys conducted for the Baltica 2 and Baltica 3, as well as the OWF BŚII and BŚIII areas. Additionally, thanks to dividing the barrier which the Baltica OWF constitutes, more or less in half the effect of making a detour with respect to a direct flight over the OWF Area is insignificant and comparable, regardless of the omission direction chosen.

Thus planned corridor free from wind power stations built this way along with expanding zones of bird flights towards the north-east (between the Baltica 2 and Baltica 3 Area) and south-western direction (between Baltica 2 and BŚIII) will make it possible to access the PLC990001 area from the directions of prevailing migrations.

On the basis of the conducted surveys it can be concluded that setting out other zones that would be free from wind power station constructions for bird migrations in the Baltica OWF Area and at a meeting point of OWF BŚII and OWF BŚIII is redundant. The mechanic barrier in the form of working Baltica OWF will be a source of direct, negative impacts on birds, of a local range, long-term, reversible, constant in the exploitation period, and of a low (for seagulls) or medium intensity.

Table 120. The creation of a mechanical barrier for birds in the exploitation phase – analysis of impacts on particular seabird species

Species	**Binomial nomenclature**	**Sensitivity of the resource (acc. to the SSI)**	**Impact susceptibility**	**Importance of the resource**	**Justification for the impact assessment**	**Impact's scale**	**Impact's significance**
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Insignificant
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Insignificant
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately numerous presence in the investment region. Moderate timidity of the species.	Small (scale of exposure – local; duration – long-term; intensity – medium)	Irrelevant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low species timidity. They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	Species is not endangered, low abundance in the region of the planned investment.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – long-term; intensity – medium)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area.	Low (scale of exposure – local; duration – long-term; intensity – medium)	Moderate

Source: internal data

Collisions with power stations

Seabirds staying in the Baltica OWF Area are vulnerable to the risk of collision with the newly-built wind farm constructions in their environment. The probability of collisions depends on the species density in the area, the time it spends on flights, the effect of avoidance, the flight height and the parameters of the wind farm (number, size and other constructional parameters of offshore wind power stations).

In order to diminish the impact of the Baltica OWF on seabirds, the Applicant decided to set the minimum clearance between the rotor work sector and the water surface to 20 m, since most of the registered flights by seabirds took place below this height above the water surface.

As the probability of bird collisions with power stations of a lattice structure (less visible for birds from a further distance), it is recommended to use towers of solid structure and abandon using lattice structures. Moreover, in order to decrease the risk of bird collision with operating power station, it is recommended to paint the ends of blades to vivid colours, which should increase the probability of noticing an operational offshore wind power station (at daytime) by birds flying by and illumination of the engine room in night conditions by installing small, weak and pulsating light sources as well as changing lighting during for from constant to pulsating and with a long interval (constantly shining, bright lights and pulsating white lights increase collision risk). The assessment of the impact on seabirds at the exploitation phase due to collisions with wind power stations was carried out assuming that the solutions listed above were applied within the framework allowed by applicable regulations.

Susceptibility of specific species to collisions with wind farms is determined taking into account information included in the guide of the European Commission "Wind energy development and Natura 2000" from 2011. According to this guide, for long-tailed duck, velvet scoters, razorbill, common murre, black-throated loon and red-throated loon there is a potential risk of collision. For the European herring gull, this guide defined the risk of such an impact as low or negligible. However, this literature item did not indicate what is the collision risk for common hull, little gull and lesser black-backed gull.

European herring gulls flew relatively abundant both at the height of approx. 20 m, as well as at the height of wind power station rotors (mainly 20–100 m). The same concerns much less frequent flights of common gull and lesser black-backed gull. Little gulls flying above the OWF Area in small numbers were flying mainly below the 20 m level. It is in accordance with the low Hg index awarded to this species (Hg = 1) (height of travel above water), that is included in the assessment of sensitivity of this species of OWF (SSI). Low Hg index lowers the sensitivity of this species to OWF and relates with a lower risk of little gull's collisions with power station. Small gulls also have high manoeuvrability in air (Man index = 1), and their general sensitivity (SSI) to OWF is low (SSI = 12.8).

However, low abundance of black-throated loon and red-throated loon does not make it possible to decide unambiguously whether these species flow primarily at a height below the operating wind power station rotor, or at the heights which may result in collision. These species have a high protection priority, in accordance with the guidelines of the European Commission (2011) there also was a potential collision risk for them. General sensitivity (SSI) of these species to OWF is high. However, black-throated loons and red-throated loons were found very often in the surveyed sea area. The scale of impact on loons was evaluated as small.

Collisions in the exploitation phase is a direct, negative impact of local range, mid-term, irreversible, repeatable in the period of exploitation, with medium intensity.

Table 121. Collisions in the exploitation phase – analysis of impacts on particular seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	A potential risk of collision occurrence	High	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Insignificant
Velvet scoter	*Melanitta fusca*	Average	A potential risk of collision occurrence	High	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Insignificant
Razorbill	*Alca torda*	Low	A potential risk of collision occurrence	Average	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	A potential risk of collision occurrence	Average	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
European herring gull	*Larus argentatus*	Low	A potential risk of collision occurrence	Low	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Average (scale of exposure – local, duration – long-term, intensity – high)	Insignificant
Common gull	*Larus canus*	Low	A potential risk of collision occurrence	Low	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Average (scale of exposure – local, duration – long-term, intensity – high)	Insignificant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Little gull	*Hydrocoloeus minutus*	Low	Small or negligible collision risk	High	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (exposure scale – local, duration – long-term, intensity – low)	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	A potential risk of collision occurrence	Low	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Average (scale of exposure – local, duration – long-term, intensity – high)	Insignificant
Black-throated loon	*Gavia arctica*	High	A potential risk of collision occurrence	High	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Moderate
Red-throated loon	*Gavia stellata*	High	A potential risk of collision occurrence	High	During the exploitation phase of the farm, collisions of seabirds with working power stations may take place.	Low (scale of exposure – local; duration – long-term; intensity – low)	Moderate

Source: internal data

The creation of artificial reef

Benthos communities used by seabirds will be partly loss at the construction phase due to settlement of OWF foundations, but new underwater structures will provide an additional hard basement at the seabed and in the water deep. These structures will be colonised by zoobenthos communities which may draw fish and certain birds. The scale of impact will depend on the number of offshore wind power station foundations, their type and size. However, scaring impact of operational wind power stations will make the birds will not commonly use this feeding grounds and the sea area occupied by the farm (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011). The scale of this impact was therefore evaluated as negligible. In the case of species that do not feed on benthos, such impact will be non-existent (seagulls) or will be negligible (diving ichthyovorous species) Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on diving ichthyophagous species.

The effect of an artificial reef in the exploitation phase is a source of direct, positive impacts of a local range, long-term, irreversible, repeatable in the period of exploitation, with medium intensity. For some birds the creation of an artificial reef will be of no significance. The analysis of the impact exerted by an artificial reef on seabirds is shown below (Table 122).

Table 122. The creation of an artificial reef – analysis of impacts on particular seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	High (species feeding on benthic organisms)	High	High protection priority. High sensibility of the species on food supply restrictions.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Velvet scoter	*Melanitta fusca*	Average	High (species feeding on benthic organisms)	High	High protection priority. High sensibility of the species on food supply restrictions.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Razorbill	*Alca torda*	Low	Low (small indirect impact on ichthyofauna constituting food of this species)	Average	The species feeds only on fish. Disturbances in communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale it will have no impact on ichthyphaga.	Negligible (No loss of resource, lack of impact on the structure and resource functioning)	Irrelevant
Common murre	*Uria aalge*	Low	Low (small indirect impact on ichthyofauna constituting food of this species)	Average	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale the impact on ichthyphaga will be negligible.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Irrelevant
European herring gull	*Larus argentatus*	Low	None (the species does not feed on benthos; the species does not dive in search for fish possibly preying on benthos communities inhabiting an artificial reef)	Low	Species does not feed on benthic organisms (no direct impact). The species feeds on fish but does not dive to look for food and has no access to fish using the benthos communities on an artificial reef (or has, but in a limited scope, i.e. only to fish swimming near the water surface); also, no indirect impact on	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
					the species via ichthyofauna feeding on benthos was recorded.		
Common gull	*Larus canus*	Low	None (the species does not feed on benthos; the species does not dive in search for fish possibly preying on benthos communities inhabiting an artificial reef)	Low	Species does not feed on benthic organisms (no direct impact). The species feeds on fish but does not dive to look for food and has no access to fish using the benthos communities on an artificial reef (or has, but in a limited scope, i.e. only to fish swimming near the water surface); also, no indirect impact on the species via ichthyofauna feeding on benthos was recorded.	Not applicable	None
Little gull	*Hydrocoloeus minutus*	Low	None (the species does not feed on benthos; the species does not dive in search for fish possibly preying on benthos communities inhabiting an artificial reef)	High	Species does not feed on benthic organisms (no direct impact). The species feeds on fish but does not dive to look for food and has no access to fish using the benthos communities on an artificial reef (or has, but in a limited scope, i.e. only to fish swimming near the water surface); also, no indirect impact on the species via ichthyofauna feeding on benthos was recorded.	Not applicable	None
Lesser black-backed gull	*Larus fuscus*	Low	None (the species does not feed on benthos; the species does not dive in search for fish possibly preying on benthos communities	Low	Species does not feed on benthic organisms (no direct impact). The species feeds on fish but does not dive to look for food and has no access to fish using the benthos communities on an artificial reef (or	Not applicable	None

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
			inhabiting an artificial reef)		has, but in a limited scope, i.e. only to fish swimming near the water surface); also, no indirect impact on the species via ichthyofauna feeding on benthos was recorded.		
Black-throated loon	*Gavia arctica*	High	Low (small indirect impact on ichthyofauna constituting food of this species)	High	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale the impact on ichthyphaga will be negligible.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Insignificant
Red-throated loon	*Gavia stellata*	High	Low (small indirect impact on ichthyofauna constituting food of this species)	High	The species feeds only on fish. Disturbances in benthos communities may indirectly impact ichthyofauna, but in the case of a local vulnerability scale the impact on ichthyphaga will be negligible.	Negligible (No loss of resource, no impact on the structure and functioning of the resource)	Insignificant

Source: internal data

The creation of a closed sea area

The Baltica OWF Area may be fully or partially closed for the fishery sector.

It such a case, it could be expected that in the farm area fish would find very good residence conditions (lack of catches, abundant benthos communities). Birds, however will use the food supply created this way only to a small extent due to the effect of scaring birds away by structures protruding high from the water and operating rotors.

The creation of a closed sea area is a source of direct, positive impacts on certain seabirds (first of all, ichthyphaga), of a local range, long-term, reversible, repeatable in the period of exploitation, with low intensity. For some birds this impact will practically be of no significance (long-tailed duck, velvet scoter). The analysis of the impact exerted by closing the seas area of the Baltica OWF on seabirds is shown below (Table 123).

Table 123. The creation of a closed sea area – analysis of impacts on particular seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	None (the species does not feed on fish)	High	The species does not feed on fish and so the possible closing of the entre sea basin or its part will not affect its food supply.	Not applicable	None
Velvet scoter	*Melanitta fusca*	Average	None (the species does not feed on fish)	High	The species does not feed on fish and so the possible closing of the entre sea basin or its part will not affect its food supply.	Not applicable	None
Razorbill	*Alca torda*	Low	High (species feeding solely on fish)	Average	Diving ichthyphaga Medium abundance of species in the OWF Area. Species of a moderate timidity.	Small (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Common murre	*Uria aalge*	Low	High (species feeding solely on fish)	Average	Diving ichthyphaga Medium abundance of species in the OWF Area. Species of a moderate timidity.	Small (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
European herring gull	*Larus argentatus*	Low	Small (species feeding on i.a. fish, but rarely fishing on its own)	Low	Omniphage – an omnivorous species which in a marine environment exhibits preference for fish, but most often collects remains from fish preparation on fishing boats, for which the sea area may be fully or partially closed.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Common gull	*Larus canus*	Low	Small (species feeding on i.a. fish, but rarely fishing on its own)	Low	Omniphage – an omnivorous species which in a marine environment exhibits preference for fish, but most often collects remains from fish preparation on fishing boats, for which the sea area may be fully or partially closed.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low	Small (species feeding on i.a. fish, but rarely fishing on its own)	High	Omniphage – an omnivorous species which in a marine environment exhibits preference for fish, but most often collects remains from fish preparation on fishing boats, for which the sea area may be fully or partially closed.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Lesser black-backed gull	*Larus fuscus*	Low	Small (species feeding on i.a. fish, but rarely fishing on its own)	Low	Omniphage – an omnivorous species which in a marine environment exhibits preference for fish, but most often collects remains from fish preparation on fishing boats, for which the sea area may be fully or partially closed.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (species feeding solely on fish)	High	Diving ichthyphaga High protection priority. High sensibility of the species on food supply restrictions. A rare species in the investment area, easily scared away.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Insignificant
Red-throated loon	*Gavia stellata*	High	High (species feeding solely on fish)	High	Diving ichthyphaga High protection priority. High sensibility of the species on food supply restrictions. A rare species in the investment area, easily scared away.	Negligible (scale of exposure – local; duration – long-term; intensity – low)	Insignificant

Source: internal data

Significance of the Baltica OWF's impact exerted at the exploitation phase on seabirds reflects the significance of such impact for long-tailed duck *Clangula hyemalis*, which was the most often observed species in the OWF Area and which suffers the highest impact of the OWF at the construction phase among seabird species analysed in this report. Long-tailed duck has an average sensitivity for the OWF impacts. The scale of the impact of scaring off birds and forcing them out of their habitats for the Applicant's variant was assessed at average. With regard to the above and in accordance with the method of assessment for seabirds assumed in this Report, the significance of the Baltica OWF in the Applicant's variant at construction phase was assessed as moderate with relation to these birds. The influence of other impacts significant at the OWF exploitation phase – appearance of a mechanical barrier effect and collision with power stations – was assessed as smaller (small impact scale, significance of the impact of little importance in relation to long-tailed duck) than the one for scaring away and forcing birds out of their habitats. The impact of the Baltica OWF exploitation phase on species of seabirds other than the most abundant long-tailed duck will be lower than in its case.

6.1.2.5.1.6 Migratory birds

In the exploitation phase, the Baltica OWF will have impact on migratory birds. Potential impacts of the Baltica OWF on migratory birds above its sea area are an effect of a barrier caused by the presence of wind power stations and the possibility of collision. Collision calculations were shown in Appendix 4 and this section presents only a synthetic compilation of the impact for specific migratory bird species.

Barrier caused by the OWF

Due to its size, the OWF may constitute a physical barrier for migratory birds that prefer a flight above open water and enter the OWF Area reluctantly. The scale of impact will depend on the number of constructed offshore wind power stations, their size as well as the emitted light.

Collision risk

Birds that migrate through the Baltic Sea may undergo collisions with offshore wind power stations (tower and blades), if they are not able to avoid it or do not notice the hazard, for instance during night migration or bad weather, or are drawn by the lights of the OWF structure. The scale of impacts depends on the number of offshore wind power stations, technical parameters of offshore wind power stations (e.g. the rotor diameter, tower height, clearance between the water surface and the bottom range of the rotor), exploitation time and the manner of lighting for offshore wind power stations in the night.

Summary

The table below (Table 124) presents a description of the barrier effect and collision impacts on specific migratory bird species along with assessment of the significance for these impacts. Collective assessment of the significance of the impact of the Baltica OWF at exploitation phase on migratory birds is an impact with a moderate impact (the highest from the ones listed above).

Table 124. Summary of impacts on marine mammals at the exploitation phase of the planned Baltica OWF

Name of the species	Binomial nomenclature	Importance of the species/resource	Impact	Spatial scale of impact	Duration	Intensity	Impact reversibility	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	High	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Insignificant
Common scoter	*Melanitta nigra*	High	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Insignificant
Velvet scoter	*Melanitta fusca*	High	Barrier effect	National	Long-term	Low	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Insignificant
Eurasian wigeon	*Anas penelope*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Average	Irreversible	Negligible	Irrelevant
Common teal	*Anas crecca*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Mallard	*Anas platyrhynchos*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Greater scaup	*Aythya marila*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Greater white-fronted goose	*Anser albifrons*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Average	Irreversible	Low	Irrelevant
Greylag goose	*Anser anser*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Average	Irreversible	Negligible	Irrelevant
Bean goose	*Anser fabalis*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Average	Irreversible	Negligible	Irrelevant
Tundra swan	*Cygnus columbianus*	High	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Insignificant

Name of the species	Binomial nomenclature	Importance of the species/resource	Impact	Spatial scale of impact	Duration	Intensity	Impact reversibility	Impact's scale	Impact's significance
Whooper swan	*Cygnus cygnus*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Mute swan	*Cygnus olor*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Black-throated loon	*Gavia arctica*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Red-throated loon	*Gavia stellata*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Razorbill	*Alca torda*	Low	Barrier effect	National	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Common murre	*Uria aalge*	Low	Barrier effect	Local	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Great black cormorant	*Phalacrocorax carbo*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Little gull	*Larus minutus*	High	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Insignificant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Insignificant
Black-headed gull	*Larus ridibundus*	Low	Barrier effect	Local	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Common gull	*Larus canus*	Low	Barrier effect	Local	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Black tern	*Chlidonias niger*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant

Name of the species	**Binomial nomenclature**	**Importance of the species/resource**	**Impact**	**Spatial scale of impact**	**Duration**	**Intensity**	**Impact reversibility**	**Impact's scale**	**Impact's significance**
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Sandwich tern	*Sterna sandvicensis*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Arctic tern	*Sterna paradisaea*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Common tern	*Sterna hirundo*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Caspian tern	*Hydroprogne caspia*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Parasitic jaeger	*Stercorarius parasiticus*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Negligible	Irrelevant
Eurasian curlew	*Numenius arquata*	Average	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Low	Insignificant
European golden plover	*Pluvialis apricaria*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Low	Irrelevant
European sand martin	*Pluvialis squatarola*	Low	Barrier effect	Regional	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Low	Irrelevant
Common crane	*Grus grus*	Low	Barrier effect	Local	Long-term	Low	Reversible	Negligible	Irrelevant
			Collision risk	Local	Long-term	Low	Irreversible	Average	Insignificant

Source: internal data

6.1.2.5.1.7 Bats

In the exploitation phase of offshore wind farm, a greater impact on chiropterofauna may be observed. The discussed phase of the investment is related with the presence and work of offshore power stations in the OWF Area. Working wind power stations constitute a physical barrier on fly routes of bats. Collision with the rotor of wind power stations is the main cause of their mortality (Kunz et al., 2007; Kepel et al., 2011). Animals struck by the paddles of the rotor die as a result of fractures, open wounds, multiple organ injuries or wing amputation (Kapel et al., 2011; Horn et al., 2008). The mortality of these animals is intensified by their atypical behaviour. It has been observed that these mammals often explore different parts of offshore wind power stations by flying around them (Horn et al., 2008). Additionally, bats migrating above the sea maintain low altitudes above water, but having encountered a power station, they can fly up from its foundation to the top in a matter of a few minutes (Kapel et al., 2008; Ahlén et al., 2009). 2009). Observations were executed first of all on wind farms located in a close proximity to the shore. Bats could also be observed on farms located at a significant distance from the shore. In the Dutch part of the North See, offshore farms are located within an average distance of approx. 66 kilometres from the coast (with minimum distance of approx. 5 km and maximum distance of approx. 169 km). In 1988–2007, as many as 34 bats were observed in the aforementioned area, whereof 26 observations regarded Nathusius's pipistrelles, 2 common noctules, 2 parti-coloured bats, 1 serotine bat and 3 parti-coloured bats. 32 individuals were observed during the spring and autumn migrations while 2 remaining ones were observed beyond the period of migration in June and January. When it comes to the number of observations made in the discussed period, Boshamer and Bekker (2008) point to an upward trend tend. Additionally, it was noticed that the majority of the conducted observations are not related with platforms located closer to the coast. Nathusius' pipistrelles were observed on platforms located within the distance of 60–80 km from Den Helder, a city in the north-western Netherlands. Average minimum observation distance of this species was approx. 56 km from the coast in the autumn and approx. 62 km in the spring, whereas the maximum one was approx. 67 km in the autumn and 65 km in the spring. In the case of the remaining species, the observation distance was comparable. Maximum average observation distance was approx. 83 km and regarded the species of parti-coloured bats (the presence not attested in the OWF Area). The only exception was common noctule, which is more often observed within a much closer distance from the coast, on platforms located within an average distance of approx. 7 km from the coast.

As already mentioned in section 6.1.1.4.1.7, new offshore objects may change the bat activity in the survey area. Most bat species of the moderate zone are insectivorous. Insects may gather around offshore wind power stations as long as the weather conditions are favourable, i.e. wind speed below 6 $m \cdot s^{-1}$, high temperature and lack of wave motion. Their high concentration may attract mammals looking for food. (Poerink et al, 2013; Ahlén et al., 2007). Offshore wind power stations start working at the approx. 4 $m \cdot s^{-1}$. Given the limited speed range (4–6 $m \cdot s^{-1}$), the probability of the occurrence of days during which bats would concentrate simultaneously with the work of turbines is small. The amount of the mentioned days in a year is limited and the impact of bats is small (Jensen et al., 2014).

In the Baltica OWF Area, hydrometeorological monitoring was conducted from March 2016 to April 2017. In the period of spring and autumn migrations, the average wind speed was approx. 5 $m \cdot s^{-1}$, and even though there were days with insignificant wave motion, the recorded average temperature was below 20°C. Given the above, it can be stated that the probability of the occurrence of days with a concentration of food supply is small.

In the recent years, changes were observed in the way of gathering food by bats, which in the period of late summer gather food at the height of about 250–500 m, and some at the height of 1200 m (Rydell et al., 2010). Resignation from the locations of feeding used so far in favour of hunting at higher altitudes was connected with the so-called hill-topping phenomenon (Kapel et al.,2011). This phenomenon is connected with migration of insects, which as result of encountering an obstacle on their way in form of an offshore wind power station head up along the obstacle and gather at the top of it. Clusters of insects around offshore wind farms move actively or passively above the area of the Baltic sea and are a significant source of food for the migrating bats as well as for the ones leading a sedentary life style (Furmankiewicz et al., 2009; Ahlén et al., 2007). Concentrations of these organisms may also be created as a result of temperature increase due to power station operation (Jensen et al., 2014). As a result, the attracted bats and ones hunting in these areas are morel exposed to collisions involving being hit by rotor paddles.

In the Baltica OWF, clusters of insects may gather in favourable weather conditions located within the distance of 26 km from the coast. The discussed clusters may attract bats which seasonally migrate over the offshore area. In the case of bat species along the Polish coast of the Baltic Sea which lead a sedentary lifestyle, the planned wind farm will probably not attract the surveyed species because of the distance and a significant abundance of onshore food supply.

Another possible impact of working wind power stations in the exploitation phase is the barotrauma phenomenon – a pressure shock in flying bats which leads to cracking of the alveoli, with no external injuries to be found in dead bats. Spinning blades of the offshore wind power stations contribute to big pressure differences. As a result, the generated phenomenon of decompression causes barotrauma in bats (Furmankiewicz et al., 2009; Baerwald et al., 2008).

Wind farms can impact bats also in the context of their habitats. Offshore wind farms do not degrade the existing bat habitats but contribute to creating new ones if bats adapt their constructional elements as new hideaways (Ahlén et al., 2007). Constructional elements may become attractive hideaways given the proximity of the already mentioned insect concentrations or the fact that they can be used as a stopover on the migration flight way (Ahlén et al., 2009; Rydell et al., 2012). However, while flying out of such places, bats are more exposed to collisions with the rotor paddles.

In the exploitation phase, the noise emitted by the constant work of wind power stations may contribute to the barrier effect. The noise can disorientate bats and force them to designate new migration routes, which will require higher energy inputs, which is essential in the migration process (European Commission, 2011). Surveys performed by Nicholls and Racey (2009) indicated that with an accurate combination of wave lengths, impulse repetition frequency and force, it is possible that activity of bats in the area of wind power stations will decrease. The noise can only be the factor attracting bats to the area of working windmills. Various types of sounds, including ultrasounds emitted by wind power stations can contribute to an increase of bat activity in the area of wind farms. However, at the present stage of surveys there is no sufficient evidence (Szewczak & Arnett, 2006).

Collisions resulting from a physical presence of vertical structures on the sea surface may constitute the main source of bat mortality. Species die as a result of being hit by spinning rotor paddles or a rapid decompression caused by the pressure shock resulting from flying in the vicinity of the rotor paddle (barotrauma phenomenon). Additionally, the power station towers and other objects will have a light, which along with the temperature increase as a result of paddles work and at favourable weather conditions may result in an increase of food supply concentration within particular farm elements, and as a consequence attract bats to hunt in the vicinity of wind power stations and power substations. As already mentioned, food supply concentration will take place at favourable weather conditions, such as wind speed up to 6 m·s^{-1} and the lack of rain. As part of the monitoring of the bat activity monitoring conducted within the planned investment, inspections were conducted at a comparable wind speed. On the basis of the hydrometeorological surveys conducted within the framework of the inventory, it was concluded that average wind speed was approx. 7 m·s^{-1} and maximum wind speed was 20 m·s^{-1}. The windless days have been recorded as well. Consequently, during migrations there may be several days when, with simultaneous operation of offshore wind power stations there may be a concentration of insects in the vicinity of wind power stations and bats start their feeding there.

Impacts of the presented factors on chiropterofauna at the OWF exploitation phase in the variant proposed by the Applicant (209 offshore wind power stations) will be negative, direct, simple, long-term, reversible and local. Additionally, on the basis of the results received within the conducted chiropterofauna surveys, bat activity in the OWF Area was found out to be low and species did not seem to migrate in the surveyed area.

Due to the above and on the basis of the current state of knowledge, as well as taking into consideration the protection status of bats, the impact scale of the planned OWF is regarded as negligible and its importance as insignificant (Table 125).

Table 125. The matrix determining the greatest significance of the impact of the Baltica OWF at the exploitation phase on chiropterofauna

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.2.5.2 Impact on protected areas

6.1.2.5.2.1 Impact on protected areas other than Natura 2000

Due to significant distance of the Baltica OWF from the protected area of the Słowiński National Park, similarly to the construction phase, in the exploitation phase there are no significant impacts on this area, including any element for which it was established to protect, that is biodiversity, resources, creations and components of inanimate nature as well as landscape values of the Park.

Attachment to the Regulation of the Minister of Environment no 31 of 16 February 2017 on protective tasks for the Słowiński National Park (Journal of Laws MoE 2013.10, item 31), where the existing and potential internal and external hazards were identified and assessed as well as methods of elimination or limitation of these hazards and their results, also indicated the hazard resulting from increasing areas for wind farms in communes adjacent to the Park in the category of existing external hazards. In the category of potential external hazards it was indicated that only the creation of wind farms in the Park prospective is a potential external hazard, therefore it should be decided that the Baltica OWF will not be a hazard to the Słowiński National Park.

6.1.2.5.2.2 Impact on the Natura 2000 protected areas

Identification and assessment of impact on protected areas within the framework of the Natura 2000 ecological network was presented in section 6.3.

6.1.2.5.3 Impact on ecological corridors

The issue of ecological corridors was described in section 6.1.1.4.3.

Given the same presumptions in the scope of knowledge on ecological corridors in marine areas as well as taking into account the spatial scale of the Baltica OWF Area with regard to the size of the Baltic Sea sea area, including the constant effect of area development and taking into account the space free from buildings between the Baltica 2 Area and the Baltica 3 Area, it was assessed that, similarly to the impact of the Baltica OWF at the phase of construction, at the exploitation phase on the migration routes of migratory species will be negligible.

6.1.2.5.4 Impact on biological diversity

Construction of the Baltica OWF will introduce into the environment structures permanently submerged in water and scour protection layer elements, thereby creating favourable conditions for development of periphyton settlements, both animal and plants. Locally, within construction elements, it may cause an increase of species diversity, increasing the food supply for fish, birds and marine mammals. Plant periphyton communities will constitute a new component of biocenosis in this area, while the remaining organisms will be present in this region (zoobenthos, fish, birds) or use it in an incidental manner (marine mammals).

The impact of OWF on diversity of seabirds is related primarily with exclusion of certain bird species from their habitats a decreasing the abundance of species more sensitive to OWF impacts in these habitats. Therefore, the impact of OWF on biodiversity mainly covers the habitat loss effect (forcing out of habitats) for seabirds. The significance of the impact of scaring off birds and forcing them out of their habitats for the exploitation phase of the OWF was assessed at moderate at most. The planned investment in the exploitation phase will not have a significant impact on biodiversity in respect to its component, that is seabirds.

The significance of the investment impact in the exploitation phase on biodiversity is of little importance, because the biodiversity is a resource with a large significance, and the scale of impacts is negligible – local impacts in the Baltic Sea scale.

6.1.2.6 The impact on cultural amenities, monuments and archaeological objects and sites

Given the fact that in the Baltica OWF Area there are no significant impacts on objects of great significance for the protection of cultural heritage from the Stone Age, there is no justification for indicating monitoring activities in this scope. It cannot be excluded that wrecks reported to the Pomeranian Regional Monument Conservator will go under the Conservator's care and require protection zones with limited construction possibilities. If such protection zones are not agreed upon till the preparation of the construction design, the Applicant assumes a protective restriction of the activities related with the seabed (installations, anchoring, settling foundations) in the distance of 100 m from the reported wrecks.

6.1.2.7 Impact on use and development of sea area as well as tangible goods

During the exploitation of the Baltica OWF, this sea area will, for safety reasons, be excluded from regular sailing.

Traffic of the remaining water crafts (fishing, research of tourism) may be approved depending on the distribution of offshore wind power stations, under the conditions agreed upon with the investors. Decisions in the scope of admission of water crafts other than the ones that service the OWF for sailing in the Baltica OWF Area are made by relevant maritime administration entities.

The presence of ships that support the farms will be allowed. An increased traffic of these ships will mean hindrances in ship traffic on a route located southwards from the OWF.

After implementation of the linear investments (electricity and teletechnical grids) in the area, the use of certain fishing equipment or emergency anchoring of ships on the route southwards from the Baltica OWF Area may cause the infrastructure elements to be disrupted.

Closing the Baltica OWF Area for sailing will cause for fishing water crafts that station in the Łeba fishing port to have a longer way to the fishing area, it also applies, to a small, or negligible degree (depending on the selected route) to Ustka. The figure (Figure 51) presents routes of fishing ships from these two ports. The greatest concentration of ship traffic is visible in squares M9 and N9, located within the area of the Słupsk Furrow (one of the most intensely exploited fishing areas in the Baltic Sea).

The analysis of intensity and traffic routes for ships that station in the Łeba port indicates that in most cases they go towards the N9 and M9 squares and the shortest route to these fishing areas is 51 km. In both cases, closing the possibility of sailing through the farm area causes the sailing route to the fishing areas to be extended.

Figure (Figure 51) also shows potential access routes towards the fishing areas from the Łeba port (using a yellow colour). Variant 1 assumes travelling eastwards from the Baltica 3 OWF and is 3 km longer – is 54 km long. Variant 2 assumes travelling between the Baltica 2 OWF Area and the Baltica 3 OWF Area and is 56 km longer (the route is longer by 5 km). Variant 3 assumes travelling westwards from the Baltica OWF and with its length of 78 km causes the route to be extended by 27 km.

Potential fishing fleet losses in the case the possibility of closing the ship passage through the farm's area will result from this extension – in **variant 1** by approx. 6 km (2 × 3 km) in **variant 2** by 10 km (2 × 5 km) and in **variant 3** by 54 km (2 × 27 km) of the route from the port to the fishing area and back to the port. It will generate additional costs resulting from increased fuel use as well as longer time of crew work offshore. Assuming the average ship passage speed equals approx. 6 NM per hour, the need to avoid the farm causes the extension of time needed to travel to the fishing area and back to the port to be extended by approx. 30 minutes (0.5 hour) in variant 1, approx. 1 hour in variant 2 and approx. 5 hours in variant 3.

In order to calculate estimated fishery losses resulting from the need to avoid the farms, the activity of fishing water crafts leaving and returning to the Łeba port from 2012 to 2016 was analysed. Calculations took into account the number of cruises in each year, where the purpose were the fishing areas located south from the Baltica OWF Area, that is fishing squares N8, N9, N10, M8, M9 and M10. Based on data from fishing journals and the ship registry, the number of fishing water crafts that make catches from the Łeba port in the area of the above-mentioned squares and the engine powers of these water crafts. The number of fishermen employed aboard ships that station in Łeba was identified based on questionnaire RRW-19 Report on economic conditions of a fishing vessel. Average consumption of fuel oil was assumed at the level of 15 l per hour[3]. The average cost of fuel use, converted per kW of engine power was calculated using average marine fuel price from

[3] *Approximated data, information from the owner of cutter no. K-15 KS, 17 metres, 121 kW engine*

2012 to 2016. The cost of additional fishermen work time was calculated based on average remuneration in this company sector.

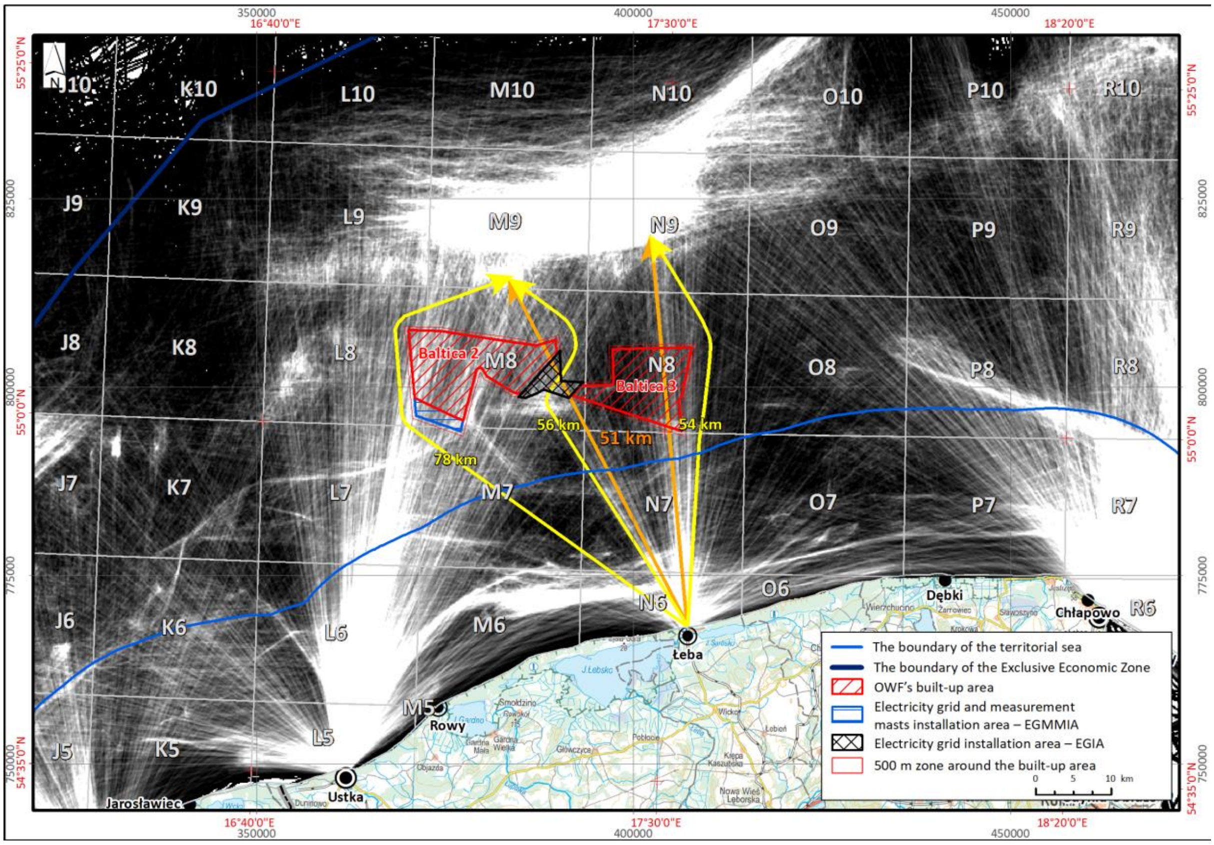


Figure 51. Extension of route from the Łeba port to the fishing area located in the Słupsk Furrow (variant 1 – 54 km, variant 2 – 56 km, variant 3 – 78 km)

Source: internal data

Tables below present data and results of calculations carried out. Additional costs of a fishing fleet resulting from the need to have a longer route to fishing areas located above the wind farm, in variant 1 were estimated at approx. **16 thousands PLN** a year, including approx. 5 thousands due to higher fuel costs and approx. 11 thousands PLN due to additional crew work time (Table 126). In variant 2, when moving along the migration corridor for birds, the estimated cost will double in relation to variant 1 (Table 127). In the case of variant 3 (avoiding the farm from the west) the estimated cost will increase, due to a significantly longer route to fishing areas were estimated at up to **154 thousands PLN** a year, including approx. 49 thousands due to higher fuel costs and approx. 105 thousands PLN due to additional crew work time (Table 128).

Table 126. Calculations of additional costs for fishery resulting from extension of way to fishing grounds (variant 1)

Year	The number of vessels	Average crew number	Number of cruises	Power of engines kW*cruise	Cost of 1 kWh	Labour costs (1 h)	Additional cruise time [h]	Additional fuel cost	Additional labour cost	Additional cost in total
	A	B	C	D	E	F	G	D*E*G	B*C*F*G	

Year	The number of vessels	Average crew number	Number of cruises	Power of engines kW*cruise	Cost of 1 kWh	Labour costs (1 h)	Additional cruise time [h]	Additional fuel cost	Additional labour cost	Additional cost in total
2012	20	3.9	207	34435	0.34	22	0.5	5936	8807	14743
2013	15	4.0	196	37740	0.33	23	0.5	6316	8918	15234
2014	13	4.2	206	38669	0.29	24	0.5	5610	10217	15827
2015	21	3.9	306	45948	0.22	25	0.5	4952	14476	19428
2016	14	4.1	225	31364	0.17	25	0.5	2636	11661	14297
Average	17	4.0	228	37631				5090	10816	15906

Source: internal data

Table 127. Calculations of additional costs for fishery resulting from extension of way to fishing grounds (variant 2)

Year	The number of vessels	Average crew number	Number of cruises	Power of engines kW*cruise	Cost of 1 kWh	Labour costs (1 h)	Additional cruise time [h]	Additional fuel cost	Additional labour cost	Additional cost in total
	A	B	C	D	E	F	G	D*E*G	B*C*F*G	
2012	20	3.9	207	34435	0.34	22	1	11708	17761	29469
2013	15	4.0	196	37740	0.33	23	1	12454	18032	30486
2014	13	4.2	206	38669	0.29	24	1	11214	20765	31979
2015	21	3.9	306	45948	0.22	25	1	10109	29835	39944
2016	14	4.1	225	31364	0.17	25	1	5332	23063	28394
Average	17	4.0	228	37631				10163	21891	32054

Source: internal data

Table 128. Calculations of additional costs for fishery resulting from extension of way to fishing grounds (variant 3)

Year	The number of vessels	Average crew number	Number of cruises	Power of engines kW*cruise	Cost of 1 kWh	Labour costs (1 h)	Additional cruise time [h]	Additional fuel cost	Additional labour cost	Additional cost in total
	A	**B**	**C**	**D**	**E**	**F**	**G**	**D*E*G**	**B*C*F*G**	
2012	20	3.9	207	34435	0.34	22	4.9	57689	85601	143291
2013	15	4.0	196	37740	0.33	23	4.9	61386	86672	148058
2014	13	4.2	206	38669	0.29	24	4.9	54524	99301	153825
2015	21	3.9	306	45948	0.22	25	4.9	48130	140696	188826
2016	14	4.1	225	31364	0.17	25	4.9	25621	113334	138955
Average	17	4.0	228	37631				49470	105121	154591

Source: internal data

From 2012 to 2016 average size of catches in the area of 5 fishing squares L8, M8, N8, M7, N7 where the Baltica OWF is located equalled approx. 819 Mg with a value of 3.0 mn PLN. The estimated amount and value of catches in the OWF Area, calculated proportionally to the size of the area which will be occupied by the farm (along with a buffer zone of maximum 500 m from the construction area, i.e. area indicated in the PSZW document) in the given square was 149 Mg and 552 thousands PLN, respectively. With respect to the overall amount and value of catches in the years 2012–2016 it comprised 0.1% and 0.3%, respectively.

Relative significance of the Baltica OWF Area is diverse depending on the place where the fishing vessels are stationed. Naturally, the highest share of amounts and values of catches carried out in the area of six fishing squares in relation to total catches in the Baltic Sea is achieved by ports located the closest to the analysed area. These include ships registered in Ustka, Łeba and Darłowo. For 2012–2016 the average share of fish caught in fishing squares L8, M8, N8, M7, N7 in relation to catches in total of units registered in the three above-mentioned ports equals 3.1%, 6.5% and 5.1% respectively in quantitative approach and 7.0%, 7.3% and 5.9% in qualitative approach. Narrowing down the quantity and quality of catches only to the area occupied by the farm, this share is respectively lower and equals 0.6%, 0.7% and 0.7% as well as 1.5%, 0.8% and 0.8%.

Potential introduction of a ban on sailing through the Baltica OWF will cause the increase of travel and operational expenses for ships that station in the Łeba port. Depending on the distance from the fishing area, this cost may range from approx. 16 thousands PLN to 154 thousands PLN a year, which constitutes from 0.3% to approx. 2.6% of average annual value of catches from 2012 to 2016.

The impacts of the Baltica OWF will be:

- negative due to the possibility to limit the fisheries;
- direct (following from restricting the possibility of catches);
- cumulated (given the planned construction of other wind farms in the close neighbourhood);
- long-term (given the planned period of the exploitation of the wind farm);
- constant (impact exerted over a long time, fishing areas closed upon the end of the decommissioning phase);
- local (impact solely in the OWF Area and the buffer zone).

In the Baltica OWF Area mostly cod and flounder is caught, that is species caught commonly also outside the Baltica OWF Area. Therefore, the value of the resource will be considered low.

The resistance to impact is average – fishing vessels have a possibility of changing fishing areas, but it will involve the risk of lowering fish catch efficiencies and lengthening the way to the fishing areas. The scale of impact will be small.

Fishery is subject to a negligible impact of the investment in the OWF Area due to small significance of the receptor and small scale of impact.

6.1.2.8 Impact on the landscape, including the cultural landscape

At the exploitation phase of the OWF, the following potential impacts of the investment on the landscape, including the cultural landscape, were identified:

- functioning offshore structures, such as wind power stations, gathering station, exporting station;

- water craft traffic for the purposes of handling the OWF.

Objectively, the landscape within the OWF will be an industrial one, but its impact will also be subjective, depending on the individual character of the viewer, and as such may be perceived as negative, positive or neutral.

The OWF impact on the landscape in the exploitation phase depends on:

- size of the structures, rotor diameter and its position with respect to the viewer;
- number and location of offshore wind power stations and objects;
- ship traffic related with the OWF servicing;
- meteorological conditions and sea state;
- the place the landscape observer is.

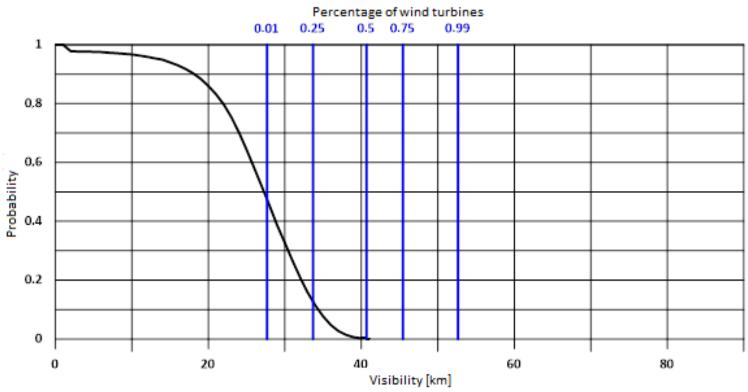
Offshore constructions will function in open sea for over 20 years.

People stay in the OWF Area for a short time, up to a couple of hours. In the exploitation phase, these will be the vessel staff, among others the ones handling the OWF Area, passengers of tourist ferries and fisherman and deep-sea anglers, tourists on pleasure crafts, participants of search and rescue missions, people who fly over the sea using planes and scientists. For these groups, the planned Baltica OWF will be the most visible, while more people will be able to watch the OWF at day rather than at night, e.g. some, e.g. part of ferry crew and passengers will be sleeping. Landscape impact will be long-term, for about 20 years, temporary, because after the exploitation phase OWF will be decommissioned.

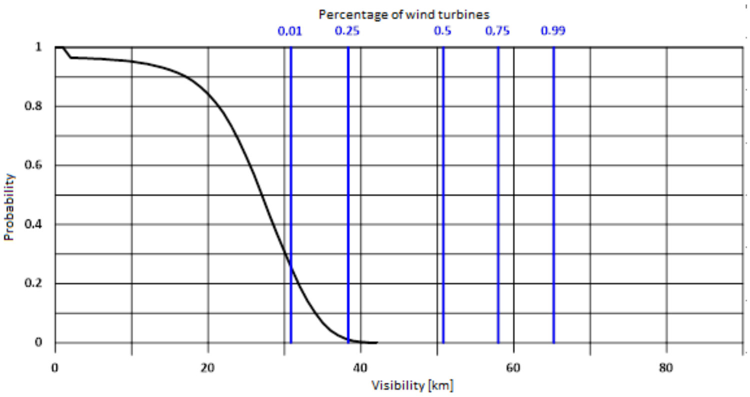
What is crucial in this phase is how long the observer will be exposed to OWF. It is expected that the aforementioned people will stay in the region where OWF is most visible occasionally, some even once.

The basic factor conditioning whether wind power stations will be visible from the coast are the weather conditions, more specifically the visibility understood as the scope of perception and object differentiation. Figures below (Figure 52) present an exceeding function of visibility (how often it happens that visibility is greater than a specific value) based on data from the UMPL atmospheric model (calculated by ICM UW – data from approximately 5 years). Exceeding functions were shown for 4 locations – Łeba, Lubiatowo, Dębki and Ustka. The plots clearly demonstrate that in the case of Dębki and Ustka, the Baltica OWF will not be visible from these locations. In the case of Łeba, single windmills may be visible even for over 4000 hours annually, but still 50% of the wind power stations installed in the Baltica OWF will not be visible. In the case of Lubiatowo, single wind power stations may be visible even for over 2000 hours annually, but still no more than 25% of the wind power stations installed in the Baltica OWF will be visible.

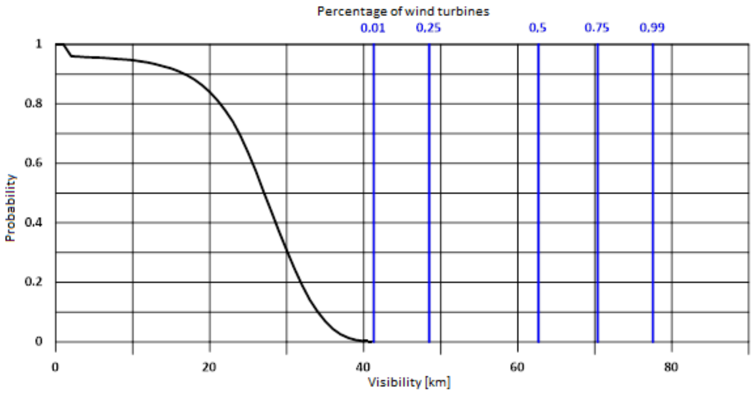
A)



B)



C)



D)

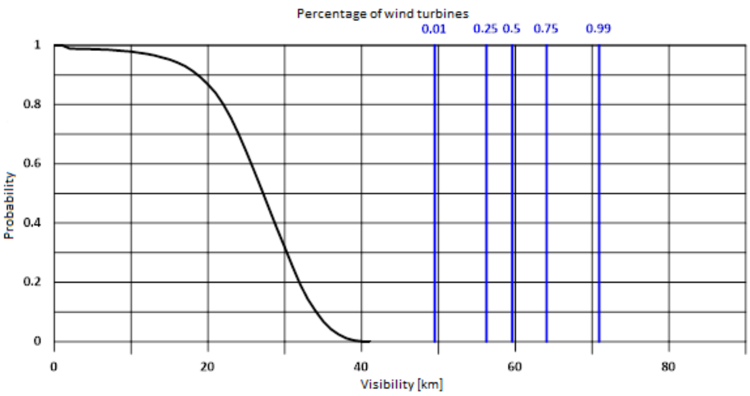


Figure 52. Exceeding function for visibility along with marked distances of offshore wind power stations in the Applicant's variant

Plot A – Łeba, B – Lubiatowo, C – Dębki, D – Ustka

Source: internal data

Additionally, the Earth curve is a visibility restriction regarding wind power stations from the land and the limitation of object height which can be seen from a large distance. In a practical manner, this limitation is shown by the fact that the greater the distance between the observer and the offshore wind power stations, the smaller part of them can be seen. The drawing below (Photo 2) shows visualisation of a view of the Baltica OWF from Łeba.

A)

B)

Photo 2. Visualisation of a view of the Baltica OWF from Łeba

Photograph A – view from Łeba during day, B – view from Łeba at dusk
Source: internal data

In the Applicant's variant, the maximum height of an offshore wind power station may equal 250 m and a maximum rotor diameter may equal 215 m. Both parameters are greater than the ones assumed for the rational alternative variant, but for an observer, such as on a ship, it will not be a visible, significant difference. Also due to the distance greater than 25 km from the shore, it will not be considered that the height of several tens of metres makes a significant difference.

The highest parts of the OWF structures will be visible from the shore, at the line of the horizon in favourable weather conditions, that is in a very good visibility. For most days of the year, OWF will be practically non-visible. The area at the section between Wicko in the west and Jastrzębia Góra in the east is in the possible OWF impact zone on landscape. Whether OWF will be visible for people on the coast or not depends on the place where they will observe the sea. For people on the beach, OWF will be less visible than for the ones staying somewhat higher with respect to the sea level, for instance places on the coast such as: Ustka, Rowy, Czołpino lighthouse, dunes in the Słowiński National Park, Łeba, Stilo lighthouse, Jastrzębia Góra. Provided that the visibility is good, the OWF will stay in the horizon line for each of the observers that are onshore (Photo 2). The functioning OWF will not exert a negative impact on onshore forms of nature and landscape conservations.

In the phase of exploitation, the OWF which is within the distance of dozens of kilometres from the coast will not exert any onshore impacts, such as the effect of rotor blades spinning, light shimmering or noise since they take place only near the working constructions and their scope does not reach the land. Offshore structures will be painted and marked, as well as properly lit at night in order to provide marine and aerial safety.

Table 129. The matrix determining the significance of the impact of the Baltica OWF in the exploitation phase on the landscape, including the cultural landscape

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

The impact was assessed as negligible, though it varies with respect to the observer's distance from OWF. The open-see landscape is not resistant to disturbance, but its value is not high as not many people for a short time will suffer from the landscape change, and some of them (e.g. tourists) may perceive it to be beneficial or interesting. The scale of spatial impact will be huge, it will decrease along with the distance from the OWF, it will be a long-time but reversible change. Onshore, the top parts of OWF may be occasionally visible (Photo 2).

6.1.2.9 Impact on population, health and living conditions of humans

Activating and functioning of subsequent offshore wind power stations involves a regular handling by the staff. During exploitation, the observed inspections and interventions carried out as a result of observed faulty operation will be accompanied by, for instance, offshore wind power stations, foundations of offshore wind power stations, power substations and subsea cables. These actions will be carried out using, for instance: specialised ships, helicopters, service ships, construction ships, submarines. During exploitation of the Baltica OWF, the number of cruises of units that support OWF may reach approx. 3 thousands a year. The vessels will move mainly between ports of the middle coast and the OWF Area. There will be much less cruises between the Gdańsk Bay and the Baltica OWF several tens each year.

Regular support of the OWF in the exploitation phase will make the changes in sailing of seagoing ships. The vessel traffic intensity between service ports in the central coast in the surroundings will be close to maximum value in the construction phase, which will have an adverse impact on the risk of emergency events.

Due to security concerns, the Baltica OWF Area will be inaccessible for fishing vessels. It will mean, for instance, limited accessibility to currently exploited fishing areas and lengthening the routes of fishing cutters from certain ports to the fishing areas located north from the Baltica OWF Area. The scale of these impacts will include several tens of cutters, particularly from the Łeba port.

Recreational fishing is also a type of sea fishing. It is cultivated both by sea fishermen, angling enthusiasts, as well as owners of pleasure boats. In such cases, it is a small group of people whose material situation will deteriorate due to construction and exploitation of the Baltica OWF.

The quality of life of inhabitants from seaside cities, communes and neighbourhoods largely depend on the development of seaside tourism and recreation. In certain communes, e.g. in Łeba, income of local self-governments and inhabitants mainly come from service of tourism traffic and qualified tourism and recreation. The tourism and recreational potential of this part of the Baltic Sea is among the largest in the country, and thousands of inhabitants provide various services for visitors, mainly in the summer season, with a tendency for the vacation period to be extended.

Due to large distance from the coast (approx. 26 km and more), the noise from windmills and servicing vessels will not reach the coastal zone. During most meteorological situations (wind, wave motion, clouds, air humidity), the operation of the Baltica OWF will not be noticeable from the level of the beach or the sand dunes. A larger number of power stations will only be noticeable from higher observation points. The number of visible wind power stations will depend on their spacing, location and distance from the shoreline.

In case of such great distances, the weather conditions will cause a maximum limitation or increase of the shadow flicker effect onshore. However, in the night, elements of lighting of the offshore wind farm will be well visible from a long part of the shore.

Health and life of people depend on direct or indirect impacts related with emissions of: noise, air pollution, electromagnetic field and radiation as well as wastewater and waste.

Mainly, these impacts will not have a significant impact on health and quality of life for humans due to their separation from objects and installations. Due to the presence of electromagnetic fields generated by devices on offshore power substations and the broadcasting power of radiolocation and radiocommunication devices, the potential hazard for service employees for these devices is maintained for the entire period of operation of power substations. Unauthorised people will never be present within the area of electromagnetic impacts of these devices. People staying in the Baltica OWF Area will be subject to Labour Law and OSH regulation, due to their occupational duties. With regard to the above, in case of presence of above-mentioned emission hazards, these people will be equipped with personal protection equipment and/or their work time in these conditions will be optimised so that they remain exposed only for the time specified in OSH regulations.

Other types of events which may impact the health and quality of live, may be various collisions of water crafts on the sea. These types of events have a random character, and the operation of the OWF may make it harder to run sea emergency actions.

Any resource, such as population, health and quality of life of humans have a great significance, due to the fact that the distance of the Baltica OWF from permanent residence and work locations is large, it was considered that the impact of the Baltica OWF is in this case negligible.

6.1.3 Overlapping of the construction and exploitation phases

The table below (Table 130) compiles information about the significance of impacts at the construction and exploitation phase, as well as on the significance of these impacts in the case of simultaneous presence of the construction and exploitation phases. It should be noted that although for overlap of construction and exploitation phases, the highest impact significance was assumed from the ones assumed at the assessments of impacts for construction and exploitation phases, the impact intensities often will not reach maximum values, understood as a sum of intensities of impacts from the construction and exploitation phases. For instance, during overlap of construction and exploitation phases, the traffic of water crafts and helicopters will be at a constant level due to the performance of construction works and it will gradually increase due to service works, proportionally to the percentage of wind power stations handed over for exploitation. The moment the majority of power stations are installed, it may turn out that the intensity of water crafts and helicopters will be equal to the traffic level of construction, plus almost the entire service traffic in the exploitation phase. However, for the majority of duration of the overlap of the construction and exploitation phases, this intensity will not be close to the sum of intensities from the construction and exploitation phases.

The majority of impact types are local in both phases, therefore it will not be possible to cumulate impacts between activities carried out for construction and exploitation processes. It results from the fact that until the moment the construction of a specific wind power station is finished, this wind power station cannot be exploited. Therefore, it was assumed that the significance of impact at the overlap of construction and exploitation phases will take the higher of the two values of impact significance at construction and exploitation phases.

In case impacts do not occur in any phase, the impact significance for the phase where this impact took place should be assumed.

Table 130. Assessment of impact significance at the construction and exploitation phase as well as at the overlap of construction and exploitation phases

Element	**Impact's significance**		
	Construction phase	**Exploitation phase**	**Overlapping of the construction and exploitation phases**
Seabed	Irrelevant	Irrelevant	Irrelevant
Wave motion and sea currents	None	Irrelevant	Irrelevant
Water turbidity	Irrelevant	Irrelevant	Irrelevant
Water quality	Irrelevant	Irrelevant	Irrelevant
Wastewater impact	Irrelevant	Irrelevant	Irrelevant
Release of seabed sediment into the sea deep	Insignificant	Insignificant	Insignificant
Contamination with compounds from anticorrosion protection agents	None	Insignificant	Insignificant
Climate and greenhouse gases	Insignificant	Irrelevant	Insignificant
Systems that use PEM	Irrelevant	Irrelevant	Irrelevant
Phytobenthos	Irrelevant	Irrelevant	Irrelevant

Element	Impact's significance		
	Construction phase	Exploitation phase	Overlapping of the construction and exploitation phases
Zoobenthos	Irrelevant	Insignificant	Insignificant
Ichthyofauna	Moderate	Of little importance – negative Moderate – positive	Moderate
Marine mammals	Moderate	Insignificant	Moderate
Seabirds	Moderate	Moderate	Moderate
Migratory birds	Insignificant	Insignificant	Insignificant
Chiropterofauna	Insignificant	Insignificant	Insignificant
Ecological corridors	Irrelevant	Irrelevant	Irrelevant
Biological diversity	Insignificant	Insignificant	Insignificant
Use and development of sea area	Irrelevant	Irrelevant	Irrelevant
Landscape	Irrelevant	Irrelevant	Irrelevant
Population	Irrelevant	Irrelevant	Irrelevant

Source: internal data

6.1.4 The closing down and decommissioning phase

6.1.4.1 Impact on geological structure, seabed sediments, access to resources and deposits

The following impacts on geological structure, seabed sediments, access to resources and deposits in the closing and decommissioning phase are expected to take place:

- disturbance of the sediment structure;
- change of the seabed morphology;
- ground subsidence;
- suspended matter agitation and sedimentation.

In the decommissioning phase, probably the removal of most of the farm objects from the seabed will occur in accordance with international legal regulations in the fields of decommissioning and construction in marine areas (UNCLOS).

Works related to decommissioning of the entire farm or its individual objects (removal of foundations and cables) will involve resuspension of surface sediments and their redeposition. In the areas where on the surface there is loose sediment or its layer is thin, the impact will be of little importance. In areas of a thicker sand layer occurrence, particularly mud loam sediments, agitated sediment will be floating in the sea deep for a longer time. The course of the entire phenomenon will definitely be smaller than in the farm construction phase. Disturbance of seabed sediment structure in the decommissioning phase was evaluated as negligible and of a local range. In the phase of decommissioning, no actions minimizing this impact are expected.

At the phase of the decommissioning of farms seabed morphology (shape) will change. In the case of removing piles, holes will remain in the seabed. The process of backfilling as a result of wave motion or sedimentation of suspension may be long-term Its pace will depend mainly on the type of basement. In areas with till forms occurrence the process takes much longer because of a low susceptibility to washing. In the location of loose sediment it will be faster, in some cases almost instantaneous. In seabed areas made up from a thick sand layer, the whole present after removal of pile foundations may be rapidly backfilled. This process may take place already during pile (or pile fragment) extraction from the seabed. The released sand, due to gravity and mass processes, supported by water movements, will slide down and backfill the hole created in the seabed. As a result of this process, only a hollow remains in the seabed. No actions minimizing this impact are expected. The change in seabed morphology in the decommissioning phase was evaluated as a negligible impact of a local range.

The settlement process will take place at farm decommissioning phase, but its course will have a different character. Ground subsidence processes will be related with natural compaction of freshly moved soil. In the course of the farm decommissioning process, hollows and holes after removed elements will be created, where the rock material will slide from the direct neighbourhood of the removed element. This process will take place mainly in areas constructed from loose sediments: sandy, sand and gravel and mud and loam. The rock material that slides down the hole will gradually fill it. The process of sedimentation of the rock material moved this way will start. The process will concern places that left after the infrastructure elements are removed and their immediate surroundings. In seabed areas made from till this process will take place very slowly. There may even be a situation when hollows and holes in a till basement, resulting from the removal of farm elements will not be filled with the material from washed till seabed, but with a material that comes from transport on seabed (e.g. sands) or from the suspended matter (loams and clays). Due to lack of significant impacts, mitigating measures are not required. Ground subsidence will be considered a negligible impact with a local range.

During the decommissioning phase, subsequent foundations of power stations and other objects of the farm will be removed (provided there is no decision to leave them in a manner ensuring navigational safety). This will cause agitation of seabed sediments and a temporary rise of suspension in the water deep. The impact scale will be lower, possibly close to the one in the construction phase. Increase of suspended matter in water in the farm decommissioning phase was evaluated as negligible and of a local range.

The joint valuation of the significance of impacts on geological structure, seabed sediments, access to resources and deposits was specified was determined to be negligible. Such assessment was determined even though the seabed is a vital habitat forming factor, but the scope of impact on the seabed is local and the seabed is sufficiently non-differentiated in the area to consider the impact as negligible despite the role of seabed in the environment. Assessment of partial impacts is included in the table below (Table 131).

Table 131. The assessment of the impact of wind power stations in the OWF Area on seabed in decommissioning phase

Type of potential impact (factor)	Description of the impact (based on data from the literature)	The evaluation of the impact on the seabed in the OWF Area
Disturbance of the seabed structure	Works causing disruption of the structure of seabed sediments will be carried out. These particularly include disassembling of foundations and power cables. Such disruptions are also caused by anchoring vessels. The immediate effect of disrupting the structure of bottom sediments will be the rising and spreading of suspension in the water deep and then its re-deposition on the seabed	Negligible impact, local scope
Change of the seabed morphology	The result of removing the foundations or cables, or leaving some elements of the farm in the seabed will be the change of its morphology (i.e. hollows left by the foundations)	Negligible impact, local scope
Ground subsidence	The result of removing the foundations may be ground subsidence (i.e. hollows left by the foundations)	Negligible impact, local scope
Suspended matter agitation and sedimentation	Work related with farm decommissioning (i.e. removing foundations and cables from the seabed) as well as anchoring of vessels will cause disruption of the seabed sediment structure and raising of suspension, which will result in increased water turbidity. Suspended matter was created as a result of resuspension of sediments during underwater operations descends to the seabed in accordance with the regional water dynamics	Negligible impact, local scope

Source: internal data

6.1.4.2 Impact on marine waters and the quality of marine waters and seabed sediments

6.1.4.2.1 Impact on marine waters

In decommissioning phase, foundations and cables connecting wind power stations and power substations will be removed. This will cause agitation of seabed sediments and rise of suspension in the sea deep. In the Applicant's variant, decommissioning of a maximum of 209 foundations for towers of offshore power stations and digging up a maximum of 418 of cable routes. The most unfavourable construction solution, due to the increase of water turbidity during decommissioning works is gravity-based foundations. The total amount of agitated sediment during decommissioning phase of the investment will be smaller than the amount of sediment agitated in the construction phase.

The increase in turbidity of water will have a short-term character and its range will be local. Due to short time of persistence of high sediment concentration in the region of works carried out, there will be no need to use mitigation measures. After the construction works are ended, everything will return to the previous state.

The significance of impact on the increase of water turbidity in the decommissioning phase was evaluated as a negligible impact of a local range.

6.1.4.2.2 Impact on the quality of marine waters and seabed sediments

In the decommissioning phase, probably the removal of most of the farm objects from the seabed will occur in accordance with international legal regulations in the fields of decommissioning and construction in marine areas (UNCLOS).

Occurrence of the following is expected in the decommissioning phase:

- contamination with accidentally released waste and domestic sewage;
- release of contaminants and nutrients from the sediment into the sea deep.

Contamination with accidentally released wastewater

Wastewater may be generated by people present on ships, as well as be generated during foundation decommissioning process, disassembly of elements (subassemblies) of wind power stations (towers, nacelles, rotors) and extracting cable.

The risk of sewage release from the ship into the water column exists at the time of collection of sewage from a ship by another vessel and in the event of a breakdown. It may cause local increase of nutrients concentration and deterioration of water quality. The released contaminants should, however, rapidly dissipate, which will not contribute to permanent environment deterioration in the investment area.

This impact will be analogous to the construction phase. A detailed description of this impact is described in section 6.1.1.2.

The contamination of water and/or seabed sediments with waste or domestic sewage is a direct negative impact, temporary or short-term, reversible, of local range. The scale of impact is negligible.

Given its universality, significance and role, the value of the water resource was evaluated as high. The impact related to wastewater impact on marine water quality was assessed as negligible, despite a great significance of the resource. Probability of wastewater entering the sea deep is negligible. Even if it happens, it may cause a local increase of nutrients concentration and deterioration of water quality. However, due to its small amount, the contamination should, however, rapidly dissipate, which will not contribute to permanent water quality deterioration in the investment area.

Release of contaminants from the sediment into the water deep related with resuspension (agitation) of seabed sediment

The release of pollutions and nutrients from seabed sediments to the sea deep during the decommissioning phase is a direct, negative, short-term, repeatable during decommissioning phase, reversible or irreversible impact with a local range. The scale of impacts for waters and sediments is small. The value of the resource both for water and sediments is large, and it is related with the habitat forming nature of both components of the environment.

During the decommissioning of foundations, anchoring vessels and removing cable, the processes of nutrients or pollutions entering the sea deep will be observed, which may have a negative impact on its quality. However, due to the expected low concentration of the listed substances in the seabed sediment, the loads of these substances will not be large. However, after cessation of activities associated with decommissioning, after reaching the equilibrium state, these substances will re-enter the sediment. Therefore the release of nutrients and pollutions from the seabed sediment to the sea deep and their resedimentation are considered of little significance for waters and negligible for sediments, despite large significance of waters/sediments and a small scale of impact. It results from the fact that even though pollutions may temporarily deteriorate the water quality, the disturbance will disappear after resedimentation, total amount of pollutions will not increase.

6.1.4.3 The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

Given the significant distance of the Baltica OWF Area from the coast, large agglomerations and other potential sources of pollution emissions it will be assumed that the air purity class within these areas will correspond to the purity class A. Given that the emission in the farm exploitation phase will be minimal (mainly from units that carry out disassembly works), practically no emission of dust pollution and only insignificant emission of gas pollution will be assumed, therefore this situation is not expected to change. In the phase of decommissioning, no emission of other greenhouse gases is expected.

In the closing and decommissioning phase there will be an insignificant increase of greenhouse gases emissions due to combustion of fuels by ships that handle disassembly of offshore wind power stations.

Within the framework of identification of impacts of the meteorological conditions on the investment the following factors were assessed: wind, air pressure, humidity and air temperature. The planned investment will have no impact on above elements of the environment.

At the closing and decommissioning phase, the significance of the climatic and greenhouse gases emission-related impact of the planned investment will be negligible, as there will be no factors which could have any noticeable impact on its change.

The impact of the planned investment at the closing and decommissioning phase on air quality will have a transitory character and will disappear after the works are ceased. Moreover, due to the fact that it is an open area with no obstacles, the concentration of pollutions will quickly decrease. With regard to the above, the significance of the impact on air quality will be of little importance.

6.1.4.4 Impact on systems that use PEM

The significance of impacts on systems that use PEM such as radar, communication and radiolocation systems will be the same as the significance of impact in the exploitation phase (section 6.1.2.4), while as the decommissioning process progresses, this impact will gradually decrease along with the decreasing number of structures above water remaining in the Baltica OWF Area.

6.1.4.5 Impact on nature and protected areas

6.1.4.5.1 Impact on biotic elements in the sea area

6.1.4.5.1.1 Phytobenthos

Due to trace amount of phytobenthos present outside the Baltica OWF Area, it was assumed that even though the significance of phytobenthos generally in the PMA is large due to the uniqueness of this resource in the PMA, in the OWF Area the significance of this resource is low.

In order to assess the impact of the Baltica OWF on phytobenthos, the authors based on data from the literature regarding other marine areas, mainly the Baltic Sea. Analysis of literature on the subject matter shown that at the phase of decommissioning of the investment, there are potentially 5 factors that impact the phytobenthos (Table 132).

Among them, one of the most significant for phytobenthos – as mentioned by Köller et al. (2006), Zucco et al. (2006), Birklund (2007) – is disruption of the basement structure: sandy, mud-sand, or stony seabed sediments, overgrown by phytobenthos. The phenomenon takes place when using jack-up installation units which are equipped with legs placed on the seabed. This results in local physical damage of phytobenthos in places where the seabed is disturbed. In the case of the Baltica OWF Area, this factor does not impact the phytobenthos since plants are present in trace amounts in the area beyond the construction zone.

Another potential factor is an increase of suspended matter concentration in the sea deep (Leonhard, 2006; Zucco et al., 2006) present during removal of support structures from the environment. Turbidity of water changes locally and at the same time there is a limitation in access of light to plants present in the area of works. In the case of increase of suspended matter concentration in the Baltica OWF Area, the impact on trace amounts of phytobenthos in the area beyond the construction line will be very unlikely due to the distance of phytobenthos from works carried out on the seabed and due to the type of sediments in the construction region – fine and medium grained sands (Appendix 1). Large water dynamics in the area (Appendix 1) causes quick diffusion of possible suspended matter, then even a temporary decrease of light access in the benthic zone which results in insignificant, short-term disruption of the photosynthesis process of trace amounts of phytobenthos will be very unlikely in the case of this investment.

Impact related with the sedimentation of suspended matter (backfilling phytobenthos communities) is the strongest locally, in places where works are carried out on the seabed (Zucco et al., 2006). Large intensity of works that cause large densities of sediment in water may cause physical destruction of natural phytobenthos communities or limitation of their development by covering the plants with a layer of sediment, which causes temporary halting of the photosynthesis process. However, the results of this impact, similarly to the increase of suspended matter concentration in the sea deep have a local character, depending on the depth and type of sediments and generally they have no significant impact on occurrence of phytobenthos. In the case of the Baltica OWF Area, the impact on trace amounts of phytobenthos present in the area beyond the construction line will be unlikely due to the distance of phytobenthos from works carried out on the seabed and due to the type of sediments in the construction region – fine and medium grained sands (Appendix 1).

The last factor which potential impact on phytobenthos, in accordance with the data from the literature, is redistribution of nutrients and pollutions from sediments into the sea deep (Zucco et al., 2006). It takes place as a result of resuspension of sediments during works at the seabed. Phytobenthos communities are then exposed to increased concentration of nutrients and pollutions in the water (e.g. heavy metals). This impact, similarly to the increase of suspended matter concentration in the sea deep, has a local character, depending on the depth and type of sediments. In the case of the Baltica OWF Area, the impact of compounds released from sediments on phytobenthos present in trace amounts in the area beyond the construction line will be unlikely due to the distance of phytobenthos from works carried out on the seabed and due to low content of nutrients and pollutions in the sediments in the OWF Area (Appendix 1).

So far, none of the offshore wind farms located in Europe has been disassembled (Vaissière et al., 2014), therefore it can only be estimated what will be the impact of removal of hard substrates from the sea environment, that is support structures and scour protection layers with periphyton communities developed during several tens of years of exploitation in the Baltica OWF Area. Most probably there will be a decrease of species diversity and macroalgal species biomass, which results in modification of the ecosystem in the region of the wind farm, that a return to previous conditions before the farm was settled. In the case of the Baltica OWF Area, removal of the structure along with the artificial reef will most probably have no significant impact on phytobenthos in the Baltica OWF Area, because due to lack of phytobenthos on the seabed there will also be no abundant presence of periphyton flora on support structures and scour protection layers. After disassembly there will be a return to environmental conditions present before the construction of a wind farm in the seabed region, where phytobenthos does not occur naturally. It will be a positive phenomenon.

In the assessment of potential impacts of the decommissioning of an offshore wind farm in the Baltica OWF Area on phytobenthos, particular attention should be paid to protected species in accordance with the Regulation of the Minister of the Environment of 9 October 2014 on plant species protection (Journal of Laws no. 2014, Item 1409). Apart from the OWF's built-up area, a 500-meter buffer zone surrounding this area, one individual from a strictly protected species was found – red algae *Furcellaria lumbricalis* (formerly *F. fastigiata*) (Appendix 1). The presence of only one individual indicates that its presence in the region was incidental. The place in Poland where it is most abundant was identified in the boulder area of the Słupsk Bank (Kruk-Dowgiałło et al., 2011), located approx. 20 km from the south-western boundary of the Baltica OWF Area.

Therefore, in accordance with the above description of factors, it will be concluded that the decommissioning of the wind farm will have no impact on the protected species of the red algae *F. lumbricalis*, because it is located outside the OWF's built-up area, and the impact of the factors above is unlikely. Possible destruction of single individuals of this species as a result of actions related with the implementation of the planned investment will not have impact on the population of this species in the PMA.

Table 132. The assessment of the impact of wind power stations in the OWF Area on phytobenthos in decommissioning phase

Type of potential impact (factor)	**Description of the impact (based on data from the literature)**	**Action the impact (based on data from the literature)**	**Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)**
Disruption of the seabed structure	When removing dredged material for foundations and during any works on the seabed related with decommissioning of structures (e.g. anchoring jack-up units)	Physical damage to natural phytobenthos communities (negative impact)	In the OWF Area, phytobenthos is present in trace amounts, only outside the construction zone No impact
Increase in suspended matter concentration in the water depth	When resuspending sediments during decommissioning works water turbidity increase will take place	The decrease of access of light in the benthic zone – shading plants on the seabed – which may disrupt their photosynthesis process (negative impact)	Plants present outside the OWF Area construction zone will most probably not be vulnerable to decrease of access of light resulting from the increase of suspended matter in water in the region where works are carried on at the seabed. In the worst case, if the impact takes place it will be: indirect simple short-term temporary reversible local negative Scale of impact: negligible Significance of impact: negligible
Suspended solids sedimentation	Suspended matter was created as a result of resuspension of sediments during dredging works descends to the seabed in accordance with the regional water dynamics	Physical destruction (backfilling) of natural physical communities of limitation of their development by disturbance of the photosynthesis process (negative impact)	Plant present outside the OWF Area construction zone will most probably not be threatened with backfilling. In the worst case, if the impact takes place it will be: indirect simple short-term temporary reversible local negative Scale of impact: negligible Significance of impact: negligible

Type of potential impact (factor)	Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Phytobenthos impact assessment in the OWF Area (based on the results of the Report from the inventory for phytobenthos)
Redistribution of contaminants and nutrients from the sediment into the sea deep	Release of nutrient and pollutions load to the sea deep (e.g. heavy metals) due to resuspension of sediments during works on the seabed	Exposure of phytobenthos communities to increased concentration of nutrients and pollutions in the water (negative impact)	Plant present outside the OWF Area construction zone will most probably not be threatened with increased concentration of nutrients and pollutions in seabed. In the worst case, if the impact takes place it will be: indirect simple short-term temporary reversible local negative Scale of impact: negligible Significance of impact: negligible
Removal of artificial hard substrate from the environment, (supporting structure and scour protection layer) overgrown with periphyton flora	Loss (extraction) of an artificial reef – destruction of a periphyton flora community that appeared at structures	Modification of qualitative and quantitative structure of phytobenthos in the farm area	The loss of most probably poor macroalgae communities that overgrow structures and scour protection layers. After disassembly there will be a return to environmental conditions present before the construction of a wind farm in the seabed region, where phytobenthos does not occur naturally. Impact: direct simple long-term constant irreversible local positive Scale of impact: negligible. Significance of impact: negligible

Source: internal materials, taking into account the results of impact analyses in paper by Dziaduch (2015)

To sum up, in the Baltica OWF Area at the phase of investment decommissioning there may be impacts on phytobenthos which are insignificant and with a negligible scale (Table 133).

Table 133. The matrix determining the significance of the impact of the Baltica OWF in the decommissioning phase on phytobenthos

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.4.5.1.2 Zoobenthos

On the basis of analysis of the literature on the subject matter, basic potential factors were identified which may impact zoobenthos in the decommissioning phase.

Disruption of the seabed sediments structure is a factor with the strongest impact on the zoobenthos that inhabits the surface and interior of seabed sediments (Köller et al., 2006; Zucco et al., 2006; Birklund, 2007). It concerns particularly the zoobenthos species that inhabit the surface of sandy sediments, mud sediments and stony seabed, which are not able to move inside the sediments. In the decommissioning phase, this phenomenon of disrupting the sediment structure takes place when removing foundations and cables, as well as during the use of jack-up installation units. Disturbance of the sediment structure results in elimination of zoobenthos in places where the seabed is disturbed.

The increase of suspended matter concentration in sea deep is a factor present during dredging works, removal of support structures from the environment (Leonhard, 2006; Zucco et al., 2006). Excessive suspended matter concentration in sea deep causes reduced feeding effectiveness of filtering organisms in zoobenthos as a result of clogging of the filtration system.

Suspended matter sedimentation is an impact that is spatially limited to the region where works are carried on at the seabed and its direct neighbourhood (Zucco et al., 2006). The negative character is related with zoobenthos species backfilling (especially the fraction living on the surface of sediments – epifauna), which have a limited capacity to move inside sediments.

Removal of artificial hard substrates from marine environment, similarly to the "appearance of artificial hard substrates" results in an alteration of a qualitative and quantitative structure of the zoobenthos community created as a result of the implementation of the investment. It is hard to unambiguously judge the impact of a factor in the context of spatial range and duration because none of the offshore wind farms constructed in Europe was decommissioned yet (Vaissière et al., 2014).

In the case of entire removal of artificial hard substrate, i.e. supporting structure and scour protection layers, periphyton zoobenthos communities formed within a period of several tens of years of the OWF exploitation will be permanently eliminated from marine environment. The decrease of biodiversity (habitat and taxonomy) will take place as well as local decrease of zoobenthos resources which is a food supply for fish and seabirds. On the other hand, the previous, natural state of seabed communities in the OWF Area will be restored, and in the area of pelagic habitat – in a region outside the OWF Area. The sum of favourable consequences allows for the assumption that the impact of the factor should be considered positive.

The assessment of impact of factors with a potential impact on zoobenthos in the closing and decommissioning phase is presented in table (Table 134)

Table 134. The assessment of the impact of wind power stations in the OWF Area on seabed in closing and decommissioning phase on zoobenthos

Type of potential impact (factor)	Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Assessment of impact on zoobenthos
Disruption of sediment structure	Disturbance of seabed structure as a result of all kinds of works on seabed related with decommissioning of wind power station structure (e.g. anchoring jack-up units)	Physical damage of periphyton zoobenthos communities	Impact: direct simple long-term constant lasting local negative Impact scale: negligible Importance of the resource: low Importance of the impact: irrelevant
Increase in suspended matter concentration in the water depth	During disassembly, backfilling the hollow in the seabed after the removed structure, drainage of water from sediments removed from the pile, local sediments resuspension will take place	Elevated concentration of the suspended matter causes reduced feeding effectiveness of filtering organisms (clogging) *clogging*)	Impact: direct simple short-term temporary reversible local negative Impact scale: low Importance of the resource: low Importance of the impact: irrelevant
Suspended solids sedimentation	Suspended matter generated as a result of resuspension of sediments during disassembly works falls to the seabed	Physical destruction of zoobenthos individuals present on the seabed surface – epifauna (negative impact)	Impact: direct simple short-term temporary reversible local negative Impact scale: low Importance of the resource: low Importance of the impact: irrelevant

Type of potential impact (factor)	Description of the impact (based on data from the literature)	Action the impact (based on data from the literature)	Assessment of impact on zoobenthos
Removal of artificial hard substrate from the environment	Elimination of artificial reef communities that appeared at structures	Restoration of marine environment conditions from the period preceding the investment	Impact: direct simple long-term constant lasting local positive Impact scale: average Importance of the resource: low Importance of the impact: insignificant

Source: internal materials, taking into account the results of impact analyses in paper by Dziaduch (2015)

Analysis of pressure factors on zoobenthos at the decommissioning phase shown that their greatest impact is identified as small in the scale of impact as well as with low significance of the resource, which gives us negligible significance in total (Table 135).

Table 135. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on zoobenthos

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.4.5.1.3 Marine ichthyofauna

The analysis of impact is hindered due to lack of experience in decommissioning as well as inability to predict what technologies will be available in the perspective of twenty or more years when the decommissioning of farms will be performed (OSPAR 2008).

The source of noise will be works related with removal of offshore wind power stations constructions and increased traffic of water crafts. Intensity of impacts depends largely on propagation of sound depending on the seabed morphology and the distance between the receptor and the sound source. Lethal effect may take place up to several tens of metres (Wilhelmsson et al., 2010), while damage to hearing and tissue up to several hundreds of metres (Nedwell et al., 2003) from the sound source. The effect of avoidance may take place even at a distance of several tens of kilometres, stretching outside the Baltica OWF Area. Results of impacts on ichthyofauna are similar as in the phase of construction. According to Wilhelmsson et al., (2010) the noise related to blowing up or cutting may cause death or very severe bodily damage of fish present in the vicinity (negative result). Therefore, blowing up structural components should be avoided, as this method is the most harmful.

Noise and vibrations emissions generated during disassembly of foundation piles may directly and negatively affect ichthyofauna. These impacts will be negative, direct, simple, short-term, instantaneous, reversible and regional. In the case of protected fish, during the surveys only larvae stages appeared, for which the impact will have a local character.

Table 136. Resistance of specific ichthyofauna species to noise and vibration impacts

Species	Impact resistance
Cod	Average (a fish with the swim bladder)
Flounder, plaice	High (no swim bladder)
Turbot	High (no swim bladder)
Herring	Average (a fish with the swim bladder)
Sprat	Average (a fish with the swim bladder)
Protected species (gobies, common seasnail)	High (higher resistance of larvae that in adult stages – Popper et al., 2014)
Salmonids (salmon, sea trout)	Average (a fish with the swim bladder)

Source: internal data

Table 137. Impact of noise and vibrations on ichthyofauna at decommissioning phase

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Low	Insignificant
Flounder, plaice	Low	Low	Irrelevant
Turbot	Average	Low	Insignificant
Herring	Average	Low	Insignificant
Sprat	Average	Low	Insignificant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Low	Insignificant

Source: internal data

During works related with disassembly of infrastructure elements, agitation of sediments and increase of water turbidity will take place. The vulnerability of ichthyofauna is specific for the species and stage of life. The size of impact depends on the suspended matter concentration, time of exposure and character of suspended matter particles. Backfilling eggs, changes in egg buoyancy, inhibition of gas exchange, hindrance for breathing, change of visibility – depending on the species and development stage they may cause increase in susceptibility to predation or feeding efficiency, increase of growth pace, disruption of physiology, effect of avoidance(negative/positive impact). It will regard relatively small areas compared to the entire area of spawning and feeding areas.

Impact related with the increase of suspended matter concentration will be a negative, direct, local, simple, short-term, instantaneous and reversible impact.

All bird species found in the OWF Area demonstrate average resistance of impacts related with the increase in suspended matter concentration.

Table 138. Impact of suspended matter concentration on ichthyofauna at the decommissioning phase

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Low	Insignificant
Flounder, plaice	Low	Low	Irrelevant
Turbot	Average	Low	Insignificant
Herring	Average	Low	Insignificant

Species	Importance of the resource	Impact's scale	Impact's significance
Sprat	Average	Low	Insignificant
Protected species (gobies, common seasnail)	High	Low	Moderate
Salmonids (salmon, sea trout)	Average	Low	Insignificant

Source: internal data

During disassembly works the sediments will be resuspended, and pollutions (e.g. heavy metals, polychlorinated biphenyls, pesticides, petroleum products) as well as nutrients from the sediment will be released to the sea deep.

Exposure of ichthyofauna to elevated concentration of pollutions and nutrients may cause increased mortality rate and diseases (e.g. skin diseases, damage to liver and gills). Wilhelmsson et al. (2010) assess the risk of a negative impact as low and limited spatially.

The risk of release of larger amounts of harmful chemical substances from sediments (according to the HELCOM classification) is small, due to their low concentrations found in the Southern Baltic sediments, confirmed by the results of surveys carried out for the investment (Appendix 1). Inventory results shown low pollution concentrations, often below the bottom limit of quantification.

Impacts related with release of pollutions and nutrients from the sediment to the sea deep will be a negative, direct, local, simple, short-term, instantaneous and reversible.

All bird species found in the OWF Area demonstrate high resistance to impacts related with the release of pollutions and nutrients to the sea deep.

Table 139. Impact of the release of contaminants and nutrients from the sediment into the sea deep at the OWF decommissioning phase on ichthyofauna

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

During decommissioning of OWF, a large part of an artificial reef will be destroyed, which was a place for dwelling, feeding, shelter and reproduction of many fish species. It may cause a decline in abundance and diversity of ichthyofauna. This negative effect may be partially limited by leaving scour protection measures on seabed, which is a significant element of a habitat formed during exploitation of this habitat. Decommissioning of OWF infrastructure will make it possible to perform catches in this area. It may counter the beneficial impact on ichthyofauna which involved stopping fishing activities there, particularly on reproduction processes of certain fish species (common seasnail, gobies).

Impact related with habitat change will be negative, direct, local, simple, long-term, stable and irreversible in character.

All fish species found in the OWF Area demonstrate high resistance to impacts related with change of habitat.

Table 140. Impact of habitat change on ichthyofauna at decommissioning phase

Species	Importance of the resource	Impact's scale	Impact's significance
Cod	Average	Negligible	Irrelevant
Flounder, plaice	Low	Negligible	Irrelevant
Turbot	Average	Negligible	Irrelevant
Herring	Average	Negligible	Irrelevant
Sprat	Average	Negligible	Irrelevant
Protected species (gobies, common seasnail)	High	Negligible	Insignificant
Salmonids (salmon, sea trout)	Average	Negligible	Irrelevant

Source: internal data

Table 141. The matrix determining the significance of the impact of the Baltica OWF in the construction phase on ichthyofauna

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Ichthyofauna is subject to moderate impact of the investments in the decommissioning phase in the OWF Area due to great significance of a receptor – fish, including protected species – as well as small scale of impact related with noise and vibration emission as well as increased suspended matter concentration, with regard to all evaluated species (cod, flounder, plaice, turbot, herring, sprat, protected species and salmonids) (Table 141).

6.1.4.5.1.4 Marine mammals

On the basis of actions carried out during decommissioning of similar investments, such as drilling and exploitation rigs, it is known that their decommissioning may be related with the use of explosives with a significant range if impact. Generally, the decommissioning phase is related with actions such as drilling, cutting constructional elements, transportation (similar number and types of ships as in the construction phase). Currently we do not have the knowledge about noise generated to the sea deep when cutting elements of an offshore wind farm. There is a collision risk for water crafts, fuel leaks and similar events related with traffic of water crafts used during the decommissioning phase of offshore wind farms which could have a negative impact on marine mammals. With regard to the fact that investment decommissioning phase is similar to the construction phase, its expected performance results will be similar to the construction phase. In this project, the course and schedule of construction works are not yet known, therefore the current assumption is that the decommissioning phase will bring about impacts on marine mammals similar to impacts at the construction phase.

The decommissioning process is a reverse process to the construction, which means that many activities related with decommissioning is similar to construction activities, but it most probably will not require piling or the use of explosives. Decommissioning of the wind power stations and other objects of the Baltica OWF will involve the following activities that cause underwater noise:

- mobilisation of a crane on the ship, a transport pontoon with a tug and a construction ship;
- hooking of a crane to a decommissioned construction;
- cutting cables;
- removal of soil from the foundation to the cutting height;
- cutting the decommissioned construction with a cutting tool at a depth 3 m below the sea level;
- lifting of the decommissioned construction;
- placing the decommissioned construction on the pontoon and fastening it;
- transport to the shore;
- recycling and removal of materials.

From this list, the most probable actions that generate noise which will be subject to assessment are ship traffic (to and from the area as well as during decommissioning works), cutting and drilling (in the construction removal process). There are no data on sound emission when cutting, therefore the main focus is no noise from sailing and drilling from platforms.

Noise from the drilling operation depends mainly on the type of drilling platform. Drill ships are characterized by the highest noise level, while the noise from drilling rigs anchors in the seabed may be low both in at the source level and the frequency level (<1.2 kHz, Richardson et al., 1995). Noise from two drilling ships is presented in the figure (Figure 53). It is considered a worst case scenario for drilling noise; the actual noise level will most probably not exceed these levels. Noise energy from two drill ships is focused mainly in frequencies below 1 kHz, and the impact on background noise in the area will be related with sound of low frequency. Basically, the noise generated during drilling will be added to the local acoustic noise background, which is already dominated by sailing noise.

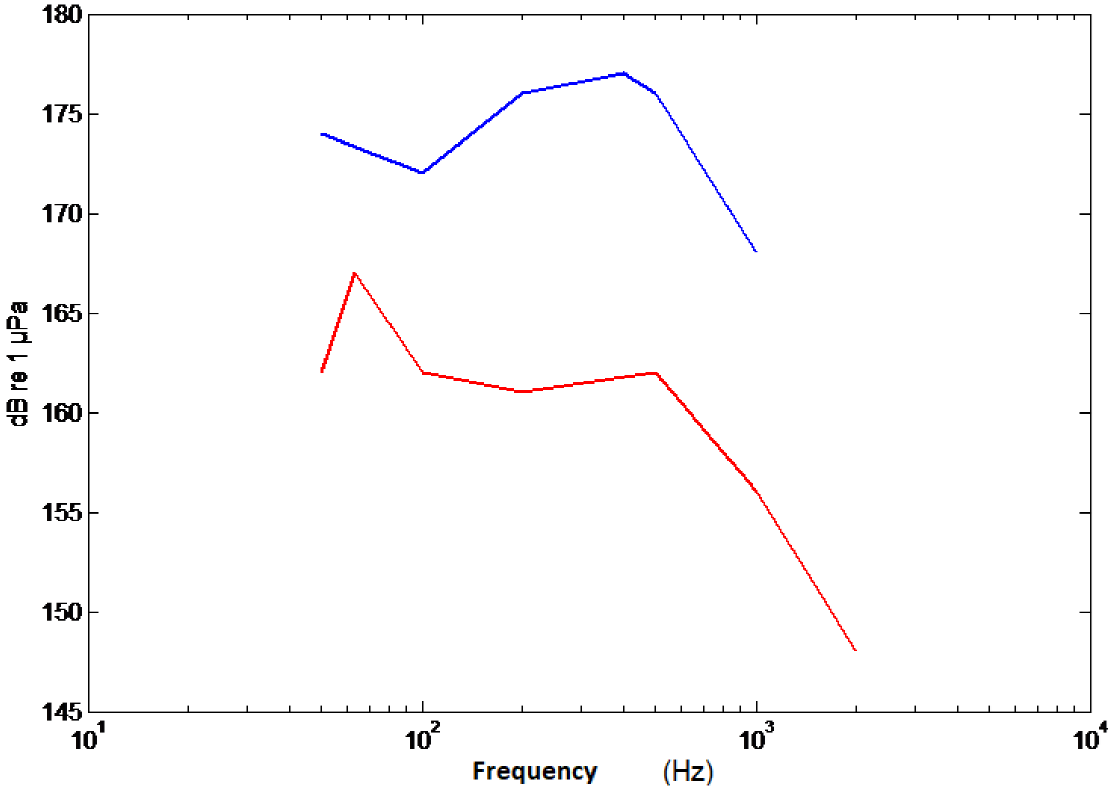


Figure 53. Source levels from two various types of drill ships for 1/3 octave bands

Source: internal materials based on Kepel et al. (1995)

Similarly to the construction phase, small and medium-sized vessels will mainly emit sounds in the range from 160 to 180 dB re 1 µPa at 1 m and will fall in the range from <1 kHz to >10 kHz. Most probably it will lead to the increase of underwater noise level during decommissioning, including frequencies which are partially significant for marine mammals.

Decommissioning of constructional elements will involve actions such as cutting, drilling and sailing. Apart from cutting, for which there is no data regarding noise level, the remaining two operations will only raise the noise level only temporarily and locally, in the scope of low frequencies in the vicinity of the Baltica OWF Area. However, the impact on the underwater noise level would be only local and temporary. Consequently, the significance of noise emitted during decommissioning is negligible for seals and of lesser importance for porpoise.

Tables below (Table 142 and Table 143) compile information about the significance of specific types of impacts in the Baltica OWF decommissioning phase on marine mammals.

Table 142. Analysis of significance of impacts on marine mammals related with actions in the decommissioning phase

Species	Impact	Range	Duration	Intensity	Impact frequency	Reversibility	Impact's scale	Impact's significance
Porpoise Phocoena phocoena	Shipping noise	Local	Short-term	Low	Constant	Reversible	Negligible	Insignificant
	Drilling	Local	Short-term	Low	Constant	Reversible	Negligible	Insignificant
	Collisions of vessels	Regional	Short-term	Average	Single	Irreversible	Negligible	Insignificant
Harbour seal Phoca vitulina and grey seal Halichoerus grypus	Shipping noise	Local	Short-term	Low	Constant	Reversible	Negligible	Irrelevant
	Drilling	Local	Short-term	Low	Constant	Reversible	Negligible	Irrelevant
	Collisions of vessels	Regional	Short-term	Moderate	Single	Irreversible	Negligible	Irrelevant

Source: internal data

Table 143. The matrix determining the significance of the impact of the Baltica OWF in the decommissioning phase on marine mammals

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.4.5.1.5 Seabirds

As the wind power stations are gradually removed, the negative impact involving scaring off birds from the occupied areas by structures protruding high from the water will decrease. The increased traffic of water crafts and helicopters as well as the noise related with disassembly of the power station will still scare birds away. However, it should be expected that after all power stations are removed, this area will draw benthivorous birds (mainly long-tailed duck and velvet scoter) because a formation of zoobenthos communities will take place on the seabed occupied by offshore wind power stations in the exploitation period. Benthivorous birds have a very strong impact on the population of their prey, leading to significant reduction of their abundance and biomass (Guillemette et al., 1996; Lewis et al., 2007). The decrease of bird abundance in the area occupied by power stations during their exploitation will cause high zoobenthos biomass, because their populations will be exploited by birds to a much smaller extent. Most probably this effect will have a periodic character, but it is hard to foresee for how long will the area after the power station remain attractive feeding grounds for this type of birds. Fragments of the OWF Area which will be the most attractive feeding grounds for these birds will include sea areas with depth up to 30 m, because in areas with greater depth these birds are present in a greater dispersion (feeding in shallower areas is more energetically effective for diving benthivorous birds). These areas occupy the surface of 6% of the OWF's built-up area form the Słupsk Bank side and the increased feeding grounds attractiveness is to be expected there.

Table 144. Potential impacts of the Baltica OWF at the decommissioning phase on seabirds

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
Traffic of water crafts and helicopters	Traffic of water crafts and helicopters at the decommissioning phase will scare off birds. The most important parameters that impact the impact scale are the number of decommissioned power stations, the length of cables and related number of used water crafts and helicopters as well as their traffic intensity.
Noise and vibrations emission	Emission of noise and vibrations in the sea area covered with decommissioning works will scare away birds. The most important parameters that impact the impact scale are the number of decommissioned power stations, the length of cables and related number of used water crafts and helicopters.
Lighting of the investment site	Lighting the decommissioning site using a strong light source may draw in nocturnal birds. The most important parameters that impact the impact scale are the number of decommissioned power stations, the length of cables and related site lighting intensity.

Cause or source of the impact	Justification for the choice and the most important parameters and factors influencing the level of impact
Decommissioning of farm objects	Gradual decommissioning of power station and power substation structures will result in disappearance of a barrier that block access to rich benthos communities, which will form in the offshore wind farm area during its exploitation. The most important parameters affecting the impact scale are the number of decommissioned power stations and the associated infrastructure.
Barrier caused by the presence of ships	See the explanation for the construction phase.
Collisions with ships	See the explanation for the construction phase.
Destruction of benthos habitats	Benthos communities formed in a form of artificial reef will be destroyed in the decommissioning phase. The most important parameters affecting the scale of impact are type, dimensions and number of decommissioned foundations and the length of decommissioned cables.
Increase in concentration of suspended solids in the water column	See the explanation for the construction phase.
Re-deposition of disrupted sediments	See the explanation for the construction phase.
Contamination of the sea deep and seabed sediments with oil-derivative substances	See the explanation for the construction phase.
Water column and seabed sediments contamination with antifouling agents	See the explanation for the construction phase.
Water column and seabed sediments contamination with accidentally released municipal waste and domestic waste water	See the explanation for the construction phase.
Contamination of the water column and bottom sediments with accidentally released chemical agents and waste from the farm decommissioning	During wind farm decommissioning, on vessels and in the decommissioning phase support situated on land (in the port that supports investment decommissioning) and at the farm site waste directly related to the decommissioning process will be generated. They can include, among others, damaged parts of disassembled farm elements etc. They can be accidentally released into the sea. Water and bottom sediments contamination may adversely affect the seabirds. The most important factors influencing the level of impact are: • the type and amount of released waste and contaminations, • weather conditions, • type of rock material that make up the seabed, determining the species composition of zoobenthos communities which may be polluted.

Source: internal data based on Meissner, 2015b, 2015c

It was assumed that mid-term impact of the investment at the construction and decommissioning phase will have a similar character in the case of water craft and helicopter traffic, increased noise level, lighting the decommissioning site and disturbances in benthos communities. Specific impact of the decommissioning phase is gradual disappearance of high structures which will result in disappearance of a barrier that blocks access to rich benthos communities, which will form in the offshore wind farm area during its exploitation.

During wind farm decommissioning, the removal of power stations will cause gradual change of bird distribution. After stopping exploitation of the farm and increasing the traffic of water crafts, a more abundant presence of seagulls is expected in this sea area. Benthivorous birds (mainly long-tailed duck) will gain access to a new feeding area and their density will most probably increase in places where power stations will be decommissioned and the ship traffic will stop and the depths will be attractive for these birds. Ichthyovorous species will also return to the area (razorbill, common murre, loons).

Decommissioning of farm objects

The impact of removal of the barrier that blocks access to rich benthos communities, which will form in the offshore wind farm area during its exploitation for most species taken into account was assessed as of little importance or negligible. For common murres this impact was assessed as moderate due to their high protection priority and high sensitivity to offshore wind farms. Loons, however, were very scarce in the OWF Area.

Gradual removal of the OWF structures will be a source of direct or indirect, negative or positive impacts on seabirds with a local, mid-term, reversible, repeatable in the decommissioning period, the intensity of which depends on the species.

The table (Table 145) shows the analysis of the significance of the decommissioning phase impact (in the scope of decommissioning of the Baltica OWF structures) divided into specific seabird species, taking into account the methodical character of disassembly works (decommissioning of the neighbouring power stations), limiting sources of strong light at night (in the scope allowed by separate regulations) and introduction of a ban on entering the Słupsk Bank area for ships that participate in decommissioning of the Baltica OWF between November and April as well as the obligation to carry out works in such a manner that does not scare birds wintering in the Słupsk Bank.

Table 145. Decommissioning of farm objects – analysis of OWF decommissioning phase impact on particular seabird species

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
Long-tailed duck	*Clangula hyemalis*	Average	Average (moderate timidity)	High	High protection priority. High timidity of the species. With the decommissioning of subsequent power stations, the impact will gradually decrease.	Small (scale of exposure – local; duration – mid-term; intensity – high)	Moderate
Velvet scoter	*Melanitta fusca*	Average	High (high timidity)	High	High protection priority. High timidity, but small abundance at the investment site. With the decommissioning of subsequent power stations, the impact will gradually decrease.	Small (scale of exposure – local; duration – mid-term; intensity – high)	Moderate
Razorbill	*Alca torda*	Low	Average (moderate timidity)	Average	Low protection priority, moderately abundant presence of individuals sitting on water in the investment region. With the decommissioning of subsequent power stations, the impact will gradually decrease.	Small (scale of exposure – local; duration – mid-term; intensity – high)	Insignificant
Common murre	*Uria aalge*	Low	Average (moderate timidity)	Average	Low protection priority, moderately abundant presence of individuals sitting on water in the investment region. With the decommissioning of subsequent power stations, the impact will gradually decrease.	Small (scale of exposure – local; duration – mid-term; intensity – high)	Insignificant
European herring gull	*Larus argentatus*	Low	Average (low timidity)	Low	A common species with a low protection priority. Low timidity of the species They gather at the open sea near ships and structures protruding from the water, which provide a resting place for seagulls.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Common gull	*Larus canus*	Low	Average (low timidity)	Low	Waterbirds rarely encountered at sea away from the coast. Species with relatively low abundance in the OWF Area. Low timidity of the species.	Negligible (scale of exposure – local; duration – mid-term; intensity –	Irrelevant

Species	Binomial nomenclature	Sensitivity of the resource (acc. to the SSI)	Impact susceptibility	Importance of the resource	Justification for the impact assessment	Impact's scale	Impact's significance
						average)	
Little gull	*Hydrocoloeus minutus*	Low	Average (low timidity)	High	High protection priority, but rarely seen (most often birds in flight) at the investment site. Presence of ships may cause more abundant presence of birds in this area.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Insignificant
Lesser black-backed gull	*Larus fuscus*	Low	Average (low timidity)	Low	A widespread species with a low protection priority. Accompanies fishing cutters in sea areas.	Negligible (scale of exposure – local; duration – mid-term; intensity – average)	Irrelevant
Black-throated loon	*Gavia arctica*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area. With the removal of subsequent power stations, the impact will gradually decrease.	Low (scale of exposure – local; duration – mid-term; intensity – high)	Moderate
Red-throated loon	*Gavia stellata*	High	High (high timidity)	High	High protection priority and high timidity, but very rarely encountered in the surveyed sea area. With the removal of subsequent power stations, the impact will gradually decrease.	Low (scale of exposure – local; duration – mid-term; intensity – high)	Moderate

Source: internal data

Significance of the Baltica OWF at the decommissioning phase in relation to seabirds reflects the significance of such an impact for long-tailed duck *Clangula hyemalis*, which was the most often observed species in the OWF Area and which suffers the highest impact of the OWF at the decommissioning phase among seabird species analysed in this report. Long-tailed duck has an average sensitivity for the OWF impacts. The scale of impact of water crafts and helicopters that carry out disassembly works related with scaring birds away and forcing birds out of their habitats was assessed as average for the Applicant's variant, such as in the case of the OWF construction. With regard to the above and in accordance with the method of assessment assumed in this Report, the significance of the Baltica OWF in the Applicant's variant at decommissioning phase was assessed as moderate with relation to seabirds. The significance of the OWF impact on the long-tailed duck, specific for the decommissioning phase (decommissioning of farm structures) was assessed as moderate (small scale of impact, average value of the resource). The impact of the Baltica OWF decommissioning phase on seabirds form other species will be no greater than in the case of long-tailed duck.

6.1.4.5.1.6 Migratory birds

In the decommissioning phase of the Baltica OWF, the impacts on migratory birds are expected to be similar to the ones expected at its construction phase. Because the course of decommissioning works is not yet known, the number of units involved in this, the order of removal of the OWF elements, the significance of impacts was considered to be the same as in the construction phase. Therefore, the information included in the chapter on assessment of impacts of the Baltica OWF construction phase will not be repeated here.

Table 146. The significance of impacts related with the offshore wind farm decommissioning phase on migratory birds travelling via the Baltica OWF Area

Species	Impact	Spatial scale of impact	Duration	Intensity	Impact frequency	Impact reversibility	Impact's scale	Impact's significance
All significant migratory bird species listed in chapter 3.7.1.5.1 (Table 27) of **high** significance	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Insignificant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Insignificant
All significant migratory bird species listed in chapter 3.7.1.5.1 (Table 27) of **medium** significance	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Irrelevant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Irrelevant
All significant migratory bird species listed in chapter 3.7.1.5.1 (Table 27) of **low** significance	Ship barrier	Local	Short-term	Low	Recurrent	Reversible	Negligible	Irrelevant
	Collisions with ships	Local	Short-term	Low	Recurrent	Irreversible	Negligible	Irrelevant

Source: internal data

Table 147. The matrix determining the significance of the impact of the Baltica OWF at the decommissioning phase on migratory birds

Impact's significance		Resource value/significance		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Presence of ships in the decommissioning phase may generate a barrier effect, forcing the change of flight trajectory during migration. The majority of impact will depend on the number of units, their size, season and duration of the decommissioning phase. Migratory waterbirds which are sensitive to disturbances generated by ships will avoid the barrier by changing their flight direction, which may make the route of a specific bird slightly longer, which will in turn increase the energetic cost related with the trip. The change of flight trajectory will concern only a small part of route and the increased energetic cost will be negligible, as it was estimated for the case of common eider by Masden et al. (2009), and for other species for which the modelling was carried out in this Report. Therefore, the significance of the barrier effect at the decommissioning phase in the Baltica OWF Area was considered negligible (for species with low and average significance) and of little importance (for species with high significance).

Collisions between birds and ships are not ruled out, particularly at night when birds are drawn to the lighting of the construction and units. The collision risk will depend on the number of units involved in the decommissioning phase, their size, lighting, season and duration of this phase. In poor weather conditions or at night, migratory birds, especially terrestrial birds, may be attracted by the lights mounted on the vessels. The probability of collision with ships is not researched well and currently it is not possible to present this phenomenon in a quantitative manner, but it was documented that similarly to onshore elements, phenomena occasionally collide with structures erected offshore (Blew, 2013). Additionally, at nights, when the weather is unfavourable, migratory birds may be attracted by lights installed on the wind power stations. Collisions of waterbirds with ships at night were documented at the south-western shores of Greenland and were indeed related with bad visibility (Merkel and Johansen, 2011). In the case of birds being drawn to light it seems that the degree of collisions is not related with the water craft sizes. Nevertheless, the knowledge obtained so far on the subject does not suggest that collisions with ships decommissioning the OWF are a serious problem and are a source of a large impact. Therefore, the impacts of collisions with ships will concern only single cases during bad weather with low visibility, on a small area. Therefore, the impact significance of collisions with ships will be considered negligible (for species with low and average significance) and of little importance (for species with high significance) and the impact of the entire investment at the decommissioning phase is presented in table (Table 147).

6.1.4.5.1.7 Bats

At the phase of decommissioning of the Baltica OWF, bats may be impacted by:

- physical removal of investment elements from the area of the project;
- storage and utilization of removed elements of the wind farm;
- presence of sailing vessels taking part in decommissioning of the farm.

Physical removal of the Baltica OWF elements and presence of sailing vessels can potentially impact bats through an increased traffic of ships and noise emission. The mentioned activities may impact bats in a scope shown in sections 6.1.1.4.1.7 and 6.1.2.5.1.7.

The increased traffic of water crafts may be a factor that increases activity of bats by increasing occurrence of clusters of insects in the area of carried out works at favourable weather conditions (Poerink et al.,2013; Ahlén, 2003). Additionally, moving ships may also be used as hideaways or stops on the flight paths due to, *inter alia*, the above-mentioned proximity of the food base (Ahlen et al., 2007, 2009; Rydell et al., 2012). The above-mentioned activities can, as a result, expose bats to collisions with ships or disassembled parts of offshore wind farm. Additionally, the decommissioning phase of the wind farm may involve emission of ultrasounds, which just like at the phase of construction, can form a barrier effect (European Commission, 2011).

Activities in the decommissioning phase involve physical removal of the OWF elements and refer mainly to works carried out over and under the surface of water. The above-mentioned activities, similarly to the construction phase, are related with increased traffic of water crafts in the OWF Area. In case of favourable weather conditions, there may be a concentration of food supply around decommissioned elements on the sea surface as well as vessel units, which may give the possibility of feeding.

The presented impacts will be negative, direct and indirect, simple, instantaneous, reversible and local. The scale of impact of the OWF decommissioning is assessed as negligible, and the significance of impact as of small importance (Table 148) analogously to the construction phase.

Table 148. The matrix determining the greatest significance of the impact of the Baltica OWF in the decommissioning phase on avifauna

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.4.5.2 Impact on protected areas

6.1.4.5.2.1 Impact on protected areas other than Natura 2000

Due to significant distance of the Baltica OWF from the protected area of the Słowiński National Park, similarly to the construction and exploitation phase, in the decommissioning phase there are no significant impacts on this area, including any element for which it was established to protect, that is biodiversity, resources, creations and components of inanimate nature as well as landscape values of the Park.

Attachment to the Regulation of the Minister of Environment no 31 of 16 February 2017 on protective tasks for the Słowiński National Park (Journal of Laws MoE 2017. 10, item 31), where the existing and potential internal and external hazards were identified and assessed as well as methods of elimination or limitation of these hazards and their results, also indicated the hazard resulting from increasing areas for wind farms in communes adjacent to the Park in the category of existing external hazards. In the category of potential external hazards it was indicated that only the creation of wind farms in the Park prospective is a potential external hazard, therefore it should be decided that the Baltica OWF will not be a hazard to the Słowiński National Park.

6.1.4.5.2.2 Impact on the Natura 2000 protected areas

Identification and assessment of impact on protected areas within the framework of the Natura 2000 ecological network was presented in section 6.3.

6.1.4.5.3 Impact on ecological corridors

The issue of ecological corridors was described in section 6.1.1.4.3.

As regarding seabirds, the impact of the process of OWF decommissioning will exert a reverse impact as compared with the construction phase. Along with removal of subsequent construction elements from the area, the possibility of bird migration will be more and more unconstrained.

6.1.4.5.4 Impact on biological diversity

Along with the process of subsea constructions removal in the phase of OWF decommissioning, periphyton communities present on them will be damaged. The works will result to disturbance of balance and a decrease of biodiversity compared to the diversity in the exploitation phase.

As regarding seabirds, the impact of the process of OWF decommissioning on biodiversity will be close to this impact at the OWF construction phase. After removal of farm objects, the diversity of seabird species and their abundance in the Baltica OWF Area will increase due to disappearance of the effects of scaring them and forcing out of their habitats as well as the barrier effect created by wind power stations.

The significance of the investment impact at the decommissioning phase on biodiversity is of little importance, because the biodiversity is a resource with a large significance, and the scale of impacts is negligible – local impacts in the Baltic Sea scale.

6.1.4.6 The impact on cultural amenities, monuments and archaeological objects and sites

As no objects of cultural amenities, monuments or archaeological sites have been detected in the Baltica OWF Area, no impact is anticipated to occur.

6.1.4.7 Impact on use and development of sea area as well as tangible goods

It is assumed that the moment the decommissioning of the Baltica OWF starts, the part of the investment area where decommissioning activities take place will be excluded from the possibility of catches.

The impacts anticipated at the stage of decommissioning will be:

- negative (restricting or prohibiting the possibility of catches);
- direct (following from restricting the possibility of catches);
- cumulated (given the other wind farms planned in a close neighbourhood);
- long-term (given the duration of the OWF decommissioning process),
- constant (impact exerted over a long time, fishing areas closed upon the end of the decommissioning phase);
- local (impact solely in the OWF Area and the buffer zone).

The estimated amount and value of catches in the Baltica OWF Area, calculated proportionally to the size of the area which will be occupied by the OWF (along with the buffer zone of a maximum width 500 m, as a maximum safety zone allowed to be set out by marine administration in the given square) with regard to the total amount of the Baltic Sea catches in 2012–2016 equalled 0.2% and 0.4% respectively (212 Mg and 780 thousands PLN). In the Baltica OWF Area mostly cod and flounder is caught, that is species caught commonly also in areas outside the planned OWF Area. Therefore, the **value of the resource will be considered low.**

Impact resistance

Resistance to impact is average – fishing vessels have a possibility of changing fishing areas, but it will involve the risk of lowering fish catch efficiencies and lengthening the way to the fishing areas.

Table 149. The matrix determining the significance of the impact of the Baltica OWF at the decommissioning phase on fishery

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Fishery is subject to an negligible impact of the investment at the decommissioning phase in the Baltica OWF Area due to small significance of the resource and small scale of impact (Table 149).

6.1.4.8 Impact on the landscape, including the cultural landscape

The impact of the OWF in the Baltica OWF decommissioning phase will be close to impacts at the construction phase, but it will take place in a reversed order. First, the objects and systems will be disassembled, then received by ships and transported onshore. Impacts on the environment in this phase will decrease as the decommissioning works progresses.

Depending on the assumed foundation technology, there may be a need to leave parts of structures under water, e.g. because they create an artificial reef. In such a case, they will be secured properly and marked for security purposes. After total decommissioning of the OWF, the landscape on the sea surface in the OWF are will return to the condition from before the implementation of the investment, but there may be a permanent change of underground landscape which will be visible only for divers as well as underwater vessels manned or equipped with cameras that make it possible to observe is on a current basis, or replay later on. such places may also become tourist attractions.

Table 150. The matrix determining the significance of the impact of the Baltica OWF in the decommissioning phase on the landscape, including the cultural landscape

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.1.4.9 Impact on people, health and living conditions of humans

Decommissioning of the OWF in marine conditions will be a very complex, long-term task with a heightened risk for water crafts that carry out disassembly of offshore wind power stations and for other users of sea areas. It should be expected, that in the period when the OWF decommissioning will be needed, the navigation intensity will be much greater than the current one in the OWF Area, and the number of additional cruises of technical water crafts of various size participating in decommissioning of wind power stations and other objects of the Baltica OWF will be close to the number of ones participating in construction, that is approx. 800 cruises annually.

At the same time it should be stressed that the routes of these additional cruises of technical water crafts dedicated to decommissioning of OWF moving between the Baltica OWF and small ports of the middle shore and the Tricity ports will cross the routes of water crafts travelling along shipping routes of the Southern Baltic.

Similarly to construction, the fishing activity will be limited in parts of fishing squares L8, M8, N8, M7 and N7.

Also, emergency response in the case of emergency events with participation of water crafts will be limited to rescue actions or combating oil contaminations.

The significance of the impact of the Baltica OWF at decommissioning phase on population, health and quality of life of humans was assessed as negligible, despite the high significance of the resource itself. It results from the fact that at decommissioning phase all sea users will be acquainted with limitations related with the presence of the Baltica OWF and its gradual decommissioning will only increase the availability of the Baltica OWF sea area to other forms of usage.

6.2 Alternative variant (rational)

Presented below is the environmental impact assessment of the Baltica OWF in the rational alternative variant at all investment phases. In the case the impact assessment (or the significance of impact) remains the same as the one for the Applicant’s variant, this fact is found out and the possible differences between variants are indicated.

6.2.1 Construction phase

6.2.1.1 Impact on geological structure, seabed sediments, access to resources and deposits

Differences between the Applicant’s variant and the rational alternative variant are negligible in the scope of geological issues. The assessment of the significance of impact of wind power stations in the OWF Area in the Applicant’s variant on the seabed is identical with the assessment in the rational alternative variant. Changes in the seabed related with the impact of the investment have a local character and in the scale of the entire area occupied for the investment it is negligible for the general character of the seabed and its structure. The impact amplitude is greater in the rational alternative variant due to greater occupation of the seabed for foundations and potentially a greater volume of works related with transportation of the sediment.

6.2.1.2 Impact on marine waters and the quality of marine waters and seabed sediments

Impact on marine waters and the quality of marine waters and seabed sediments in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant’s variant. The impact amplitude is greater in the rational alternative variant, because a greater number of structures cause higher water craft traffic and a larger number of operations at construction works. The volume of potential works related with transportation of sediments also increases. The basic potential parameters of the rational alternative variant are presented below in the scope of agitated sediment and possibly the pollutions load released in to sea deep.

In the rational alternative variant, using gravity based foundations, the removed sediment layer has a depth up to 3 m and a diameter of 65 m (35 m of the foundation diameter + 15 m belt from its boundary), which totals to a maximum of 205,884 m^3 of agitated sediment in the form of suspended matter (Appendix 3).

In the case of considered foundation technologies – large-diameter piles– the volume of agitated sediment will be much lower. It results from the fact that in most cases they do not require seabed preparations and also that the diameter of driven foundation piles will be many times smaller than the diameter of a gravity based foundation. The sediment around the driven in piles will be agitated due to vibration caused by the operation of a jackhammer. In case of driving a single large-diameter pile with a diameter of 7 m (the **rational alternative variant**) the amount of sediment which will be agitated equals approx. 42 m^3.

Additionally, regardless of the selected foundation type, sediment will be agitated while laying the cable. The width of a cable trench is approximately 3 m, the average depth – up to 3 m and the length – up to 638 km, which in total gives 316,958 Mg of sediment in the form of suspended matter for the entire internal cable network) (Appendix 3).

Taking into account the content of pollutions and nutrients in the seabed sediment in the OWF Area as well as possibility of their movement into sea deep (section 3.2.2), as well as the volume of sediment which may be resuspended as a result of foundation construction and laying cable, the estimates of emissions of metal, nutrients and organic pollutions into the sea deep which may take place in the Investor's variant as a result of construction of a maximum of 319 wind power station foundations and up to 25 of other foundations as well as placing 638 km of cable inside the OWF Area (Table 151). The calculations assume an average bulk density of the sediment of 1.8 g·cm^{-3} (1800 kg·m^{-3}) and an average humidity of sediment in the amount of 20.13%.

Table 151. Comparison of contaminants and nutrients mass, which can potentially be released into the sea deep during construction of the OWF (construction phase, rational alternative variant maximum number of foundations) with the load brought by the Baltic Sea via rivers and wet precipitation

Parameter	**Alternative variant (rational) (334 foundations)**	**Power cables (638 km)**	**Annual load launched with the rivers into the Baltic Sea**	**Annual load launched with wet precipitation into the Baltic Sea**
The volume of agitated sediment [m^3]	205,884	176,088	No data available	No data available
The weight of agitated sediment [Mg]	370,592	316,958	No data available	No data available
Dry weight of agitated sediment [Mg]	296,472	253,567	No data available	No data available
Lead (Pb) [kg]	889	761	50,000	200,000
Copper (Cu) [kg]	252	216	100,000	No data available
Zinc (Zn) [kg]	1512	1293	No data available	No data available
Nickel (Ni) [kg]	288	246	No data available	No data available
Chromium (Cr) [kg]	356	304	700,000	No data available
Cadmium (Cd) [kg]	Concentration in the sediments in the OWF Area below the bottom limit of quantification		No data available	7
Mercury (Hg) [Mg]	Concentration in the sediments in the OWF Area below the bottom limit of quantification		No data available	3
Congeners from the PCB group [g]	0.14-1.18	0.13-1.09	715,000	260,000

Parameter	Alternative variant (rational) (334 foundations)	Power cables (638 km)	Annual load launched with the rivers into the Baltic Sea	Annual load launched with wet precipitation into the Baltic Sea
Analytes from the PAHs group [g]	171.96	147.07	No data available	No data available
Assimilable phosphorus (P) [Mg]	19.04	16.28	12,000 (P tot)	No data available

Source: internal data

6.2.1.3 The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

The significance of the Baltica OWF impact at the construction phase in the rational alternative variant on climate and air quality remains the same as in the Applicant’s variant. Higher impact amplitude should be expected, because in order to construct a larger number of offshore wind power stations a higher number of operations of water crafts will be needed, and therefore the number of fuel used during construction will be greater.

6.2.1.4 Impact on nature and protected areas

6.2.1.4.1 Impact on biotic elements in the sea area

The significance of the impact on phytobenthos, zoobenthos, marine ichthyofauna, marine mammals and bats at the construction phase of the rational alternative variant will be the same as in the case of the Applicant’s variant, but the impact intensity may differ. However, these differences will not be large enough to change the significance of the impact.

6.2.1.4.1.1 Migratory birds

Despite differences between the Applicant’s variant and the rational alternative variant, the analyses of impact on migratory birds have shown that impacts will be the same, while the raw result – the number of birds that participate in collisions – differs (but give the same assessment of impact significance).

The numbers of collisions differ between variants and the greatest role is played by the number of offshore wind power stations and the size of the clearance, directly related with the height of the entire wind power station. In a broad approach, the numbers of collisions would be higher for the alternative variant, due to the greater number of offshore wind power stations planned in this variant (110 more than in the Applicant’s variant). The variants were considered for various amounts of clearance between the water table and the bottom position of blades. The modelling results shown that the lowest offshore wind farms (with the smallest clearance) in the alternative variant contribute to the death of the largest number of waterbirds, mainly ones flying at low altitudes. The highest offshore wind power stations (with the highest clearance) are more hazardous for land birds such as cranes, which fly at a much higher altitude. At is was stressed before, the collision risk in the case of cranes must be treated conservatively, due to lack of information on the behaviour of this species. The selection of a variant and height of offshore wind power stations must be concerned primarily with the impact on of species of the highest significance. The main conclusion from this Report is the significance of impacts on all species taken into account in the assessment, which is of small importance or negligible.

6.2.1.4.1.2 Seabirds

The impact of both analysed investment variants (Applicant's variant, rational alternative variant) on seabirds is comparable to negligibly greater negative impact of the rational alternative variant compared to the Applicant's variant.

Traffic of water crafts and helicopters

Both of the analysed variants differ with respect to the number of power stations, which will possibly influence the length of the period of farm construction and decommissioning, and as a consequence, the length of the period of an increased water craft and helicopter traffic. The variant choice will not influence the scope and significance of the investment impact on seabirds since in the case of all of the considered variants the increased water craft and helicopter traffic scares birds away from the place where the works are carried out. That is why the section on the Applicant's variant contains a joint assessment of both of the analysed variants of the planned wind power station.

Noise and vibrations emission

Both of the analysed variants differ with respect to the number of power stations, which will possibly influence the length of the period of farm construction and decommissioning, and as a consequence, the length of the period of an increased level of noise and vibration. The variant choice will not influence the scope and significance of the investment impact on seabirds since in the case of all of the considered variants the increased level of noise and vibration scares birds away from the place where the works are carried out. That is why the section on the Applicant's variant contains a joint assessment of both of the analysed variants of the planned wind power station. This applies to impacts related with:

- lighting of the investment site;
- creation of a barrier for birds (caused by the presence of power stations);
- creation of a barriers for birds (caused by the presence of ships);
- collisions with vessels;
- destruction of benthos habitats;
- increase of suspended matter concentration in the water;
- deposition of agitated sediment.

6.2.1.4.2 Impact on protected areas

Impact on protected areas, including the Natura 2000 sites and the continuity of ecological corridors, in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.4.3 Impact on ecological corridors

Impact on ecological corridors of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.4.4 Impact on biological diversity

Impact on biological diversity in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.5 The impact on cultural amenities, monuments and archaeological objects and sites

Impact on cultural qualities, monuments and archaeological sites and objects in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.6 Impact on use and development of sea area as well as tangible goods

Impact on use and development of sea area as well as tangible goods in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.7 Impact on the landscape, including the cultural landscape

Impact on the landscape, including the cultural landscape, in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.1.8 Impact on people, health and living conditions of humans

Impact on people, health and living conditions of humans in the construction phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2 Exploitation phase

6.2.2.1 Impact on geological structure, seabed sediments, access to resources and deposits

Impact on geological structure, seabed sediments, access to resources and deposits in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.2 Impact on marine waters and the quality of marine waters and seabed sediments

Impact on marine waters and the quality of marine waters and seabed sediments in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant. The impact amplitude may differ (be greater for the rational alternative variant) due to a greater volume of works related with maintenance operations and potentially bigger release of anti-corrosion protection substances to the environment. Both differences result from a greater number of constructions in the Baltica OWF Area.

6.2.2.3 The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition) in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.4 Impact on systems that use PEM

Impact on systems that use PEM in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant. The intensity of impacts may be greater, which is related with a greater number of wind power stations in use. Given the requirement of agreeing upon the impact on radar, communication and radiolocation systems with relevant administrative bodies, this impact will be diminished to the level acceptable by the users of the systems of such a type.

6.2.2.5 Impact on nature and protected areas

6.2.2.5.1 Impact on biotic elements in the sea area

Impact on phytobenthos, zoobenthos, marine ichthyofauna, marine mammals, migratory birds and bats in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.5.1.1 Seabirds

Traffic of water crafts and helicopters

Two analysed variants of the Baltica OWF differ with respect to the number of power stations, which will possibly influence the number and the duration of servicing vessels appearing in the farm area. The variant selection has no significant impact on the size and significance of the investment impact on seabirds. However, the predominant behaviour is that birds avoid the area occupied by wind power stations which results in their drop of abundance in radius up to 2 and sometimes even to 4 km from the OWF (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011). 2011). Therefore, it is assumed that the selection of a variant will not have a significant impact on the magnitude and significance of this impact and in the section on the Applicant's variant contain a joint assessment of both of the analysed variants of the planned wind power station.

Scaring off and forcing out birds of the habitats

Scaring off and forcing out from habitats caused by the presence of structures above ground will be the same for both considered variants, because despite a different number of power stations they will occupy the same area. The current state of knowledge does not make it possible to determine the differences in impact involving forcing out of the habitat depending on the size of offshore wind power stations, their density and distribution. That is why the section on the Applicant's variant contains a joint assessment of both of the analysed variants of the planned wind power station.

Creation of a mechanical barrier

Given the lack of detailed information on behavioural reactions of seabirds to the presence of wind farms, the effects of both of the considered variants (variant chosen for implementation and rational alternative variant) are regarded as the same. That is why the section on the Applicant's variant contains a joint assessment of both of the analysed variants of the planned wind power station.

Collisions with power stations

In the Applicant's variant, roughly 35% less powers stations will be built than in the rational alternative variant. Thus the impact of the Baltica OWF on seabirds with respect to possible collisions will be proportionally bigger. However, given the small risk of seabird collisions with power stations caused by scaring them away of the OWF Area, the section regarding the Applicant's variant contain a joint assessment of both of the analysed variants of the planned wind power station.

The creation of "artificial reef"

In the Applicant's variant, roughly 35% less powers stations will be built than in the rational alternative variant. Therefore the impact of the Baltica OWF on seabirds with respect to the artificial reef will be proportionally bigger. Given the negligible significance of this impact on nearly all of the analysed seabird species (little significance for only black-throated loons and red-throated loons, the populations of which were scarce in the OWF Area), the section regarding the Applicant's variant contain a joint assessment of both of the analysed variants of the planned wind power station.

The creation of a closed sea area

The most important parameters affecting the scale of impact are the surface of the sea area occupied by the farm, the number of wind power stations and their distribution. This impact will be the same regardless of the chosen variant of the investment, since despite a different number of planned wind power stations in the analysed variants, the surface area of OWF is the same.

6.2.2.5.2 Impact on protected areas

Impact on protected areas, including the Natura 2000 sites and the continuity of ecological corridors, in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.5.3 Impact on ecological corridors

Impact on ecological corridors of the rational alternative variant will be the same at the exploitation phase as in the case of the Applicant's variant.

6.2.2.5.4 Impact on biological diversity

Impact on biological diversity in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.6 The impact on cultural amenities, monuments and archaeological objects and sites

Impact on cultural qualities, monuments and archaeological sites and objects in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.7 Impact on use and development of sea area as well as tangible goods

Impact on use and development of sea area as well as tangible goods in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.8 Impact on the landscape, including the cultural landscape

Impact on the landscape, including the cultural landscape, in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.2.9 Impact on population, health and living conditions of humans

Impact on people, health and living conditions of humans in the exploitation phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.3 Overlapping of the construction and exploitation phases

The significance of impacts of the overlapping phases of construction and exploitation for the rational alternative variant will be the same as in the Applicant's variant, although slightly bigger impact scale – for example the size of the covered seabed – given the greater number of constructions and installations than in the Investor's variant. Also the vessel traffic will be busier.

6.2.4 Impact in the phase of closing and decommissioning

6.2.4.1 Impact on geological structure, seabed sediments, access to resources and deposits

Differences between the Applicant's variant and the rational alternative variant are negligible in the scope of geological issues. The significance of impact of wind power stations in the OWF Area in the Investor's variant on the seabed is identical with the assessment in the rational alternative variant. Changes in the seabed related with the impact of the investment have a local character and in the scale of the entire area occupied for the investment it is negligible for the general character of the seabed and its structure.

6.2.4.2 Impact on marine waters and the quality of marine waters and seabed sediments

Impact on marine waters and the quality of marine waters and seabed sediments in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.3 The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition)

The climate impact, including emissions of greenhouse gases and impacts significant from the point of view of adjustment to the climate change, impact on atmospheric air (air purity condition) in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.4 Impact on nature and protected areas

6.2.4.4.1 Impact on biotic elements in the sea area

Impact on phytobenthos, zoobenthos, marine ichthyofauna, marine mammals, migratory birds and bats in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.4.1.1 Seabirds

The impact of both analysed investment variants (Applicant's variant, rational alternative variant) on seabirds is comparable to negligibly greater negative impact of the rational alternative variant compared to the Applicant's variant.

The majority of OWF impacts in the decommissioning phase are the same as in the OWF construction phase, hence this is where they are evaluated. Specific impact of the decommissioning phase is gradual removal of high structures which will result in removal of a barrier that blocks access to rich benthos communities, which will form in the offshore wind farm area during its exploitation. The significance of this impact for most assessed species has been determined to be of little importance or negligible. It is solely for common murres that this impact was assessed as moderate due to their high protection priority and high sensitivity to offshore wind farms. Loons, however, were very scarce in the Baltica OWF Area. The impact will be similar in both of the analysed variants since birds are scared away from an area of a similar size in each case. However, the predominant behaviour is that birds avoid the area occupied by wind power stations which results in their drop of abundance in radius up to 2 and to a lesser extent, even to 4 km from the OWF (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011). That is why the section on the Applicant's variant contains a joint assessment of both of the analysed variants of the planned wind power station.

6.2.4.4.2 Impact on protected areas

Impact on protected areas, including the Natura 2000 sites and the continuity of ecological corridors, in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.4.3 Impact on ecological corridors

Impact on ecological corridors of the rational alternative variant will be the same at the decommissioning phase as in the case of the Applicant's variant.

6.2.4.4.4 Impact on biological diversity

Impact on biological diversity in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.5 The impact on cultural amenities, monuments and archaeological objects and sites

Impact on cultural qualities, monuments and archaeological sites and objects in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.6 Impact on use and development of sea area as well as tangible goods

Impact on use and development of sea area as well as tangible goods in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.7 Impact on the landscape, including the cultural landscape

Impact on the landscape, including the cultural landscape, in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.2.4.8 Impact on people, health and living conditions of humans

Impact on people, health and living conditions of humans in the decommissioning phase of the rational alternative variant will be the same as in the case of the Applicant's variant.

6.3 Impact assessment on the Natura 2000 sites

6.3.1 Initial assessment

The general aim of protecting the Natura 2000 sites is to maintain or restore the conservation status of the species and natural habitats (of the protected species) for the protection of which they have been designated.

The proposed project, the Baltica OWF, is not directly related or necessary to the management of the Natura 2000 sites, hence the need for an impact assessment on the Natura 2000 sites.

The description and characteristics of the proposed project are presented in section 2.

The key element of the initial impact assessment of the OWF on the areas of the Natura 2000 ecological network is to find out whether the particular Natura 2000 site is within the range of the Baltica OWF's interactions.

The Baltica OWF Area is located outside the Natura 2000 sites. The location of the Baltica OWF Area in relation to the Natura 2000 sites is presented in the figure (Figure 54).

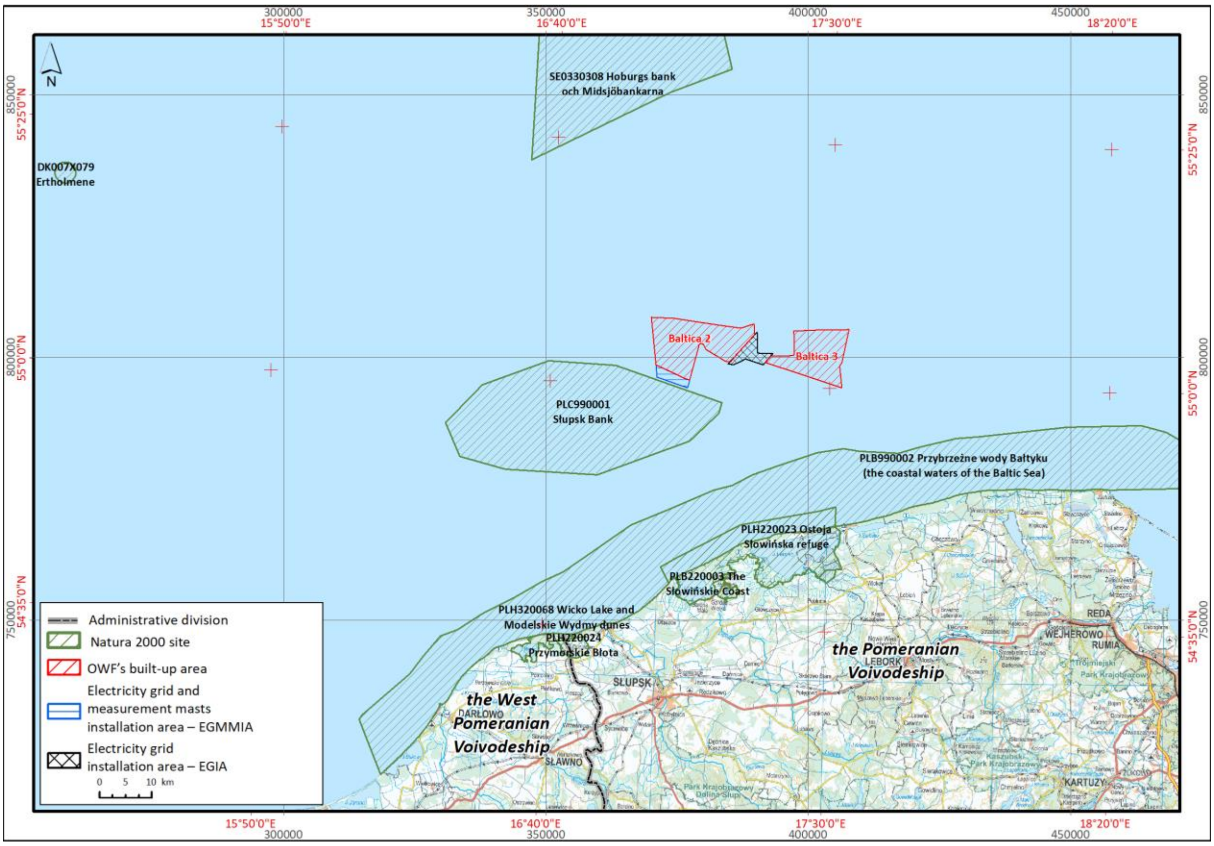


Figure 54. The areas of the Natura 2000 ecological network near the Baltica OWF Area

Source: internal data

The distances between the Natura 2000 sites and the Baltica OWF Area and the list of the protected species occurring in these areas have been presented in the table (Table 152).

Table 152. Marine or coastal areas of the Natura 2000 ecological network closest to the Baltica OWF

Code of the area	Name of the area	Minimum distances to the Natura 2000 site's border [km]		Codes of protected species in the potentially affected area		
		The Baltica 2 Area	The Baltica 3 Area	Marine habitats	Marine biota species	Bird species
SE0330308	Hoburgs bank och Midsjöbankarna	36.968	50.761	1110, 1170	1351	A063, A064, A202
PLC990001	The Słupsk Bank	0.513	10.227	1110, 1170	–	A064, A202
PLB990002	*Przybrzeżne wody Bałtyku* (The coastal waters of the Baltic Sea)	20.103	11.609	–	–	A064, A065, A066, A184, A200, A202
PLH220023	Ostoja Słowińska (The Słowińska reserve)	27.972	22.767	1170	1095, 1096, 1099, 1103, 1134, 1351, 1364, 1831, 2522	–
DK007X079	Ertholmene	113.103	133.599	1170	1364	A199, A200

Source: internal data

6.3.1.1 Determining the impact range of the project

6.3.1.1.1 Assumptions and methodology for determining impact ranges

The identification and assessment of impacts on particular elements of the environment are presented in chapters 6.1 and 6.2. Interactions that may extend beyond the Baltica OWF Area in at least one of the three phases of the project include:

- the increase in the suspension concentration in the water resulting from the works disturbing the seabed sediments and the sedimentation of the suspended solids resulting from the increase in the suspension concentration;
- underwater noise emission resulting from the specificity of the construction work performed, including the highest intensity in the case of piling foundations;
- space disturbance resulting from the construction of wind power stations, the presence of ships and lighting, which may have a significant impact on the protected species in the areas of the Słupsk Bank site (PLC990001) and *Przybrzeżne wody Bałtyku* site (Coastal waters of the Baltic Sea) (PLB990002) as well as the integrity of the area of *Przybrzeżne wody Bałtyku* (PLB990002) and the coherence of the Natura 2000 network.

The following assumptions have been made when determining the impact range of the increase in suspended solids concentration in the water and the resulting sedimentation:

- the maximum range of the suspension of 4 mg dm^{-1} concentration is 5 km from its origin;
- the maximum area of sedimentation of the suspended solids of 1.5 mm thickness is 2 km.

The effects of the suspended solids increase on biotic components have been described in section 6.1.4.5 and 6.2.1.4. The literature data indicating what values of the suspended solids concentration may have significant impact is available only in the case of eggs and juvenile fish. The values indicated therein, from which a significant negative impacts on the described organisms occur, range from 10–12 mg dm^{-1}, and the avoidance reactions have been observed at concentrations of 3–5 mg dm^{-1}. Hence, using the precautionary approach, it was assumed that the boundary for the significant impact was an increase in the suspended solids concentration of up to 4 mg dm^{-1}.

The destruction of benthic organisms could indirectly affect the deterioration of the bird's food supply. To determine the extent of the significant impact of the suspended solids sedimentation, a value of 1.5 mm of the deposited sediment was adopted cautiously, assuming that dissolved oxygen in the process of diffusion reaches up to 2 mm within the sediment's depth (Hinchey et al., 2006).

A detailed methodology for determining the extent of the impact of cumulative underwater noise generated by piling with the use of the noise reduction system is described in the Appendix 2 to the EIA Report.

The noise reduction system, which is an integral part of the project during the construction stage, aims to reduce the underwater noise to such an extent that it is negligible for marine organisms, i.e. it does not exceed the TTS values at the Natura 2000 sites boundaries in which these organisms are being protected.

In the case of determining the impact range of the underwater noise on particular species or groups of organisms, three ranges have been indicated:

- the PTS impact range, i.e. permanent shift of the auditory threshold in organisms;
- the TTS impact range, i.e. temporary shift of the auditory threshold in organisms;
- the range of behavioural responses of organisms.

The value of TTS has been adopted as the boundary of the significant impact of the underwater noise on organisms. In the case of the behavioural responses of organisms to the underwater noise, its effect is discontinuous, short-lived and does not cause significant changes in the organisms' behaviour. The impacts of the underwater noise on fish and marine mammals, including the values of the individual noise response thresholds, have been presented in the section 6.1.

In the case of the birds wintering within the Słupsk Bank site (PLC990001), a value of 117 dB was adopted as the level of behavioural responses, which is the level of noise heard by birds (Crowell, 2014). In accordance with the precautionary principle, this value was adopted as the level of noise which does not startle birds. Maintaining this level of noise at the Słupsk Bank (PLC990001) boundary determines the possibility of conducting foundation works from November to April. This issue has been described in the section 11, where the planned actions to avoid, prevent and reduce negative impacts on the environment have been specified.

In addition, as part of the initial assessment, the principles of selecting projects that could generate interactions which would accumulate with the Baltica OWF's impact have been adopted. At present, there is no intensive business activity near the Baltica OWF Area – apart from fishing and navigation. The existing linear infrastructure nearby (the SwePol Link cable west of the Baltica OWF and the gas pipeline to Władysławowo from the gas fields north-east of the OWF) do not generate any impacts that could accumulate with the impact of the Baltica OWF and other offshore wind farms. Also, the current operation related to the extraction of gas on offshore platforms is placed far enough from the Baltica OWF Area not to cause cumulative impacts.

Consequently, other planned offshore wind farms, for which EIA reports and/or environmental decisions have been issued, were also included beside the Baltica OWF in the analysis of cumulative impacts. This stage of the OWF implementation provides access to the data, assumptions and analyses that characterise these projects. In the context of the cumulative impacts, the impacts of the offshore wind farms BŚII, Baltica and BŚIII are important. The Sodra Midsjobanken offshore wind farm, located in the Swedish exclusive economic zone, will not generate cumulative impacts resulting from underwater noise in relation to the Natura 2000 sites. In this case, it is important that the cumulative impact of the parallel operations in the area of the Słupsk Bank and the Middle Bank will be small – the work in the area of the Słupsk Bank will not increase the impact of the work in the area of the Middle Bank and vice versa. This is due to the large distance between the sandbanks and the underwater noise whose level of interaction decreases logarithmically with the increase in distance causing the underwater noise generated in the area of the Middle Bank will be orders of magnitude lower in the area of the Słupsk Bank than that generated directly in the area of the Słupsk Bank. This means that, in order to ensure that there is no significant negative impact of the underwater noise on the Natura 2000 sites, work should be carried out in such a way that there is no impact directly related to the work in the areas of the Słupsk and Middle Banks separately. Additionally, it is assumed that for other offshore wind farms, in order to avoid significant impact on the Natura 2000 sites, the condition for the projects' implementation will be the compliance at the boundaries of these sites with the levels of underwater noise that is safe for the protected species within them.

In the context of the protected natural habitats which are the subject of conservation, i.e. the Sublittoral sandbanks (1110) and Reefs (1170) in the area of the Słupsk Bank (PLC990001), the issues arising from the potential impact of the increase in suspended solids and the resulting sedimentation on their conservation status have been assessed for three parameters characterising the habitats:

- surface;
- specific structure and function;
- protection perspectives.

Due to its nature, the underwater noise emission generated during palling will not affect the protected natural habitats Sublittoral sandbanks (1110) and Reefs(1170) in the Słupsk Bank site (PLC990001).

6.3.1.1.2 Determining the range of impact on natural habitats

The increase in the suspended solids' concentration and their sedimentation due to the extent of this phenomenon will not affect the "Surface" parameter of the Sublittoral sandbanks habitat (1110) in the Słupsk Bank (PLC990001). The morphological changes of the seabed will be caused by works related to the construction of wind power stations' foundations and cable-laying activities within the Baltica OWF Area, however, they will be limited to places where these activities are carried out. Taking into consideration the need to distance the nearest farm structures from the boundary of the Sublittoral sandbanks habitat (1110) and the maximum range of sedimentation of the suspended solids, the boundary of the habitat defined conventionally by the course of the 20 m isobath, will not change. The insignificant increase in the deposited suspended solids with the maximum thickness of 1.5 mm in the north-eastern part of the area will not affect the surface of the habitat.

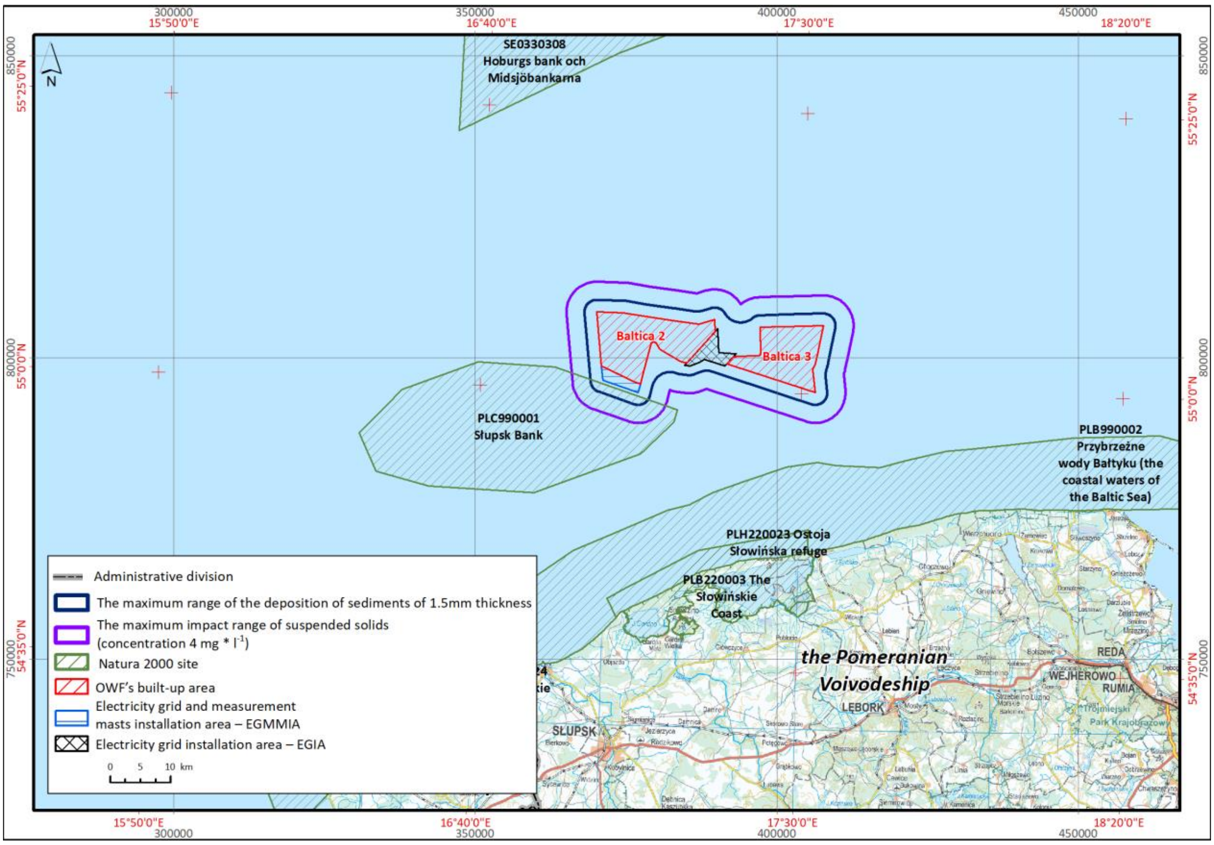


Figure 55. The impact range of the suspended solids concentration increase and the resulting sedimentation for the Baltica OWF

Source: internal data

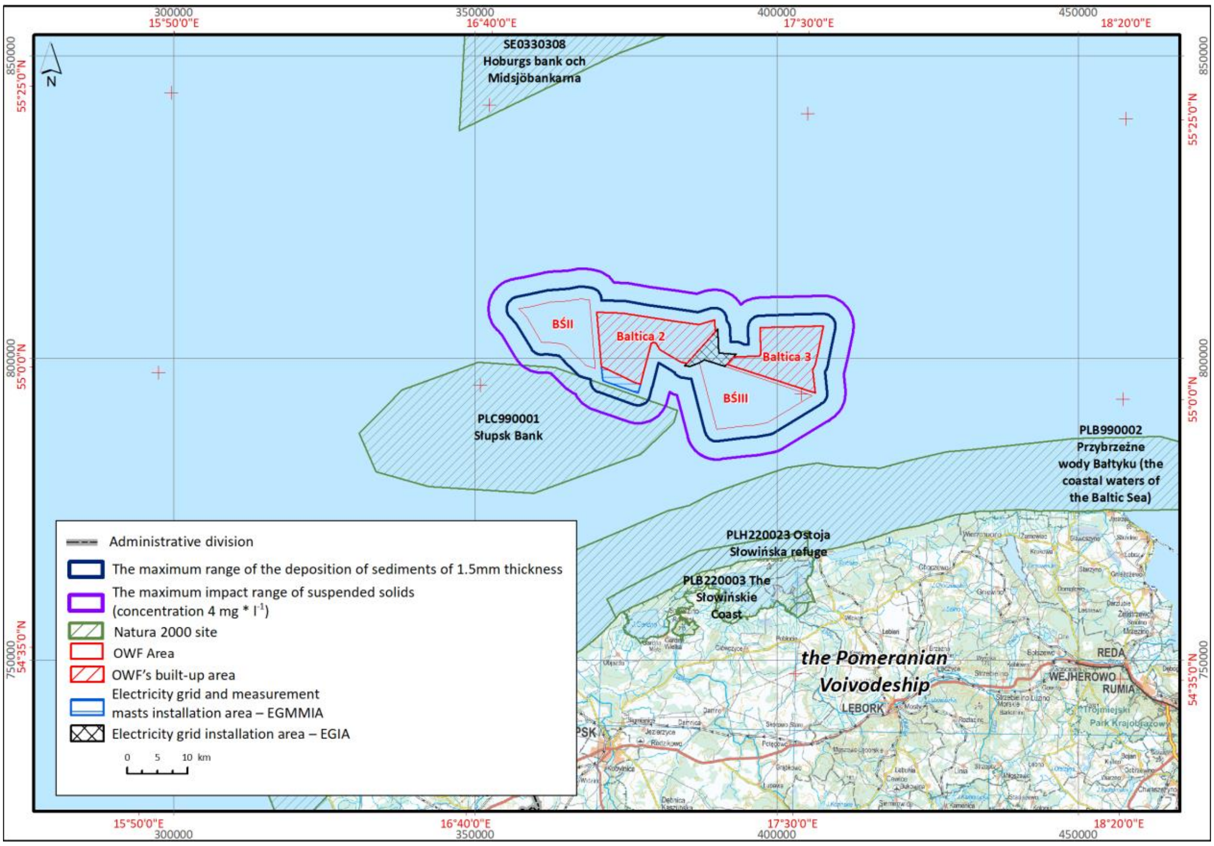


Figure 56. The impact range of the suspended solids concentration increase and the resulting sedimentation accumulated for the Baltica OWF and other offshore wind farms

Source: internal data

The Reef (1170) natural habitat located in the north-western part of the Słupsk Bank site (PLC990001) will not be subject to surface change or fragmentation resulting from the works related to the construction of the Baltica OWF. This is due to its location at a considerable distance from the place of construction work within the Baltica OWF Area.

Currently, on commission of the Chief Inspector for Environmental Protection, there is ongoing work to develop indicators for the "Structure and function" parameter for both habitats occurring within the Słupsk Bank site (PLC990001), i.e. Sublittoral sandbanks (1110) and Reefs (1170). The results will be available in 2018. No protection Plan for the Natura 2000 site has been developed as yet for the Słupsk Bank site (PLC990001). Hence, this parameter evaluation is descriptive.

The Sublittoral sandbanks habitat (1110) within the Słupsk Bank site (PLC990001) is characterized by a high degree of naturalness, and its location far from inland pollution sources as well as its form prevent the deposition of organic matter (Warzocha, 2004a). The basis of the habitat preservation is the maintenance of the undisturbed seabed structure and consequently the stable development of the benthic fauna (Warzocha, 2004a), which is a food supply for the fish and marine birds inhabiting it. Activities related to the construction of the Baltica OWF will not cause significant changes in the seabed structure of the Słupsk Bank. The results of the analyses of the modelling of dispersion and sedimentation of the sediment disturbed as a result of the construction works related mainly to the settlement of the wind power stations' foundations indicate that the sediment will be able to move into the Słupsk Bank area but the thickness of the sediment layer will not exceed 1.5 mm at a distance of 2 km from the OWF's built-up area. This value is comparable to the value of the sedimentation (per annum) resulting from the natural processes taking place in this area. Thus, the potential increase in quantity of the deposited sediment will not affect the quantitative and qualitative structure of benthic organisms, and consequently the function of the Sublittoral sandbanks habitat (1110) within the Słupsk Bank site (PLC990001) will not be affected.

The Reefs habitat (1170) within the Słupsk Bank site (PLC990001) is also characterised by a high degree of naturalness for the same reasons as the Sublittoral sandbanks habitat (1110). There are numerous species of macroalgae, macrozoobenthos and phytophyllic fauna in the boulder area of the Słupsk Bank. The uniqueness of plant communities on the rocky bottom is due to the presence of vegetation that settled at a considerable distance from the land and up to a depth of 20 m. This creates favourable conditions for the development of demersal invertebrate communities and many species of fish (Warzocha, 2004b). The preservation of the structure and function of the habitat in unaltered form depends primarily on the preservation of water transparency and the unchanged substrate (Warzocha, 2004b). The results of the model analyses indicate that the suspended matter resulting from the construction work carried out will be carried out in the water and with the increase of the distance from the source its concentration will decrease. Higher concentrations of suspended matter (ranging from a dozen to several dozen $mg \cdot dm^{-3}$) will be limited to the local area of the construction site. Moreover, the modelling results indicate that the impact of suspended solids on the marine environment in the least favourable scenario does not exceed 42 hours from the beginning of work on the seabed on a single foundation (this condition is determined by the moment of reaching the negligible concentration, lower than 2 $mg \cdot dm^{-3}$). The shortest distance from the place of the carried out work in the Baltica OWF Area to the Reefs habitat (1170) in the Słupsk Bank site (PLC990001) is about 20 km, hence virtually no deterioration in the environmental conditions that may affect both the structure and the functioning of the habitat will take place.

Activities related to the construction of the Baltica OWF will not cause deterioration of the environmental conditions of habitats in the analysed Natura 2000 sites, which could disturb their structure and functioning. Hence, these actions will not have an impact on the assessment of the "protection perspectives" parameter, which is generally defined within the 10–20 years context.

6.3.1.1.3 Determining the range of impact on species

Analysing the ranges of the underwater noise impact on the grey seal, which is the subject of protection of the *Ostoja Słowinska* site (PLH220032), it can be stated that the range of significant impact (TTS) extends beyond the boundary of the Baltica OWF Area without reaching the boundary of this Natura 2000 site (Figure 57).

In the case of a cumulative impact that involves simultaneous piling in the BŚII or BŚIII area with the piling in the Baltica OWF Area, the TTS range will also not reach the *Ostoja Słowinska* site (PLH220032) (Figure 58).

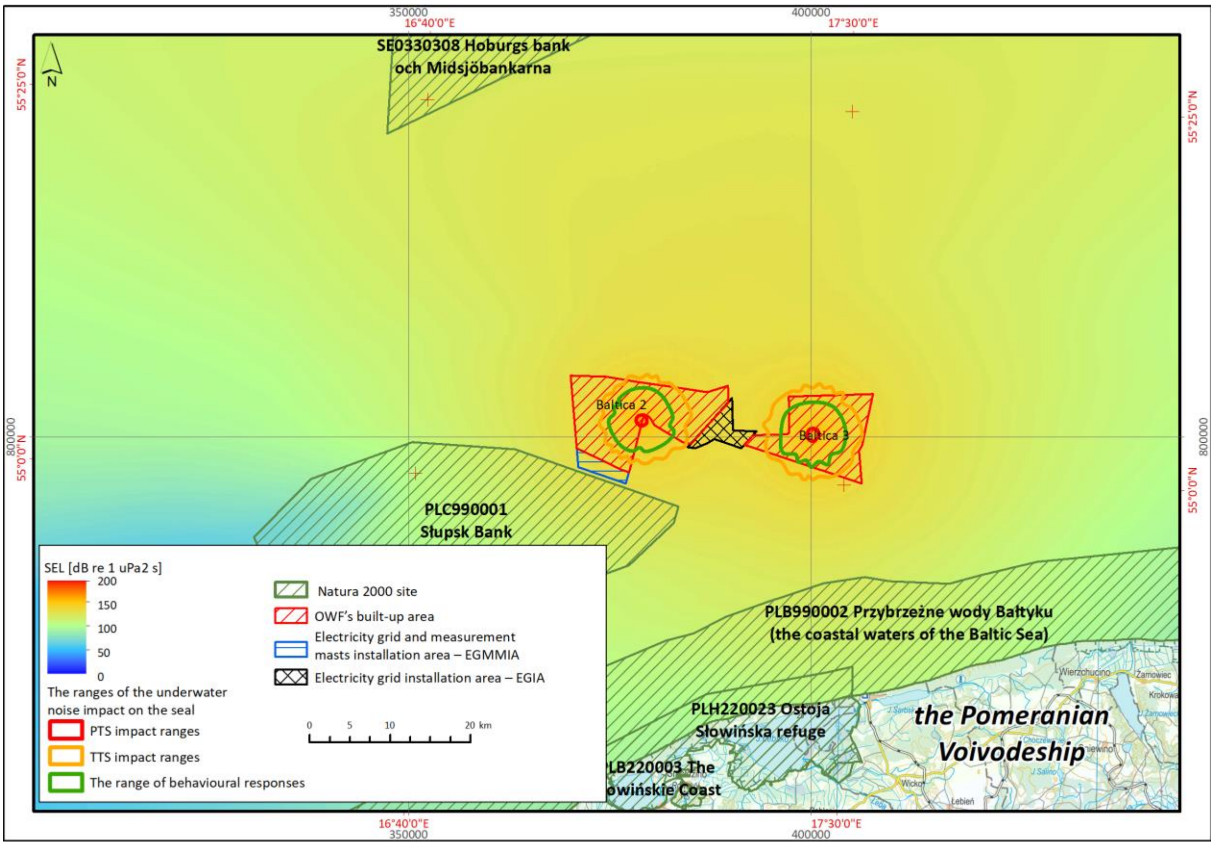


Figure 57. The ranges of the underwater noise impact on seals for the Baltica OWF (SEL from single strike for two simultaneous pilings – weighted with PW function – NMFS, 2016)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

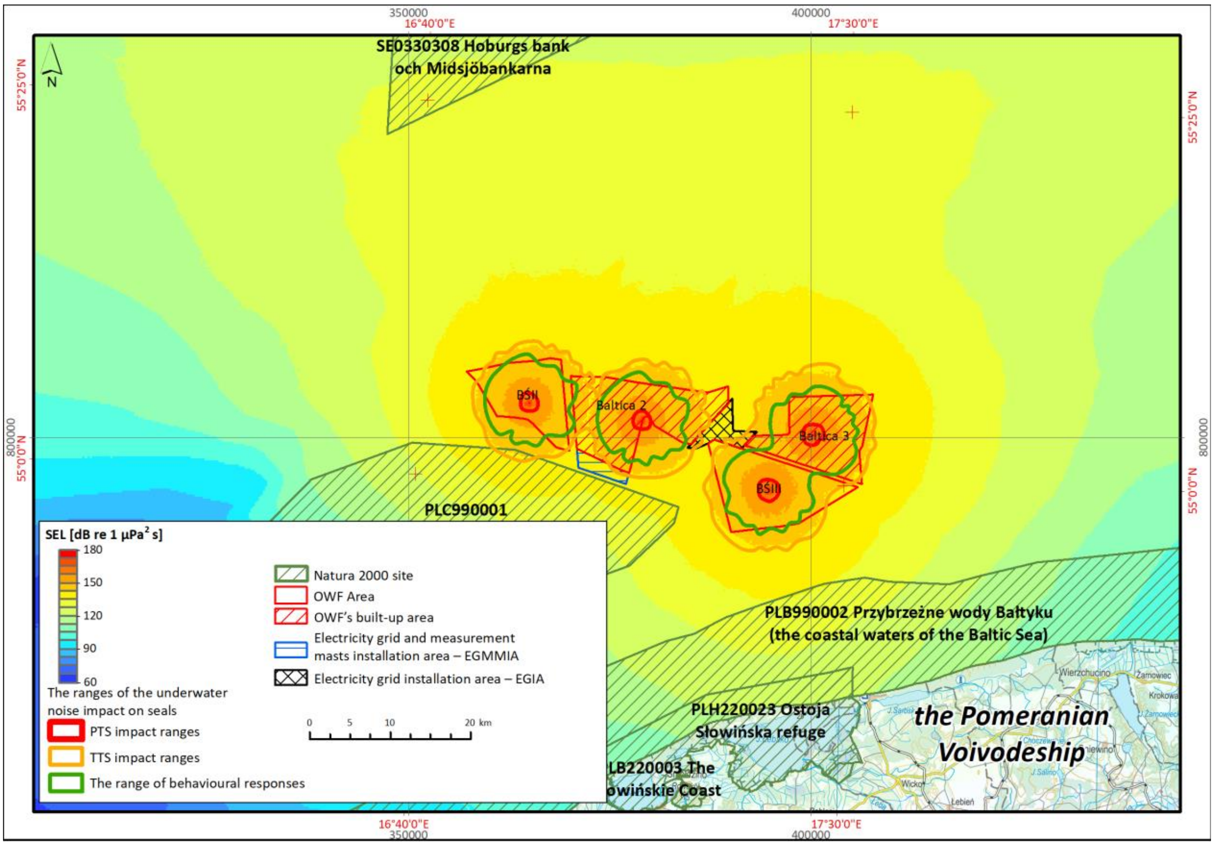


Figure 58. The ranges of the underwater noise impact on seals accumulated for the Baltica OWF and other offshore wind farms (SEL from single strike for two simultaneous pilings – weighted with PW function – NMFS, 2016)

The ranges of TTS and PTS impact for SEL_{cum}
Source: internal data

Analysing the ranges of underwater noise impact on porpoise, which is the subject of protection of the *Ostoja Słowińska* site (PLH220032) and the Hoburgs bank och Midsjöbankarna site (SE0330308) it can be stated that the range of significant impact (TTS) extends beyond the boundary of the Baltica OWF Area without, however, reaching the boundaries of these sites (Figure 59).

In the case of a cumulative impact that involves simultaneous piling in the BŚII or BŚIII area with the piling in the Baltica OWF Area, the TTS range will also not reach the following sites: *Ostoja Słowińska* (PLH220032) and Hoburgs bank och Midsjöbankarna (SE0330308) (Figure 60).

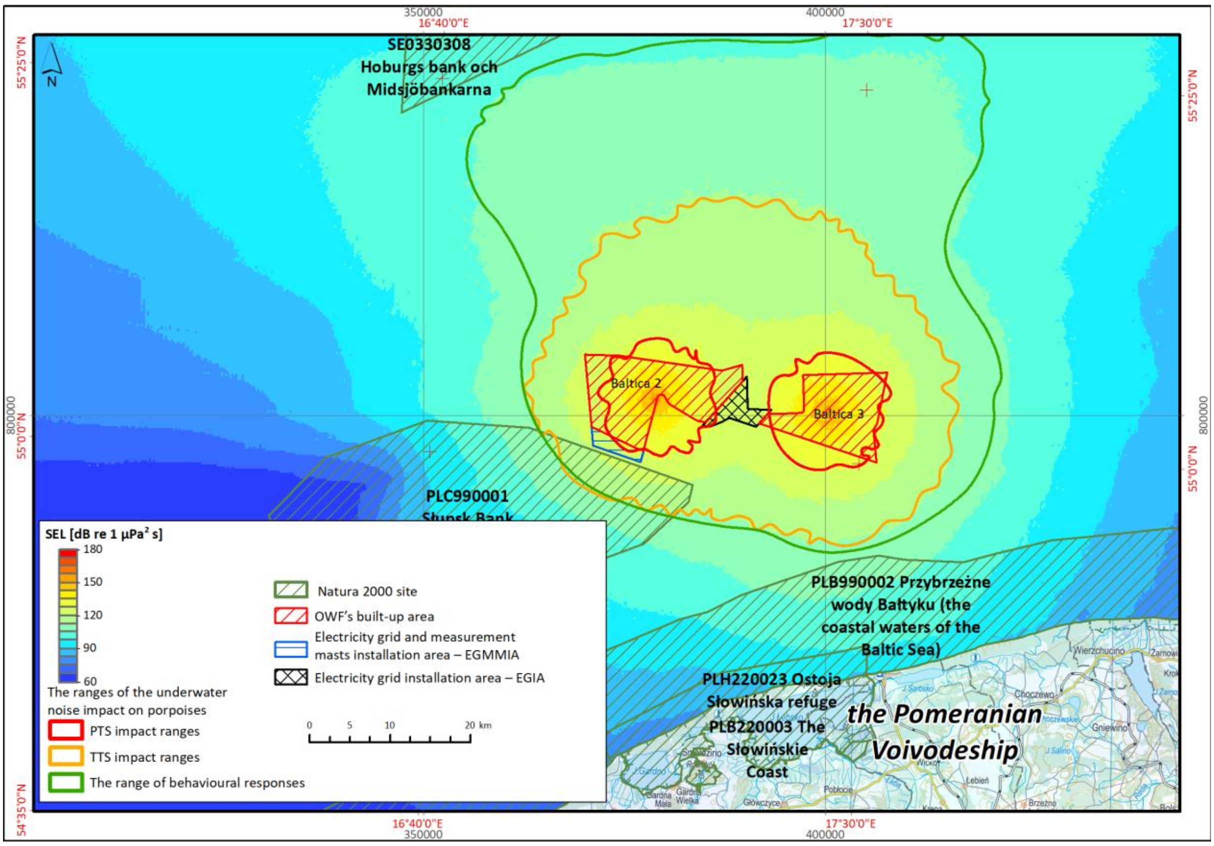


Figure 59. The ranges of the underwater noise impact on porpoise for the Baltica OWF (SEL from single strike for two simultaneous pilings – weighted with HF function – NMFS, 2016)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

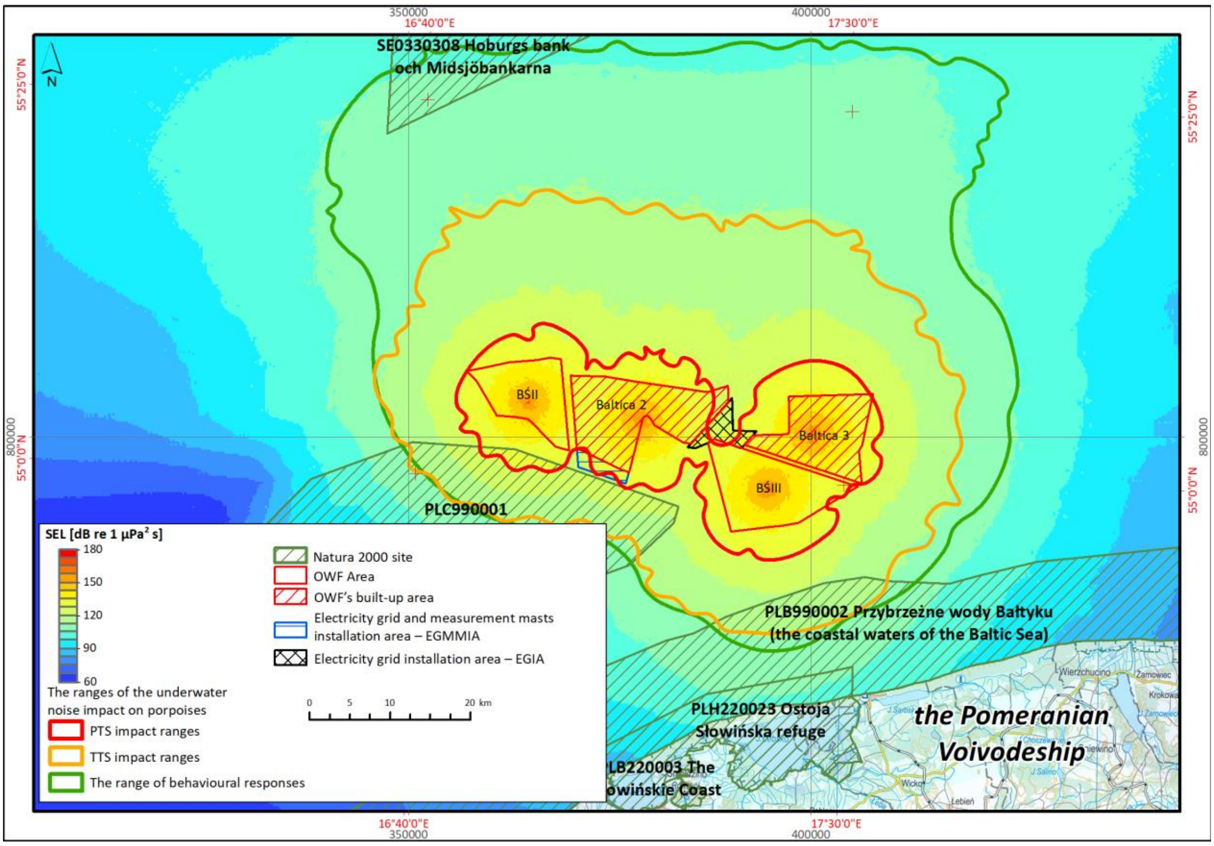


Figure 60. The ranges of the underwater noise impact on porpoise accumulated for the Baltica OWF and other offshore wind farms (SEL from single strike for two simultaneous pilings – weighted with HF function – NMFS, 2016)

The ranges of TTS and PTS impact for SEL_{cum}
Source: internal data

Analysing the ranges of the underwater noise impact on fish both with and without swim bladders, which are the subjects of protection of the *Ostoja Słowinska* site (PLH220032), it can be stated that the range of significant impact (TTS) extends beyond the boundary of the Baltica OWF Area without reaching, like in the case of marine mammals, the boundary of this site (Figure 61 and Figure 63).

In the case of a cumulative impact that involves simultaneous piling in the BŚII or BŚIII area with the piling in the Baltica OWF Area, the TTS range will also not reach the *Ostoja Słowinska* site (PLH220032) (Figure 62 and Figure 64).

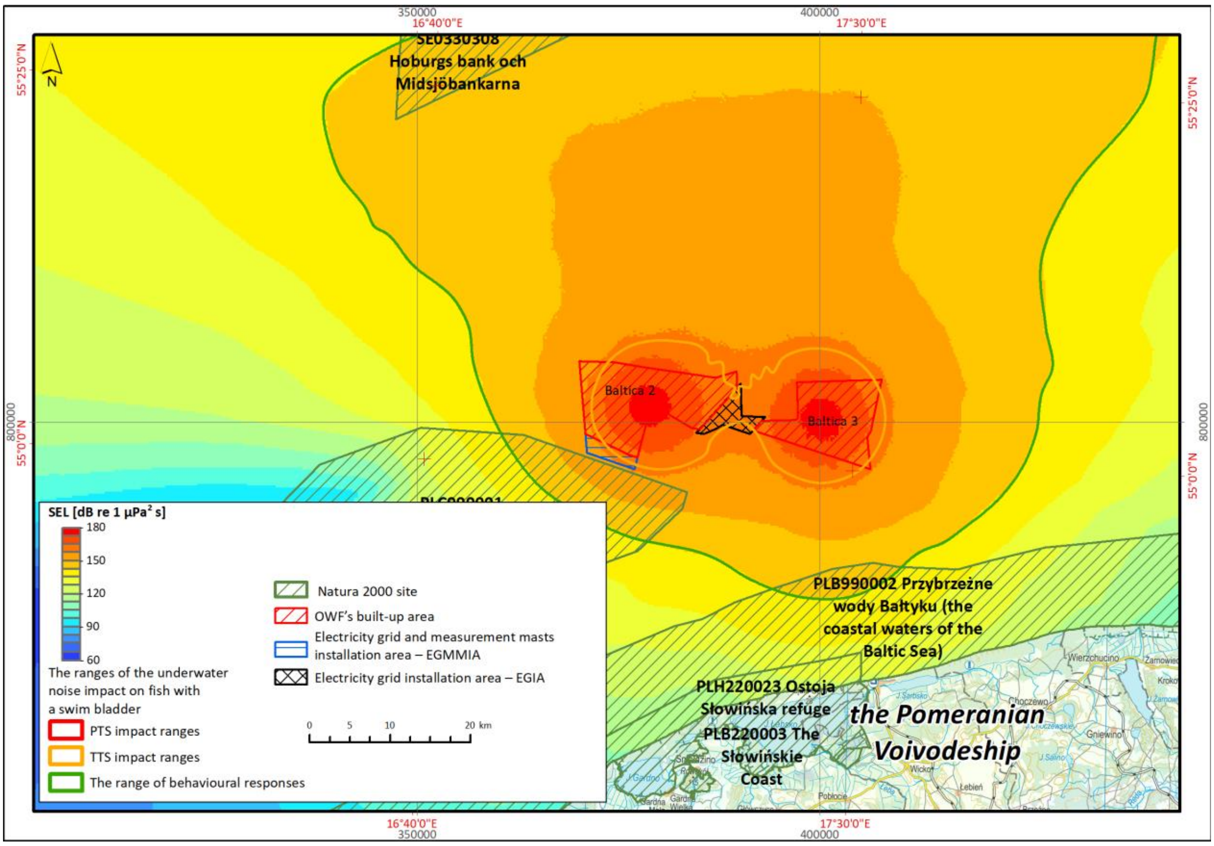


Figure 61. The ranges of the underwater noise impact on fish with swim bladders for the Baltica OWF (SEL from single strike for two simultaneous pilings – unweighted – Popper et al., 2014)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

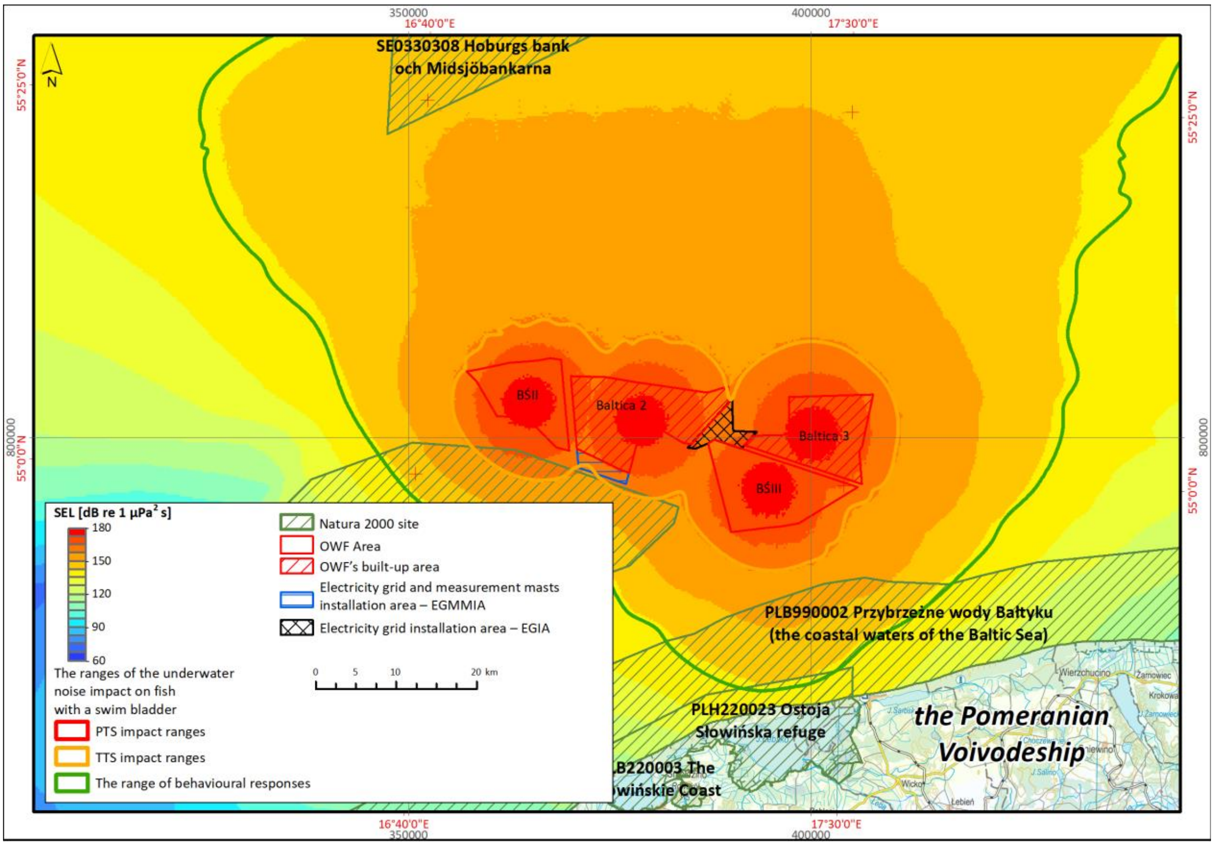


Figure 62. The ranges of the underwater noise impact on fish with swim bladders accumulated for the Baltica OWF and other offshore wind farms (SEL from single strike for two simultaneous pilings – unweighted – Popper et al., 2014)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

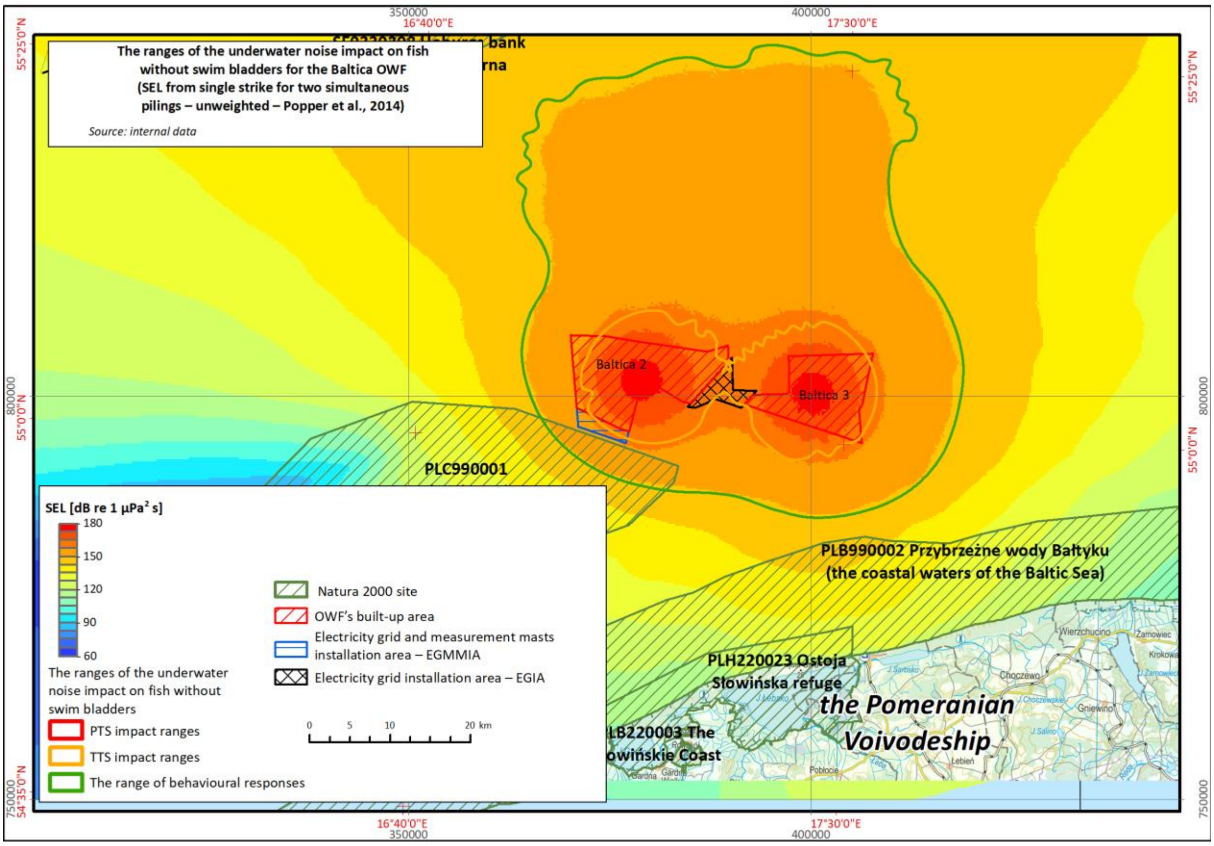


Figure 63. The ranges of the underwater noise impact on fish without swim bladders for the Baltica OWF (SEL from single strike for two simultaneous pilings – unweighted – Popper et al., 2014)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

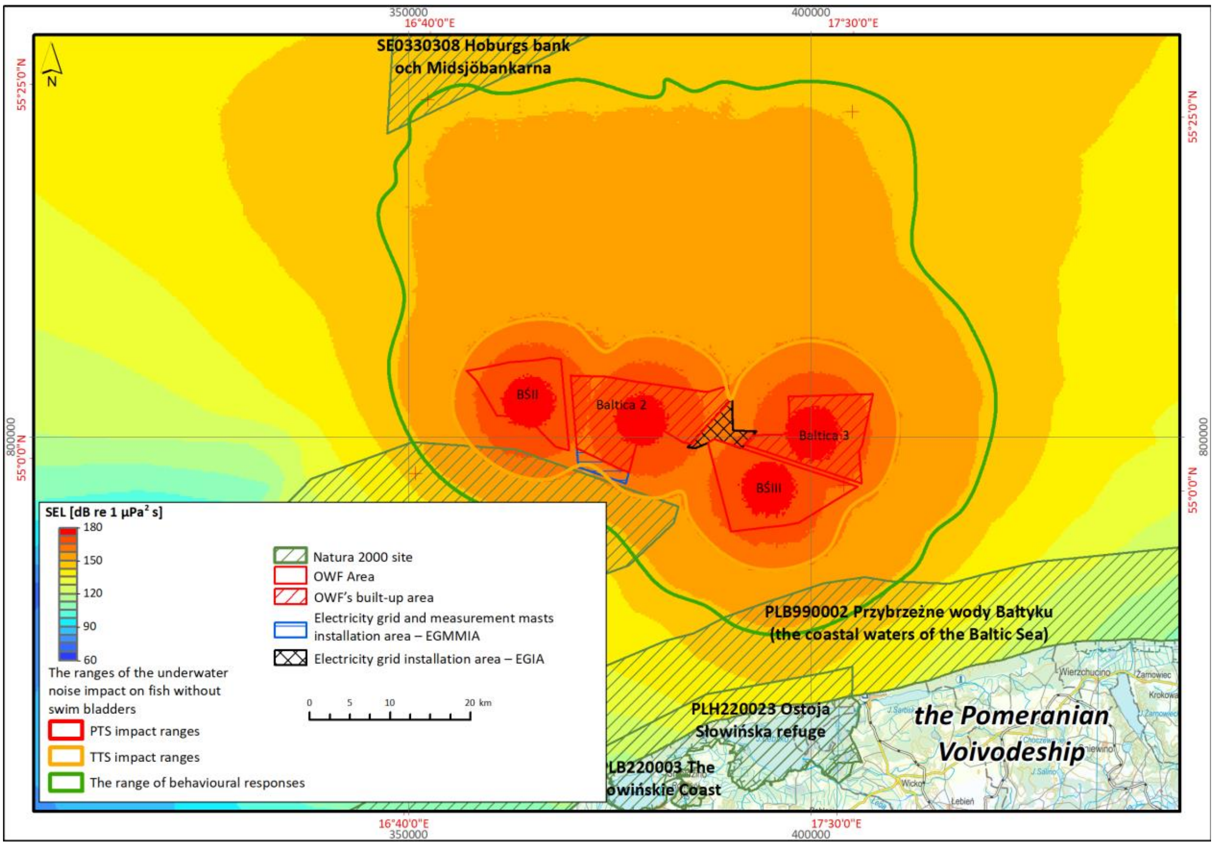


Figure 64. The ranges of the underwater noise impact on fish without swim bladders accumulated for the Baltica OWF and other offshore wind farms (SEL from single strike for two simultaneous pilings – unweighted – Popper et al., 2014)

The ranges of TTS and PTS impact for SEL_{cum}

Source: internal data

6.3.1.2 Summary of the initial assessment

As a result of the initial assessment of the planned project's impact on Natura 2000 sites, taking into account the ranges and nature of the impact, both separately and accumulated with other projects it was indicated that two Natura 2000 sites are within the range of the potential impact, i.e. the Słupsk Bank – *Ławica Słupska* (PLC990001) and the coastal waters of the Baltic Sea – *Przybrzeżne wody Bałtyku* (PLB990002). The impacts that could affect these areas and which have been analysed at the initial assessment stage are: space disturbance, underwater noise and the increase of the suspended solids in the water and their resulting sedimentation.

The initial assessment has shown that there is no significant impact on the natural habitats which are the subjects of protection of the concerned Natura 2000 sites.

Therefore, the main assessment of the project's impact on Natura 2000 sites has included the aspect related to the probable significant impact caused by the disturbance of space which would affect birds that are the subject of protection of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002), the integrity of the Słupsk Bank site (PLC990001) and the coherence of the Natura 2000 network.

6.3.2 Main assessment

Due to significant differences between the different phases of the planned project (construction, exploitation and decommissioning) and therefore different impacts, the assessment of the aspect resulting from the impact of space disturbance on the subjects of protection has been exploited separately for each phase. Issues related to the integrity of Natura 2000 sites and the coherence of the Natura 2000 network have been assessed without division into phases of the project.

6.3.2.1 Areas of the Natura 2000 network

Taking into account the distances of the Natura 2000 sites indicated in the table (Table 152) from the Baltica OWF Area and the range of impacts generated by the Baltica OWF, which may affect the subjects of protection and integrity of these sites, two sites, the characteristics of which based on the data from the literature have been presented below, have been chosen for further analyses of the potential impacts of the proposed project.

6.3.2.1.1 The Słupsk Bank site (PLC990001)

The Słupsk Bank is an area in the Southern Baltic which covers the area with a shallow seabed. The boundaries of the area were delineated along the course of 20 m isobath. The area has a much diversified seabed structure with numerous lowerings and elevations. The shallow water is inhabited by numerous invertebrates which provide a rich food supply for the flocks of wetland birds stopping there in the autumn and winter. The prevailing plants are macroalgae, including among others the red algae: *Furcellaria lumbricalis*, *Ceramium diaphanum*, Black siphon weed *Polysiphonia fucoides* (Kruk-Dowgiałło et al., 2011). Two bird species from the ones listed in the Appendix 1 of the EU Birds Directive i.e. The black-throated loon and red-throated loon winter in this area. During the winter there is at least 1% of the long-tailed duck and black guillemot migratory population there. Wetland birds are present in concentrations above 20 000 individuals.

Within the boundaries of the Słupsk Bank site (PLC990001), the subjects of protection of this area are two bird species (Table 153):

- black guillemot;
- long-tailed duck

and two natural habitats which are the subject of protection in this area (Table 154):

- Sublittoral sandbanks (1110);
- Reefs (1170).

During the surveys for the EIA Report for the BŚIII project, the average number of the long-tailed ducks wintering in the Słupsk Bank area was estimated at about 120 000, which is considerably above the values specified in the standard data form for this area or even in the BirdLife International database. On the basis of the surveys conducted for the EIA Report during the winter season 2016/2017, the number of the long-tailed duck within the Słupsk Bank was estimated at about 44 000 individuals. According to the data from the literature (the surveys conducted between 2012–2014) 2850 specimens of the black guillemot were observed within this area during the winter (Meissner, 2014).

Table 153. Basic information about seabirds in the Słupsk Bank site (PLC990001)

Species	Type of population in the area	Evaluation of the area for the population*	Abundance (specimens)	Percentage of the migratory population
Black guillemot Cepphus grylle	Wintering	C	400–1000**	At least 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	25 000–32 000**	At least 1%
Black-throated loon *Gavia arctica*	Wintering	D	Single	Below 1%
Red-throated loon *Gavia stellata*	Wintering	D	140	Below 1%

**Class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%; area assessment for population D (species not subject of protection of the area)*
***In the SDF the size of the population was given incorrectly. The values quoted here have been taken from the BirdLife International database (http://www.birdlife.org/datazone/sitefactsheet.php?id=9562; accessed 16-06-2017) containing the data provided in the SDF*
Source: own materials based on SDF Słupsk Bank (2017)

The Sublittoral sandbanks habitat (1110) (Table 154) in the Słupsk Bank site (PLC990001) is one of the three localities of such habitat within the PMA. The conventional boundary of the habitat is the 20 m isobath (Interpretation Manual of European Union Habitats, 2013). In the Słupsk Bank site there is a sandy gravel sediment, with island-like rocks and postglacial boulders.

The Reefs habitat (1170) (Table 154) is located in the north-western part of the Słupsk Bank. It is a unique area in the southern part of the Baltic Sea due to the nature of the geological structure and the type of rock substrate (Kotliński, 1985; Kramarska, 1991a, 1991b). This is the only place identified thus far, within the PMA, distant from the shore, where numerous macroalgae grow on the rocky seabed (Okołotowicz, 1991; Andrulewicz et al., 2004).

Table 154. Basic information about natural habitats within the Słupsk Bank site (PLC990001)

Code of the habitat	Name of the habitat	Coverage [ha]	Representativeness[1]	Relative surface[2]	Conservation status[3]	General assessment[4]
1110	Underwater sandbanks	16010.06	A	A	A	A
1170	Reef	48030.18	A	A	A	A

[1]The classification system of representativeness assessment: A: excellent, B: good, C: considerable, D: negligible representativeness
[2]Class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%
[3]The classification system of conservation status assessment: A: excellent, B: good, C: average or impoverished status
[4]The classification system of general assessment: A: excellent, B: good, C: considerable
Source: own materials based on SDF Słupsk Bank (2017)

6.3.2.1.2 *Przybrzeżne wody Bałtyku* site (PLB990002)

The *Przybrzeżne wody Bałtyku* site (PLB990002) includes the Baltic Sea coastal waters of the depth from 0 to 20 m. Its boundaries stretch for 200 km beginning at the base of the Hel Peninsula and ending in the Pomeranian Bay. The seabed is uneven, the height differences reach 3 m. Small crustaceans dominate in the benthic fauna. Two bird species from the ones listed in the Appendix 1 of the EU Birds Directive i.e. The black-throated loon and red-throated loon winter in this area.

During the winter there is over 1% of the migratory species of long-tailed duck in here and at least 1% of the black guillemot and velvet scoter. Among the species included in the assessment of the Baltica OWF's impact on seabirds within the *Przybrzeżne wody Bałtyku* site (PLB990002), the wintering populations of long-tailed duck, velvet scoter, razorbill and European herring gull are under protection. It is estimated that 90–120 thousand individuals of the long-tailed duck, 14–20 thousand individuals of velvet scoter, and 8–15 thousand individuals of European herring gull winters in this area (Meissner, 2010a). Whereas, the population of razorbills wintering in this area is estimated at 500 to 1000 individuals (SDF *Przybrzeżne wody Bałtyku*, 2017). In the *Przybrzeżne wody Bałtyku* site (PLB990002), the wintering and passing population of the common scoter and the wintering population of the black guillemot are also under protection. (Table 155)

Table 155. Basic information about seabirds in the *Przybrzeżne wody Bałtyku* site (PLB990002)

Species	**Population type**	**Evaluation of the area for the population***	**Abundance (specimens)**	**Percentage of the migratory population**
Black-throated loon *Gavia arctica*	Wintering	D	200-500	Below 1%
Red-throated loon *Gavia stellata*	Wintering	D	100-500	Below 1%
European herring gull *Larus argentatus*	Wintering	C	8000–15 000	Below 1%
Common gull *Larus canus*	Wintering	D	1000	Below 1%
Black guillemont *Cepphus grylle*	Wintering	B	200-1100	At least 1%
Razorbill *Alca torda*	Wintering	C	500-1000	Below 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	90 000–120 000**	Above 1%
Velvet scoter *Melanitta fusca*	Wintering	C	14 000–20 000**	At least 1%
Common scoter *Melanitta nigra*	Wintering	C	5000-8000	Below 1%
Common scoter *Melanitta nigra*	Passing	C	3000	Below 1%

**Estimating the size of the species population and its density in relation to the national population; class ranges: A: 100 ≤ p > 15%, B: 15 ≤ p > 2%, C: 2 ≤ p > 0%; area assessment for population D (species not subject of protection of the area)*
***In the SDF the size of the population was given incorrectly. The values quoted here have been taken from the BirdLife International database (http://www.birdlife.org/datazone/sitefactsheet.php?id=9562; accessed 16-06-2017) containing the data provided in the SDF*
Source: own materials based on SDF Przybrzeżne wody Bałtyku (2017)

6.3.2.2 Subject of protection

In the context of the protection of the seabirds population within the Natura 2000 network, the significant features of the Słupsk Bank site (PLC990001) and *Przybrzeżne wody Bałtyku* site (PLB990002) will be:

- their location on the migration route of the Eurasian population of seabirds to the wintering grounds located in this area;
- the appropriate habitat conditions that make these areas attractive as wintering grounds or resting places during the autumn and/or spring migration of seabirds;
- the accessibility of these areas for the populations of wintering birds and birds resting during migration.

In the context of preserving the coherence within the Natura 2000 network, it is also important to preserve the ability to move between the sites for the populations of birds without the threat of significant population depletion and/or significant energy expenditure that may affect the ecology and biology of these populations.

In the present state, prior to the construction of the Baltica OWF and other OWF projects in Polish marine areas, the protection of wintering and migratory birds within the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) is appropriate.

In the assessment of the Baltica OWF's impact on Natura 2000 sites in the context of birds, the results of the ornithological surveys carried out for the EIA Report, the data from the Standard Data Forms for the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku site* (PLB990002) and the recommendations of the European Commission guidance on "Wind energy developments and Natura 2000" have been used.

6.3.2.2.1 Construction phase

The OWF's built-up area will be located outside Natura 2000 sites, with a minimum distance of 2 km from the Słupsk Bank site (PLC990001) boundary. The movement of vessels and helicopters supplying the OWF with resources for its construction may, however, run across the *Przybrzeżne wody Bałtyku* site (PLB990002).

The impact of the planned investment during the construction stage will be mainly related to the rise, along the progress of the construction, of the barrier effect created by the structures of wind power stations, power substations and the presence of ships. Lighting of the investment site during the construction may impact the environment to a relatively small distance from the OWF Area. At a greater distance from the OWF Area, the impact of the planned investment may be reflected in the increased traffic of vessels and helicopters transporting resources necessary for the OWF construction.

The following impacts on bird species (long-tailed duck, velvet scoter and razorbill) which are the subjects of protection of the Natura 2000 sites Słupsk Bank (PLC990001) and *Przybrzeżne wody Bałtyku* (PLB990002), and which occur within the investment area cannot be ruled out:

- habitat displacement of the seabirds that are, at least seasonally, in the proposed Baltica OWF Area, which may result in their relocation to other areas (including the above mentioned Natura 2000 sites) where they will encounter increased competition for food (they will join birds already occupying these areas). As a result, the population of these species may decrease, including the decrease within the above mentioned Natura 2000 sites whose subjects of protection these birds are;

- increased mortality due to collisions with power stations, which may result in the loss of some of the birds heading to nearby Natura 2000 sites, resulting in reduced population in the conservation area;
- the formation of a barrier as a result of the construction of a greater number of OWFs, hindering seabirds from reaching the wintering grounds located near the farm, which are also Natura 2000 sites, i.e. the Słupsk Bank site (PLB990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) or impeding local movements in the area.

Due to the long-term process of the OWF construction, the above mentioned impacts occur progressively during the construction phase as the work advances and during the exploitation phase. For this reason, they have been taken into account already at the construction stage of the OWF.

The types of impacts are described in detail and assessed in sections 6.1 and 6.2. An abstract and a summary of the conducted analyses of potential impacts on the subjects of protection of Natura 2000 sites has been presented below (Table 156). During the construction phase of the Baltica OWF the impacts on seabirds associated with the Słupsk Bank site (PLC990001) and *Przybrzeżne wody Bałtyku* site (PLB990002) will be mostly negligible and the rest of them will be of little importance.

Table 156. The assessment of the potential impacts of the Baltica OWF during the construction phase on seabirds that are the subject of protection of the nearby Natura 2000 sites

Type of impact	*Przybrzeżne wody Bałtyku* (The coastal waters of the Baltic Sea)	The Słupsk Bank
Traffic of water crafts and helicopters	**Insignificant** – ships involved in the construction of the farm will cross through this area. Birds scared away from the construction site can move to the area of the site *Przybrzeżne wody Bałtyku*.	**Irrelevant** – the movement of vessels involved in the construction of the farm will not happen in this area. Birds scared away from the construction site can move to the nearby area of the Słupsk Bank site.
Lighting of the investment site	**Irrelevant** – the considerable distance from the construction site limits the impact on the birds of this area.	**Insignificant** – the distance from the construction site reduces, to some extent, the impact on the birds of this area. The scale of this impact depends on the intensity of the work. The impact should be expected in the part of the farm closest to the boundary of this Natura 2000 site. The illumination of the place of investment can attract birds active at night, such as long-tailed ducks during transit, increasing the risk of collisions with the elements of the power station and vessels carrying out the construction of the farm. This may slightly reduce the population of these birds, including their abundance within the Słupsk Bank Natura 2000 site.
The creation of a barrier for birds (the presence of power station, the risk of collision, the exclusion of feeding grounds)	**Irrelevant** – the considerable distance from the construction site limits the impact on the birds of this area**.** Birds scared away from the construction site can move to the area of the site *Przybrzeżne wody Bałtyku*. Due to the considerable distance between the investment area and the above mentioned Natura 2000 sites, it is not very likely that seabirds will travel between these feeding grounds. It is unlikely that a significant number of seabirds using the feeding grounds at the *Przybrzeżne wody Bałtyku* site would collide with the power stations in the Baltica OWF Area. Moreover, the risk of bird collisions with non-operational wind power stations is very low.	**Insignificant** – birds scared away from the construction site can move to the area of the Słupsk Bank site, where they will increase the abundance of their species and consequently the intraspecific competition for food resources. After the exclusion from the construction of power stations the part of the farm adjacent to the Słupsk Bank birds will not lose completely the access to the feeding grounds located here. As a result, a large number of birds using the part of the OWF Area located at the Słupsk Bank will not have to move from it, including moving to the Natura 2000 site. Moreover, the risk of bird collisions with non-operational wind power stations is very low and will only be a threat to seabirds moving between the Słupsk Bank site and the OWF Area. Therefore, the reduction in abundance of the seabird species' populations which are the subjects of protection of Natura 2000 site resulting from a collision with non-operational power stations is unlikely.
The creation of a barrier for birds (the presence of ships)	**Irrelevant** – a negligible increase in the energy costs will occur for birds stationed at the Natura 2000 site and migrating to or from the area, which is related to the avoidance of the construction site. Due to the relatively large distance between the Natura 2000 site and the OWF Area, only a small number of seabirds will move between these feeding grounds. Therefore, only a few birds of the species which are the subjects of protection of the area will meet the barrier located in the OWF Area.	**Irrelevant –** there will be a slight increase in the energy costs for stationary and migratory birds related to the avoidance of the construction site. The barrier will occupy only a small area and will change its location in connection with the construction of further wind power stations. Thus, it will not affect significantly the seabirds that are subject of protection of the site or the site's integrity.
Collisions with ships	**Irrelevant** – the collisions of the subjects of protection of the site with ships are extremely unlikely due to their mainly daily activity and high sensitivity to interference. The movement of vessels involved in the construction of the OWF may cross through the area of the *Przybrzeżne wody Bałtyku* site, but the	**Irrelevant –** the collisions of the subjects of protection representatives with ships are extremely unlikely due to their mainly daily activity and high sensitivity to interference. Collisions of birds with ships can take place at night as a result of the illumination of the vessels which attract birds. The mainly daily activity of the

Type of impact	*Przybrzeżne wody Bałtyku* (The coastal waters of the Baltic Sea)	The Słupsk Bank
	likelihood of birds collisions with ships is low. In addition, due to the significant distance between the Natura 2000 site and the OWF Area, the collisions of birds (travelling from the Natura 2000 site to a feeding ground in the OWF Area) with the ships at the construction site are few. Consequently, this impact will be negligible for the subjects of protection of Natura 2000 sites.	subjects of protection of the Słupsk Bank Natura 2000 site greatly reduces the risk of their collisions with ships and the potential impact of the investment on the area.

Source: internal data

During the construction phase, it is expected that birds will be gradually scared away from the site of the construction work. This will cause changes in the distribution of the particular species in the Baltica OWF Area and the Słupsk Bank site (PLC990001), and to a much lesser degree also in the *Przybrzeżne wody Bałtyku* site (PLB990002). The more skittish species, such as razorbill, long-tailed duck and velvet scoter, will move to the areas neighbouring the Baltica OWF Area, possibly to the Słupsk Bank site (PLC990001) and to a lesser extent to the *Przybrzeżne wody Bałtyku* site (PLB990002), where there are important in the Baltic Sea places of seabirds' concentration. Increased concentration of seabirds at the feeding grounds may adversely affect their ability to obtain adequate for them amounts of food, which may increase their mortality. This may result in the reduction in abundance of the seabird species' populations which are the subjects of protection of the Natura 2000 site Słupsk Bank (PLC990001) and, to a lesser extent, also the *Przybrzeżne wody Bałtyku* site (PLB990002).

Based on the described above analysis of the significance of the Baltica OWF's impact on Natura 2000 sites during the construction phase, it has been stated that the OWF can have the greatest impact on the occurring in large numbers within its area the subject of protection of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) i.e. the long-tailed duck. Although the significance of the particular impacts of the Baltica OWF on velvet scoter (the subject of protection of the *Przybrzeżne wody Bałtyku* site [PLB990002]) was the same as for the long-tailed duck, velvet scoter occurred sparsely within the Baltica OWF Area. Also razorbill, although its abundance exceeded the limit of 1% in the grouping of birds during the spring and autumn migration, occurred within the surveyed area in average abundance, and the significance of the Baltica OWF's impact during the construction phase on this species, which is the subject of protection of the *Przybrzeżne wody Bałtyku* site (PLB990002) was negligible or insignificant.

The key impact of the Baltica OWF on the long-tailed duck is scaring it away and the loss of important habitats. As indicated by the publication of Petersen et al. (2006), many years of pre- and post-investment surveys carried out on offshore wind farm Nysted in Denmark prove that long-tailed duck avoids the area of the constructed offshore wind farm. It is also considerably displaced from the 2 km zone, and to a lesser extent also from the 2–4 km zone, around the borders of the built-up area. The decline in abundance in the 2–4 km zone was not statistically significant.

The boundary of the OWF's built-up area is at least 2 km away from the boundary of the Słupsk Bank site (PLC990001). Thanks to such distance the long-tailed duck will only be slightly driven away from the Słupsk Bank site (PLC990001).

In the winter period, 222 individuals of this species may be scared away [the percentage of long-tailed ducks driven out from the area is approx. 25% in accordance to Petersen et al. (2006), though the authors failed to achieve a statistical validity for driving away from the buffer zone). This value would represent 0.51% of the average long-tailed duck abundance in the Słupsk Bank site (PLC990001) (43 910 indiv.), as identified in the research for the EIA Report. It would also represent only 0.11% of the national population of this species (210 000 indiv. according to Skov et al., 2011) and a maximum of 0.89% of the winter population of this species, which is the subject of protection of the Słupsk Bank site (PLC990001) (25 000–32 000 indiv. according to the BirdLife International database, http://www.birdlife.org/datazone/sitefactsheet.php?id=9562, accessed 16-06-2017, containing the data provided in the SDF).

According to the above calculations, there is no significant impact of the planned investment on the wintering population of the long-tailed duck, which is the subject of protection of the Słupsk Bank site (PLC990001).

The surveys for the EIA Report on seabirds have been conducted in the Słupsk Bank site (PLC990001) and in the Baltica OWF Area. Both areas have been surveyed at the same time, making it possible to directly compare the results in the context of the determination of their significance for the long-tailed duck. The density of the long-tailed duck in particular depth classes during winter 2016/2017 has been presented in the figure (Figure 65).

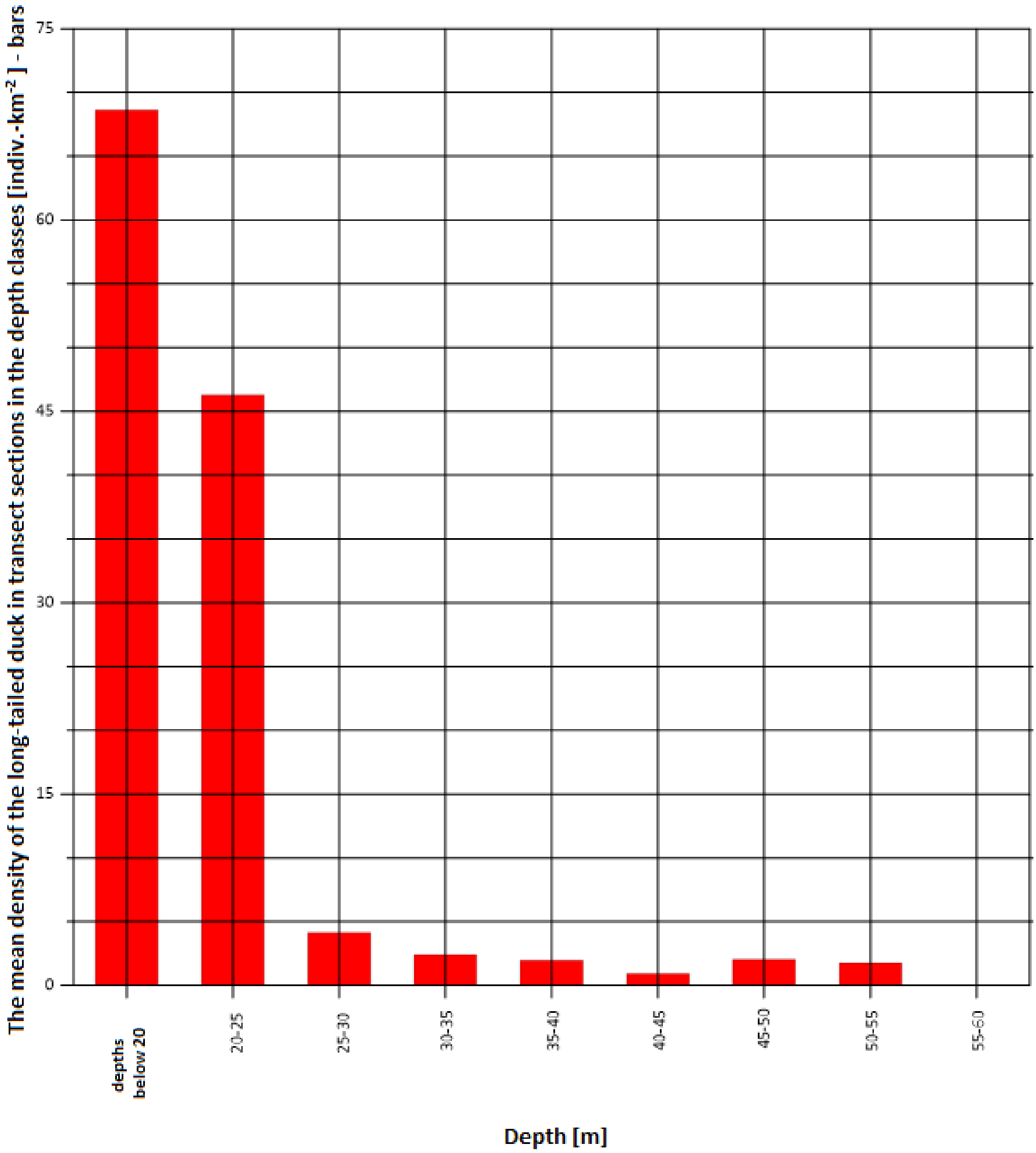


Figure 65. The long-tailed duck density in particular depth classes

Source: internal data

The highest average densities of the long-tailed duck have been recorded in areas of the depth up to 20 m, where it reached 70 indiv.·km^{-2} and in areas with depths of 20–25 m (46.30 indiv.·km^{-2}). In the next depth zone (25–30 m) the mean density of the long-tailed duck was over ten times smaller and amounted to 4.11 indiv.·km^{-2}. The lowest average density was recorded in the 40–45 m zone (1 indiv.·km^{-2}). In the depth of 55–60 m, this species has not been recorded.

The survey's results indicate the boundary of the long-tailed ducks stationing during wintering in the area of Słupsk Bank. This boundary is the depth of 30 m, which largely coincides with the border of the Słupsk Bank site (PLC990001). The area is used primarily by the species as winter and spring habitats, although birds of this species are also found here in the autumn, but in smaller numbers. This area is a feeding ground for the long-tailed ducks and a place to rest. Outside of this area the long-tailed ducks occurred highly dispersed.

94% of the Baltica OWF built-up area is located outside the 30 m depth zone, i.e. in areas not used by the long-tailed ducks as feeding grounds or places to stay. The construction of the Baltica OWF will not have an influence on the deterioration of the conservation status of this subject of protection of the Słupsk Bank site (PLC990001).

It should also be noted that similar situation has been described in another OWF, located in the vicinity of the Baltica OWF's area, i.e. BŚII. There also, the highest density of the long-tailed ducks were found at the boundary of the Słupsk Bank site (PLC990001), which led to the decision to exclude this part of the sea area from the development of wind farms.

No wind power stations will be built in the part of the Baltica OWF Area adjacent to the Słupsk Bank site (PLC990001), but there may be other farm installations which do not cause permanent scare effect, i.e. electricity grid, teletechnical network and measuring masts. Birds will only be scared away from the area excluded from power stations' construction at the stage of construction and decommissioning of farm installations other than wind power stations, also it is not anticipated that these could have a negative impact on seabirds during farm's exploitation.

As a result of the above mentioned exclusion, there will be a shift northwards of the 2-kilometer impact zone around the farm. Therefore, it will not coincide with the boundary of the Słupsk Bank site (PLC990001).

As for the construction phase impact of lower significance, birds can also be expected to be scared away by the increase in the movement of vessels and helicopters within among others the *Przybrzeżne wody Bałtyku* site (PLB990002), through which some of the vessels heading into the area of construction work may cross. The location of the Słupsk Bank site (PLC990001) practically excludes the increase of the movement of vessels related to the construction of the farm in its area. However, it is justified to implement rules mitigating the effects of the construction (and decommissioning) of the Baltica OWF on the long-tailed duck, i.e. the ban on entering of the ships participating in its construction (and decommissioning) on the area of the Słupsk Bank during the period of the numerous occurrence of this species (November–April) in this area.

As indicated above, the long-tailed duck displaced from the Baltica OWF sea area will most likely migrate to the Słupsk Bank, which is the nearest suitable habitat for this species. It is also likely that some birds will migrate to the *Przybrzeżne wody Bałtyku* site (PLB990002). However, it is not possible to determine their number, due to the lack of knowledge about the extent of this species travels during winter (in the Słupsk Bank site (PLC990001) the subject of protection is the wintering population of the long-tailed duck). The long-tailed ducks can be very mobile and use large areas during wintering.

Nevertheless, the *Przybrzeżne wody Bałtyku* site (PLB990002) is located quite far from the Baltica OWF Area, and thus the probability that birds staying in this area would regularly use the Baltica OWF Area is low. In addition, due to the large distance between them and the presence of other suitable habitats at similar distances, it is not expected that a large proportion of birds displaced from the Baltica OWF Area will migrate to the *Przybrzeżne wody Bałtyku* site (PLB990002). Therefore, it is unlikely that within the *Przybrzeżne wody Bałtyku* site (PLB990002) there will be negative impact of the farm related to the increase in birds' density. Consequently, the negative impact on the *Przybrzeżne wody Bałtyku* site (PLB990002) due to scaring away of the long-tailed duck and its displacement from the habitats can be ruled out.

In conclusion, it should be stated that no significant, negative impact of the Baltica OWF resulting in the displacement from habitats of the bird species which are the subject of protection within the Słupsk Bank (PLC990001) (Table 157) and the *Przybrzeżne wody Bałtyku* (PLB990002) (Table 158) sites is expected.

Table 157. The matrix determining the significance of the Baltica OWF's impact on the Słupsk Bank site (PLC990001) during the construction stage

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	**Insignificant**
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Table 158. The matrix determining the significance of the Baltica OWF's impact on the *Przybrzeżne wody Bałtyku* site (PLB990002) during the construction stage

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	**Insignificant**
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.3.2.2.2 Exploitation phase

The potential impact of wind power stations located in the open sea areas on seabirds relates to increased mortality due to collisions with power stations and to changes in the distribution and behaviour of birds (scaring away and displacing from habitats as well as the barrier effect). The highest death rates are recorded for wind farms located on feeding grounds and on regular migration routes.

Wind farms make changes in the way birds use space, which also affects the sea areas. In the vast majority of cases, power stations act on birds as deterrents and the flying waterbirds evade wind farms at a distance from 100 m to as much as 3000–4000 m. Consequently, the areas directly adjacent to them are much less used as feeding grounds and resting places. The area where the wind power stations are located is bypassed by a significant proportion of the majority of seabirds' species, and in some cases distinctly reduced bird density is observed within a radius of up to 2 km and even up to 4 km from the power station (Petersen et al., 2004). The surveys conducted at the areas occupied by the offshore wind farms prove that most bird species avoid areas occupied by the OWF and adjacent to them.

The types of impacts are described in detail and assessed in section 6.1.2.5.1.5. An abstract and a summary of the conducted analyses of potential impacts related to the space disturbance during the OWF's exploitation phase on the subjects of protection of Natura 2000 sites has been presented below (Table 159). During the construction phase of the Baltica OWF the impacts on seabirds associated with the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) will be mostly irrelevant and the rest of them will be insignificant.

Table 159. The assessment of the potential impacts of the Baltica OWF during the exploitation phase on seabirds that are the subject of protection of the nearby Natura 2000 sites

Type of impact	***Przybrzeżne wody Bałtyku* – The coastal waters of the Baltic Sea (PLB990002)**	**The Słupsk Bank (PLC990001)**
Traffic of water crafts and helicopters	**Insignificant** – vessels and helicopters servicing the farm can move through the area, which will slightly increase the frequency of birds being scared away. Gulls associated with the area may follow water crafts heading in the direction of the OWF.	**Irrelevant** – the movement of vessels involved in the servicing of the farm will not happen in this area.
Scaring off and forcing out of habitats	**Irrelevant** – the analysed species are susceptible to disturbances caused by the presence of a wind farm and the movement of ships. Birds displaced from the farm area are likely to migrate to the Słupsk Bank site (PLC990001), and possibly in a smaller number to the *Przybrzeżne wody Bałtyku* site (PLB990002). Vessels and helicopters servicing the farm will scare the birds away only slightly Gulls are not susceptible to this kind of OWF's impact, on the contrary, they can be attracted by the protruding from the water structures that can be treated by them as resting places.	**Moderate** – analysed species are susceptible to disturbances caused by the presence of a wind farm and the movement of vessels and helicopters. Most likely, they will not be staying within the farm, and the negative impact of the power station's presence will be within a 4 km radius. The relocation of the Baltica OWF built-up area boundary away from the boundary of the Słupsk Bank site (PLC990001) will significantly reduce the scale of scaring birds away and their displacement from habitats. Birds displaced from the farm area are likely to migrate mostly to the Słupsk Bank site (PLC990001), and possibly in a smaller number to the *Przybrzeżne wody Bałtyku* site (PLB990002).
The creation of physical barrier (the presence of power station)	**Negligible** – the considerable distance from the OWF limits the impact on the birds of this area**.** In the case of displacement, birds may encounter a barrier the avoidance of which will slightly increase the energy cost of their passage and limit their ability to use alternative feeding grounds. Gulls are not susceptible to this kind of OWF's impact, on the contrary, they can be attracted by the protruding from the water structures that can be treated by them as resting places.	**Insignificant** – birds (mainly long-tailed ducks) staying on the Słupsk Bank will encounter a barrier limiting their ability to move to a nearby feeding grounds and consequently the need to evade the OWF. The relocation of the area built-up with wind power stations away from the Słupsk Bank site (PLC990001) and leaving space free from installations between the Baltica 2 and Baltica 3 Areas will result in lesser impact.
Collisions with power stations	**Irrelevant** – the scaring effect and the low level of most flights mean that the risk of collisions with power stations is low. Due to the large distance from the investment site, the risk of collision is likely to be limited to birds in the area.	**Irrelevant** – due to the proximity to the investment site, the risk of collisions is higher than for Natura 2000 sites located further away, however, the scaring effect and the low level of most flights will reduce the risk of bird collisions with wind power stations.
The creation of artificial reef	**Irrelevant** – benthophagous birds avoid staying within wind farm areas. Thus it is expected that they will use the new feeding grounds sporadically.	**Irrelevant** – benthophagous birds avoid staying within wind farm areas. Thus it is expected that they will use the new feeding grounds sporadically.
The creation of a closed sea area	**Irrelevant** – ichthyophagous birds avoid staying within wind farm areas. Thus it is expected that they will use the new feeding grounds sporadically.	**Irrelevant** – ichthyophagous birds avoid staying within wind farm areas. Thus it is expected that they will use the new feeding grounds sporadically.

Source: internal data

The assessment of the Baltica OWF's impact on scaring and displacing the birds from their habitats in the Słupsk Bank site (PLC990001), particularly on the long-tailed duck, has been included in the section 6.1.1.4.1.5 on the construction phase of the Baltica OWF.

Another, important for the seabirds, impact of the Baltica OWF during the exploitation phase will be the disturbance of space as a result of its development, which may affect the increase in bird mortality due to collisions. This disturbance will occur in all phases of the project, however, during the exploitation phase it will be the greatest.

Seabirds avoid the area covered with the installations of wind power stations. The barrier effect that will be created by the Baltica OWF and even more by the group of OWF projects that are planned on the north-east slope of the Słupsk Bank is primarily related to migratory seabirds that may head to the nearby areas of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002), where they have their stopping or wintering places.

The results of the surveys on migratory birds conducted for the EIA Report indicate the typically migratory nature of birds' passages over the Baltica OWF Area. Most of the recorded birds' flight trajectories, pointed to their north-east direction in the spring and south-west direction in the autumn. The north-east direction of passages of long-tailed ducks migrating in the spring would indicate their movement from the main wintering grounds in the Pomeranian Bay, the coastal waters of the Baltic Sea and the Słupsk Bank, to the spring habitats in the north-east Baltic, i.e. in the Gulf of Riga and the West Estonian Archipelago. In the autumn, the long-tailed ducks moved in the opposite direction. Velvet scoters, flying north-east in spring, would most likely be flying from the main wintering grounds located in the west (from the Pomeranian Bay and the coastal waters of the Baltic Sea) to spring habitats in the Gulf of Riga and the West Estonian Archipelago, where they usually stay until the middle or end of May before heading to the breeding grounds located further north. Whereas razorbill nests on the islands and coasts of the North Atlantic, and winters on the Baltic Sea. So its flights take place between these destinations, which is in the spring in the north-west direction, and in the autumn, the south-east. This is a different direction of migration than in the case of sea ducks (the long-tailed duck and velvet scoter).

According to modelling conducted for the EIA Report on migratory birds (Appendix 4), the long-tailed ducks flight routes that take into account the barrier effect extend the overall migration route by an average of 12.3 km, which means an overall increase of 0.3% (the whole migration route is approximately 3245 km). This indicates that this effect will be negligible (Keslinka et al., 2017). However, it may be more significant in the case of journeys at shorter distances, e.g. between feeding grounds. The surveys conducted in the area of Hel Peninsula and the Przekop Wisły Vistula estuary (Kotowska, 1997 and unpublished data) indicate that such journeys are frequent. Regularly flying around the extensive barrier of several neighbouring offshore wind farms can have a negative impact on the birds' condition. The behaviour of long-tailed ducks in areas located far from the coast is unknown, thus it cannot be ascertained whether such local travels are as frequent as in the coastal area. However, they cannot be ruled out. In the case of velvet scoter, long-tailed duck and razorbill, the increase in the number of individuals passing during the spring season coincided with the high abundance of these species on the water. Also, the increase in the number of individuals of these species that passed during the autumn coincided in time with the increase in their abundance on the water. Thus it can be assumed that some of the observed flights of the long-tailed ducks, velvet scoters and razorbills, even during spring and autumn migrations, were related to local crossing between feeding grounds (Meissner, 2017).

The single farm barrier will have no significant impact on adult birds migrating to and from wintering grounds located in the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002). Birds will avoid the areas built-up with wind power stations, rather than try to fly between rows of turbines, which is less likely because waterbirds usually bypass such objects at a distance of 2 km. Adult birds will most likely be able to get accustomed to the presence of wind farms (so-called habituation process), but for young birds flying for the first time towards the wintering grounds, bypassing the widespread barrier can be a problem. This is due to their lesser experience causing their increased mortality during the first year of life (Clark and Martin, 2007; Redmond and Murphy, 2012; McKim-Louder et al., 2013).

It cannot be ruled out that the extensive barrier in the form of a group of wind farms on the north-east slope of the Słupsk Bank would have a significant negative impact on the integrity of the Słupsk Bank site (PLC990001) and the cohesion of the Natura 2000 network by hindering the migration of sea ducks (long-tailed duck and velvet scoter) to the wintering grounds located in these areas (and the return of birds from these wintering grounds) and by hindering local crossings. This would also have a negative impact on the subject of protection of these Natura 2000 sites.

It cannot be ruled out that such an extensive barrier could adversely affect razorbill which is the subject of protection of the *Przybrzeżne wody Bałtyku* site (PLB990002), by hindering its local passages, for example in the search for food.

Between the Baltica 2 and the Baltica 3 Areas, there is a space free from installations the width of which in the narrowest place is 5 km. It will allow free passages of birds migrating in the north-east direction. This space will also provide free access for birds onto the Słupsk Bank site (PLC990001), thereby limiting the barrier effect.

Seabirds staying in the area of wind power stations are exposed to collisions with rotors and tall structures that protrude above the surface of the water. The risk of collisions increases with the increasing birds' abundance, but it also depends to a large extent on the time that these birds spend flying and the level at which local crossings occur. In the case of the species considered which are the subjects of protection of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002), i.e. the long-tailed duck, velvet scoter and razorbill, the risk of collision is low, as most of their local flights are at low altitude below the range of working rotors.

During the surveys conducted for the EIA Report on seabirds, it has been found that the long-tailed duck was the most abundant species observed flying. The height of its flights above the water surface was mostly low and reached below 20 m (for 98.68% of long-tailed ducks). At the altitudes likely to cause collisions with a working rotor of a wind turbine (20–100 m and 100–250 m) throughout the entire survey period, only 1.32% of the long-tailed ducks have been found. Also the vast majority of velvet scoters, which are the subject of protection of the *Przybrzeżne wody Bałtyku* site (PLB990002), crossed over the OWF's area at altitudes below 20 m (95.58% of velvet scoters). The remaining velvet scoters (4.42%) were flying at a height of 20–100 m above the water surface, i.e. within the range of the wind turbine's rotor. The majority of the razorbills (98.24%) which are the subject of protection of the *Przybrzeżne wody Bałtyku* site (PLB990002) have also flown at the altitude of below 20 m above the surface of the water. Whereas, the airspace in the 20–100 m zone, which covers the range of the working wind turbine rotors, was used by 1.76% of razorbills (Meissner, 2017).

Due to the above-mentioned results of seabirds' surveys, it was assumed that the minimum clearance between the working area of the rotor and the water surface would be 20 m. This would ensure that the risk of collision of seabirds, which are the subject of protection of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) with working wind power stations will be irrelevant.

The mortality risk of birds that are the subject of protection of the above-mentioned Natura 2000 sites is also being reduced due to the deterrent effect which causes these birds not to approach the wind farms.

Therefore, it is not anticipated, that during the exploitation phase this interaction would have a significant impact on the subjects of protection of the concerned sites the Słupsk Bank (PLC990001) (Table 160) and the *Przybrzeżne wody Bałtyku* (PLB990002) (Table 161).

Table 160. The matrix determining the significance of the Baltica OWF's impact on the Słupsk Bank site (PLC990001) during the exploitation stage

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Table 161. The matrix determining the significance of the Baltica OWF's impact on the *Przybrzeżne wody Bałtyku* site (PLB990002) during the exploitation stage

Impact's significance		Resource value/meaning of the receptor		
		Low	Average	High
Impact's scale	Negligible	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.3.2.2.3 Decommissioning stage

During the decommissioning phase of the Baltica OWF the space occupied by the project will be gradually released until the return to its original state. The process will be accompanied by the reduction of the above described impacts on the Natura 2000 sites. Once the wind turbines are shut down, the risk of bird collision with structural components will be reduced. Dismantling will generate ship traffic within the Baltica OWF's area, but its impact will not be greater than during the construction phase. Gradually, in line with the progress of dismantling work, the barrier effect will also decrease.

The types of impacts are described in detail and assessed in the chapter "The impact on biotic components in the sea". An abstract and a summary of the conducted analyses of potential impacts on the subjects of protection of Natura 2000 sites have been presented below (Table 162). During the decommissioning phase of the Baltica OWF the impacts on seabirds associated with the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002) will be mostly negligible and in one case moderate.

Table 162. The assessment of the potential impacts of the Baltica OWF during the decommissioning phase on seabirds that are the subject of protection of the nearby Natura 2000 sites

Type of impact	*Przybrzeżne wody Bałtyku* – The coastal waters of the Baltic Sea (PLB990002)	The Słupsk Bank (PLC990001)
Traffic of water crafts and helicopters	**Insignificant** – ships involved in the decommissioning of the farm will cross through this area. Birds scared away from the area of work can move to the *Przybrzeżne wody Bałtyku* site.	**Irrelevant** – in line with the proposed mitigation measures, the movement of vessels involved in the decommission of the farm will not happen in this area. Birds scared away from the area of work can move to the area of the Słupsk Bank.
Lighting of the investment site	**Irrelevant** – the considerable distance from the decommissioning site limits the impact on the birds of this area.	**Irrelevant** – the distance from the decommissioning site reduces, to some extent, the impact on the birds of this area. The force of this impact depends on the intensity of the work. The impact should be expected in the part of the farm closest to the boundary of this Natura 2000 site. Birds scared away from the area of work can move to the area of the Słupsk Bank.
Decommissioning of the farm's installations	**Insignificant** (positive) – disassembled turbines will expose to the birds the area, which may become, at least temporarily, an attractive feeding ground for benthophagous birds.	**Moderate** (positive) – disassembled turbines will expose to the birds the area, which may become, at least temporarily, an attractive feeding ground for benthophagous birds.
	Irrelevant (negative) – the considerable distance from the decommissioning site limits the impact on the birds of this area. The strong deterrent effect makes the risk of collision with the non-operational turbines very low.	**Insignificant** (negative) – the considerable distance from the decommissioning site limits the impact on the birds of this area. Birds scared away from the area of the work carried out can move to the area of the Słupsk Bank. The risk of collisions with non-operational turbines is very low.
Barrier caused by the presence of ships	**Irrelevant –** there will be a slight increase in the energy costs for birds related to the bypassing of the area of work. Some birds may move to the waters of the *Przybrzeżne wody Bałtyku* site.	**Irrelevant –** there will be a slight increase in the energy costs for birds related to the bypassing of the area of work. Some birds may move to the Słupsk Bank.
Collisions with ships	**Irrelevant** – the collisions of the representatives of species which are the subjects of protection of the site with ships are extremely unlikely due to the former's mainly daily activity (they can see obstructions) and high sensitivity to interference.	**Irrelevant** – the collisions of the representatives of species which are the subjects of protection of the site with ships are extremely unlikely due to the former's mainly daily activity (they can see obstructions) and high sensitivity to interference.

Source: internal data

In conclusion, it should be stated that during the Baltica OWF's decommissioning phase no significant, negative impact consisting mainly in the disturbance to the birds' presence in the areas analysed and the decrease in the barrier effect for the bird species which are the subject of protection within the Słupsk Bank site (PLC990001) (Table 163) and the *Przybrzeżne wody Bałtyku* site (PLB990002) (Table 164) is expected. In the case of the Słupsk Bank site (PLC990001), while determining the impact of the Baltica OWF, negative impacts were taken into account.

Table 163. The matrix determining the significance of the Baltica OWF's impact on the Słupsk Bank site (PLC990001) during the decommissioning stage

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	**Insignificant**
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

Table 164. The matrix determining the significance of the Baltica OWF's impact on the *Przybrzeżne wody Bałtyku* site (PLB990002) during the decommissioning stage

Impact's significance		Resource value/meaning of the receptor		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	**Insignificant**
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.3.2.3 Integrity

Due to the location of the Baltica OWF, the impact of the planned investment on the integrity of the Natura 2000 site can be seen in the context of the nearest to the network area, i.e. the Słupsk Bank site (PLC990001).

Within the Słupsk Bank site (PLC990001) there are two natural habitats for the protection of which this site has been delineated, i.e. the Sublittoral sandbanks (1110) and the Reefs (1170). At the same time, this area is a place of occurrence of birds, which are also the subject of its protection. Therefore, preserving the integrity of the Słupsk Bank site will depend on the lack of significant impact on both the subjects of protection (species and habitats) and on other elements of environment that may have an indirect impact on this site's functioning. The potential impact on individual subjects of protection has been discussed in earlier chapters. It has been shown there, that the subjects of protection will not be affected significantly, by the planned investment, in particular, by the underwater noise as well as the increase in suspended solids and the sedimentation resulting therefrom.

Other important elements of the environment of the Słupsk Bank site (PLC990001) that have an influence on the preservation of this area in an undeteriorated state include: the quality of water and seabed sediments, the status of habitats for benthic and pelagic organisms, which represent the diversity of this area and are primarily the food supply for birds. As indicated in the chapter on the impact on seabed sediments, the planned investment's impact on them will be irrelevant and occur only locally, i.e. outside the Natura 2000 site. Also, the impact on the pelagic habitat, both in terms of water dynamics and its physico-chemical parameters, has been determined as irrelevant. In view of the above, and considering the location of the planned Baltica OWF outside of the Słupsk Bank site (PLC990001), its construction will not fragment the site, nor will it lead to disturbances that could affect the size of the population, the density or the existing balance between the key organisms and the abiotic elements of this area.

Concluding, it can be stated that the significance of the Baltica OWF's impact on the integrity of the Słupsk Bank site (PLC990001) will be insignificant (Table 165).

Table 165. The matrix determining the significance of the Baltica OWF's impact on the integrity of the Słupsk Bank site (PLC990001)

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.3.2.4 The coherence of the Natura 2000 network

Very poor knowledge of birds in the Polish Exclusive Economic Zone and the lack of data on the movements of birds and marine mammals within its area is a serious impediment in determining the possible disturbance of the coherence of the Natura 2000 network, understood as a set of environmental features and elements that provide connection between particular areas. At the current stage there is lack knowledge of seabirds congregating on the Baltic Sea away from the coast, thus the relevant links between the different Natura 2000 sites cannot be fully assessed.

The Baltica OWF Area is located near the Słupsk Bank site (PLC990001), which is an important wintering ground for the long-tailed duck. An important aspect of the Natura 2000 sites coherence is to ensure accessibility to this area.

As part of the planned project, a space free from wind farm installations near the south-western border of the Baltica 2 Area and the Słupsk Bank site (PLC990001) is designed, which will significantly reduce the impact of the offshore wind farm on the neighbouring Natura 2000 site. Also, the creation of a migration corridor between the areas of the Baltica 2 and the Baltica 3, free from wind power stations, will have a positive influence on the coherence of the Natura 2000 network by enabling the birds an unconstrained migration in the north-east to south-west direction, where most of the bird species assessed in terms of the OWF's influence on seabirds migrate.

There is no clear data on the occurrence and preferred routes of marine mammals' migrations. According to the descriptions of porpoise biology, it feeds and lives mainly in coastal waters, and the determinant of its occurrence is the availability of food. Also, the grey seal is recorded primarily in the coastal zone, and its only permanent place of residence is found in the vicinity of the Przekop Wisły Vistula estuary. Porpoise is the subject of protection in three coastal areas of the Natura 2000 network in the PMA: the *Ostoja na Zatoce Pomorskiej* site (PLH990002), the *Ostoja Słowińska* site

(PLH220023) and the Puck Bay and Hel Peninsula site (PLH220032) as well as in Hoburgs Bank och Midsjöbankarna site (SE0330308) in the Swedish marine area. The Natura 2000 sites, the subject of protection of which is the grey seal, are located in the coastal zone, i.e. in the central coast area (the *Ostoja Słowińska* site (PLH220023)), the Bay of Puck (the Puck Bay and Hel Peninsula site (PLH220032)), the Vistula estuary (the *Ostoja w Ujściu Wisły*) site (PLH220044)) and on the Vistula Lagoon (the *Zalew Wiślany and Mierzeja Wiślana* site (PLH280007)). The construction of the Baltica OWF at a considerable distance from these areas and the potential routes of marine mammals' migration between these sites will not affect their migration potential, and consequently on the coherence of the Natura 2000 network.

Bearing in mind the above, it can be assumed that the impact's significance of the investment in question on the Natura 2000 network's coherence will be of little importance. (Table 166)

Table 166. The matrix determining the significance of the Baltica OWF's impact on the coherence of the Natura 2000 network

Impact's significance		**Resource value/meaning of the receptor**		
		Low	**Average**	**High**
Impact's scale	**Negligible**	Irrelevant	Irrelevant	Insignificant
	Low	Irrelevant	Insignificant	Moderate
	Average	Insignificant	Moderate	Significant
	High	Moderate	Significant	Significant

Source: internal data

6.3.2.5 Summary of the main assessment

As a result of the main assessment of the Baltica OWF's impact on bird species which are the subject of protection of the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002), as well as the integrity of the Słupsk Bank site (PLC990001) and the coherence of the Natura 2000 network, it can be stated that the planned project, both in the form proposed by the Applicant as well as a reasonable alternative will not cause significant impact on the analysed Natura 2000 sites.

7 Cumulative impacts of the planned project (taking into account the existing, being implemented and planned projects and activities)

7.1 Preface

The assessment of the cumulative impact resulting from the implementation of the Baltica OWF in connection with other projects has taken into account, in accordance with Art. 66 of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (Journal of Laws of 2017, item 1405) the existing, being implemented or planned projects for which the decisions on environmental conditions have been made and which are within the area where the implementation of the Baltica OWF is planned, as well as the projects in the area of the Baltica OWF's impact or the impact of which is within the range of the Baltica OWF's impact – in such scope within which their impact can lead to accumulation of the impacts with the Baltica OWF's impact.

Currently, there are no existing or underway projects in the Baltica OWF's area, which may generate cumulative impacts with the potential impacts resulting from the construction, exploitation or decommissioning of the Baltica OWF. The commencement of the construction activities in the Baltica OWF's area for the period of implementation of this project will limit the possibility of realization of other investment projects in this area.

The possibility of generating cumulative effects will result from the implementation of projects outside the Baltica OWF's area.

7.2 Existing, being implemented and projects with issued decision on environmental conditions

Within the PMA, the projects connected to the hydrocarbon and gas extractions, which are issued with decisions on environmental conditions, are being implemented or planned (Figure 66), i.e.:

- Re-injecting water into deposit, through selected, existing boreholes to crude oil deposit B3, located in the Polish Exclusive Economic Zone of the Baltic Sea – existing license No. 108/94 issued by the Minister of Environmental Protection, Natural Resources and Forestry on 29 July 1994 and "Łeba" mining area with an area of 31.168 km^2, which coincides with the mining area (decision no. RDOS-22-WOO.6670/62-5/09/AT dated 19 October 2009 (hereinafter: Deposit B30];
- the extraction of natural gas from subsea hydrocarbon deposits B4 and B6 and its transmission to the installations of the electrical and heating power station in Władysławowo [decision no.: RDOŚ-Gd-WOO.4211.12.2014.ER.8 dated 16 May 2014 (hereinafter: Deposits B4 and B6.
- the extraction of crude oil and co-occurring natural gas from the deposit B8 located in the Polish Exclusive Economic Zone of the Baltic Sea using an offshore platform with the ability of injecting water into the bedrock (decision no.: RDOŚ-Gd-WOO.4211.16.2015.ER.6 dated 11 August 2015 (hereinafter: Deposit B8)].

In addition, two projects related to the construction of the OWF, which are in its neighbourhood (Figure 66) are issued with the decisions on environmental conditions, i.e.:

- Construction of the Bałtyk Środkowy III offshore wind farm [decision no.: RDOŚ-Gd-WOO.4211.12.2015.KP.22 dated 07 July 2016 (BŚIII)];
- Construction of the BŚII offshore wind farm [decision no.: RDOŚ-Gd-WOO.4211.26.2015.KSZ dated 27 March 2017 (BŚII)].

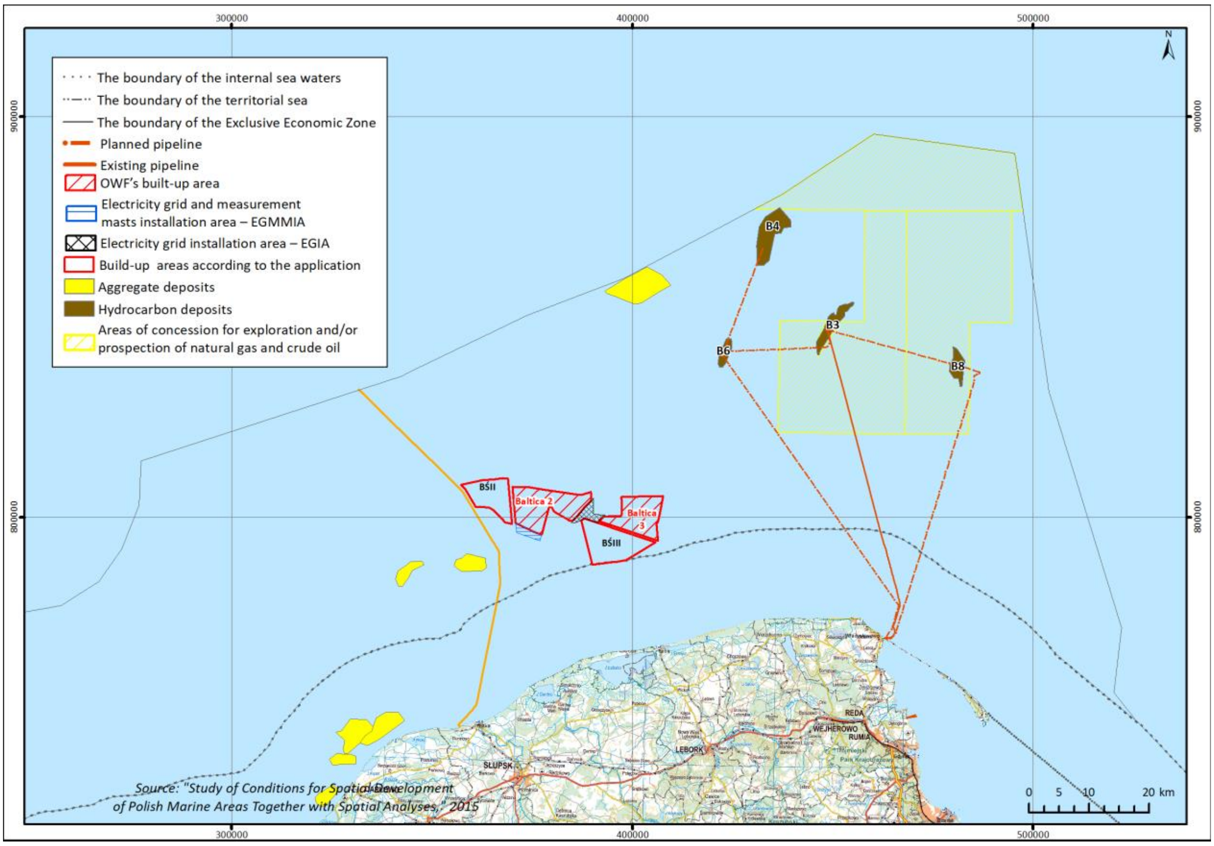


Figure 66. The location of the Baltica OWF Area and other projects within PMA with issued decisions on environmental conditions

Source: internal data

At present, it is difficult to predict in what time frame the projects of construction and operation of offshore wind farms and investments related to the extraction of hydrocarbons and gas in the vicinity of the Baltica OWF Area will be implemented. This is due to the fact that there are many conditions, also independent of investors, such as procedural and financial requirements which have a significant impact on the decision to commence the implementation of the investment.

7.3 The types of impacts which may cause cumulative impact

The assessment of the Baltica OWF's impact on particular elements of the environment including the impact's significance has been presented in chapter 6. The cumulative impact of the Baltica OWF and other offshore wind farms may occur if actions generating similar impact are carried out simultaneously. In the case of impacts that are classified as temporary, the cases of simultaneous execution of the same actions by different Investors should be considered as rare. Also, the impacts that have been identified as local will not result in cumulative impact, as in most cases their range will be limited to the built-up area of the Baltica OWF.

Therefore, the Baltica OWF's impacts, which may generate a cumulative impact with other projects, include impacts that are at least medium-term and their range extends beyond the built-up area of the Baltica OWF, i.e.:

- space disturbances, including: barriers restricting the free movement of birds and the displacement of birds from their habitats, disturbances in the landscape and disturbances in radar work as well as restrictions on fishing;
- underwater noise;
- the increase in suspended solids and their sedimentation.

7.4 The identification of projects which may cause cumulative impact

The enterprises listed in the section 7.2, which have obtained decisions environmental conditions, can be divided into two groups, i.e. related to the extraction of hydrocarbons and gas and related to the acquisition of energy from wind energy in offshore areas. Each of these activities has its specific characteristics, including different environmental impacts and their type, extent, time range and scale.

Decisions on environmental conditions for the projects related to the extraction of hydrocarbon and gas indicate impacts and their significance. In the context of the impact that characterizes the Baltica OWF, and which may generate a cumulative impact, the impacts of hydrocarbon and gas extraction are so irrelevant that they will not cause cumulative impact.

In the decision on environmental conditions for Deposit B8, it was indicated that the noise associated with the operation of the machines on the platform would not be emitted into the waters and thus no adverse impact on the surroundings or the marine environment is expected. Similarly, for Deposits B4 and B6 and Deposit B3, the impact of the noise generated during the work related to these projects will be insignificant. In the case of Deposits B4 and B6, the gas pipeline construction will cause local and temporary water turbidity only in the immediate vicinity of the works. Entries from the environmental decisions that indicate the possible impacts of the implementation of these projects have been presented in the table (Table 167).

Table 167. Entries from the decision on environmental conditions for projects: Deposit B8, Deposit B4 and B6 and Deposit B3

Investment	Entries from decisions about environmental conditions
Deposit B8	No negative impact of the exploitation of the Deposit B8, including the injection of reservoir waters, on geological structure and seabed sediment pollution in the mining area is expected.
	The noise associated with the operation of machines on the platform will not be emitted into the water, so no harmful effects on the surroundings and the aquatic environment are anticipated.
	No cumulative impact of simultaneously carried out prospect well drilling and seismic prospecting within other concessions owned by LOTOS Petrobaltic S.A. is expected
Deposit B4 and B6.	As the planned boreholes will be drilled successively by the same drilling rig, no cumulative effects are anticipated due to the drilling of the planned exploitation boreholes in Deposits B4 and B6 with prospecting wells drilling in adjacent exploration concessions.
	According to the EIA Report, the underwater noise emitted in connection with the planned work will not exceed the background parameters.
	The impact on the ichthyofauna will consist of the local and temporary turbidity of the water during the excavation and the burying of the gas pipeline, which may affect particularly the individuals in the early stages of development. Discontinuation of work has been ordered in spawning season of species staying permanently or coming during spawning season into the area of work.
	No negative impact on marine mammals is expected due to their unlikely presence in the work area.
Deposit B3	Noise emission into the environment, related to the operation of pumps and other equipment which is part of the system for purification and injection of water. The noise intensity concerns the area restricted by the drilling platform structure. Noise has no harmful effects on the

Investment	Entries from decisions about environmental conditions
	surroundings and the aquatic environment and is not emitted into the waters around the platform.

Source: internal data based on the issued decisions (see section 7.2)

In case of the implementation of the two adjoining the Baltica OWF Area offshore wind farms, i.e. BŚIII and BŚII, due to the similar nature of the projects and the resulting similar impacts as well as their proximity, cumulative impacts may occur. The OWF's built-up area, irrespective of the project variant, is 237.63 km^2. The number of offshore wind power stations within the Baltica OWF Area is at most 209 for the variant proposed by the Applicant or 319 for the rational alternative variant.

Within the BŚII and BŚIII areas, the number of wind turbines will reach the maximum of 120, which together with the Baltica OWF will add up to 449 offshore wind turbines for the variant proposed by the Applicant and to 559 offshore wind turbines for the rational alternative. Each of the investments will also include the associated infrastructure and cables within the OWF.

7.5 Assessment of cumulative impacts

7.5.1 Space disturbances

In assessing the cumulative effects resulting from space disturbance, the focus was primarily on impacts on birds, the significance of which was assessed as the highest, i.e. as moderate. Thus the impact on the exclusion of seabirds from feeding grounds (scaring away and displacement from habitats) and the creation of a barrier for birds caused by the presence of wind turbines has been analysed. The assessment of cumulative impact does not, however, account for the impact on the black- and red-throated loon of "creation of a closed sea area," which for the exploitation phase of the Baltica OWF has been given moderate significance, due to the very small number of these birds within the Baltica OWF. The relatively high importance given to this impact was primarily due to the high conservation status of these species of loons and their high sensitivity to the impact of offshore wind farms.

7.5.1.1 Exclusion of feeding grounds

Exclusion from the feeding grounds may be caused by the vessels and helicopters' traffic, emission of noise and vibration, illumination of the investment site and the destruction of benthos during various phases of the investment (the impact on the long-tailed duck, velvet scoter, black-throated loon and red-throated loon).

The physical structure of the OWF, the emission of light and noise can be a source of disturbance for some sensitive bird species (long-tailed duck, velvet scoter and loons) and cause their complete or partial move outside the farm area. The level of disturbance depends on the number of offshore wind turbines, their size and the emitted light and noise, but for both variants of the analysed investment will be similar due to the strong effect of deterring birds from offshore wind farms area and the same size of development area in both variants of the OWF.

The issues of displacement from habitats and scaring away the seabirds have been described in chapter 6. The area of the limited accessibility of feeding grounds for seabirds increases with the increasing area adjacent to the Baltica OWF occupied by other OWFs. Different bird species are susceptible to a different degree to the scaring away and displacement from habitats caused by the presence of wind turbines. For example, gulls, including the relatively numerous within the OWF

Area, European herring gull, are not sensitive to this impact (Petersen et al., 2006). More sensitive to the displacement from habitats are species such as the long-tailed duck, velvet scoter or loons, however, out of these species only the long-tailed duck has occurred numerously within the Baltica OWF Area.

The cumulative effect of displacement from habitats of the long-tailed duck's winter population, which is the subject of protection of the Natura 2000 site Słupsk Bank (PLC990001), has been presented in the table (Table 168). In the winter, most long-tailed ducks will potentially be displaced from the BŚII area, and without applying the restriction on the Baltica OWF development area, which the Applicant decided on, the next place in terms of displacement from habitats of the long-tailed duck wintering population would be held by the Baltica OWF. By restricting the development area of the Baltica OWF and removing the boundary of the area built-up with wind turbines away from the Słupsk Bank site (PLC990001), the number of this species' individuals displaced in winter from habitats will be four times lower than for the BŚII. It will also be smaller than the number of long-tailed ducks displaced from the BŚIII area, although the area of the Baltica OWF is significantly larger than the area of the BŚIII.

The total displaced from habitats long-tailed ducks of the wintering population for the Baltica OWF Area and the two farms for which environmental decisions have already been issued (BŚII and BŚIII) will equal 9839 individuals. This means that in the case of simultaneous construction, exploitation or decommissioning of these wind farms, their cumulative impact concerning the displacement from habitats of the long-tailed duck's wintering population may have moderate significance (displacement 4.69% of the national long-tailed duck population N = 210 000, [Skov et al., 2011]). However, it is unlikely that intensive construction or demolition works in the areas of these wind farms will be carried out simultaneously, and their exploitation phases will probably overlap partially.

Table 168. Estimated long-tailed duck's abundances (most abundant in the Polish Exclusive Economic Zone waters) and the quantity of their potential displacement during wintering by the Baltica, BŚII and BŚIII OWFs

Offshore wind farm	Project area + buffer zone [km^2]	Total number of birds that will be displaced*
The Baltica OWF	237,63 + 495,88	1358
BŚII	122,00 + 82,00	6038
BŚIII	116,60 + 109,00	2443
In total	476,23 + 686,88	9839

** A 75% level of displacement for the main farm area and a 50% level of displacement for the buffer zone from 0 to 2 km from the farm boundary have been established.*
Source: internal data based on Meissner, 2015c

7.5.1.2 The creation of physical barrier

The erected during the construction phase subsequent wind turbines and power substations will gradually occupy an increasing part of the farm's area, creating a physical barrier for migratory birds and seabirds crossing locally between feeding grounds and/or resting areas that are reluctant to fly over obstacles. The barrier effect scale will depend on the number of offshore wind turbines erected, their density, size, the clearance between the surface of the sea and the lower position of the rotor blade, rotor's diameter and the emitted light and noise. However, the choice of the variant will not have a significant influence on the size and significance of the impact of the investment on seabirds (the same development area). This is due to the identified clear avoidance by seabirds of the area occupied by wind power stations and their decline in the radius of up to 2 km, and to a lesser extent even up to 4 km from the OWF (Christensen et al., 2003; Petersen et al., 2006; Leopold et al., 2011).

The most important parameters influencing the cumulative impact are: the total number of wind turbines in the neighbouring OWFs, the density of wind turbines within the farm area and the size of the development area. The total maximal number of wind power stations in the Baltica OWF Area and the two offshore wind farms: BŚII and BŚIII, will be 449 in the variant proposed by the Applicant, and 559 in the rational alternative variant. The location of offshore wind turbines in these areas is not yet known. Therefore, in order to overcome the impact of the compact barrier created by the wind turbines, the Applicant decided to create a space free from installations between the Baltica 2 Area and the Baltica 3 Area. The free from development space issue has been described in the section 2.1.2.

For the analysis of the cumulative impact of the Baltica OWF during the construction phase on seabirds, a simplified assumption has been adopted that it would coincide with the exploitation of the offshore wind farms BŚII and BŚIII, for which decisions on environmental conditions have been issued. The analysis of these potential cumulative effects during the construction phase of the Baltica OWF on particular bird species has been presented in the table (Table 169).

Table 169. The potential cumulative impact during the construction phase of the Baltica OWF with the simultaneous exploitation of the BŚII and BŚIII OWFs, for which environmental decisions have already been issued

Species	**Binomial nomenclature**	**The scale of cumulative impact**	**Cumulative impact's significance**
Long-tailed duck	*Clangula hyemalis*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds	Moderate
Velvet scoter	*Melanitta fusca*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds	Moderate
Razorbill	*Alca torda*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds	Insignificant
Common murre	*Uria aalge*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds	Insignificant
European herring gull	*Larus argentatus*	Low – the short distance between the farms increases the deterrent effect but the species is not timid; the European herring gull has a low conservation status and it is a common species; in the open sea it usually accompanies fishing vessels	Irrelevant
Common gull	*Larus canus*	Low – the short distance between the farms increases the deterrent effect but the species is not timid; the common gull is rarely observed in the open sea, where it usually accompanies fishing vessels	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low – the short distance between the farms increases the deterrent effect but the species is not timid; the gull occurs in the area of the investment not abundantly	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low – the short distance between the farms increases the deterrent effect but the species is not timid; the Lesser black-backed gull has a low conservation status and it is a common species; in the open sea it usually accompanies fishing vessels; it occurs in the area of the investment during its migration	Irrelevant

Species	Binomial nomenclature	The scale of cumulative impact	Cumulative impact's significance
		period	
Black-throated loon	*Gavia arctica*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds but the species does not occur in the Areas of the Baltica, BŚII and BŚIII OWFs	Moderate
Red-throated loon	*Gavia stellata*	Medium – the short distance between the farms increases the deterrent effect and creates a barrier for the passing birds but the species does not occur in the Areas of the Baltica, BŚII and BŚIII OWFs	Moderate

Source: internal data

For four of the ten species of seabirds, the scale of the cumulative impact was evaluated as average. The wind power stations built or exploited on a large area of neighbouring farms will cause the birds to escape from the vast area, limiting their access to the feeding grounds. The high timidity of these species, however, diminishes the risk of collisions with power stations. The scale of impact on all four species of gulls was defined as small. The European herring gull has a low conservation status and is a common species whose appearance on the open sea is strongly associated with the presence of fishing boats. The lesser black-backed gull behaves similarly, but it is much less abundant within the surveyed area than the European herring gull. Little gull also occurs in this part of the Baltic Sea sparsely, and therefore no significant adverse impact of simultaneous construction of several wind farms on its population is expected. Whereas, the common gull is a waterbird rarely seen away from the coast.

In assessing the cumulative effects during the exploitation phase of the Baltica OWF the maximum option has been adopted, i.e. the one in which the Baltica, BŚII and BŚIII OWFs are fully completed and in exploitation phase. In the context of the cumulative impact of the Baltica OWF and two other farms (BŚII and BŚIII), it can be stated that the Applicant's decision to reduce the development area of the Baltica OWF (the removal of the boundary of the development area away from the Natura 2000 site Słupsk Bank (PLC990001), as in the case of BŚII and leaving a free from installations space between the Baltica 2 Area and the Baltica 3 Area) will significantly reduce the cumulative impact of these three farms, including the exploitation phase, on marine birds.

The single OWF barrier will have no significant impact on adult birds migrating to and from wintering grounds located in the Słupsk Bank site (PLC990001) and the *Przybrzeżne wody Bałtyku* site (PLB990002). However, the enlargement of the area built-up with wind turbines, resulting from the construction of subsequent adjacent OWFs (BŚII and BŚIII), could have a significant negative impact on birds, in the absence of a free space for their direct access to feeding grounds in the Słupsk Bank site. Birds would avoid the areas built-up with wind power stations, rather than try to fly between rows of turbines (which is less likely because waterbirds usually bypass such objects at a distance of 2 km). Adult birds would most likely be able to get accustomed to the presence of OWFs, but for young birds flying for the first time towards the wintering grounds, bypassing the widespread barrier could be a problem. This is due to their lesser experience causing their increased mortality during the first year of life (Clark and Martin, 2007; Redmond and Murphy, 2012; McKim-Louder et al., 2013). Hence, the Applicant's decision to leave a free from installations space between the Baltica 2 Area and the

Baltica 3 Area, whereby the cumulative impact of the Baltica OWF in the exploitation phase with other OWFs will not be significant for seabirds (Table 170).

Table 170. The potential cumulative impact during the construction phase of the Baltica OWF with the simultaneous exploitation of the BŚII and BŚIII OWFs

Species	Binomial nomenclature	The scale of cumulative impact	Cumulative impact's significance
Long-tailed duck	*Clangula hyemalis*	Average – the creation of a widespread barrier; a species of high conservation status and highly timid; however, the Applicant's decision to reduce the development area of the Baltica OWF (the removal of the boundary of the development area away from the Natura 2000 site Słupsk Bank (PLC990001) and leaving a free from installations space between the Baltica 2 Area and the Baltica 3 Area) reduced the scale of the cumulative impact on this species	Moderate
Velvet scoter	*Melanitta fusca*	Average – the creation of a widespread barrier; a species of high conservation status and highly timid; however, it does not occur numerously within the area	Moderate
Razorbill	*Alca torda*	Average – the creation of a widespread barrier; species with low conservation status and moderately timid; however, in average number within the area	Insignificant
Common murre	*Uria aalge*	Average – the creation of a widespread barrier; species with low conservation status and moderately timid; however, in average number within the area	Insignificant
European herring gull	*Larus argentatus*	Average – the creation of a widespread barrier; a species of low conservation status and low timidity; its presence within the discussed area depends on fishing activities (the birds accompany fishing vessels)	Insignificant
Common gull	*Larus canus*	Low – the creation of a widespread barrier; a species of low timidity, rarely occurring in open sea away from the coast	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low – very low abundance of this species within the discussed area	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Average – the creation of a widespread barrier; a species of low conservation status and low timidity; its presence within the discussed area depends on fishing activities (the birds accompany fishing vessels)	Insignificant
Black-throated loon	*Gavia arctica*	Low – the creation of a widespread barrier; a species of high conservation status and highly timid; however, its abundance within the discussed area is very low	Moderate
Red-throated loon	*Gavia stellata*	Low – the creation of a widespread barrier; a species of high conservation status and highly timid; however, its abundance within the discussed area is very low	Moderate

Source: internal data

None of the Baltic wind farms have entered the decommissioning phase yet and therefore it is difficult to predict how many groups of birds would appear in the zone released from wind power stations. When assessing the size of cumulative impacts during the phase of decommissioning of the Baltica OWF it was assumed that at the time the BŚII and BŚIII farms will be either in the phase of decommissioning or already decommissioned.

It is anticipated that with the gradual dismantling of wind turbines, the negative impacts consisting of the deterrence of birds from the area occupied by them will be reduced. The area freed from the wind power stations will most likely become at least temporarily an attractive feeding ground for sea ducks (mainly long-tailed duck), because during the exploitation of wind farms, zoobenthos groups, which are these birds feed, would be formed on the seabed. However, due to the direction of migration of most birds, including seabirds, in the area of investment, along the north-east to south-west line, the wind farms most likely still in operation at that time will have an impact on them. This could result in a move of the bird migration front, which would otherwise fly over the area occupied by these two farms, to the areas of the decommissioned Baltica OWF. Birds will be able to use the food supplies formed during the exploitation of the Baltica OWF, though in accordance with the performed surveys, this may be associated mainly with the sea areas with the depth of up to 30 m, where mostly benthivorous species tend to feed. In the case of the Baltica OWF together with the BŚII and BŚIII, the area constitutes approx. 18% of the built-up area of these farms, i.e. almost 74 km^2. The scale and significance of the cumulative impact of the Baltica OWF with the BŚII and BŚIII in the decommissioning phase on individual species of birds has been presented in the table (Table 171)

Table 171. The potential impact of the Baltica OWF in the decommissioning phase accumulated with BŚII and BŚIII

Species	Binomial nomenclature	The scale of cumulative impact	Cumulative impact's significance
Long-tailed duck	*Clangula hyemalis*	Average – a species of high conservation status and highly timid	Moderate
Velvet scoter	*Melanitta fusca*	Average – a species of high conservation status and highly timid	Moderate
Razorbill	*Alca torda*	Low – a species of low conservation status and moderately timid	Irrelevant
Common murre	*Uria aalge*	Low – a species of low conservation status and moderately timid	Irrelevant
European herring gull	*Larus argentatus*	Low – a species of low conservation status and moderately timid; gathers in the open sea by ships and structures protruding from the water, which provide the gulls with a place to rest; its abundance within the discussed area depends on fishing activities (the birds accompany fishing vessels)	Irrelevant
Common gull	*Larus canus*	Low – a species of low timidity, a waterbird species which rarely occur in the open sea away from the coast	Irrelevant
Little gull	*Hydrocoloeus minutus*	Low – a species of low timidity and abundance	Irrelevant
Lesser black-backed gull	*Larus fuscus*	Low – moderately timid species; gathers in the open sea by ships and structures protruding from the water, which provide the gulls with a place to rest; its abundance within the discussed area depends on fishing activities (the birds accompany fishing vessels)	Irrelevant
Black-throated loon	*Gavia arctica*	Low – a species of high conservation status and highly timid but occurring in small numbers within the areas of the Baltica, BŚII and BŚIII OWFs	Moderate
Red-throated loon	*Gavia stellata*	Low – a species of high conservation status and highly timid but occurring in small numbers within the areas of the Baltica, BŚII and BŚIII OWFs	Moderate

Source: internal data

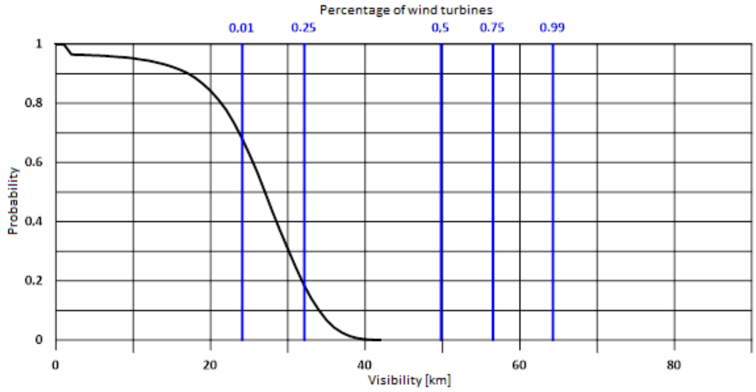
The creation of a physical barrier may also affect birds migrating over the areas of the Baltica OWF, BŚII and BŚIII. In this case, we can meet with the effect of bypassing the barrier and the possibility of collisions with offshore wind power stations. During the overlapping construction and exploitation phases, the bypassing may concern the power stations under construction (unfinished and unexploited), exploited power stations and vessels participating in the construction works. Due to the fact that construction works will be limited in time and space to the currently constructed wind power stations for logistic reasons (limited number of construction teams), the scale of impact of ship barriers and collisions with ships during the construction and decommissioning phase of the OWF was considered negligible, which causes the resultant significance of these impacts to be at most insignificant (only for species of great importance). According to Appendix 4, the impact's significance concerning the collisions of migratory birds with offshore wind power stations is the same for the cumulative impact as for the individual impact of the Baltica OWF. It was estimated at values from irrelevant to insignificant.

7.5.1.3 Landscape disturbances

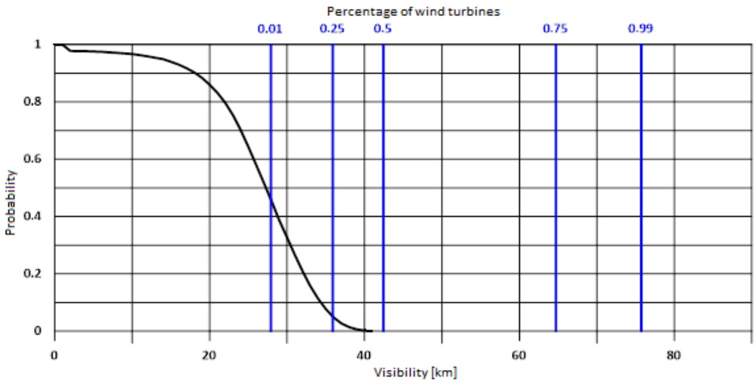
Landscape disturbances in the case of cumulative impacts related to the simultaneous exploitation of the Baltica OWF, BŚII and BŚIII, as described in the section 6.1.2.8, depend mostly on weather conditions – visibility and the curvature of the Earth.

The function of visibility exceedance (how often visibility is greater than the specific value) based on the UMPL atmospheric model data (calculated in ICM UW – about 5 years' worth of data) has been presented in the charts (Figure 52) The functions of visibility exaggeration have been presented for 4 locations, i.e. Łeba, Lubiatowo, Dębki and Ustka. The charts clearly show that in the case of Dębki and Ustka there will be virtually no situation where the wind power stations of the Baltica OWF, BŚII and BŚIII would be visible from these towns. In the case of Łeba, single windmills can be seen for more than 5000 hours per year, but 50% of wind power stations installed in the above mentioned OWFs will never be visible. In the case of Lubiatowo, individual wind turbines can be seen for about 4000 hours a year, while no more than 25% of wind power stations installed in the above mentioned OWFs will ever be visible.

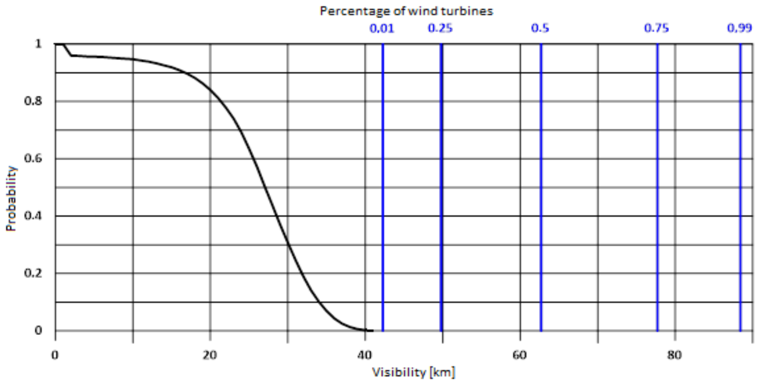
A)



B)



C)



D)

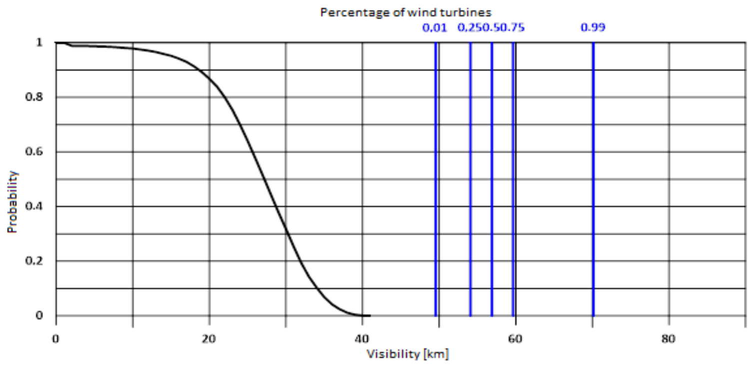


Figure 67. The function of exceedances for the visibility from the town: Łeba (A), Lubiatowo (B), Dębki (C) and Ustka (D) including the distances of the offshore wind power stations of the Baltica, BŚII and BŚIII OWFs

Source: internal data

Additionally, the constraint associated with the visibility of wind turbines from land is the Earth's curvature and the associated height restriction of the objects that can be seen from a great distance. In a practical manner, this limitation is shown by the fact that the greater the distance between the observer and the offshore wind power stations, the smaller part of them can be seen. The visualisation of the views of the Baltica OWF together with BŚII and BŚIII from Łeba has been presented in the photos (Photo 3 and Photo 4) below.

Photo 3. The visualisation of the views of the Baltica OWF together with BŚII and BŚIII from Łeba during the day

Source: internal data

Photo 4. The visualisation of the views of the Baltica OWF together with BŚII and BŚIII from Łeba at dusk

Source: internal data

As in the case of non-cumulative effects the impact was assessed as irrelevant, although it varies depending on the observer's distance from the OWF. In the open sea, the landscape is not immune to the disturbance, but its value is not high, because very few people and only for a short time will be exposed to the change of landscape, and some of them (e.g. tourists) may perceive it as advantageous or interesting. The impact will be huge, it will decrease along with the distance from the OWF. This change will be long-time but reversible. On land, the upper fragments of the OWF can be seen sporadically (Photo 3 and Photo 4).

7.5.1.4 Interference in the operation of systems using EMF

Disturbances in the operation of systems using EMF, such as navigation radars of water crafts, coastal surveillance systems, radio communication equipment and terrestrial radio and television broadcasting, will certainly take place, both in the case of the exclusive existence of the Baltica OWF and in the case of the coexistence of the Baltica, BŚII and BŚIII OWFs.

As in the case of the exclusive impact of the Baltica OWF, in accordance with the conditions included in the PSZW (also for BŚII and BŚIII) investors, during the construction design stage, are required to agree with relevant users (the Border Guard, Ministry of National Defense and maritime administration), to implement solutions that will allow them to accept the Baltica, BŚII and BŚIII OWFs' impact on communication and radiolocation systems. Therefore, despite the importance of these systems for society and the state's interest, it should be assumed that the significance of the Baltica, BŚII and BŚIII OWFs' impact on these systems will be irrelevant.

To achieve the above mentioned requirements, it can be expected that remedial measures will be necessary, such as the installation on the northern outskirts of the Baltica and BŚII OWFs' communication and radar systems, supporting especially these maritime administration, Border Guard and Polish Navy systems, which are based on the systems of stations located on the shore. The installed devices will have to be communicated in real time with the relevant organs using dedicated teletechnical links. The determination of concrete solutions will only be possible at the construction permit stage, once the parameters of the turbines (the shape of blades, tower and nacelle of the wind turbine as well as its number and distribution) for all of the aforementioned OWFs are known.

7.5.1.5 Fisheries

In the immediate vicinity of the planned Baltica OWF, two other OWFs have been issued with decisions on environmental conditions (BŚII and BŚIII). In the case of the non-availability of the area free from installations between the planned farms, the route of fishing vessels stationed in Ustka, and especially in Łeba, will be extended (Figure 68). The use of an undeveloped area between Baltica 2 Area and Baltica 3 Area as a route leading to fisheries located north of the OWF could significantly reduce this additional distance.

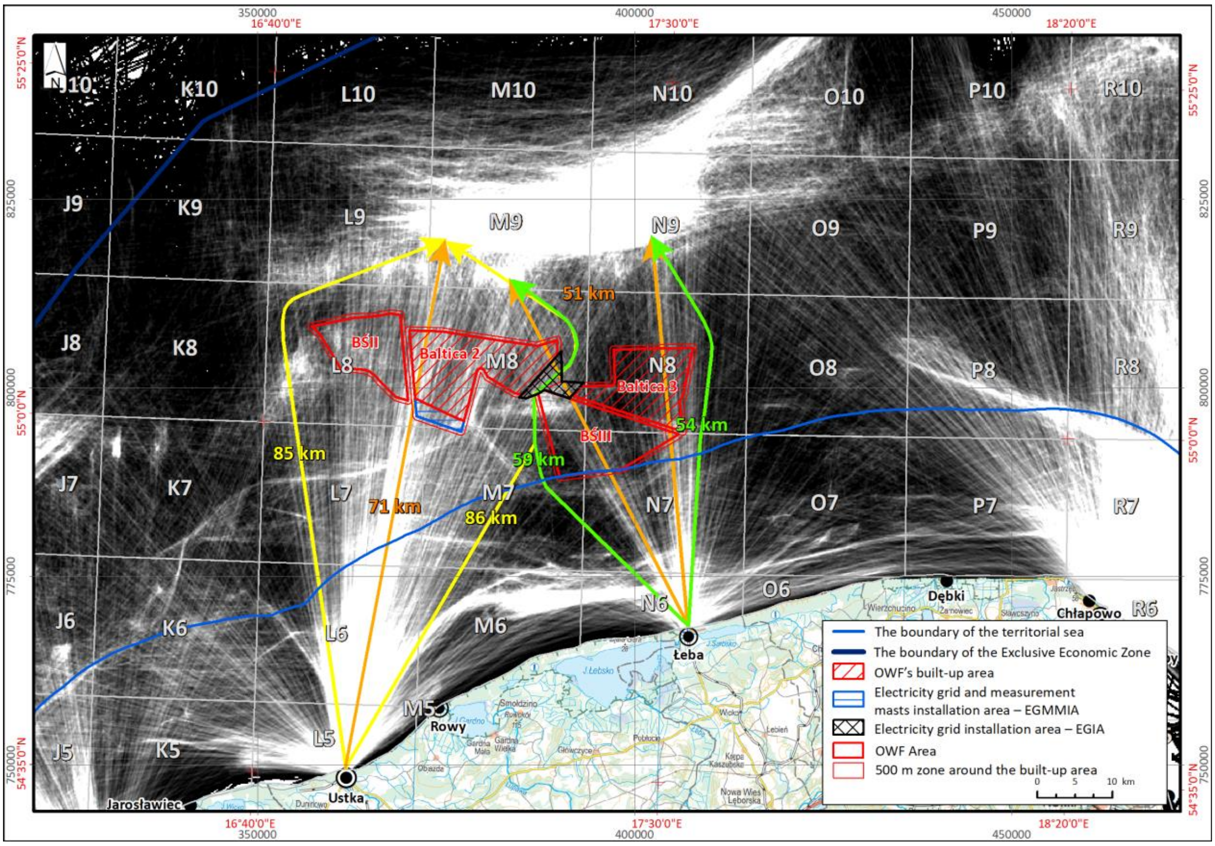


Figure 68. The extension of the route from the port in Łeba and Ustka to fisheries located on the Słupsk Furrow (cumulative effect)

Source: NMFRI materials based on the data from the Fisheries Monitoring Centre

For vessels operating from the port of Łeba, the additional distance to overpass (using the undeveloped area between the Baltica 2 Area and the Baltica 3 Area) will be 16 km ([59 km – 51 km] × 2). For vessels stationed in the port of Ustka, the route will extend from 71 km to 85–86 km in the case of a route along the western boundary of the BŚII OWF or the use of the undeveloped area.

The calculations of the cost's increase based on the methodology described in the section 6.1.2.7, indicate that the travel time of vessels stationed in Łeba due to the need to bypass the farms when travelling to and from the fisheries will increase by approximately 1.3 hours. This will increase the cost of crew's salaries by about 28.5 thousand PLN per year. Extending the route will also increase fuel costs by approximately 13.2 thousand PLN per annum (Table 172).

Table 172. The calculation of additional costs for fishing industry resulting from the extension of the route to fisheries for fishing vessels stationed in Łeba (cumulative effect)

Year	The number of vessels	Average crew /A/	Number of cruises /B/	Engine power kW*cruise /C/	The cost of 1 kWh /D/	Labour cost (1 h) /E/	Additional:			
							Crossing time (h) /F/	Fuel cost /C*D*F/	Labour cost /A*B*E*F/	Total cost
2012	20	3.9	207	34,435	0.34	22	1.3	15,220	23,089	38,309
2013	15	4.0	196	37,740	0.33	23	1.3	16,190	23,442	39,632
2014	13	4.2	206	38,669	0.29	24	1.3	14,578	26,994	41,572
2015	21	3.9	306	45,948	0.22	25	1.3	13,141	38,786	51,927
2016	14	4.1	225	31,364	0.17	25	1.3	6931	29,981	36,913
Average	17	4	228	37,631				13,212	28,458	41,671

Source: internal data

The impossibility to pass across the farm area for the fishing vessels and the failure to provide a navigation corridor between the Baltica 2 Area and the BŚII OWF area will result in a 28 km extension of the route to and from the fishery for vessels stationed in Ustka. As a result, the time of arrival and return from the fishery will be extended by 2.5 hours. The calculations based on the data from the years 2012–2016 demonstrate that the extension of the route will increase the cost of fishing by about 205 thousand PLN per year, including 60 thousand PLN due to additional fuel costs and 145 thousand PLN due to the increase of labour costs (Table 173). Similar costs will be related to the use of the route running through the undeveloped area between the Baltica 2 Area and the Baltica 3 Area by fishing vessels from Ustka.

Table 173. The calculation of additional costs for fishing industry resulting from the extension of the route to fisheries for fishing vessels stationed in Ustka (cumulative effect)

Year	The number of vessels	Average crew /A/	Number of cruises /B/	Engine power kW*cruise /C/	The cost of 1 kWh /D/	Labour costs (1 h) /E/	Additional:			
							Crossing time (h) /F/	Fuel cost /C*D*F/	Labour cost /A*B*E*F/	Total cost
2012	56	4.0	715	108,749	0.34	22	2.5	93,725	158,035	251,759
2013	48	4.1	564	75,002	0.33	23	2.5	62,760	131,512	194,272
2014	46	4.2	606	96,794	0.29	24	2.5	70,213	151,948	222,161
2015	42	4.1	520	78,018	0.22	25	2.5	42,042	130,744	172,786
2016	47	4.1	586	82,946	0.17	25	2.5	34,857	152,915	187,773

Year	The number of vessels	Average crew /A/	Number of cruises /B/	Engine power kW*cruise /C/	The cost of 1 kWh /D/	Labour costs (1 h) /E/	Additional:			
							Crossing time (h) /F/	Fuel cost /C*D*F/	Labour cost /A*B*E*F/	Total cost
Average	48	4.1	598	88,302				60,719	145,031	205,750

Source: internal data

Fisheries are subject to irrelevant cumulative impact due to the low value of the resource and the small scale of the impact.

7.5.2 Underwater noise

The issue of the underwater noise in the context of the cumulative impact of the Baltica OWF with the BŚII and BŚIII OWFs has been described in detail in the section 6.3. This section describes the impact on the ichthyofauna, seabirds and marine mammals in the context of the Natura 2000 ecological network, also in the context of the cumulative impact of the Baltica, BŚII and BŚIII OWFs. From the description of impacts and their ranges presented in Appendix 2 it follows that in no case will they be significant impacts, provided that the condition of carrying out a maximum of 2 simultaneous piling in the Baltica, BŚII and BŚIII OWFs' areas will be maintained. With simultaneous piling in more than two locations, there may be a significant impact (TTS impact range) on porpoises, the subject of protection in the area of the Natura 2000 site *Ostoja Słowińska* (PLH220023).

An additional potential source of cumulative underwater noise may be seismic surveying by high-energy sound sources (such as an airgun). Such surveys are used in prospecting for hydrocarbon deposits under the seabed. Sources such as airgun are characterised by very high sound intensity, comparable to the source sound pressure level used in piling, although they are characterised by other properties (Genesis, 2011). It is anticipated that seismic surveys may lead to the porpoise being displaced on a scale comparable to that of piling, with sound levels above re 1 $\mu Pa^2 \cdot s$ (Day et al., 2016). Therefore, in the case of simultaneous seismic surveys and foundations laying in the Baltica OWF Area, cumulative impact may be significant. Very few physical remedies are used during seismic surveys – the source of noise during the survey is mobile and therefore noise reduction systems are not applicable. It is possible to reduce the arduousness by the appropriate use of the work of marine mammal observers, as recommended (JNCC, 2004). When marine mammals are observed, seismic surveys are paused and marine mammals deterrents are activated to return to seismic surveys after some time. The simplest way of avoiding the cumulative impact is in this case the appropriate organization of actions over time – avoiding simultaneous foundation laying and seismic surveys. The significance of the impact of such underwater noise accumulation seems irrelevant because the hydrocarbon exploration licenses issued are located at a considerable distance from the Baltica OWF.

7.5.3 The increase in suspended solids and their sedimentation

The issue of the increase in suspended solids and their sedimentation in the context of the cumulative impact of the Baltica OWF with BŚII and BŚIII OWFs has been described in detail in section 6.3.1.1.

8 Transboundary impacts

The purpose of the following analyses is to identify or exclude the possibility of significant transboundary environmental impact associated with the implementation of the Baltica OWF. In accordance with Art. 104 point 1 of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws 2017 item 1405) if the possibility of significant transboundary environmental impact originating from the territory of the Republic of Poland as a result of the implementation of the planned project covered by the decision on environmental conditions is identified, the procedure for transboundary environmental impact will be carried out.

the Baltica OWF is located in the Polish Exclusive Economic Zone. The minimum distances from the Baltica OWF to the neighbouring exclusive economic zones of other countries are: 30 km to the Swedish and Danish exclusive economic zone, 135 km to the Russian exclusive economic zone and 150 km to the German exclusive economic zone.

The impact assessments on the analysed elements of the environment, broken down into particular phases of the planned project implementation, have been described in section 6. In the cases of the Baltica OWF's impacts on:

- geological structure, seabed sediments, access to raw materials and deposits;
- sea water and the quality of sea water and sediments;
- climate;
- biotic elements (phytobenthos, zoobenthos, bats);
- protected areas;
- biological diversity;
- cultural amenities, monuments and archaeological objects and sites;
- use and development of the area and material goods;
- landscape;
- population, health and living conditions of people,

they are of local range and in no case a significant impact has been observed.

Only in three cases, the impact of the Baltica OWF has a regional range. This applies to the following types of impact:

- underwater noise during the construction phase on adult fish and marine mammals;
- barrier effect in the exploitation phase on birds.

The underwater noise analysis carried out for the purposes of the EIA Rapport for both fish and marine mammals has shown that the range of significant impact determined by TTS values do not exceed the border of the Polish Exclusive Economic Zone.

In the case of seabirds and migratory birds, despite the regional impact on certain species, the significance of this impact has been assessed at most as moderate.

Taking the above into consideration, it should be stated that there is no possibility of significant transboundary environmental impact in relation to the implementation of the Baltica OWF.

9 Analysis and comparison of the variants considered and the most favourable variant for the environment

The issues related to variants of the project, including the descriptions and comparison of technical parameters for the two options considered, i.e. the variant proposed by the Applicant and the rational alternative variant, are included in the chapter 2.3. Due to the specificity of the planned project, including in particular the issued PSZW decision, it is unreasonable to consider, in the rational alternative scenario, the location issues of the Baltica OWF.

The fundamental difference between the variant proposed by the Applicant and the rational alternative variant is based on technical solutions resulting from the intensive development of offshore wind energy technology. The maximum installed capacity specified in the PSZW decision is the upper limit that can be implemented in both analysed variants. This limit can be realized on the basis of currently available technologies or on the assumption of their continuous development. The main factor which differentiates the two variants is the possibility of producing more powerful wind stations in the future.

In the rational alternative variant, the wind stations with the highest power used commonly at the moment, i.e. 8 MW, was taken into consideration. Under this assumption, in order to obtain the OWF's maximum installed capacity set out in the PSZW decision, it would be necessary to erect 319 wind power stations. In the variant proposed by the Applicant, it has been assumed that the constructed wind stations will be bigger, which would enable to reach the maximum installed capacity of the OWF by erecting 209 wind power stations. Both variants assume the possibility of building wind power stations of various sizes (power) using the maximum number of wind turbines – 209 for the variant proposed by the Applicant and 319 for the rational alternative variant.

The construction of a smaller number of wind power stations means less interference in the environment through: shorter construction and decommissioning phase, the use of smaller amount of building and exploitation materials, and the shorter maximum length of cable routes between wind power stations. To clarify, in the case of the rational alternative variant, the maximum length of cable routes is 220 km longer than in the variant proposed by the Applicant. Also, in the exploitation phase of the OWF, fewer wind turbines will require less service and maintenance and will therefore contribute to a smaller environmental impact.

The use of wind power stations of higher power output in the variant proposed by the Applicant may result in the need to use larger support structures and larger foundations. As a result, the seabed area occupied by one foundation will be larger, but the total area of the seabed occupied by all foundations in the variant proposed by the Applicant, due to the smaller number of wind power stations, will be smaller by 44 000 m^2.

A similar situation occurs when air space is taken by rotors. Larger wind power stations may require larger rotors, resulting in a larger area occupied by a single rotor, however, in the variant proposed by the Applicant, the total area occupied by rotors is smaller by over 21 000 m^2 compared to the rational alternative variant.

In both cases, i.e. the size of the foundations and the size of the rotors, it was assumed that the wind power stations with higher power will be larger in the variant proposed by the Applicant. This assumption is due to the precautionary approach. However, it cannot be ruled out that in the future more powerful wind power stations will not require increasing the physical parameters of the individual structural components of a wind power station, which may further reduce the impact of the Baltica OWF on environment in the variant proposed by the Applicant in relation to the rational alternative variant.

Concluding the above considerations, it should be stated that the main factor which differentiates the two variants considered is the power of the wind power stations used and the resulting number of wind turbines built. This determines, in consequence, the magnitude of impacts on particular elements of the environment.

Comparing both variants, including, in particular, the resulting from them possible environmental impacts, it should be indicated that the most favourable option for the environment is the variant proposed by the Applicant.

10 The comparison of proposed technology with technology meeting the requirements referred to in Art. 143 of the Environmental Protection Law

In accordance with Art. 143 of the Environmental Protection Law, technologies used in newly launched installations should meet the requirements the determining of which takes into consideration the following issues:

- the use of substances with low hazard potential;
- efficient production and use of energy;
- assertion of the rational consumption of water and other raw materials as well as resources and fuels;
- the use of waste-free and waste-to-waste technologies and the possibility of waste recovery;
- determination of the type, range and size of emissions;
- the use of comparable processes and methods that have been successfully applied on an industrial scale;
- scientific and technical progress.

This catalogue of requirements refers to newly launched industrial installations and equipment that are the source of environmental hazards. Due to the technological specification of the construction, exploitation and decommissioning phases, as well as special conditions of operation in the marine environment, offshore wind farms require these conditions to be verified at an early stage of investment planning.

Structural elements of the OWF are to be constructed of neutral materials in relation to seawater and substrate (seabed). The resistance to erosion, corrosion or chemical compounds activity that may occur in water is a basic condition for failure-free exploitation of the OWF.

The efficiency of energy production will be one of the basic criteria for the selection of offshore wind power stations and their distribution as well as the method of transfer of the generated energy from the OWF to the National Power System with a reduction in transmission losses. The overriding criterion of energy efficiency is its production, with obvious limitations related to the windiness of the area, without the consumption of energy resources – in a fully renewable manner.

In the case of this type of renewable energy, the actual efficiency of energy use involves non-returnable energy consumption for the production of the OWF components (wind power stations and other facilities) and their installation at sea.

The consumption of water, resources, raw materials and fuels will take place during the construction process (installation of further wind turbines and laying of undersea cables) and during the dismantling of the OWF's elements after they have been worn out. For 20–30 years of exploitation, wind power stations will require the use of consumable resources and fuels during servicing.

The emissions and their range will primarily concern the acoustic impact associated with the operation of wind turbines. They will not affect marine organisms significantly nor cause noticeable electromagnetic interactions.

Experiences related to the exploitation of wind turbines in the Baltic Sea allow the installation of the most efficient and proven solutions that meet the requirements of the most advanced technologies, resistant to the operating conditions of the marine environment at very variable winds.

11 Description of the prospective actions to avoid, prevent and reduce negative impacts on the environment

The conducted assessment of the Baltica OWF's impact in the variant proposed by the Applicant indicated the lack of significant negative impacts on individual elements of the environment.

The limiting of the wind farms' development area in relation to the area indicated in the PSZW, through its removal from the boundaries of the Natura 2000 site, the Słupsk Bank (PLC990001) and leaving the space free of installations between the Baltica 2 Area and the Baltica 3 Area results in the lack of significant negative impact on both birds staying within the Natura 2000 site, the Słupsk Bank (PLC990001), as well as the migratory birds. Planning and application by the Applicant of the underwater noise reduction system during works related to laying the foundations of wind farm structures will prevent or significantly reduce the negative impact on marine mammals, birds and fish. The above mentioned restrictions of the development area as well as the actions connected to the noise reduction are an integral part of the planned investment and will be taken into account in the design, construction and exploitation phases.

Taking into account that in the course of the OWF's implementation in all its phases i.e. construction, exploitation and decommissioning, impacts on environmental elements classified in most cases as irrelevant or at most moderate will occur, the following actions to avoid, prevent or limit these impacts have been proposed:

- the selection of solid construction towers for the wind power stations and the abandonment of lattice structures due to the smaller probability of birds colliding with solid construction towers;
- to prepare sewage and solid waste management procedures for each phase of the project;
- the incorporation in the executive plan and the selection of building contractors with ships whose hulls have not been covered with anti-fouling paint containing tin compounds (TBT);
- the limitation of the use of strong lighting that could attract birds during all phases of the project within the scope of the applicable regulations (for example, the aid to navigation);
- painting the ends of blades with bright colours to increase the birds ability to see the wind turbines;
- beginning piling from the so-called *soft start* procedure, i.e. performing a few blows of lesser force, and consequently a lower noise level, to allow marine mammals, fish and birds to leave the work site;
- dismantling the structure without the use of explosive methods to reduce the impact of the underwater noise.

All the activities indicated above are a result of the experience gained from the offshore wind farms implemented or in exploitation and are considered effective solutions to mitigate the impact of wind farms on the environment.

Additionally, taking into account the location of the Baltica OWF, and in particular, its proximity to the Natura 2000 site, the Słupsk Bank (PLC990001) the following should be ascertained:

- the minimum clearance between the working area of the rotor and the water surface should be 20 m, which minimizes the risk of bird collisions with working wind turbines. Based on the birds survey conducted for this EIA Report, it has been found that the vast majority of the long-tailed ducks, velvet scoters, razorbills and common murres travels at height below 20 m. The greater the clearance between the working area of the rotor and the water surface, the lower the possibility of a bird's collision with the rotor;
- an entry ban into the area of the Słupsk Bank site (PLC990001) for vessels engaged in the investment's implementation in all its phases (construction, exploitation and decommission) during the period from the beginning of November to the end of April due to the numerous occurrence of the long-tailed duck;
- the laying of foundations in the Baltica OWF Area in the period from the beginning of November to the end of April should be allowed, provided that the underwater noise resulting from these works at the boundary of the Słupsk Bank site (PLC990001) is maintained at a level that would not disturb the birds which are the subject of protection of the area. Based on the available literature (Crowell, 2014), it has been determined that the noise level that is audible to birds is 117 dB re 1 $\mu Pa^2 s$ SEL_{cum}. In the absence, at the moment, of scientifically confirmed information on the noise level which scares birds away, the value of 117 dB re 1 $\mu Pa^2 s$ SEL_{cum}, was adopted, in accordance with the precautionary approach, as the level of noise which did not startle the birds.

12 Proposal for monitoring the impact of the planned project and information on the available results of another monitoring, which may be important for establishing responsibilities in this area

According to the Art. 66 of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment (Journal of Laws of 2017, item 1405), a proposal for monitoring the impact of the planned project at the stage of is construction and exploitation or use, in particular on forms of nature protection, referred to in the Art. 6, paragraph 1 of the Act of 16 April 2004 on the nature conservation, including the objectives and the subject of protection of the Natura 2000 site, and the continuity of the wildlife corridors connecting them, as well as the information on the available results of other monitoring, which may be important for establishing responsibilities in this area have been presented in this chapter.

12.1 Proposal for monitoring the impact of the planned project

Due to the length of the construction process (about 8 years), the staged entry of the particular parts of the OWF into operation, and thus the overlapping of the construction and exploitation phases, the schedules of the individual monitoring processes have been described in a continuous manner, indicating four clear points of the project implementation:

- the beginning of construction – understood as the first activities in the area of the Baltica OWF Area associated with its construction;
- the beginning of exploitation – understood as the first production launch of the Baltica OWF, a phase that may overlap with ongoing construction works on other parts of the Baltica OWF;
- the completion of construction – understood as the completion of all construction works in the Baltica OWF Area and the moment when the project involving the construction of wind power stations reaches the maximum installed capacity.

The monitoring surveys methodologies will be presented to the Regional Director of Environmental Protection to be agreed on before the start of the surveys.

In the case of impacts of irrelevant or insignificant importance identified in the EIA Report, there is no need to monitor them.

12.1.1 Underwater noise monitoring

The underwater noise monitoring will be carried out between the beginning and the completion of the construction.

The underwater noise caused primarily by the piling of wind power station's foundations, was defined in the EIA Report as a factor that could have a negative impact on the marine organisms under evaluation i.e. birds, fish and mammals.

In accordance with the provisions adopted for activities aimed at avoiding, preventing and limiting negative impacts on the environment, the value of the underwater noise level at the boundary of the Słupsk Bank site (PLC990001) may not exceed 117 dB re: 1 μPa^2s SEL_{cum}, due to the necessity to protect the wintering population of the long-tailed duck, the subject of protection of this area, from being scared away. The proposed value is a precautionary estimate based on existing knowledge and it is assumed that if new survey results regarding the impact of underwater noise on long-tailed ducks are obtained, the Applicant will inform the Regional Directorate for Environmental Protection about this fact in order to agree on a different noise level limit. The underwater noise monitoring will be carried out from the beginning of November to the end of April for the entire duration of the construction phase during foundations laying. The location of the two noise detection stations will be determined so that it is possible to assess the level of underwater noise at the boundary of the Natura 2000 site Słupsk Bank (PLC9900001) for works performed both in the Baltica 2 Area and in the Baltica 3 Area.

The second survey area will be the boundary of the Natura 2000 site the *Ostoja Słowińska* (PLH220023), where due to the presence of fish and marine mammals, which are the subject of protection of this area, the permissible level of underwater noise cannot exceed: for fish 186 dB re 1 μPa^2s SELcum, for porpoise 140 dB re 1 μPa^2s SELcum and weighted by the HF function [HF weighting function for marine mammals with high sensitivity to high frequency sounds (NMFS, 2016)], for seals 170 dB re 1 μPa^2s SELcum and weighted by the PW function [PW weighting function for pinniped marine mammals (NMFS, 2016)]. The location of the two noise detection stations will be determined so that it is possible to assess the level of underwater noise at the boundary of the Natura 2000 site the *Ostoja Słowińska* (PLH220023) for works performed both in the Baltica 2 Area and in the Baltica 3 Area.

Noise measurements will be performed using hydrophones calibrated in the frequency range of 10 Hz – 20 kHz.

The results of the underwater noise monitoring will be forwarded to the Regional Director of Environmental Protection in the form of periodic reports. In the case of the indication of the above mentioned noise levels exceedance, the actions preventing or minimizing these impacts will be proposed together with an indication of the methods of their implementation and control of the results.

12.1.2 Migratory birds monitoring

Migratory birds monitoring will be carried out in two cycles during the year, due to the two periods of birds' migration, i.e. from March to May and from July to November, in four segments:

- 2 cycles of surveys during migration periods, 4 years after the beginning of exploitation (due to the possibility of the continuation of construction for more than 4 years from the beginning of exploitation and the need to verify the assessments' assumptions);
- 2 cycles of surveys during migration periods in the 1st year from the completion of construction.

Each time these tests will be carried out using ornithological radar for at least 10 days in a cycle. In addition, daily visual observations and acoustic recordings will be carried out at the same time. The survey will cover the area between the Baltica 2 Area and the Baltica 3 Area, north-east of the Słupsk Bank.

12.1.3 Marine bird monitoring

The marine bird monitoring will be conducted from August till May and the research effort will be at least 10 inspections (distributed possibly evenly into individual months, with a break of at least a week between the inspections) in the following periods:

- the year before the beginning of construction;
- in the 4th year from the beginning of exploitation;
- in the 5th year from the beginning of exploitation;
- in the 1st year from the completion of construction;
- in the 2nd year from the completion of construction.

Each of the surveys will include bird counts along the transects conducted in daytime in a manner allowing comparison of the monitoring results with the results of the environmental inventory performed for the purposes of the EIA Report. The research will cover the Baltica OWF Area and the area of the Słupsk Bank Natura 2000 site (PLC990001).

12.1.4 Monitoring of marine mammals

Marine mammals monitoring will be carried out on a continuous basis. The monitoring will begin 6 months before construction starts and it will be completed 24 months after the completion of construction.

The monitoring will be carried out using C-POD devices, including at least six C-PODs located within the Baltica OWF Area and at least six spaced perpendicularly to the OWF Area in three directions (south, north-east, north-west). The nearest C-POD in each direction will be located at least 20 km from the OWF's area boundary.

12.1.5 Benthic organisms monitoring

The monitoring of zoobenthos organisms on the seabed will be carried out in the first year from the settlement in the seabed of each of the five foundations of wind power station selected for monitoring. Zoobenthos sampling stations will be placed on two perpendicular to each other transects at a distance of 20, 50 and 100 m from the edge of the anti-erosive layer protecting the foundation of the offshore wind power station against leaching.

The monitoring of zoobenthic organisms, after the first year of survey, will be continued in the third and fifth consecutive year along the same transects.

The monitoring of the periphytic fauna and flora will be carried out in the second year from the settlement of the foundations. Sampling will be carried out between June and September. Periphytic fauna and flora's samples will be collected on five supporting structures.

The monitoring of fauna and periphytic flora will be continued in the same places in the 4th and 6th year after installation of the foundations.

12.2 The information on the available results of another monitoring, which may be important for establishing responsibilities in this area

The Baltic Sea monitoring is carried out as part of the National Environmental Monitoring (Water Quality Monitoring subsystem). Since 1979, within its framework regular marine environment surveys are carried out testing the physico-chemical conditions (temperature, salinity, oxygen concentration, secchi disc visibility, the content of nutrient, heavy metals and non-volatile organic compounds), the biological parameters of the marine environment (phytoplankton, zooplankton, phytobenthos and zoobenthos) as well as the level of harmful substances in water and marine organisms and the content of radionuclides in water and sediments. Also, ichthyofauna and facultative microbiology tests, hydrographic conditions, waste in the marine environment and underwater noise analyses are performed (Program PMŚ, 2015). The results of this monitoring are gathered and stored in the Oceanographic Data Base of the IMWM-NRI Marine Section in Gdynia, and in the "ICHTIOFAUNA" database of the General Inspectorate of Environmental Protection in Warsaw (Program PMŚ, 2015).

In addition, two monitoring surveys are carried out in PMA, which are an extension of the marine environment survey:

- The Monitoring of Wintering Seabirds in the scope of which ten main species of birds closely related to the marine environment (the so-called basic species) are monitored, including those described in this Report: red-throated loon, black-throated loon, long-tailed duck, common scoter, velvet scoter, common murre, razorbill and black guillemot, as well as the so-called additional species, such as European herring gull and common gull. Altogether, in the PMA, survey is conducted along 56 transect sections, eight of which is located in the area of the Słupsk Bank site (PLC990001). The results of this monitoring are available at the Chief Inspectorate for Environmental Protection in Warsaw;
- The Monitoring of Marine Habitats and Species includes the monitoring of eight species of fish and lampreys (marine lamprey, river lamprey, twaite shad, asp, European weather loach, spined loach, sabrefish and European bitterling), four species of marine mammals (harbour porpoise, grey seal, harbour seal and ringed seal) and five natural habitats connected to marine areas (Sublittoral sandbanks (1110); Estuaries (1130), Coastal lagoons (1150); Large shallow inlets and bays (1160) and Boulder areas and rocky reefs, Reefs (1170)]. The habitats: Sublittoral sandbanks (1110) and Boulder areas and rocky reefs, Reefs (1170) are the subject of protection of the Natura 2000 site, the Słupsk Bank (PLC99001). Currently, work is underway to implement this monitoring, including its IT system. The

monitoring results will be available at the Chief Inspectorate for Environmental Protection in Warsaw, after the completion of the implementation phase, i.e. in 2018.

On the basis of bird surveys in the area of the Słupsk Bank site (PLC990001), the following indicators are determined: the abundance (density) and the prevalence of the species (www.monitroingptakow.gios.gov.pl).

The conservation status of a given habitat is assessed on the basis of the environmental research conducted as part of the MMHS. Three parameters describing the area of the habitat, its specific structure and function as well as the prospects for its conservation are used in this assessment. As part of this monitoring, two habitats which are the subject of protection of the Natura 2000 site, the Słupsk Bank (PLC990001), i.e. sublittoral sandbanks (1110) and Boulder area and rocky reefs, Reefs (1170) are assessed.

In the perspective of several dozen years, for which the construction and exploitation of the Baltica OWF is expected, the results obtained from the marine monitoring carried out in the area can be used to monitor the investment's impact on the environment. This is due to the fact that the scope of the monitoring includes these elements of the marine environment which the project may directly and indirectly affect, including in particular the subjects and objectives of protection and the integrity of the Natura 2000 site Słupsk Bank (PLC990001). In addition, the lengthy series of survey, due to the nature of monitoring, will allow eliminating in the assessment the short-term changes in the environment resulting from natural fluctuations in the complex marine ecosystem, and not being a consequence of the planned project's impact.

13 Limited use area

The issue of the creation of a limited use area (LUA) is regulated by the provisions of Art. 135 paragraph 1 of the Environmental Protection Law: "*If from the ecological review or from the project's environmental impact assessment required by the provisions of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessment or from the post-implementation analysis, it appears that despite the use of the available technical, technological and organisational solutions, environmental quality standards cannot be observed outside the factory or other facility for wastewater treatment plants, landfill sites, composting sites, communication route, airport, overhead power line and power substation as well as radiocommunication, radionavigation and radiolocation installations, an area of limited use is created.*"

From among the above mentioned tasks, two prepared for implementation within the planned project, i.e. power lines and power substations as well as radiocommunication, radionavigation and radiolocation installations, may require the creation of a LUA.

The legitimacy of establishing a LUA with respect to the planned OWF should be considered by analysing whether the environmental quality standards outside the planned OWF Area cannot be met, within the meaning of art. 3 point 48 where "factory – means one or several installations together with the land, to which the operator has legal title, and the devices located on it".

This EIA Report has indicated that at the current stage of investment's preparation there is no ground for stating the probability of exceeding the environmental quality standards for air, noise, sewage and PEM – the magnetic and electric fields magnitude will not exceed the maximum permissible values outside the area, to which the Applicant has a legal title. The nearest areas for which environmental quality standards have been specified in the above mentioned scope are located on land, more than 25 km from the planned project.

14 Analysis of possible social conflicts related to the planned undertaking, including the analysis of impacts on the local community

The beginning of the period of informing on the planned Baltica OWF should be indicated as 2009 and the subsequent years, when:

- The Applicant has obtained:
  - the Decision of the Minister of Transport, Construction and the Maritime Economy No. MFW/4/12 of 16 April 2012 – the permit to erect and exploit artificial islands, installations and equipment in Polish marine areas for the investment under the name: “The Complex of Offshore Wind Farms with the maximum total power of 1500 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and exploitation stages”,
  - the Decision of the Minister of Transport, Construction and the Maritime Economy No. MFW/5/12 of 16 April 2012 – the permit to erect and exploit artificial islands, installations and equipment in Polish marine areas for the investment under the name: “The Complex of Offshore Wind Farms with the maximum capacity of 1050 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and exploitation stages”,
- The basic documents defining the spatial policy of the country and the region have been accepted:
  - “Polish Energy Policy until 2030” adopted by the Resolution of the Council of Ministers No. 201/2009 of 10 November 2009,
  - “Maritime Policy of the Republic of Poland until 2020 (with forecasts until 2030)” (Ministry of Infrastructure, Warsaw 2015) elaborated by the Inter-Ministerial Maritime Policy Team of the Republic of Poland on the basis of the document “Guidelines on Maritime Policy of the Republic of Poland until 2020” of September 14, 2009,
  - the National Spatial Management Concept 2030 adopted by the Resolution No. 239 of the Council of Ministers on 13 December 2011,
  - The Director of the Maritime Office in Gdynia, the Director of the Maritime Office in Słupsk and the Director of the Maritime Office in Szczecin on 15 November 2013 made public the information about joining the planning process, the purpose of which is to draft a “Spatial Development Plan for Polish Marine Areas.” The planning process includes the development of: “Study of conditions for the plan” and “Spatial Development Plan for Polish Marine Areas”; the “Study of Conditions for Spatial Development of Polish Marine Areas Together with Spatial Analyses” was completed in 2015. The preparation of the plan’s proposal is projected for the turn of 2017 and 2018,
  - “2020 Pomorskie Voivodeship Development Strategy” adopted by the Resolution No. 458/XXII/12 of the Regional Council of the Pomeranian Voivodeship of 24 September 2012,
  - “*Regionalny Program Strategiczny w zakresie energetyki i środowiska. Ekoefektywne Pomorze*” [“Regional Strategic Program in the field of energy and the environment. Eco-

efficient Pomerania"] adopted by the Resolution No. 931/274/13 of the Management Board of the Pomeranian Voivodeship of 8 August 2013,

- "Spatial Development Plan of the Pomeranian Voivodeship 2030" adopted by the Resolution No. 318/XXX/16 of the Regional Council of the Pomeranian Voivodeship on 29 December 2016 regarding the adoption of the new Spatial Management Plan for the Pomeranian Voivodeship and forming a part of it the metropolitan spatial development plan for the Tricity area.

The aforementioned permits and agreements for planning documents envision the implementation of offshore wind energy as part of the National Power System.

The projects of strategic documents along with environmental impact forecasts were subject to the public participation procedure along with social consultations conducted by the competent administrative authorities prior to their adoption under the provisions of the Act on spatial planning and development.

The starting point for conducting public consultations regarding the planned OWF was the requirements of the Polish national law and the European Union law, which indicate that the planned projects which may significantly affect the environment, such as the implementation of offshore wind farms, should be consulted with the public at the earliest possible stage by recognizing the opinions of people interested and local communities, in order to identify potential problems and determine ways to solve them, as well as provide information to interested groups or individuals.

The planned OWF is located in the Baltic Sea within the Polish Exclusive Economic Zone north of the shore at the height of Rowy–Łeba location, at a distance of about 25 to 50 km from the mainland. The closest seaports are Łeba and Ustka in the Pomeranian Voivodship. The regional, maritime-land nature of the project means a wide range of potential stakeholders and interested entities from the northern part of the Pomeranian Voivodeship and other interested bodies.

Target groups to conduct information meetings with have been selected taking into account a number of criteria: the nature of the project, location, potential impacts of the planned project and the type and degree of interest of various social groups exhibited for other investments at sea.

The planned OWF has been located on the waters exploited and used by people, therefore it can be expected that the implementation and exploitation of the investment, and above all, the exclusion or restriction of current use and difficulties resulting from the establishment of transportation corridors will potentially cause social conflicts. The permission to use the area, the safety zones and other rigours will be defined in the future by the Director of Maritime Offices in Słupsk. Given the nature of the OWF, it has been considered probable that it could affect fisheries and navigation within and around the OWF.

The following aspects related to the planned OWF have been identified as the ones that may cause social conflicts:

- construction and transport of large size offshore structures;
- concerns about the state of the environment in the Baltic Sea, issues related to the broadly understood nature and birds protection. This applies especially to the nearest Natura 2000 site, the Słupsk Bank;

- concerns of the existing and potential users of the OWF Area about the possibility of access to this area, concerns about job prospects, e.g. related to fishing, concerns related to the ensuring of proper functioning of communication systems;
- concern related to the establishment of the transportation corridor through the OWF and its parameters;
- landscape aspects, the OWF's visibility;
- concerns about the impact on tourism in coastal districts;
- concerns about the impact on the economy in coastal districts.

The potential positive changes that the planned OWF may trigger have also been identified:

- jobs for the inhabitants of coastal municipalities during the construction phase and the long-term exploitation of the OWF;
- impact on tourism and the perception of the OWF as a tourist attraction.

The basis of the potential conflict regarding the planned OWF are the following issues:

- depending on the provisions of the maritime administration or the maritime spatial development plan, the difficulties for fishing on the waters occupied by the farm, due to the restricted access to the area and thus impediments to unconstrained fishing and transit through the farm area should be expected;
- incompatibility of the objectives and interests of the parties, the objective indicated by the fishermen's community is to fish within and to cross through the OWF Area to further fisheries, as well as to ensure the occurrence of fish in the Baltic Sea;
- the disruption in the environment that the planned OWF may cause.

The potential stakeholders (target groups) are:

- public administration and state institutions;
- local government units and institutions;
- industry organisations, including fishing organisations;
- national, regional and local associations and social organisations;
- non-governmental environmental organisations;
- potential suppliers, partners, other offshore investors;
- research and design units.

Due to the location and the scope of tasks of the planned OWF and by accepting the direct users of the sea in this region at the current, early stage of the investment preparation, the Applicant decided to conduct information meetings with the fishing community. As part of this Report elaboration, in June 2017 the information meetings with the representatives of fishermen's organizations were held. Formal consultations will be carried out during the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection. Two information meetings were organized, on 12 June 2017 in Łeba and on 14 June 2017 in Ustka. Presentations and information materials were prepared.

The participants of the consultation meetings pointed out many problems of various significance, including environmental issues. The results of the consultations have been used in the work on this Report on the environmental impact of the OWF.

The main conclusions from the information meetings held in 2017 were as follows:

- the problems of occupying the fishing grounds by the OWF Area, of transit through the OWF Area as well as the way for the shared use of the OWF Area for fishing and transit of fishing vessels to fishing grounds located north of the OWF Area and of extending the route to these fisheries. the Applicant participates in consultations on the maritime spatial development plan to develop system solutions for compensation/regulation of issues related to the closure of some areas for fisheries;
- fishermen showed interest in the surveys' methods and data and research results obtained as well as natural environmental inventory results, primarily in the field of ichthyofauna and birds and the condition of the ecosystem, in the context of fish returning after the construction phase into the OWF Area and also the decline of mussels' presence in the OWF Area;
- the opinion the fishing community regarding the lack of consent for any investments in offshore wind energy (OWE) have been expressed. Information on the protest submitted to the representatives of Nord Stream 2 regarding the alleged impact of the Nord Stream gas pipeline on the ecological status of the Baltic Sea was presented. In this context, it was noted that adding new investments may diminish the ecological status of the Baltic Sea and therefore the fishing community expresses its opposition to any investments;
- the fishing party pointed to the possibility and need for further discussions within various thematic areas, which could include impact on fishing, impact on the marine environment, regulations related to the access to the OWF Area, technological issues – both in the field of offshore wind farm construction technologies as well as permissible forms of use for fishing in the OWF Area;
- the potential benefits for the municipality of Łeba, such as the development of the port towards servicing of the OWF and the use of the vessels' potential for tourism connected with the OWF Area were indicated. Possible benefits, such as servicing the OWF's construction and exploitation, and maritime tourism, according to stakeholders, will not compensate for the fishermen's losses whose priority is fishing.

Stakeholders' comments and conclusions submitted during information meetings have been recorded on electronic devices and written down. At the same time, they create premises for a broad public participation as part of the procedure regarding the environmental impact assessment.

15 Indication of difficulties resulting from technical shortcomings or gaps in contemporary knowledge encountered in the preparation of the report

Knowledge on the PMA is not uniform. The abiotic environment is relatively well known. Therefore, there are no knowledge gaps in the field of seabed sediments, hydrology, hydrometeorology and geology of the surface features. Basic deficiencies in knowledge refer to all biotic elements: phytobenthos, zoobenthos, ichthyofauna, marine mammals, seabirds, migratory birds, and bats.

Concerning phytobenthos, there is lack of results of surveys on the succession of periphyton flora in the PMA on structures located at depths greater than 20 m. These results would provide a solid basis for analysis of the potential impacts of the investment on phytobenthos in the PMA.

As a result of zoobenthos research, a set of data was obtained enabling the elaboration of comprehensive characteristics and assessment of natural assets and the condition of the benthos communities within the OWF Area in 2016. Because there are no results in the scientific literature of previous benthos research within the Baltica OWF Area, it is impossible to determine the nature and direction of changes, which took place in the benthos communities of this region from a historical perspective.

A technical shortage can be considered the lack of effective tools for quantitative sampling of zoobenthos from the surface of stones. The stone gripper used in this project provided for the quantitative sampling of the periphyton species and only the qualitative sampling of other mobile organisms inhabiting the surface of stones, plants and spaces between stones.

The shortcomings of current knowledge regarding the ichthyofauna of the Southern Baltic are the result of a relatively small number of surveys conducted on the impact of offshore wind farms. While for commercial species such as herring, cod, salmonids, flat fish and eel, there are data available on reactions to such factors as noise, suspended solids or electromagnetic field, it is difficult to find similar information for species irrelevant from the economic point of view, such as gobies, common seasnail, sand lance or shorthorn sculpin.

Moreover, a large part of the research on the influence of such factors as noise, electromagnetic field or increased concentration of the suspended solids, has been carried out in laboratory conditions. The reaction of organisms in experimental conditions, in which they are exposed to additional stress, may differ from their behaviour in the environment. Another unknown are the directions of climate change and their impact on fish communities in the Southern Baltic area. These long-term changes in environmental conditions may be conducive to the settlement of new species in a given region (also foreign). The combination of changes in environmental conditions with the emergence of a habitat created by farm constructions (artificial reef) may lead to the formation of new ichthyofauna communities or pose a potential threat of it being settled with foreign species. It is difficult to predict the interactions that may occur between native species and new arrivals in the light of changing environmental conditions and their effects.

Previous surveys do not provide full knowledge on the subject of the reaction of ichthyofauna to particular types of impacts. This particularly applies to the impact of the electromagnetic field on fish. Wilhelmsson et al. (2012) assessing the impact of this factor as relatively small, emphasized at the same time the uncertainty of this assessment. Also Zucco et al. (2006) indicate the need to conduct surveys that would allow obtaining more unequivocal conclusions.

Particularly difficult to predict is the impact of factors associated with the decommissioning phase of offshore wind farms. The analysis of the impact is hindered by the lack of experience in such projects resulting from the early stage of wind energy development, as well as the inability to predict what technologies will be available in the course of twenty or more years when the decommissioning of farms will be performed (OSPAR 2008). It can be assumed that the impact factors will be similar to those in the construction phase (suspended solids, noise, contamination with foreign substances in the marine environment, among others ones harmful to aquatic organisms), but the intensity of their impact will largely depend on the currently unpredictable technology of demolition and structure removal.

No ichthyoplankton surveys had been carried out in the OWF Area before. The only source of information, with which the obtained results may be compared, are data compiled in the one year long monitoring of ichthyofauna conducted in the located in the vicinity area of the planned wind farms BŚII and BŚIII Scarcity of data on shallower areas of the Southern Baltic is related to the fact that the region is located outside the network of survey stations at which NMFRI conducts standard plankton surveys. The network is designed to ensure that it covers spawning areas of most commercial fish species while leaving out the shallower areas. Information on non-commercial fish species, early development stages of which inhabit both the deep-water and the coastal zones, are scarce, often outdated, and they do not apply directly to the survey area.

There is some information on spatial distribution of ichthyoplankton in the coastal zone of the Baltic Sea of up to 40 m in depth, but it is relatively limited. Surveys on this topic were carried out at random, often only once, at stations in various areas. Some results apply to single stations distributed along the Polish coast, while others to stations in the Gdańsk Bay and in the area of the Pomeranian Bay. There are also no data on seasonal and multi-annual variability.

Analysis of samples collected using a Bongo net provides reliable information on larvae and pelagic eggs. However, only long-term subsea surveys requiring widespread diving works would be the source of complete knowledge on the subject of occurrence and abundance of demersal eggs of species such as herring and most non-commercial fish species, the larvae of which were found in the survey area.

The only scientific surveys of mature fish were conducted within the framework of the BITS research cruises. In 2006–2016, species composition recorded in the catches was very poor.

As far as ichthyofauna and the cyclostomata group are concerned, effective fishing of lampreys and eels on the sea proves difficult. As this group of organisms occurs within the open sea waters in very low concentrations, the trawl methods appear to be the only theoretically effective means of gathering data; however, it should be based on long-term data series and the values of fishing effort which are virtually impossible to obtain.

The importance of the area for salmonids (salmon and sea trout) is confirmed only by data from landings of fishing boats. Low density of these fish and their long-distance migrations are the reasons why these species were not recorded during the marine survey catches. There are also no standardized methods of catching these species in the Baltic Sea for the purpose of a survey. The estimation of these fish resources is based on inland water surveys supported by data from the sea catches.

With reference to ichthyofauna, no research methods can guarantee that the obtained results are each-time fully representative of the surveyed area due to occurrence of objective local difficulties generated by the extreme hydrological conditions (upwelling, shifting sea currents), climate (radically different weather conditions characterising subsequent years) or factors altering selectivity of survey tools (by-catching of material brought by sea currents or of organisms such as jellyfish). Despite this fact, the authors of this Report consider the applied survey methods to be adequate to the environmental conditions (among others the characteristics of the seabed, hydrometeorological conditions and the usage in fisheries) prevailing in the OWF Area. Moreover, the use of the standard methods for fish haul and biological analyses guarantees comparability of compiled and analysed data.

The results obtained during pre-investment monitoring demonstrate certainly that marine mammals occur in very small numbers in the studied area. In this respect, these results are concurrent with the results obtained during the SAMBAH survey. It should be noted, however, that the confidence limits in the SAMBAH survey are very high. In general, there is very high statistical variability in estimates of cetaceans (see Thomsen et al., 2011). This makes it difficult to carry out impact assessments. For example, depending on whether the upper or lower confidence limits are used, PTS can occur in 0 to 2 porpoises using a noise reduction system (BBC). It is unlikely that, at such a small scale, the surveys for other EIA reports would shed more light on the exact number of porpoises in the survey areas due to their relatively small range and the resulting abundance differences. It is also unlikely that the continuation of the SAMBAH surveys will lead to more precise estimates of these species abundance, because the total number of porpoises is very low in the eastern part of the Baltic Sea, and therefore prone to statistical variation.

Another issue which is highly uncertain is exposure criteria. The criteria published by the NMFS in 2016 are another approximation, as they indicate the dependence of the frequency and audibility of marine mammals in a more comprehensive way than it was previously known. However, many assumptions, especially on the weighing functions and thresholds for seals and cetaceans using high frequency sounds, such as porpoises, are based on very few surveys.

One of the substantial difficulties in assessing the OWF's impact on the environment is insufficient knowledge on the migration of birds to the PMA. Therefore, the assessment had to rely on data collected as part of the survey for the purposes of this Report, assuming that the survey period was representative.

There is a lack of knowledge about the avoiding offshore wind farms reaction for virtually all bird species. Due to this lack of knowledge, the collision risk is often assessed using the precautionary principle. For some species, such as the common crane, there is also no knowledge about the reaction of macro avoidance of offshore wind farms. Therefore, the collision risk assessment used in this study can be overestimated if the birds actually notice and bypass the wind farm. Wind farms may arouse the interest of some species (e.g. eagles, probably cranes and other land birds) (Skov et al., 2012), however, this phenomenon is still insufficiently known.

There is also insufficient knowledge in the field of quantifying the light impact of the OWF construction on the probabilities of nocturnal migrants' collisions. In general, the frequency of collisions of nocturnal migrants – passerines and breeding birds – is unknown for offshore wind farms located in the Southern Baltic. Currently, there are no reliable methods that would complete the knowledge gaps on the frequency of nocturnal migrants' collisions.

Apart from the surveys and the monitoring presented in this Report and the monitoring carried out for the BŚII and BŚIII projects, no surveys have been conducted in this part of the Baltic Sea. Analyses carried out for the OWF Dębki-Białogóra are available, but the observations were not carried out continuously throughout the migration period, and the survey was directed only at water birds (Busse, 2015).

Also, little is known about the behaviour of the nocturnal migrants which are not active vocally. The sizes of biogeographic populations of passerine birds are reported in millions or hundreds of thousands, however, it is not known what fraction of these populations travels over the open waters of the Baltic Sea.

The current knowledge on the occurrence of seabirds in the Baltic Sea is based primarily on the surveys conducted in the winter (Durinck et al., 1994; Skov et al., 2011). In the Polish zone of the Baltic Sea, the surveys during other phenological periods were carried out as a part of pre-investment monitoring (the OWFs Dębki-Białogóra, Bałtyk Północny, BŚII and BŚIII) or surveys implemented as part of creating protection plans for marine areas of the Natura 2000 network (Pomeranian Bay and *Przybrzeżne Wody Bałtyku*), but the lack of data on birds occurring at sea within the Polish Exclusive Economic Zone outside the above mentioned places is a serious impediment in the full interpretation of the results obtained. The example of the detection of large, previously unknown concentrations of a common murre in the OWF Area demonstrates that the current knowledge of birds outside the 12-mile belt of territorial waters is still incomplete.

It is also not known whether seabirds spend the entire winter in one sea area, or whether they move into different parts of the Baltic Sea. Movements over small distances in reaction to changes in abundance of food supply are very likely (Meissner 2010). However, there are still no reliable data on movement of seabirds around the Baltic Sea (including the most abundant species of sea ducks) from one wintering grounds to other, distant places.

With the current state of knowledge about seabirds gathering in the Baltic Sea away from the coast, the links between various Natura 2000 sites cannot be fully assessed.

The existing data on the impact of operating offshore wind farms on birds concern wind farms of smaller sizes than the Baltica OWF's. Therefore, it is not known what the reactions of birds will be to a farm of a larger area, as well as to several farms located close to each other. Due to the lack of the data of this kind, it has been assumed in this study, that the seabirds' behaviour will be similar to the reactions to farms of smaller sizes than the investment in question.

It is not currently known whether the species considered vulnerable to the presence of a wind farm (e.g. loons, long-tailed duck and velvet scoter) will adapt (and if so, to what extent) to the offshore wind farm and start using the area again.

The period of examination was divided into four phenological phases. This division is arbitrary to a large extent, since various species migrate at different times of the year, and so the autumn migration of common scoters is observed as early as in August, while long-tailed ducks begin their autumn flight at the end of September (Meissner 2011a). As shown by the results obtained in this survey and presented in Appendix 1, the spring migration period of sea ducks ends in April and for these species May should rather be considered as summer period. The adopted division into four phenological phases enables the grouping of observations into periods in which the majority of waterbird species which presence can influence decisions related to the investment, migrates, is wintering or stays in the coastal area.

It should be noted that results of the visual observations of migrating birds conducted during research cruises may constitute only an auxiliary material in analysis of data obtained in the course of surveys with use of radars directed at birds flying above the OWF Area. Vast majority of passerine birds cross the Baltic Sea at night, hence registration of their flights with use of radars is necessary to study the directions, fight height limits and intensity of the migrations Observations conducted by day are primarily related to individuals, which did not adopt a typical scheme of behaviour schemata, and so their flight over the sea does not necessarily have to be conducted the same way as at night. Moreover, a visual assessment of a flight height is certainly vitiated by error due to e.g. the position of an observer in relation to a flying bird, movement of the ship's deck resulting from the wave motion, and the distance from the observed bird, as well as individual predisposition to assess the distance correctly. Additionally, birds, especially the ones of small species, are difficult to notice when they are flying at significant heights. This is why their number may be underestimated. The methodology applied does not offer a full overview of the birds' flights, and it only completes the results compiled with use of radars.

In this Report, the European herring gull is treated as a species *sensu lato*, i.e. a taxon including three differentiated nowadays but very similar species: the European herring gull *Larus argentatus – sensu stricto*, the Caspian gull *Larus cachinnans* and the yellow-legged gull *Larus michahelllis.* The surveys conducted in northern Poland indicate that a species that predominated decisively among the three is the European herring gull, and the two other species occur there rarely (Meissner and Betleja 2007, Meissner et al., 2007).

Currently, there are no binding “methodical guidelines” for monitoring bats and the analysis of the wind farms impact on their population. The surveys on bats’ activity in the OWF Area aimed at determining the possible migration corridors were based on the methodology presented in the project called “Guidelines for the assessment of impact of wind turbines on bats” elaborated by Polish specialists and practitioners on a commission of the GDEP in 2011 (Kepel et al. 2011). The survey methods, analyses and results presented in the above mentioned project refer to the wind farms located on land.

16 Summary of information on investment

The planned project consisting in the construction, exploitation and decommissioning of the Baltica Offshore Wind Farm has been located in the Polish Exclusive Economic Zone of the Baltic Sea, north and north-east of the Słupsk Bank, more than 25 km north from the shoreline.

The planned project includes the Baltica OWF, within the area specified in the PSZW obtained by the Applicant. The total area designated for the facilities and installations of the Baltica OWF is 268.20 km^2, including:

1) the built-up section of the OWF with a total area of 237.63 km^2;
2) power grid and measuring masts installation section with a total area of 11.55 km^2;
3) the power grid installation area with a total of 19.02 km^2.

The planned project will be implemented in stages.

Offshore wind turbines, offshore power substations, power and teletechnical networks together with the infrastructure necessary for the proper operation of the Baltica OWF will be installed on the seabed with variable depths ranging from 21 m to 53 m.

The undertaking, subject to separate proceedings on the issue of a decision on environmental conditions, will be the connection line for the transmission of electric energy generated by the Baltica OWF from the offshore power substations to the Żarnowiec Main Power Point.

A summary of the most important parameters of the Baltica OWF has been presented in the table (Table 174).

Table 174. The list of the most important parameters of the offshore wind farm for the variant proposed by the Applicant

Parameter	**Variant proposed by the Applicant**
Maximum installed capacity [MW]	2550
Maximum number of wind power stations [items]	209
The maximum diameter of the rotor [m]	220
Minimum clearance between the working area of the rotor and the water surface [m]	20
Maximum height [m]	250
Maximum number of power substations [items]	21
Maximum number of service and residential platforms [items]	2
Maximum number of research and measurement platforms [items]	2
The maximum diameter of the gravity based structure [m]	40
Maximum area of the seabed occupied by the gravity based structure [m^2]	1257
Maximum area of the seabed occupied by the foundations [m^2]	262713

Source: internal data

The Baltica OWF concept is based on the assumptions adopted in the initial phases of pre-project work. Therefore, the technical parameters and their limit values for the Baltica OWF and particular types of facilities or equipment have been specified in an envelope manner and have maximum permissible limits. The detailed parameters of individual wind power stations and their distribution within the OWF are not known. Their selection will depend, among others on the results of pre-project work and surveys, e.g. geotechnical. The results of which alongside the depth of the sea will be the basis for choosing among others the technology for anchoring floating structures or the method of foundation construction, among which the following can be distinguished:

- gravity based structure, filled with ballast with a reinforced concrete base;
- monopiles with a concrete or steel base drilled or hammered into the seabed;
- tripods, built from three pillars set on or hammered into the seabed;
- Jacket type lattice foundations, on four legs fixed to the seabed with piles.

As part of the planned project, the following will be deployed within the sea area:

- offshore wind power stations, anchored or installed on foundations set on or embedded in the seabed;
- cable installations of internal electricity grid and teletechnical networks;
- power substations;
- optionally, research and measurement platforms as well as residential and service platforms.

The employment of wind power stations of various types, capacities and foundations has been accounted for.

The Baltica OWF’s life cycle covers the following phases:

- construction and manufacturing works on land;
- the implementation of a wind farm in the maritime area;
- several years of simultaneous construction and exploitation of subsequent stages of the Baltica OWF (currently a two-stage implementation of the project has been assumed) included in the NPS;
- exploitation period of the Baltica OWF;
- gradual decommission of the Baltica OWF’s components.

The Applicant with the aim of avoiding, preventing and limiting negative impacts as well as taking into account the environmental conditions of the planned project, including in particular the location of the Baltica OWF Area in relation to the Natura 2000 site Słupsk Bank (PLC990001) has applied restrictions to the built-up area in comparison to the PSZW, i.e.:

- removed the OWF built-up area from the boundary of the Natura 2000 site (PLC990001), due to the possible negative significant impact on the long-tailed duck, which is the subject of protection of this area;
- left a free from offshore wind turbines area between the Baltica 2 Area and the Baltica 3 Area, thus enabling access to the Natura 2000 site Słupsk Bank (PLC990001) for birds migrating from the north-east direction.

The indicated restrictions apply to: locating structures of offshore wind power stations, offshore power substations, residential and service platforms as well as measurement and research platforms.

Moreover, during the construction works related to the piling of foundations, the noise reduction system will be implemented. Its use will significantly reduce underwater noise, thus minimizing its impact on marine mammals, fish and birds. In order to monitor the effectiveness of this solution, hydrophones recording the noise level will be placed in the region of the planned project. It has been assumed that the level of underwater noise at the boundary of:

- the Słupsk Bank site (PLC990001) cannot exceed 117 dB re: 1 μPa^2s SEL_{cum}, due to the need to protect against scaring away the wintering population of long-tailed duck, which is the subject of protection of this area, from November to April. The value of the noise limit level has been adopted cautiously in line with the knowledge available at the time of the Report's preparation. In the event that new knowledge on the underwater noise level at which the long-tailed ducks are scared will be available, the Applicant will inform the Regional Directorate for Environmental Protection about this fact in order to agree a new level;
- the *Ostoja Słowińska* site (PLH220032) cannot exceed: for fish the value of 186 dB re 1 μPa^2s SEL_{cum}, for porpoise the value of 140 dB re 1 μPa^2s SEL_{cum} and weighted by the HF function (NMFS, 2016) and for seals the value of 170 dB re 1 μPa^2s SEL_{cum} and weighted by the PW function (NMFS, 2016).

The impact assessment's results of the planned project in particular phases of its implementation on environmental elements have been presented in the table below (Table 175). The restrictions applied to the built-up areas of the OWF and the restrictions related to the application of the underwater noise reduction system, both in the variant proposed by the Applicant and in the rational alternative variant have been taken into account in the environmental impact assessment.

Table 175. The impact assessment results of the planned project in the variant proposed by the Applicant in the various phases of its implementation on the environmental elements being assessed

Element	Significance of the Baltica OWF's impact in the phase of:			
	construction	exploitation	construction and exploitation	decommissioning
Seabed	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Wave motion and sea currents	None	Irrelevant	Irrelevant	None
Water turbidity	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Water quality	Irrelevant	Irrelevant	Insignificant	Irrelevant
Wastewater impact	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Release of pollutants from the seabed sediment to the water column	Insignificant	Insignificant	Insignificant	Insignificant
Contamination with compounds from anticorrosion protection agents	None	Insignificant	Insignificant	None
Climate and greenhouse gases	Insignificant	Irrelevant	Insignificant	Irrelevant
Systems using EMF	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Phytobenthos	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Zoobenthos	Irrelevant	Insignificant	Irrelevant	Irrelevant
Ichthyofauna	Moderate	Of little importance – negative Moderate – positive	Moderate	Moderate

Element	Significance of the Baltica OWF's impact in the phase of:			
	construction	exploitation	construction and exploitation	decommissioning
Marine mammals	Moderate	Insignificant	Moderate	Insignificant
Seabirds	Moderate	Moderate	Moderate	Moderate
Migratory birds	Insignificant	Insignificant	Insignificant	Insignificant
Chiropterofauna	Insignificant	Insignificant	Insignificant	Insignificant
Ecological corridors	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Biological diversity	Insignificant	Insignificant	Insignificant	Insignificant
Use and development of sea area	Irrelevant	Insignificant	Insignificant	Irrelevant
Landscape	Irrelevant	Irrelevant	Irrelevant	Irrelevant
Population	Irrelevant	Irrelevant	Irrelevant	Irrelevant

Source: internal data

Taking into account the nature and scale of the planned project, its location and the taken into account by the Applicant restrictions in the built-up area and the application of the noise reduction system, in order to avoid, prevent and limit negative impacts of the Baltica OWF, it is recommended:

- to make the selection of solid construction towers for the wind power stations and the abandonment of lattice structures due to the smaller probability of birds colliding with solid construction towers;
- to prepare sewage and solid waste management procedures for each phase of the project;
- to incorporate in the executive plan and during the selection of building contractors the building contractors with ships whose hulls have not been covered with anti-fouling paint containing tin compounds (TBT);
- to limit the use of strong lighting that could attract birds during all phases of the project within the scope of the applicable regulations (for example, the aid to navigation);
- to paint the ends of blades with bright colours to increase the birds ability to see the wind turbines;
- during construction, to begin piling from the so-called *soft start,* i.e. performing a few blows of lesser force, and consequently a lower noise level, to allow marine mammals, fish and birds to leave the area of work;
- to dismantle the structure without the use of explosive methods to reduce the impact of the underwater noise.

Moreover, taking into account the location of the Baltica OWF, and in particular its proximity to the Natura 2000 site Słupsk Bank (PLC990001), it is also recommended to introduce an entry ban into the area of the Słupsk Bank site (PLC990001) for vessels engaged in the investment's implementation in all its phases (construction, exploitation and decommissioning) during the period from the beginning of November to the end of April due to the numerous occurrence of the long-tailed duck.

It should be emphasized also that using a noise reduction system it is possible to carry out simultaneous piling in two locations without the risk of significant negative impact of underwater noise on the environment. The performance of simultaneous piling in a greater number of locations can lead to a significant negative impact on the environment. Therefore, it is recommended that foundation contractors ensure in an operational manner that such situation will not take place. In this case, there is a requirement for the works to be coordinated.

The EIA Report describes the impact of the investment on the environment in a complete and exhaustive manner, indicating that both separately and in conjunction with other projects for which decisions on environmental conditions have been issued, regardless of the technology used – e.g. the type of foundation, the size of wind turbines – in the scope outlined in the description of the Investor's variant and the rational alternative does not cause significant negative impact on the environment. This also applies to the impacts on the Natura 2000 Ecological Network.

The centreless character of this Report causes that the actual impact of each possible investment implementation technology will be smaller than the one described herein. A good example may be the choice of foundations. If the gravity foundation is selected, the impact associated with solid matter will be the greatest but the underwater noise will be much less significant than in the case of foundations that require pile driving works. The latter generate only minimal impact on suspended solids and the greatest noise.

Impact of the investment on the environment has been minimised by means of separating location of the wind power stations from the Nature 2000 site PLC9900001 The Słupsk Bank and leaving a migration corridor for birds between the Baltica 2 and Baltica 3 Areas. The bird migration corridor between the Baltica 2 and Baltica 3 Areas answers also the requests included in the environmental permits concerning the BŚII and BŚIII OWFs which underline the need to delineate a migration corridor for birds crossing the areas of the offshore wind farms. The migration corridor between the Baltica 2 and Baltica 3 Areas has been delineated based on the results of the migratory bird surveys conducted for the purposes of the Report. It accounts also for the results of the surveys performed for the BŚII and BŚIII OWFs. Data from the surveys for the Baltica OWFs confirm the flight directions and routes determined in the previous surveys and provide sufficient grounds to delineate the migration corridor.

This Report specifies especially the fact that there is no significant impact associated with the exact location of wind power stations within the built-up area OZ MFW on any of the natural environment components at any phase of the investment implementation. Therefore, it can be concluded that another environmental impact assessment is not necessary as part of the construction permit process.

Both the Applicant's variant and the analysed rational alternative variant are characterised by impact from insignificant to moderate at all stages of the investment implementation. Intensity of certain impacts in the rational alternative variant is higher than in the case of the Applicant's variant. These include, for example, greater movement of vessels, the larger predicted quantity of generated waste, and the larger area of occupied seabed. The relatively higher intensity of these impacts would be the result of a greater number of wind power stations to be constructed, and thus many impacts may last longer and be repeated more times during individual phases of the project. Therefore, it should be stated that the investment in the Applicant's variant is the most favourable option for the environment.

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