Hornsea 4

Ørsted

Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 5, Annex 7.1: Commercial Fisheries Technical Report

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Glossary

Term	Definition
Beam trawl	A method of bottom trawling with a net that is held open by a beam, which is generally a heavy steel tube supported by steel trawl heads at each end. Tickler chains or chain mats, attached between the beam and the ground rope of the net, are used to disturb fish and crustaceans that rise up and fall back into the attached net.
Bycatch	Catch which is retained and sold but is not the target species for the fishery.
Demersal	Living on or near the sea bed.
Demersal trawl	A fishing net used by towing the trawl along or close to the sea bed.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Fish stock	Any natural population of fish which an isolated and self-perpetuating group of the same species.
Fishery	A group of vessel voyages which target the same species or use the same gear.
Fishing ground	An area of water or sea bed targeted by fishing activity.
Fishing mortality	Mortality due to fishing; death or removal of fish from a population due to fishing.
Fleet	A physical group of vessels sharing similar characteristics (e.g. nationality).
Gear type	The method / equipment used for fishing.
Hornsea Four	The proposed Hornsea Four offshore wind farm project; the term covers all elements within the DCO (i.e. both the offshore and onshore components).
ICES statistical rectangles	ICES standardise the division of sea areas to enable statistical analysis of data. Each ICES statistical rectangle is '30 min latitude by 1 degree longitude' in size (approximately 30 x 30 nautical miles). A number of rectangles are amalgamated to create ICES statistical areas.
Industrial fishery	Highly mechanised commercial fishing operations whose ultimate products are principally fish meal and fish oil.
Landings	Quantitative description of amount of fish returned to port for sale, in terms of value or weight.
Maximum Sustainable Yield	Maximum sustainable yield (MSY) is the largest yield (catch, in tonnes) that can be taken from a specific fish stock over an indefinite period under

Term	Definition
	constant environmental conditions. Fishing at MSY levels should ensure the capacity of the stock to continue to produce this level in the long term.
Metier	A homogenous subdivision, either of a fishery by vessel type or a fleet by voyage type.
Minimum Landing Size	Is a technical measure that limits the size of fish or shellfish species that can be legally landed and sold. The MLS varies per species. With the implementation of the Landings Obligation, the existing MLS are changed into minimum conservation reference sizes (MCRS), but they will remain largely the same.
Otter trawl	A net with large rectangular boards (otter boards) which are used to keep the mouth of the trawl net open. Otter boards are made of timber or steel and are positioned in such a way that the hydrodynamic forces, acting on them when the net is towed along the seabed, pushes them outwards and prevents the mouth of the net from closing.
Pelagic	Of or relating to the open sea.
Pelagic trawl	A net used to target fish species in the mid water column.
Quota	A proportion of the Total Allowable Catch for a fish stock.
Recruitment	Recruitment can be defined as the number of fish surviving to enter the fishery or to some life history stage such as settlement or maturity.
Scallop dredge	A method to catch scallop using steel dredges with a leading bar fitted with a set of spring loaded, downward pointing teeth. Behind this toothed bar (sword), a mat of steel rings is fitted. A heavy net cover (back) is laced to the frame, sides and after end of the mat to form a bag.
Spawning	The act of releasing or depositing eggs (fish).
Spawning stock biomass	This is the combined weight (in tonnes) of all the fish of one specific stock that are old enough to spawn. It provides an indication of the status of the stock and the reproductive capacity of the stock.
Stock assessment	An assessment of the biological stock of a species and its status in relation to defined references points for biomass and fishing mortality.
String	A series of static fishing gear (pots) joined together to form a single deployable linear line of pots.
Total Allowable Catch	Total Allowable Catches (TACs) are catch limits, expressed in tonnes or numbers, that are set for some commercial fish stocks.
Vessel Monitoring System	A system used in commercial fishing to allow environmental and fisheries regulatory organizations to monitor, minimally, the position, time at a position, and course and speed of fishing vessels.
Vivier	A fishing vessel, normally targeting crab, which has a tank on board allowing the catch to be stored live in water.

Acronyms

Acronym	Definition
DCF	Data Collection Framework
DCO	Development Consent Order
ECC	Export Cable Corridor
EEFPO	Eastern England Fish Producers Organisation
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
EUMOFA	European Market Observatory for Fisheries and Aquaculture Products
HFIG	Holderness Fishing Industry Group
ICES	International Council for the Exploration of the Sea
IFCA	Inshore Fisheries and Conservation Authority
MLS	Minimum Landing Size
MMO	Marine Management Organisation
NEIFCA	North Eastern Inshore Fisheries and Conservation Authority
NFFO	National Federation of Fishermen's Organisations
PEIR	Preliminary Environmental Information Report
PO	Producer Organisation
SICG	Scallop Industry Consultation Group
TAC	Total Allowable Catch
UK	United Kingdom
VMS	Vessel Monitoring System

Units

Unit	Definition
€	Euros
£	Great British Pounds
£/kg	Great British Pounds per kilogram
hp	horsepower
kg	Kilograms
km	Kilometres
kW	Kilowatts
m	Metres
NM	Nautical Mile

1 Introduction

1.1 Introduction

1.1.1.1 Ørsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter Hornsea Four). Hornsea Four will be located approximately 65 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone (please see **Volume 1, Chapter 1: Introduction** for further details on the Hornsea Zone). Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume 1, Chapter 4: Project Description** for full details on the Project Design). The location of the offshore infrastructure search area is shown in **Figure 1**. The Preliminary Environmental Information Report (PEIR) boundary combines the search areas for the onshore and offshore infrastructure.

1.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 848 km^2 at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project is currently giving due consideration to the size and location (within the existing AfL area) of the final project that will be taken forward to consent application (DCO). This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction. The combination of Hornsea Four's Proportionality in EIA and Developable Area process has resulted in a marked reduction in the AfL taken forward at the point of PEIR (see **Figure 1**). The evolution of the AfL is detailed in **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives Chapter** and **Volume 3, Annex 3.2: Selection and Refinement of Offshore Infrastructure**. The final developable area taken forward to development consent application may differ from that presented in **Figure 1** due to the results of the EIA, technical considerations and stakeholder feedback.

1.1.1.3 Poseidon Aquatic Resource Management Ltd (Poseidon) was commissioned by the Applicant to prepare a Commercial Fisheries Technical Report that provides a detailed review of the commercial fisheries fleets that operate within and adjacent to the Hornsea Four array area and offshore export cable corridor (ECC).

1.1.2 Aims and objectives

1.1.2.1 The information on commercial fisheries activity presented in this document is intended to inform the Environmental Impact Assessment (EIA) for Hornsea Four by providing a detailed understanding of the commercial fisheries baseline, against which the potential impacts of Hornsea Four can be assessed. An overview of the information presented in this Technical Report is provided in **Volume 2, Chapter 7: Commercial Fisheries** of the PEIR.

2 Methodology

2.1 Study Area

2.1.1.1 The Hornsea Four array area and offshore ECC are located within the southwest portion of the International Council for the Exploration of the Sea (ICES) Division 4b (Central North Sea) statistical area; outside the 12 nm limit in UK Exclusive Economic Zone (EEZ) waters. For the purpose of recording fisheries landings, ICES Division 4b is divided into statistical rectangles which are consistent across all Member States operating in the North Sea.

2.1.1.2 The Hornsea Four commercial fisheries study area lies within OSPAR Region 2 – Greater North Sea. The commercial fisheries study area is defined by the ICES statistical rectangles that overlap with the Hornsea Four array area and offshore ECC, as shown in **Figure 1**. The commercial fisheries study area therefore comprises six ICES rectangles (ICES Rectangles 37E9 to 37F1 and 36E9 to 36F1), within which the Hornsea Four array study area (ICES rectangles 37F0, 37F1, and 36F1) and offshore ECC study area (ICES rectangles 37E9, 37F0, 37F1, 36F1, 36F0, and 36E9) are located. The Hornsea Four array area and offshore ECC occupy only a portion of these ICES rectangles (8.83%).

2.2 Data Sources

2.2.1.1 A number of data sources have been reviewed in compiling this Technical Report. These are identified under the headings below.

2.2.1.2 A five-year trend analysis has been undertaken, using the most recent annual datasets available at the time of writing. The temporal extent of this five-year period is dependent on each data source analysed, e.g. 2012 to 2016 or 2013 to 2017, as annotated below.

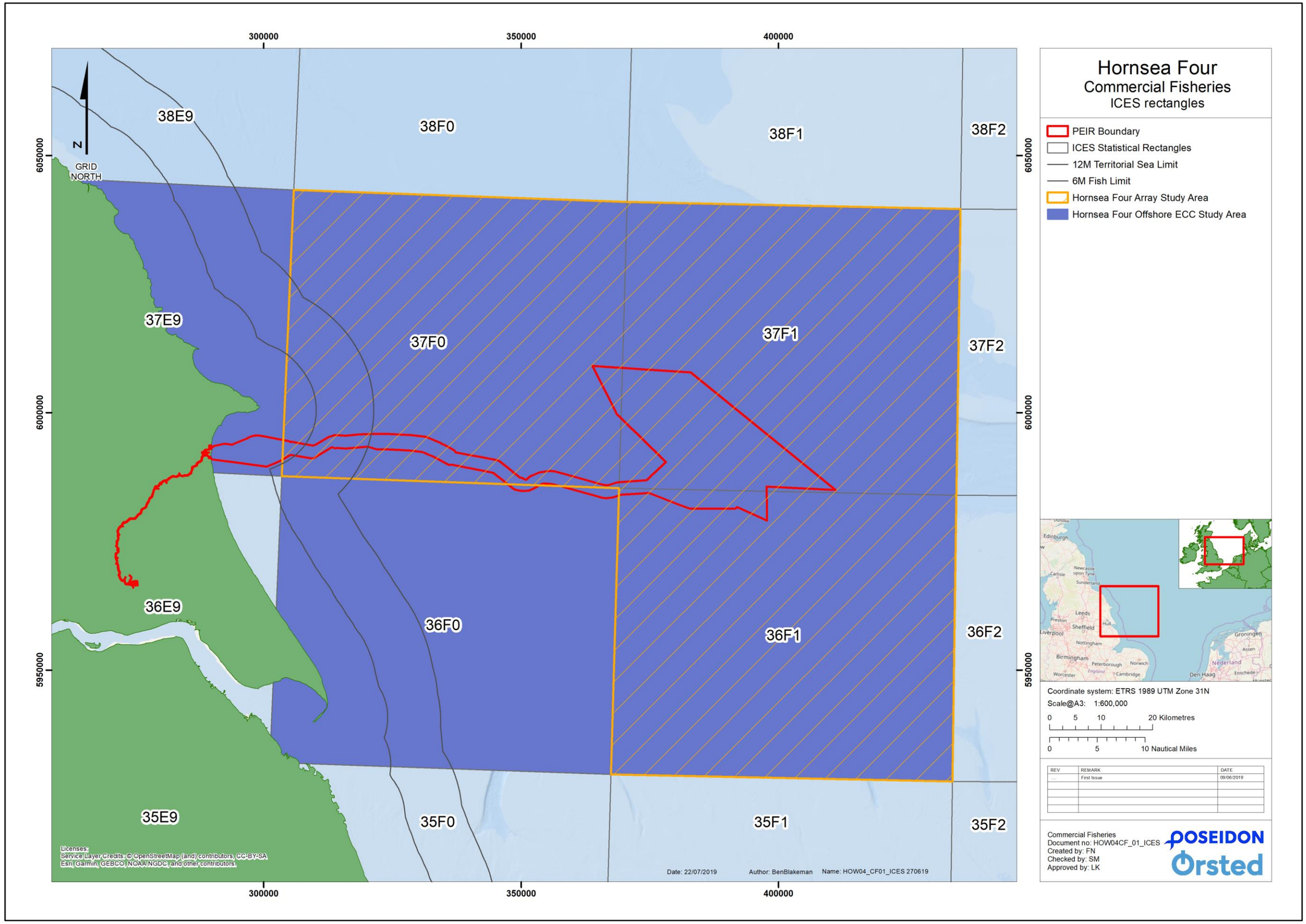

Figure 1: Commercial Fisheries ICES statistical rectangles and the Hornsea Four PEIR boundary (not to scale).

2.2.2 Desktop Review

2.2.2.1 The following data sources, which have been subject to desktop review, have been key to the assessment of fisheries activity:

- Landings statistics for fisheries operating within the study area. Data for UK landings is primarily sourced from the Marine Management Organisation (MMO) and covers the period 2013 – 2017, and data for non-UK landings is sourced from the European Union (EU) Data Collection Framework (DCF) and covers the period 2012-2016;
- Landings value data for non-UK Member States, sourced from the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA) and covering the period 2012 – 2016;
- Vessel Monitoring System (VMS) data for vessels ≥15 m covering the period 2013 - 2017;
- Vessel sightings data provided by North East Inshore Fisheries Conservation Authority (NE IFCA); and
- Data derived from fisheries reconnaissance surveys commissioned by Hornsea Four (2018).

2.2.2.2 Data has also been sourced from a number of European fisheries bodies, including Government agencies, research bodies and directly from the fishing industry and its representative organisations. A summary of data sources is provided in Table 1.

2.2.2.3 Relevant literature from a number of sources has also been reviewed in the preparation of this Technical Report. A full list of references is provided at the end of this document and are cited within the text where appropriate.

Table 1: Data sources used to inform this Technical Report.

Member State	Data	Timeframe	Source
United Kingdom	Fisheries reconnaissance surveys commissioned by Hornsea Four to map static gear positions.	2018	Hornsea Four
United Kingdom	Landings statistics data for UK-registered vessels, with data query attributes for: landing year; landing month; vessel length category; ICES rectangle; vessel/gear type; port of landing; species; live weight (tonnes); and, value	2013 - 2017	MMO
United Kingdom	VMS data for UK-registered vessels with data query attributes for time fishing and value of catch at a resolution of 200th of an ICES rectangle, amalgamated for all mobile gear vessels and all static gear vessels	2013 - 2016	MMO
United Kingdom	Vessel sightings data indicating location of fishing vessels and gear type from patrol surveys.	2011 - 2016	NE IFCA
All Europe	Landings statistics for Belgian, Danish, Dutch, French, German, Swedish and UK registered vessels with data query attributes for: landing year; landing quarter; ICES rectangle; vessel length; gear type; species; and, landed weight (tonnes)	2012 - 2016	EU DCF
All Europe	Price data for species landed by Belgian, Danish, Dutch, French, German, and Swedish registered vessels with data query attributes for: landing year; species; and, price (Euros per kilogram)	2012 - 2016	EUMOFA

Member State	Data	Timeframe	Source
All Europe	VMS data for Belgian, Danish, Dutch, French, German, and Norwegian registered vessels with data query attributes for time fishing at a resolution of 1/200th of an ICES rectangle amalgamated for all mobile vessels	2013 - 2017	ICES
All Europe	Commercial fishing activity density mapping across the former Hornsea Zone for beam trawl and demersal otter trawl	2010	The Crown Estate

2.2.3 Consultation

2.2.3.1 Consultation with commercial fisheries stakeholders undertaken to inform the Hornsea Four PEIR is detailed in **Volume 2, Chapter 7: Commercial Fisheries**.

3 Key Species and Fishing Gears

3.1 Key Species

3.1.1 Overview of Landings

3.1.1.1 Average annual landings by all Member States from the study area are presented by species and landed weight

3.1.1.2 The Hornsea Four array area and offshore ECC overlaps ICES rectangles 37E9, 37F0, 37F1, 36E9, 36F0 and 36F1, which have an annual average value of £19.51 million for all UK vessels for the years 2013 to 2017 (MMO, 2019).

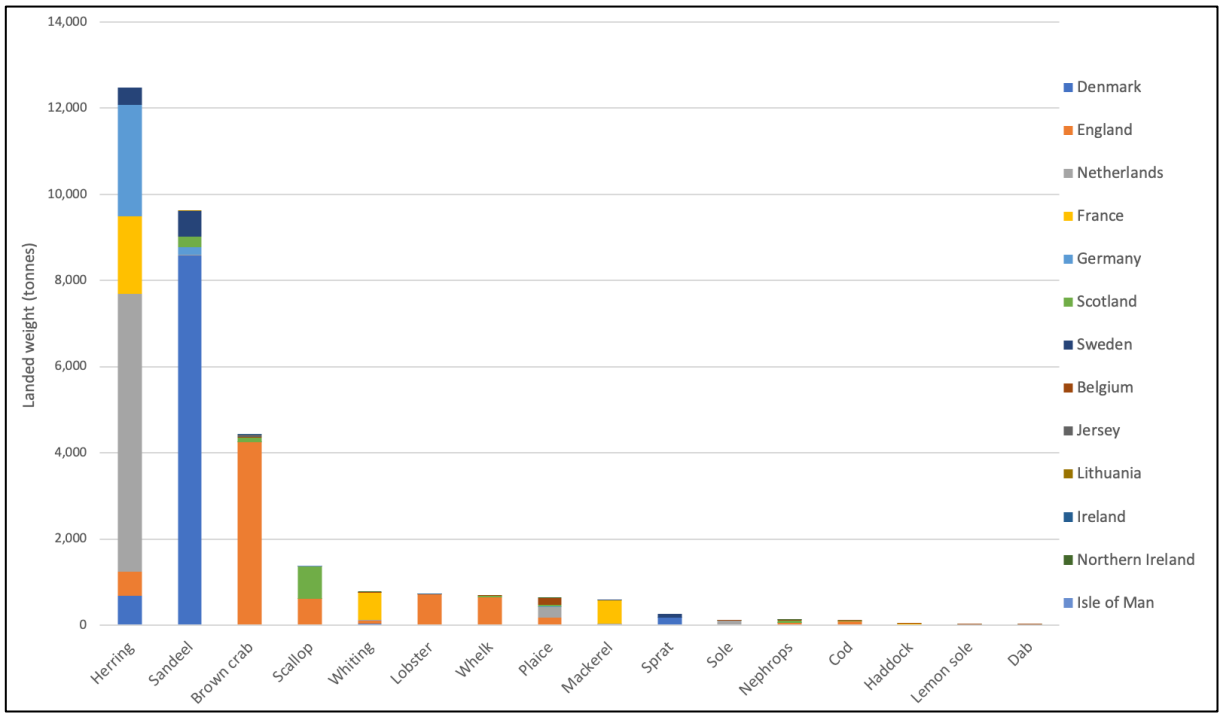

Figure 2: Average annual landed weight (tonnes) of species landed by all Member States from the Hornsea Four commercial fisheries study area (based on five years' data from 2012 to 2016) (EU DCF database, 2019).

3.1.1.3 For non-UK vessels, the commercial fisheries study area is dominated by landings of herring *Clupea harengus* by Dutch and German vessels in particular (Figure 3), and of sandeels *Ammodytes marinus*, predominantly by Danish vessels (Figure 4). The significant landings are reflective of the industrial scale of these fisheries. The average annual value of herring landings between 2012 and 2016 was in excess of approximately £5.67 million, and for sandeel landings the equivalent value was approximately £1.75 million. Data shows notable fluctuations in annual landings for both species, indicative of the opportunistic nature of the fisheries. Herring, caught mainly by pelagic trawl, are primarily landed from ICES rectangle 37F0, which overlaps with the offshore ECC and a small portion of the array area. Highly mobile pelagic species, that move in shoals and are not associated with specific seabed habitats, are assumed to be available to catch across large areas i.e., if a shoal of herring cannot be caught within Hornsea Four array area or offshore ECC, this shoal is expected to move to an area where they can be caught.

3.1.1.4 Sandeels, caught mainly by otter trawl, are primarily landed from ICES rectangle 37FI, which overlaps with a large portion of the array area and the offshore ECC to a lesser extent. North Sea sandeel grounds are well-mapped, and data indicates that whilst the array area does partially overlap with some grounds, the majority of grounds within ICES rectangle 37F1 are to the north of the array area (based on sandeel fishing tracks, provided by the Danish Fishermen's Association).

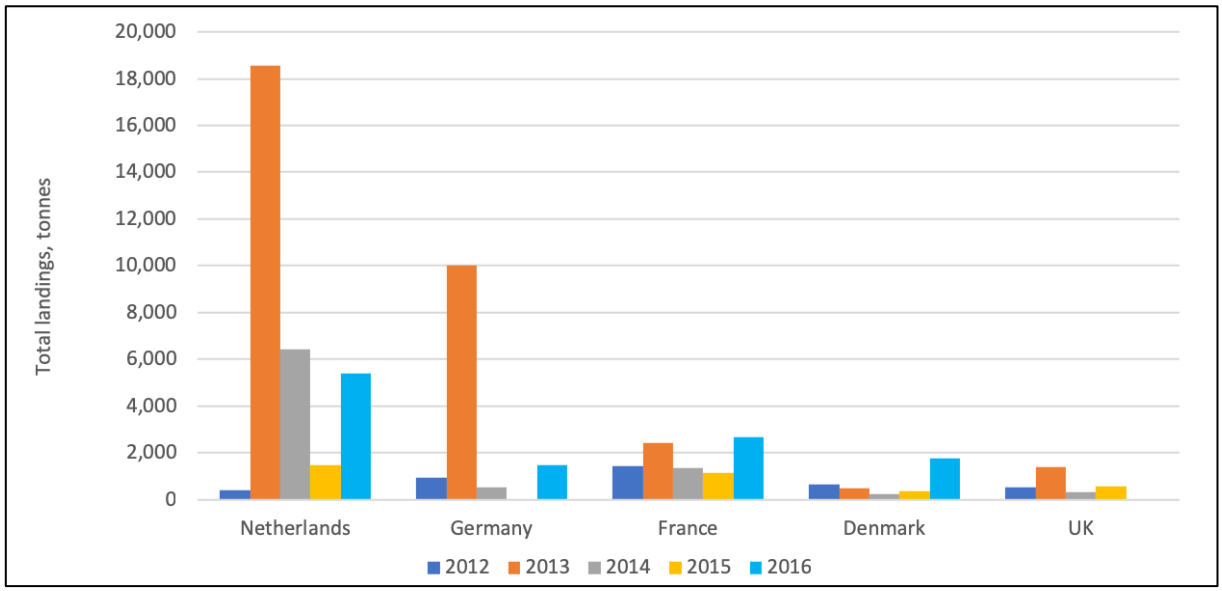

Figure 3: Total weight (tonnes) of landings of herring from 2012 to 2016 from the Hornsea Four commercial fisheries study area by vessel registered nationality (EU DCF, 2019).

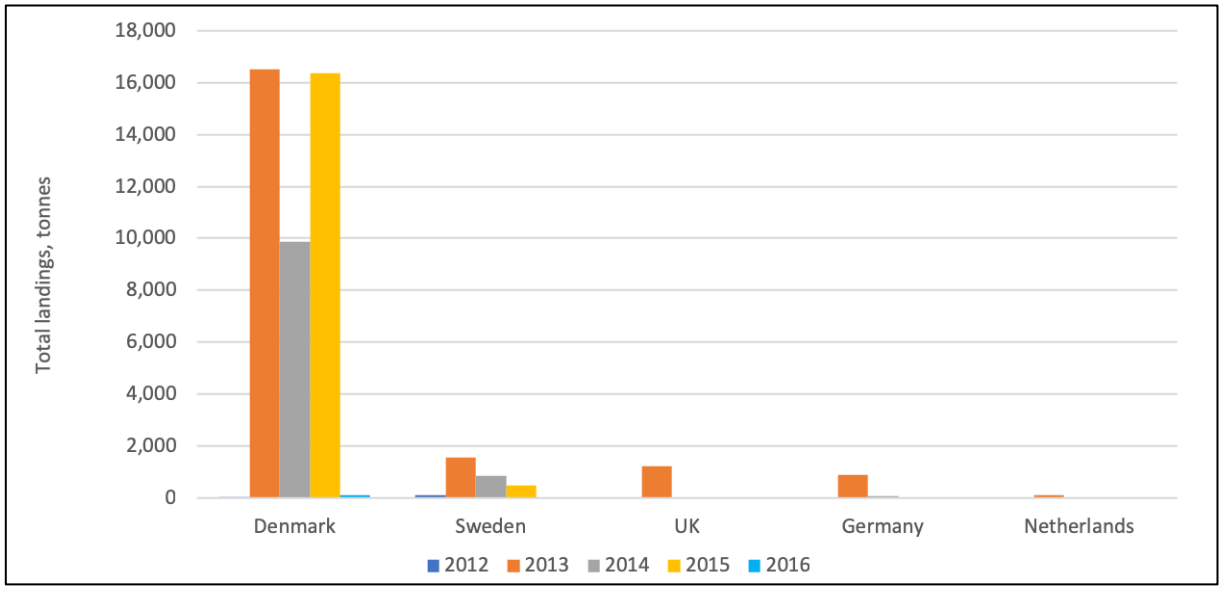

Figure 4: Total weight (tonnes) of landings of sandeels from 2012 to 2016 from the Hornsea Four commercial fisheries study area by vessel registered nationality (EU DCF, 2019).

3.1.1.5 Excluding herring and sandeel fisheries, Figure 5 shows the top twelve species landed from the entire Hornsea Four commercial fisheries study area by weight from 2012 to 2016. The key species are brown crab *Cancer pagurus* and King scallop *Pecten maximus*, targeted primarily by UK potters and dredgers respectively. Brown crab represent the most significant landings by weight across the inshore and southern portion of the study area in ICES rectangles 37E9, 36E9, 36F0 and 36F1. Landings have steadily increased over the five-year study period, peaking at over 5,500 tonnes in 2016. Scallop landings originate primarily from inshore ICES rectangle 37E9, and annual landings fluctuate markedly over the five-year study period, peaking in 2015 at over 2,800 tonnes. Other species of importance based on landings weight include whiting *Merlangius merlangus*, European lobster *Homarus gammarus*, whelk *Buccinum undatum*, plaice *Pleuronectes platessa* and mackerel *Scomber scombrus*.

3.1.1.6 Figure 6 shows, for landings by UK vessels only, the top twelve species landed from the entire Hornsea Four commercial fisheries study area by value, from 2013 to 2017 (MMO, 2018). The key species in terms of value (excluding herring and sandeel and other species landed by foreign vessels) are European lobster, brown crab and King scallop. When compared with the weight of landings in the Hornsea Four commercial fisheries study area (Figure 7), it can be seen that while catches of lobsters are considerably lower by weight than brown crabs, their value exceeds that of brown crab, owing to a higher market price. The data suggests that both brown crab and lobster landings are of particular importance in the study area and are the most valuable landings in all five years of the study period. Scallop landings values fluctuate across the five-year period, peaking markedly in 2015 and 2017 and reflecting a peak in landings weight. It is also worth noting that a number of species with low catch weights have relatively high total values (e.g. cod *Gadus morhua* and Norway lobster *Nephrops norvegicus*) and can also be considered key target species in the study area.

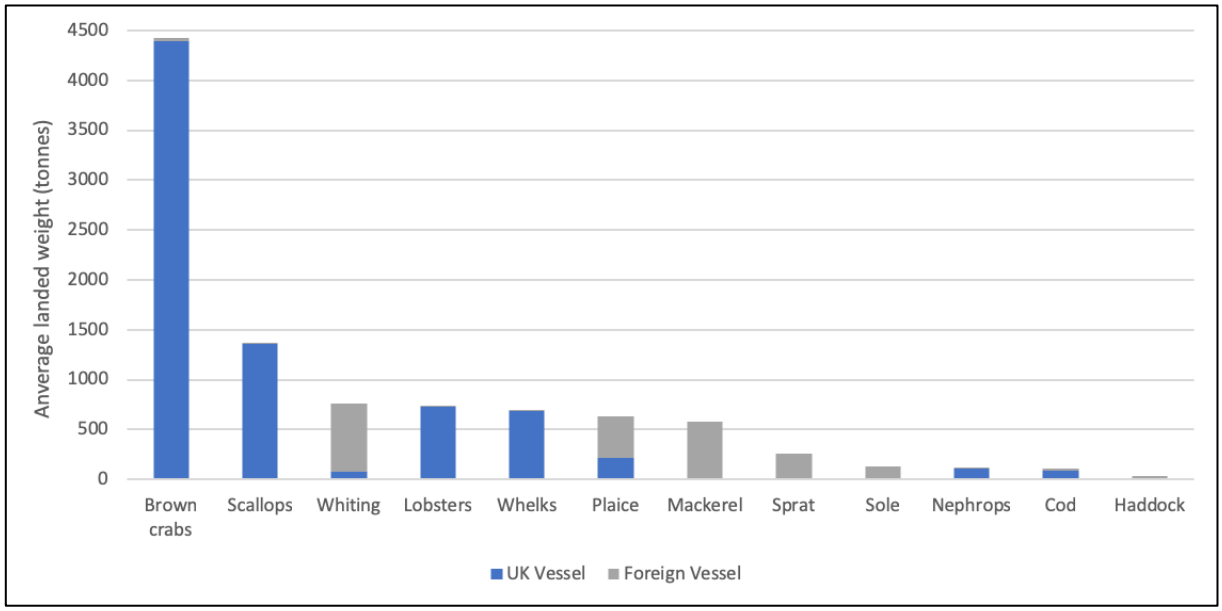

Figure 5: Top twelve species by weight (tonnes) from 2012 to 2016 landed from the Hornsea Four commercial fisheries study area by vessel nationality, excluding sandeel and herring (EU DCF, 2018).

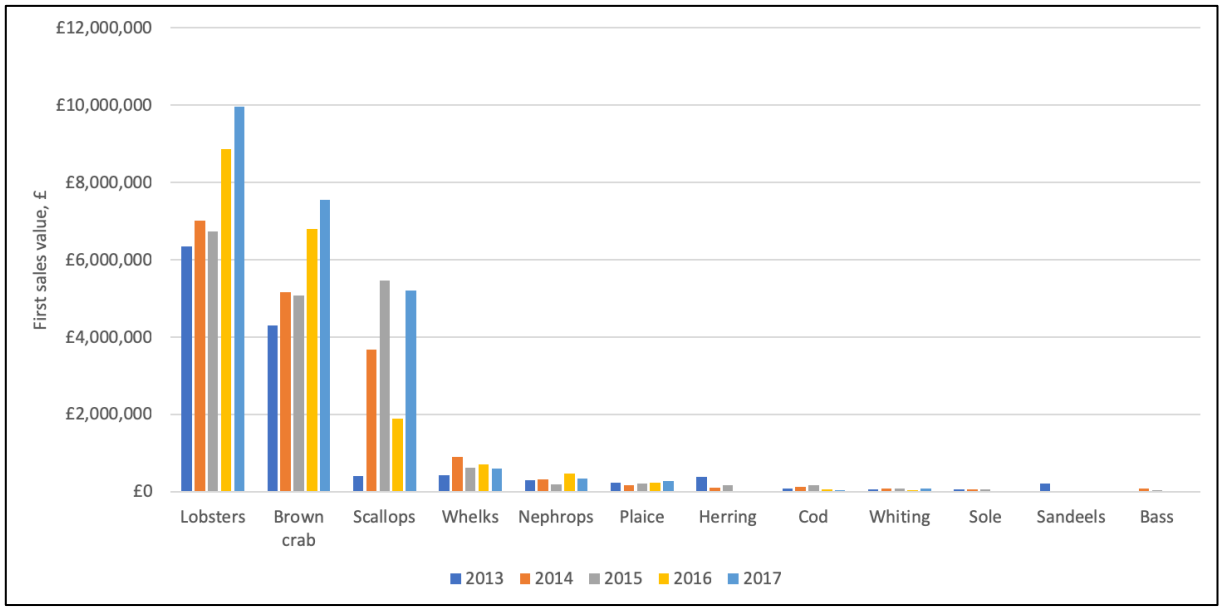

Figure 6: Top twelve species by value (GBP) from 2013 to 2017 landed from the Hornsea Four commercial fisheries study area by UK vessels only (MMO, 2018).

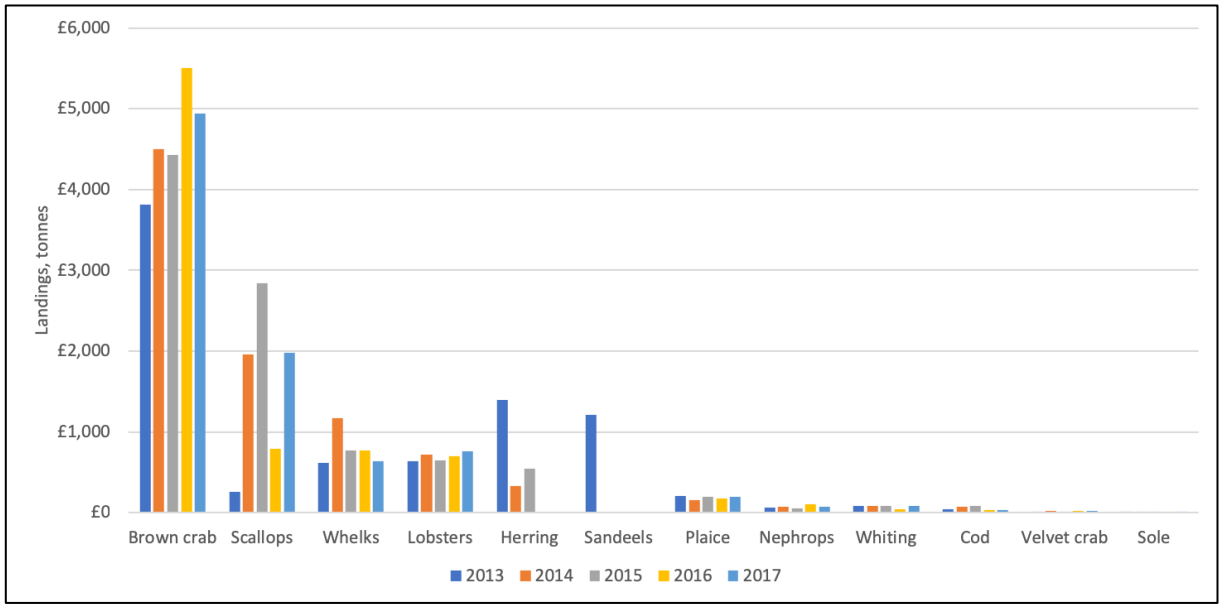

Figure 7: Top twelve species by weight (tonnes) from 2013 to 2017 landed from the Hornsea Four commercial fisheries study area by UK vessels only (MMO, 2018).

3.1.2 Total Allowable Catch and Quotas

3.1.2.1 As per EU Council Regulations, Total Allowable Catches (TACs) and quotas are in place for many commercial fish species based on their stock distribution across ICES Divisions, as presented in Figure 8. TACs are intended to allocate fish resources to different Member States and to control the amount of fish removed each year. When setting TACs the European Commission is informed by scientific stock assessments and advice provided by ICES on an annual basis. Different quotas are applied to different areas for different species. The TACs set for a species across ICES Divisions 4 (North Sea) and 2 (Norwegian Sea) for example, allow countries that have been allocated a quota from this TAC to fish within ICES Divisions 4a, 4b, 4c, 2a and 2b. TACs and quotas per country are presented in Table 2 for key species landed from the study area.

3.1.2.2 Within the UK Exclusive Economic Zone (EEZ), fishing activity from the shore to 6 NM is only permissible for UK-registered vessels. A number of restrictions are in place based on byelaws set by English Inshore Fisheries and Conservation Authorities (IFCA) that control fisheries out to 6 NM. From 6 NM to 12 NM, non-UK vessels may fish if they have acquired historical rights to do so. Outside 12 NM, international vessels are permitted to fish subject to quota allocation and other EU level restrictions including technical gear measures and effort restrictions such as days at sea.

Table 2: Total Allowable Catch and quotas in tonnes per country for key species landed from the study area for 2019 (EU, 2019; EU, 2017).

Species	ICES Division	TAC (tonnes)	UK	Netherlands	Denmark	Germany	France	Belgium	Sweden	Norway
Herring	4, 7d, 2a	13190	240	65	12628	65	65	65	62	0
		Proportion	1.8%	0.5%	95.7%	0.5%	0.5%	0.5%	0.5%	0.0%
Sandeel *	4, 2a, 3a	0	0	0	0	0	0	0	0	0
		Proportion	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4, 2a, 3a (2017)	486115	10024	0	458552	701	0	0	16838	0
		Proportion	2.1%	0.0%	94.3%	0.1%	0.0%	0.0%	3.5%	0.0%
Sprat *	4, 2a	0	0	0	0	0	0	0	0	0
		Proportion	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4, 2a (2017)	176411	6264	1890	149592	1890	1890	1890	1995	10000
		Proportion	3.6%	1.1%	84.8%	1.1%	1.1%	1.1%	1.1%	5.7%
Mackerel	4, 3a-c, 2a	653438	1243	1342	14480	441	1333	423	4034	135398
		Proportion	0.2%	0.2%	2.2%	0.1%	0.2%	0.1%	0.6%	20.7%
Nephrops	4, 2a	22103	19145	595	1156	17	34	1156	0	0
		Proportion	86.6%	2.7%	5.2%	0.1%	0.2%	5.2%	0.0%	0.0%
Whiting	4, 2a	17191	7062	565	977	254	1468	226	2	1219
		Proportion	41.1%	3.3%	5.7%	1.5%	8.5%	1.3%	0.0%	7.1%
Plaice	4, 2a, 3a	125435	26336	35589	18506	5338	1068	5694	0	8780
		Proportion	21.0%	28.4%	14.8%	4.3%	0.9%	4.5%	0.0%	7.0%
Common sole	4, 2a	12555	538	9439	478	836	209	1045	0	10
		Proportion	4.3%	75.2%	3.8%	6.7%	1.7%	8.3%	0.0%	0.1%
Cod	4, 2a, 3a	29437	10914	2688	4758	3017	1023	828	32	0
		Proportion	**37.1%**	**9.1%**	**16.2%**	**10.2%**	**3.5%**	**2.8%**	**0.1%**	**0.0%**

*Sandeel and sprat TAC and quotas set at zero in 2019 and 2018, based on scientific advice related to stock abundance; data for 2017 is therefore provided for context. Cells are highlighted where a significant proportion of the TAC is held by one country.

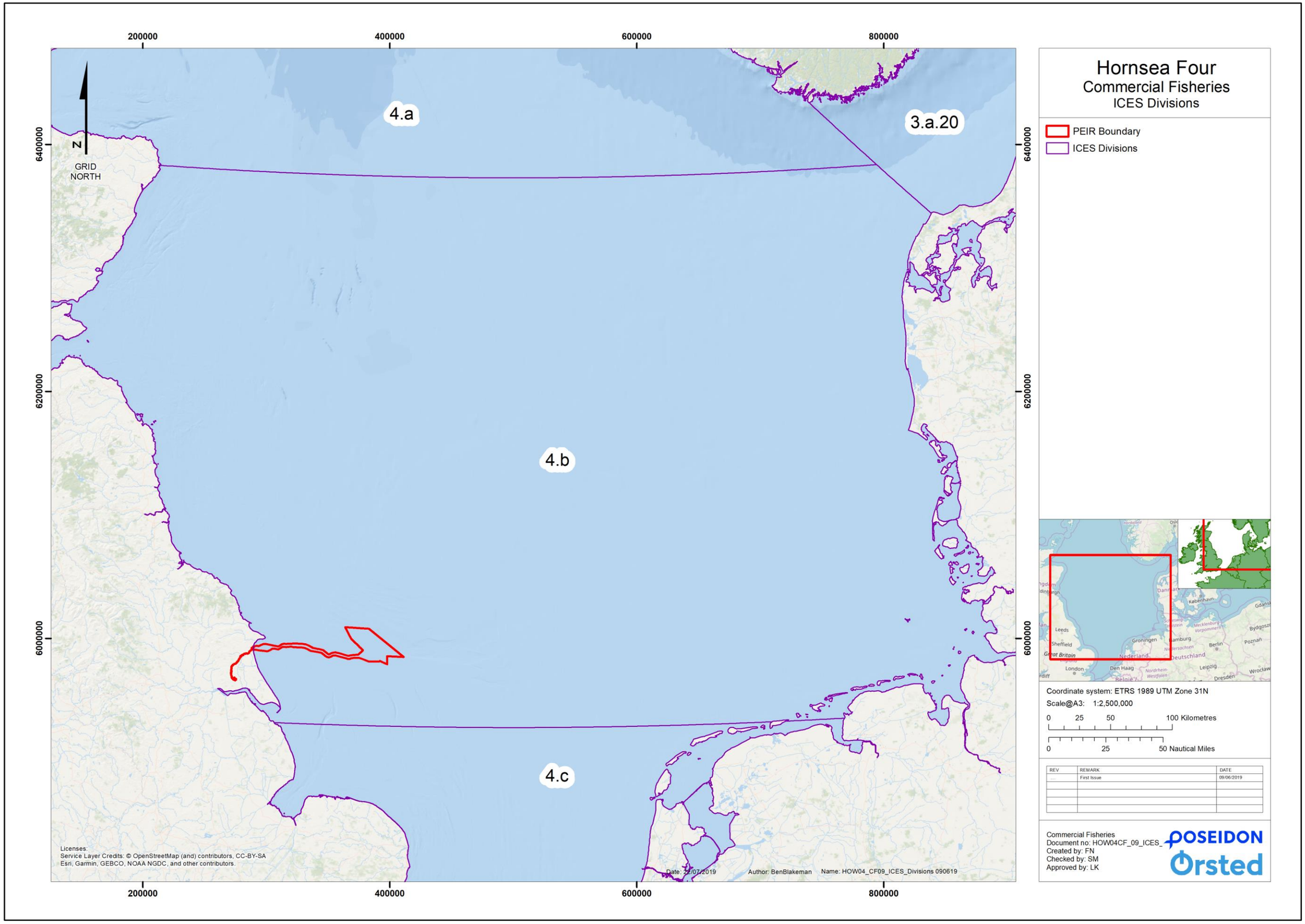

Figure 8: ICES Divisions (not to scale).

3.1.3 Shellfish

European lobster

3.1.3.1 European lobster *Homarus Gammarus* (hereon referred to as lobster) is a long-lived decapod crustacean. Lobster breed once per year in the summer and newly berried females begin to appear from September to December. Lobsters do not undertake any significant migrations and juveniles in the first three to four years of life may be particularly sedentary. From hatching it takes approximately five years for a lobster to recruit to the fishery. Lobsters typically inhabit rocky reef and rough ground, sheltering in crevices between rocks and boulders. The availability of suitable habitat is considered to influence the carrying capacity and size structure of lobster populations (Seitz *et al.*, 2014).

3.1.3.2 Lobsters are caught by pots and there are no TACs or quotas in place. Primary management is by the technical measure of a Minimum Landing Size (MLS) of 87 mm (Council Regulation 850/98). Due to the inshore location of lobster they are predominantly targeted by the UK potting fleet along the Yorkshire/Humber coast, under the jurisdiction of the North Eastern IFCA from 0 to 6 NM and the MMO and Defra from 6 to 12 NM.

3.1.3.3 Lobster is one of the highest value per kilogram, commercially exploited shellfish species found in UK waters. Fishing activity typically peaks between July and September (**Figure 9**).

3.1.3.4 A recent Cefas stock assessment reports that exploitation of the lobster stock in the Yorkshire/Humber region is very high (above the maximum reference point limit) but has decreased in recent years. Fishing pressure is considered to be particularly high around the Minimum Landing Size (Cefas, 2017a). The assessment reports that since 2010 the lobster fishery has expanded into grounds further offshore.

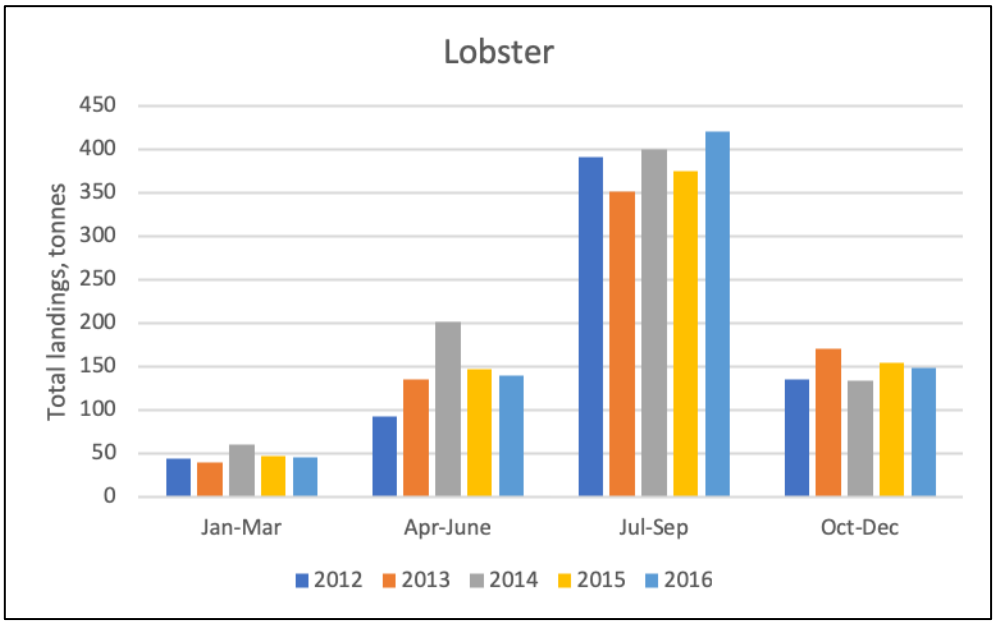

Figure 9: Seasonality of total landings (tonnes) of lobster from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Brown crab

3.1.3.5 Brown crab is a long-lived, large decapod crustacean. Brown crabs are very productive animals and each female can hatch between 1 and 4 million eggs. Post larvae are known to settle inshore and juvenile crabs are more common in shallow waters. Adult crabs undertake extensive migrations, which may be associated with their reproductive cycle. Brown crab is found across a wide range of habitat types, ranging from rocky reefs to soft mud and sand.

3.1.3.6 As with lobster, brown crab are predominately targeted by the UK potting fleet located along the Yorkshire/Humber coast, under jurisdiction of the North Eastern IFCA from 0 to 6 NM and the MMO and Defra from 6 to 12 NM. As with lobster, brown crab are caught by pots and have no TACs or quotas in place. Primary management is by the technical measure of a Minimum Landing Size (MLS) of 115 mm carapace width inside 6 NM and 130mm outside 6NM (Council Regulation 850/98).

3.1.3.7 A recent assessment undertaken by Cefas reports on the status of the brown crab stock in the Southern North Sea, which supports three distinct fisheries, the Holderness fishery off Yorkshire, and two Norfolk fisheries (Cefas, 2017b). The Cefas report indicates strong seasonal fluctuations in landings of crab, with the spring fishery (March – May) seeing the highest catch rates (Cefas, 2017b); landings data however indicates greater landings from the autumn/winter crab fishery (Figure 10). The fishery in this area has increased in range with the decline of trawling, as operators target grounds beyond 6 NM and increased landings and animal sizes have been noted on the quayside within the North Eastern IFCA

district (Cefas 2017b). The inshore fishery has also seen an increase in pots hauled and pots set across the North Eastern IFCA range (Cefas, 2017b).

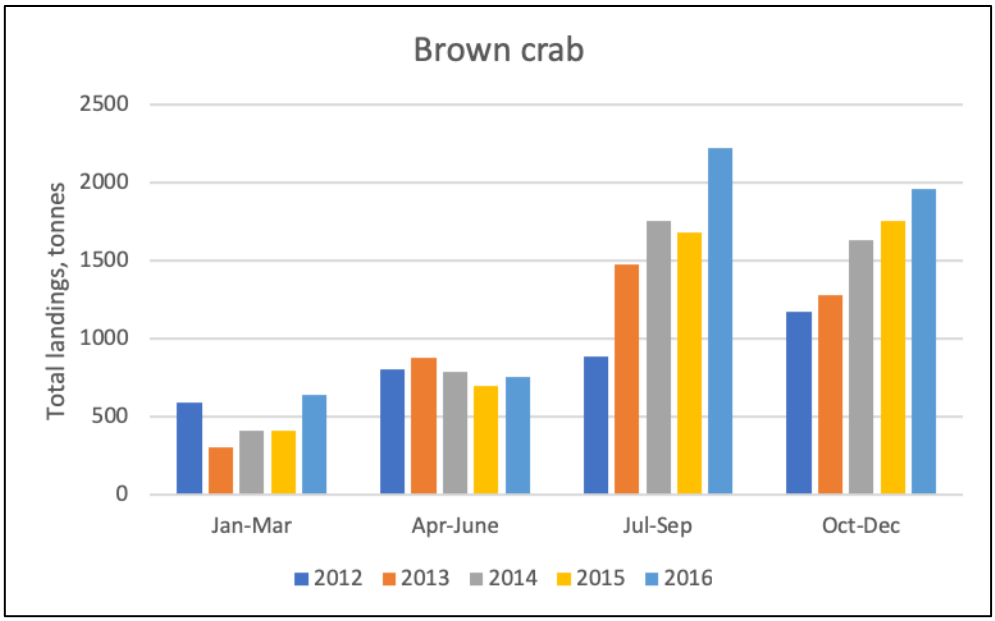

Figure 10: Seasonality of total landings (tonnes) of brown crab from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Common whelk

3.1.3.8 Common whelk are found across a range of habitats including muddy sand, gravel and rock. Whelk are caught using plastic pots often deployed by the same potting vessels that target crab and lobster. Landings data illustrate peaks in catches in the first half of the year. Whelk are cleaned and frozen raw in-shell to be exported to the far east. The fishery is very dependent on market conditions and prices. Fishing activity typically peaks from April to June (**Figure 11**).

3.1.3.9 No TAC or quotas are in place for whelk. A MLS of 45 mm is in place outside 6 NM (Council Regulation 850/98), while a minimum legal size of 55 mm is defined for 0 to 6 NM.

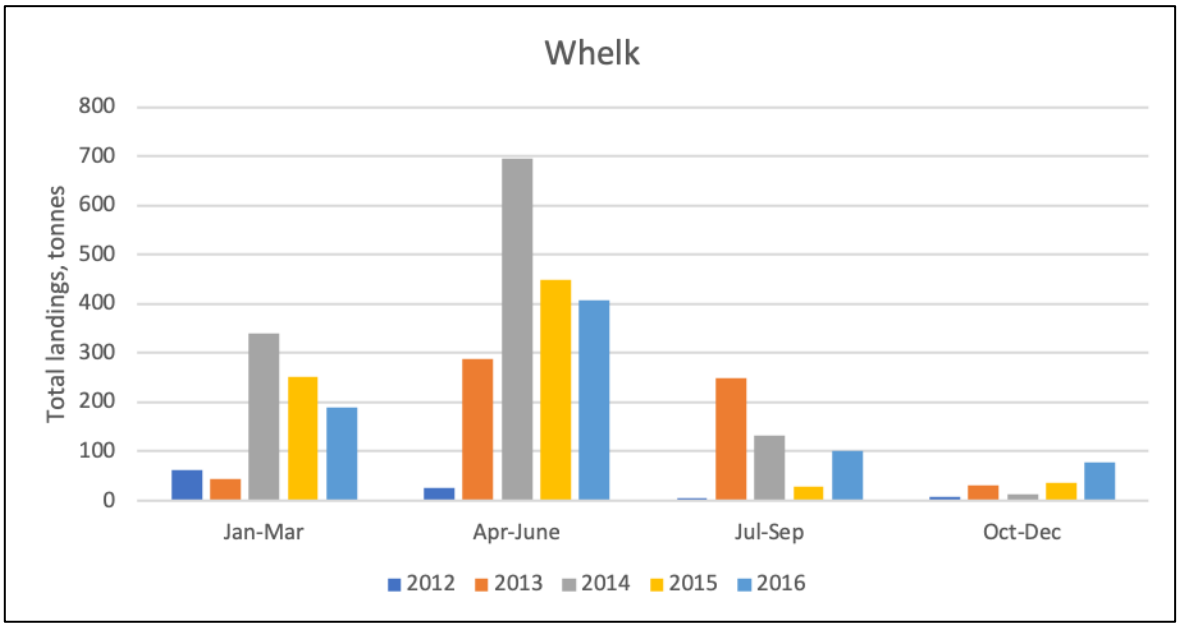

Figure 11: Seasonality of total landings (tonnes) of whelk from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Nephrops

3.1.3.10 *Nephrops* (known as langoustine, prawn and Norway lobster, hereon referred to as *Nephrops*) are limited to muddy habitats and therefore stock assessments are based on nine separate Functional Units (FUs) within the North Sea. The study area lies across part of the Botney Gut –Silver Pit FU. The *Nephrops* fisheries in the Botney Gut are solely bottom trawl fisheries.

3.1.3.11 Landings from the FU have been relatively steady, with notable peaks in 2016 and 2017 (ICES, 2018a). The UK holds 87% of the quota for the North Sea and Norwegian Sea; there are no restrictions in terms of which North Sea FUs this quota can be taken from. The state of this stock is unknown. Preliminary stock surveys (2010 and 2012) indicate relatively high density compared to neighbouring FUs (ICES, 2018a). Landings peak during late summer and early autumn (Figure 12).

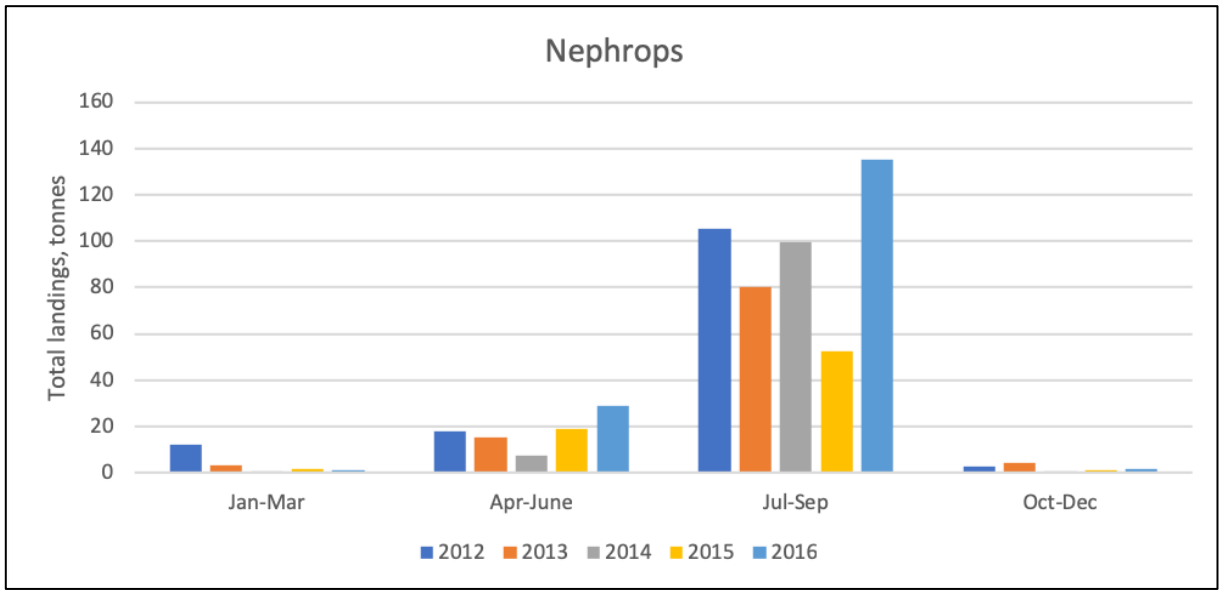

Figure 12: Seasonality of total landings (tonnes) of *Nephrops* from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

King scallop

3.1.3.12 King scallop *Pecten maximus* (here on referred to as scallop) are most common in water depths of 20 to 70 m, in areas of clean firm sand and fine gravel exposed to water currents, which provide good feeding conditions for this bivalve mollusc. Recruitment is usually unpredictable as it depends not only on successful spawning and larval production but also on retention of larvae or transport of larvae into areas suitable for settlement. Settlement in a particular area may be unpredictable leading to an unstable age structure. As a consequence of this, scallop beds frequently show a regional separation of year classes and spatial variability in age structure.

3.1.3.13 Scallop are targeted almost exclusively in this area by UK-registered dredgers and there are no TACs or quotas in place with this species, therefore this species is primarily managed by a MLS of 100 mm (Council Regulation 850/98).

3.1.3.14 In a recent stock assessment for the area through which the ECC is routed, Cefas report the presence to two main scallop beds, which have been defined using VMS data. One of these beds overlaps the ECC (Cefas, 2019). Landings in this area fluctuate throughout the year but tend to be higher in quarters one and two (Cefas, 2019 and **Figure 13**). The Cefas assessment was the first undertaken for scallops in this region, and no conclusions are reached regarding harvest rates relative to maximum sustainable yield (Cefas, 2019).

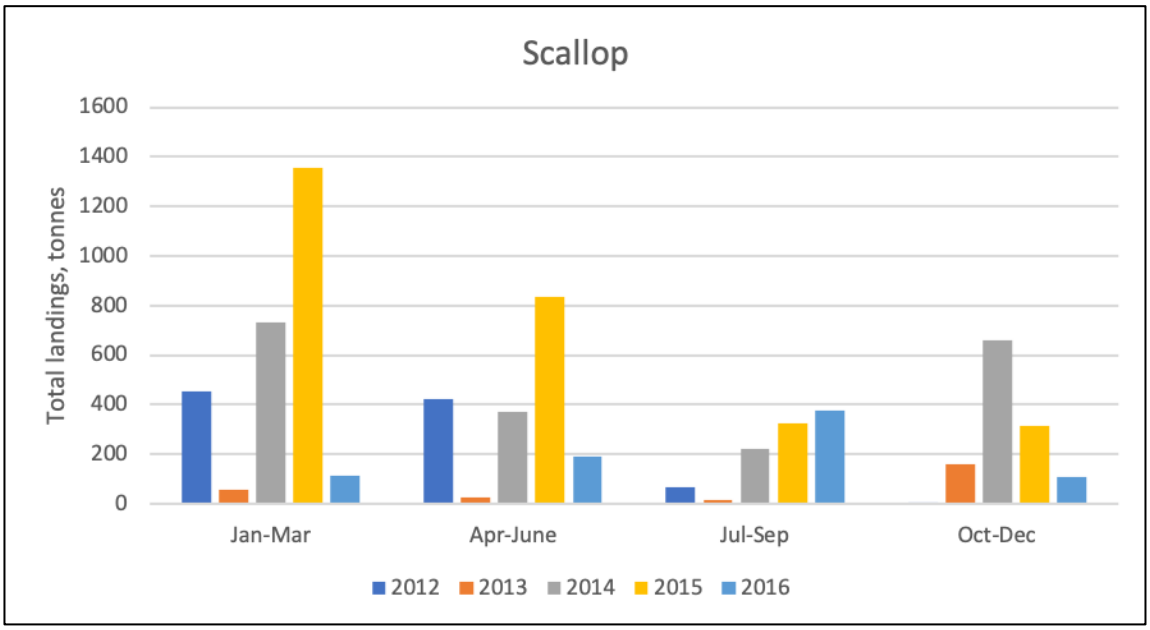

Figure 13: Seasonality of total landings (tonnes) of scallop from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Velvet crab

3.1.3.15 Velvet crab *Necora puber* are typically taken as bycatch in the crab and lobster fisheries. There are no TACs or quotas in place with this species, therefore this species is primarily managed by a MLS of 65 mm carapace width.

3.1.4 Pelagic Finfish

Sprat

3.1.4.1 Sprat *Sprattus sprattus* is a short-lived clupeoid species with large inter-annual fluctuations in stock biomass, mainly driven by recruitment variability. Sprat in the North Sea has a prolonged spawning season ranging from early spring to the late autumn and is triggered by the water temperature.

3.1.4.2 The majority of the sprat landings are taken in industrial trawl fisheries with juvenile herring; landings of sprat are typically limited by herring bycatch restrictions. Danish fisheries and to a lesser extent, Swedish fisheries, target sprat (**Figure 2**).

3.1.4.3 The North Sea and Norwegian Sea sprat TAC and quotas were set at zero in 2019 based on scientific advice related to stock abundance, this was also the case in 2018. In 2017, when a TAC was set, Denmark held the majority (85%) of the quota (**Table 2**). Such large variations in TACs on a year-by-year basis means that the fisheries targeting sprat must be highly adaptive to change (e.g. by targeting alternative fisheries or different TAC areas). The fishery is seasonal with landings mostly in late autumn and winter (**Figure 14**).

3.1.4.4 Recruitment from sprat since 1986 has been more stable than is often the case for short-lived species. Spawning stock biomass has been at or above maximum sustainable yield since 2013, whilst fishing mortality has been higher than average for the last four years (ICES, 2019b).

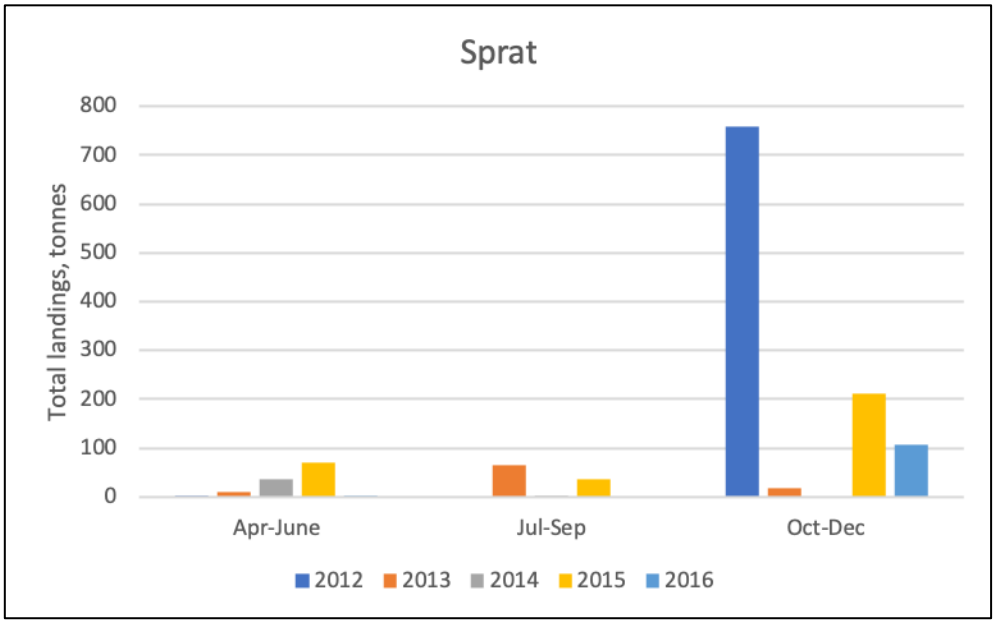

Figure 14: Seasonality of total landings (tonnes) of sprat from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Herring

3.1.4.5 The North Sea herring stock, which collapsed in the 1970s and was closed to fishing for several years, subsequently recovered, and although it fell back in the mid-1990s, it has again been rehabilitated. Since 1998 spawning stock biomass has been above maximum sustainable yield and fishing pressure has remained below the maximum sustainable yield benchmark (ICES, 2019c). Although the advice for 2020 from ICES is for an increase in catch, a reduction in stock size is expected in the coming years; this is because there is a lack of strong incoming year classes.

3.1.4.6 Herring schools move between spawning and wintering grounds in coastal areas and feeding grounds in open water. Herring populations are known to use traditional spawning grounds, many of which are along shallow coastal areas (15 to 40 m depth) or on offshore banks down to 200 m. Spawning usually occurs on gravel or rock bottoms.

3.1.4.7 The majority of the herring landings are taken in the Danish pelagic trawl fishery, with Denmark holding 96% of the TAC. The fishery is seasonal with landings occurring most prominently in late summer and autumn (Figure 15).

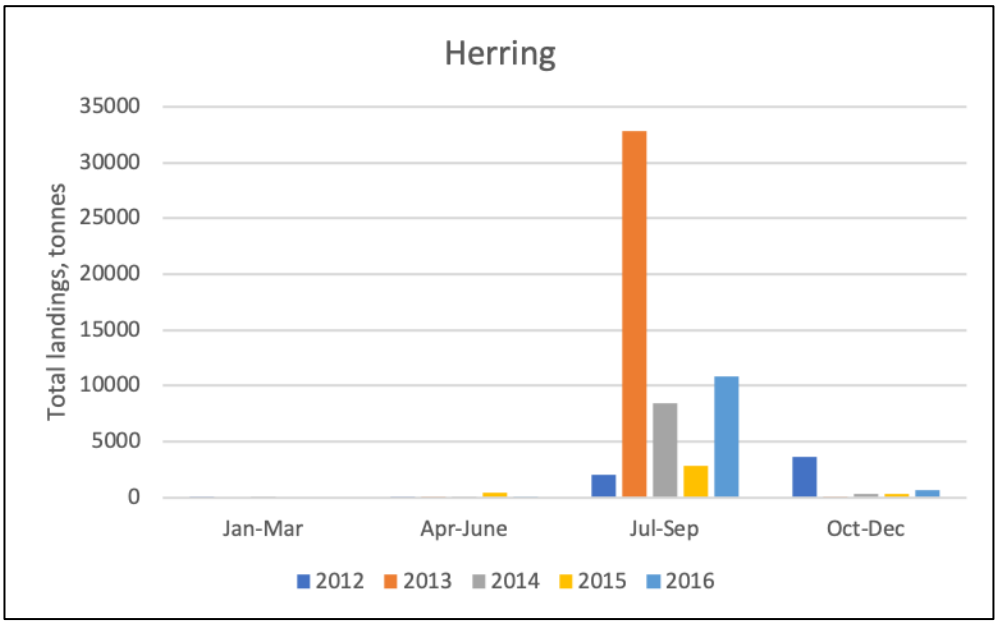

Figure 15: Seasonality of total landings (tonnes) of herring from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Mackerel

3.1.4.8 North Sea mackerel overwinter in the deep water, to the east and north of Shetland and on the edge of the Norwegian Deep. In the springtime, they migrate south to spawn in the central part of the North Sea from May until July. This species is targeted by pelagic trawlers and pelagic purse seine and in 2019 Norway had the greatest share of the quota allocation in the North Sea.

3.1.4.9 Each year, the number of mackerel in the sea depends on the number of young fish which survive from spawning to enter the adult fishery as recruits. Stronger recruitment in recent years has led to an increase in stock size, supporting the increase in catches seen since the mid-2000s. Fishing mortality has been above the maximum sustainable yield judged by ICES since 1985 (ICES, 2019d). Current catches would not be sustainable if recruitment goes back to the levels estimated during the period 1985 to 2000 (ICES, 2019d).

3.1.4.10 ICES consider that the North Sea spawning mackerel should be protected to conserve stock structure and dynamics in the mackerel stock; existing management measures to ensure the protection of the North Sea component, i.e. no mackerel fishing in divisions 3.a and 4.b–c, or in Division 4.a during the period 15 February–31 July, and a 30 cm minimum landings size should therefore remain in place for precautionary reasons (ICES, 2019d). The fishery is highly seasonal with landings occurring most prominently in spring (Figure 16).

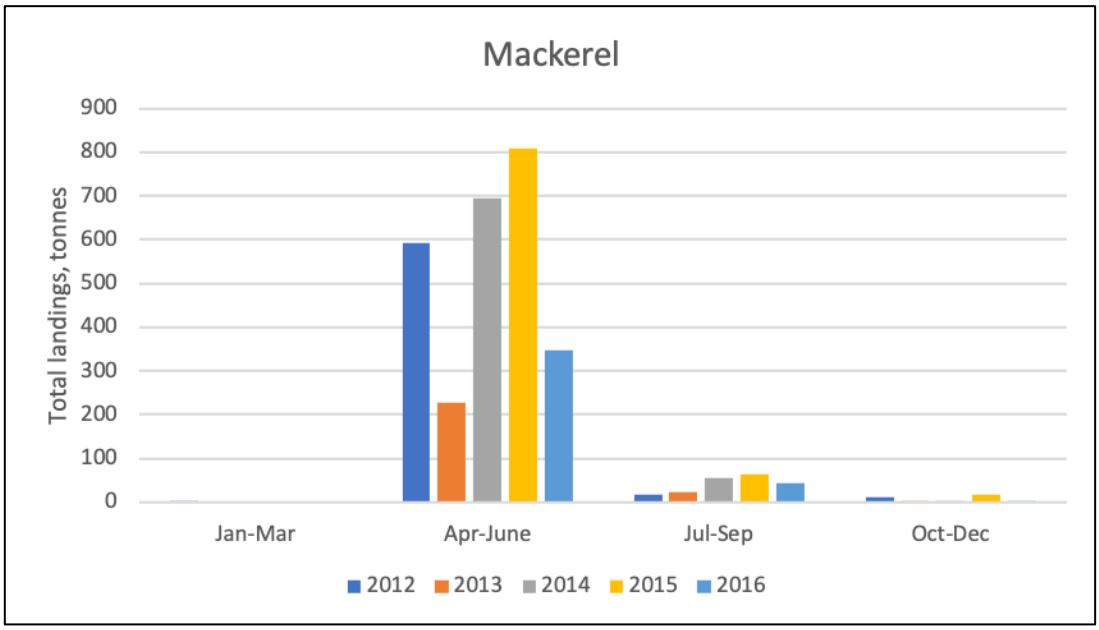

Figure 16: Seasonality of total landings (tonnes) of mackerel from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

3.1.5 Demersal Finfish

Sandeel

3.1.5.1 Lesser sandeel is a short-lived species. Sandeels spend a large part of their juvenile and adult life buried in the seabed in areas with well-oxygenated bottom substrate consisting of gravel or coarse sand. They remain buried throughout the diel cycle in winter, except during spawning around new-year. However, in early spring they start to emerge on a daily basis to feed and become one of the most abundant fish species in the water column of the North Sea for the following three to four months.

3.1.5.2 Sand eel in the North Sea has historically been targeted by an industrial fishery. Annual catches peaked in the 1980s and 1990s exceeding one million tons in some years. All fishing takes place in spring and early summer. Sandeel are taken by trawlers using small-mesh demersal otter trawl gear (based on landing statistics, EU DCF, 2019).

3.1.5.3 From 2010 onwards, ICES has presented advice for the North Sea sandeel divided into 7 management areas, based on the assumption that this will better reflect the stock structure and enable improved management avoiding local depletion. The area relevant to the study area is the Dogger Bank area, referred to as 'SA1'.

3.1.5.4 In SA1, spawning stock biomass has been recovering from lowest values (2013-2014) and was above the precautionary biomass level up to 2019, when stock size is reported as below maximum sustainable yield (ICES, 2019e). Catches of sandeel from this area have

fluctuated, showing a declining trend since the mid-2000s followed by an increase in 2017 and 2018 to approximately the long-term average (ICES, 2019e).

3.1.5.5 Since 2011 separated quotas are defined for each of the seven management areas and the EU has been using a real-time monitoring for setting TACs. In 2018, the TAC and quotas were provisionally set at zero before ICES scientific advice was released. The EU then established the final TAC value for Dogger Bank (SA 1r) in 2018 and followed scientific advice setting the area quota at ~134,000 tonnes. Temporal fishery closures are in place from 01 January to 31 March and from 01 August to 31 December annually. Landings therefore predominantly occur from April to June (Figure 17).

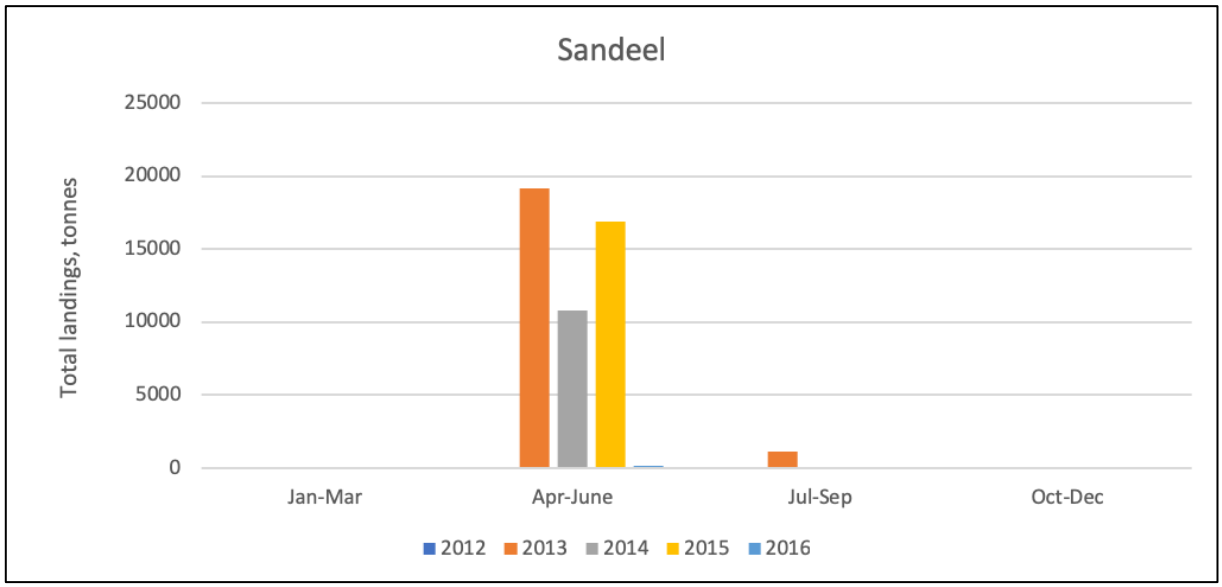

Figure 17: Seasonality of total landings (tonnes) of sandeel from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Sole and Plaice

3.1.5.6 Sole and plaice are demersal flatfish occurring on sandy and mud bottoms, and typically caught by the beam trawl fleet working with 80 mm mesh nets and targeting a mixed fishery. Between 2014 and 2017, ICES noted that the use of pulse trawls in the main fishery operating in the North Sea increased and less vessels were operating with traditional beam trawls. The pulse gear allows fishing of softer grounds and as a result the spatial distribution of the main fisheries has changed to the southern part of ICES Division 4c (ICES, 2018f), out with the study area.

3.1.5.7 Catches of sole have declined since the mid-1990s. ICES considered in 2018 that the stock was being harvested sustainably, though at a rate above the maximum sustainable yield (ICES, 2018f). Spawning stock biomass has increased since 2007 and is estimated to have been above the maximum sustainable yield reference point since 2012 (ICES, 2018f).

3.1.5.8 Catches of plaice peaked in the late 1980s and have been relatively stable since the 1990s. The North Sea plaice stock is well within precautionary boundaries and has reached its highest levels in recorded history since 1957 (ICES, 2018g). Since 2009 fishing mortality has been estimated to be around the maximum sustainable yield (ICES, 2018g).

3.1.5.9 Sole TAC is set for the stock across the North Sea and Norwegian Sea. Countries that have been allocated a quota from this TAC can fish for sole within ICES Divisions 4a-c and 2a. In 2019 Netherlands was allocated 75% of quota for the sole stock defined in these areas; Belgium had 8%, Germany 7%, UK 4%, Denmark 4% and France 2% (**Table 2**).

3.1.5.10 Plaice TAC is set for the stock areas across the North Sea, Norwegian Sea and Skagerrak and Kattegat. In 2019 Netherlands had 28% of quota allocation for the plaice stock defined in area 4, 2a and 3a; the UK had 21%, and Denmark had 15% (**Table 2**).

3.1.5.11 Landing statistics for the study area indicate that sole and plaice landings peak in autumn and winter (**Figure 18** and **Figure 19**).

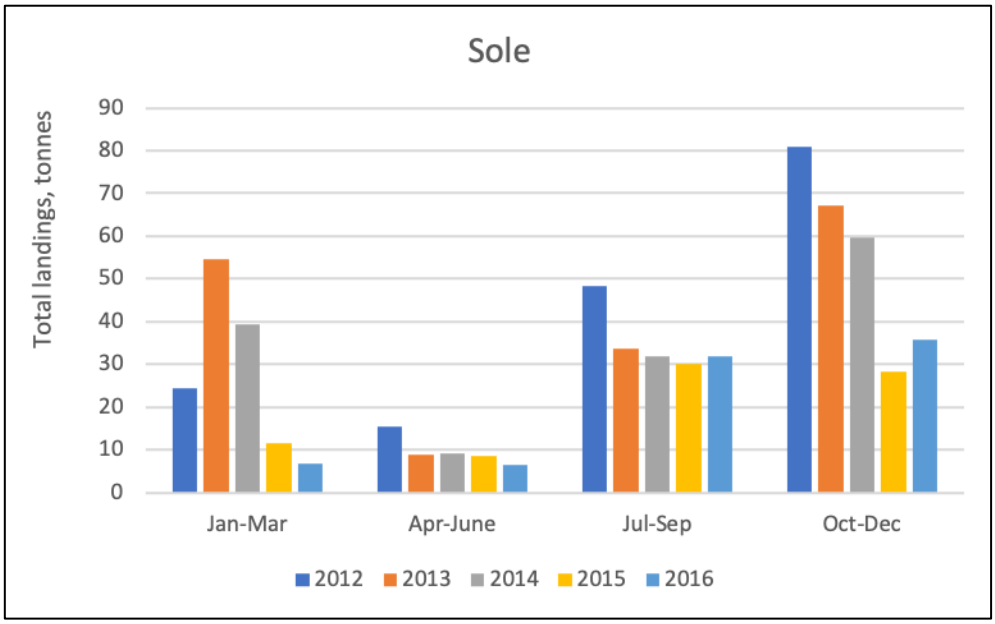

Figure 18: Seasonality of total landings (tonnes) of sole from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

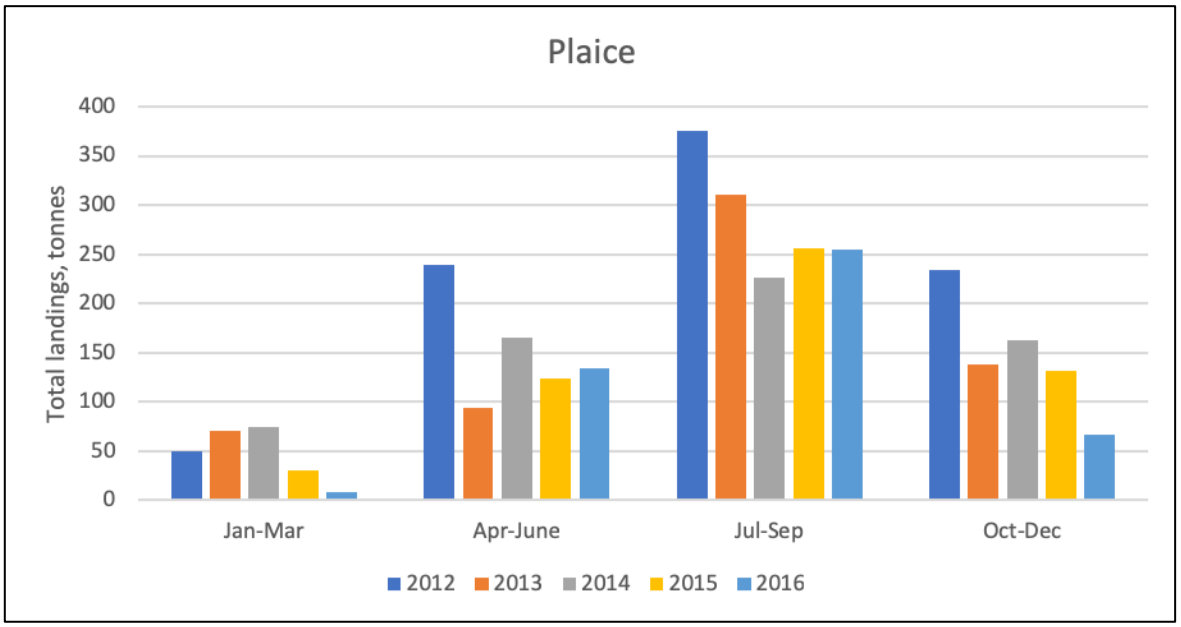

Figure 19: Seasonality of total landings (tonnes) of plaice from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Whiting

3.1.5.12 Whiting are widely distributed both inshore and offshore throughout the North Sea. Whiting are commonly found on mud and gravel bottoms, but also on sand and rock. Immature fish are typically found in inshore areas and whiting migrate to the open sea after the first year of life (Cohen et al., 1990).

3.1.5.13 Whiting are typically targeted by demersal otter trawlers during spring months as part of both targeted and mixed demersal fisheries. Whiting TAC is set for the stock across the North Sea and Norwegian Sea. Countries that have been allocated a quota from this TAC can fish for sole within ICES Divisions 4a-c and 2a. In 2019 the UK was allocated 41% of the TAC, followed by France with 8.5% (Table 2).

3.1.5.14 Catches of the North Sea whiting have decreased since the late 1970s, but fishing mortality has been above the maximum sustainable yield trigger point since 2005 (ICES, 2018h). The spawning stock has fluctuated significantly and is presently considered by ICES to be above maximum sustainable yield (ICES, 2018h). The majority of catches are taken in spring and summer months (Figure 20).

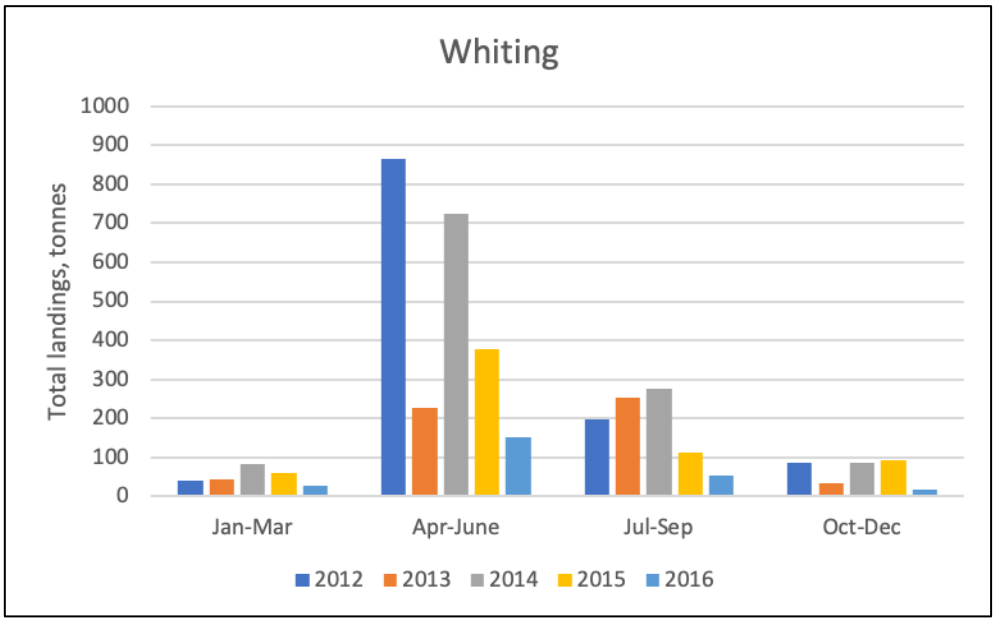

Figure 20: Seasonality of total landings (tonnes) of whiting from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

Cod

3.1.5.15 Cod is widely distributed throughout the North Sea. They can be found living a solitary existence or they may occur in large shoals. Generally, they spend their first winter in the shallower inshore waters before moving offshore into deeper waters.

3.1.5.16 Within the study area, cod are primarily targeted by demersal otter trawls deployed from UK-registered vessels as part of a mixed demersal fishery, with landings occurring throughout the year (Figure 21). In 2019 the UK has the greatest share of quota allocation for the stock defined in ICES areas 4, 2a and 3a.

3.1.5.17 The cod stock declined severely during the late 1990s and early 2000s and despite formal recovery and management plans, the cod stock in the North Sea has continued to be assessed as suffering reduced reproductive capacity by ICES. The spawning stock biomass has increased from the historic low in 2006 but is still below the maximum sustainable yield reference point. Fishing mortality has declined since 2000, but remains above maximum sustainable yield (ICES, 2018i). Recruitment has remained poor since 1998.

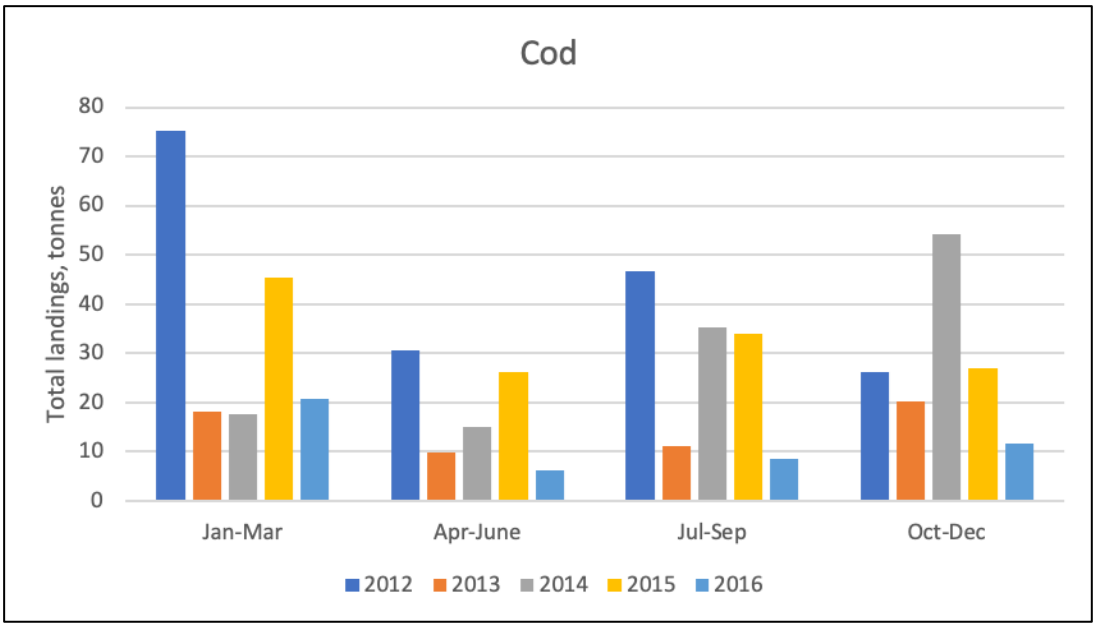

Figure 21: Seasonality of total landings (tonnes) of cod from 2012 to 2016 for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

3.2 Key Gears

3.2.1.1 There are three descriptive units used for defining fisheries (Marchal, 2008):

- Fishery – a group of vessel voyages which target the same species or use the same gear;
- Fleet – a physical group of vessels sharing similar characteristics (e.g. nationality); and
- Métier – a homogenous subdivision, either of a fishery by vessel type or a fleet by voyage type.

3.2.1.2 A range of fleets target different fisheries across the Hornsea Four commercial fisheries study area, as indicated by landings statistics for registered vessel nationality and gear type (Figure 22). Across the study area, the highest proportion of landings by weight are caught by pelagic trawl vessels, followed by pots, otter trawl, dredge and beam trawl.

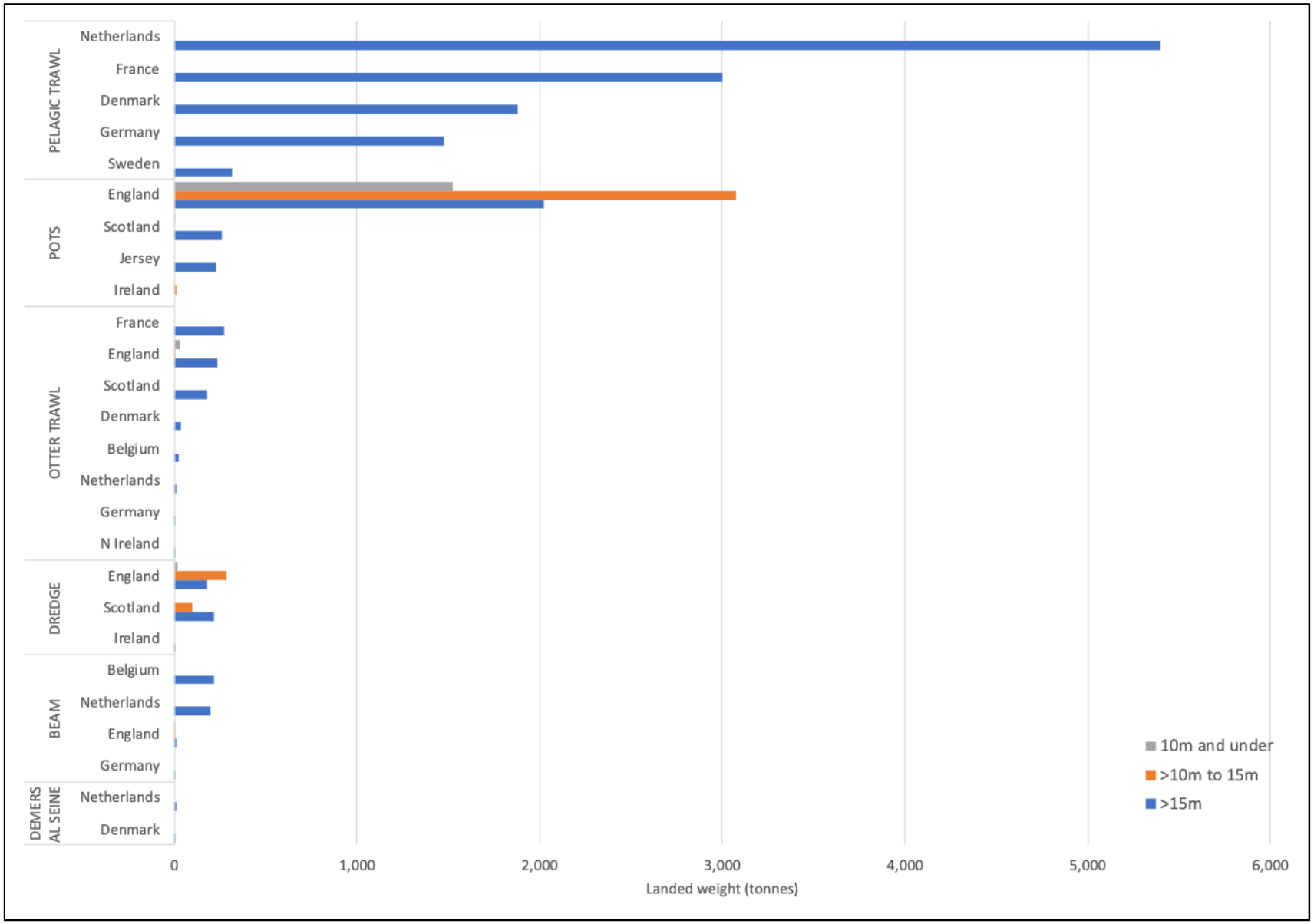

Figure 22: Total landings (tonnes) in 2016, by gear type and vessel nationality for the Hornsea Four commercial fisheries study area (Data source: EU DCF database, 2019).

3.2.1.3 Vessel and gear types within the key fleets and fisheries that operate across the study area are described within this section.

3.2.2 Potting

3.2.2.1 Figure 23 shows typical potting vessels and pots and Table 3 describes the profile of potting vessels active across the study area. The offshore ECC study area represents significant crab and lobster fishing grounds. A large crab and lobster fishery is exploited from Whitby, Scarborough, Bridlington and Grimsby. The majority of potters are under 10 m, with some 10 to 15 m in length and operate as day boats; returning to port after hauling and re-setting fleets of pots. Pots are therefore not normally returned to shore but left in the water.

3.2.2.2 Whelk are caught by pots that are small but heavy, often made from discarded plastic containers, or purpose built. The bottom of the plastic pot is weighted to ensure that the pot lands and remains upright on the seabed when it's fishing.

Table 3: Profile of typical potting vessels active across the study area.

Parameter	Indicative details
Main target species	Lobster, brown crab, whelk
Nationality	UK
Vessel length	Majority under 10 m, some up to 15 m
Horsepower	60 hp to 200 hp
Typical speed when shooting and hauling gear	0 to 9 knots
Typical gear	Fleets of baited pots placed on the seabed Pots typically hauled every week, but may be left number of weeks Generally, day boats, but also includes vivier fleet (crabs stored live in water tanks)

Figure 23: Typical potting vessel, based at Bridlington (Source: Fishing News, 2016).

3.2.3 Scallop dredge

3.2.3.1 A typical scallop dredging vessel is shown in Figure 24 and Table 4 describes the profile of scallop dredging vessels active across the study area. Scallop dredgers fish as the tooth bar of each dredge rakes through the sediment lifting out scallops and the spring-loaded tooth bar swings back, allowing the dredge to clear obstacles on the seabed. The dredges are held in a series on two beams, which are fished on each side of the vessel.

Table 4: Profile of typical scallop dredging vessels active across the study area.

Parameter	Indicative details
Main target species	Scallop
Nationality	UK
Vessel length	10 m to 25 m
Horsepower	200 hp to 400 hp
Typical towing speed	2 to 6 knots
Typical gear	8 to 10 dredged per side of vessel Each dredge consists of a triangular frame leading to an opening, a tooth bar with spring-loaded teeth, and a bag of steel rings and netting back

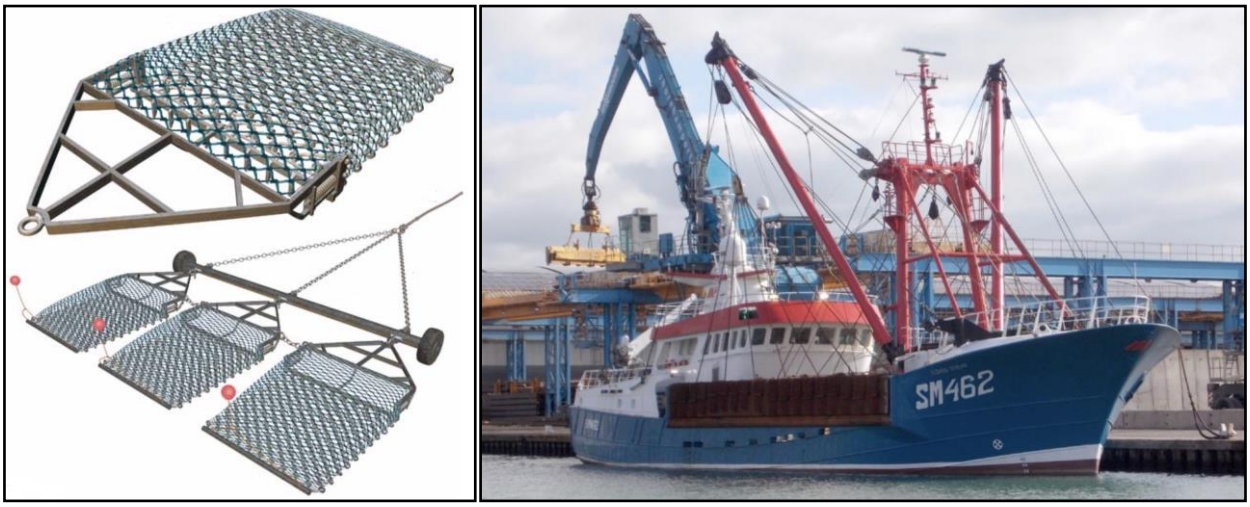

Figure 24: Typical scallop dredging vessel (Source: Undercurrent News, 2019).

3.2.4 Pelagic trawl

3.2.4.1 Figure 25 shows a typical pelagic trawl vessel and Table 5 describes the profile of pelagic trawl vessels active across the study area.

3.2.4.2 Pelagic or mid-water trawls are towed at the appropriate level in the water column to intercept shoaling fish such as herring, sprat and mackerel. The location of the shoals is determined by sonar or vertical sounder echoes.

3.2.4.3 Catches with pelagic trawl form a significant portion of the annual landings (46% by landings weight) from the study area. Landings are made by vessel greater than 15m in length, across a number of Member States, including Netherlands, France, Denmark, Germany and Sweden.

Table 5: Profile of typical pelagic trawling vessels active across the study area.

Parameter	Indicative details
Main target species	Herring, sprat, mackerel, whiting
Nationality	Danish, Swedish, French
Vessel length	30 m to 50 m
Horsepower	500 hp to 1,200 hp
Typical towing speed	2.5 to 5 knots
Typical gear	Pair or single trawls Net depth changed by altering either warp (rope) length or towing speed

Figure 25: Profile of typical pelagic trawling gear (Source: Galbraith *et al.*, 2004) and vessel (Source: Poseidon) active across the study area.

3.2.5 Demersal otter trawl

3.2.5.1 Figure 26 shows a typical UK demersal trawler and associated gear and Table 6 describes the profile of demersal otter trawling vessels active across the study area. Otter trawls typically catch gadoids, other groundfish, plaice, and *Nephrops*; however, the species composition of the catch depends on the area and depth fished and the gear design.

3.2.5.2 Vessel numbers vary, and their presence is dependent upon the success of demersal and/or *Nephrops* catches elsewhere. Important *Nephrops* grounds are located within the Outer Silver Pit, which is located outside and to the east of the array area.

3.2.5.3 Demersal trawlers operating across study area tend to tow in directions which are in line with natural seabed contours.

Table 6: Profile of typical otter trawling vessels active across the study area.

Parameter	Indicative details
Main target species	*Nephrops*, cod, whiting, haddock
Nationality	UK, Dutch, Belgian, Danish, French, Swedish
Vessel length	16m to 35m
Horsepower	300 hp to 850 hp
Typical towing speed	2 to 6 knots
Typical gear	Demersal otter trawl Possible twin or multi-rig bottom trawl Two trawl doors ('otter boars') approximately 1 tonne each hold the net open Various forms of ground gear depending on target species

Figure 26: Typical demersal otter trawler vessel and gear diagram (Sources: Visserijnieuws, 2010; Seafish, 2019).

3.2.6 Beam trawl

3.2.6.1 Figure 27 shows a typical beam trawler and associated gear and Table 7 describes the profile of beam trawling vessels active across the study area. The use of pulse trawls has increased over time.

3.2.6.2 Beam trawl gear is used to target flatfish such as sole and plaice, which are often somewhat buried in the seabed. Traditional beam trawls use tickler chains to scare the flatfish into the net. Pulse beam trawls replace tickler chain with drag wires through which electric impulses are sent, which stimulate the fish out of the seabed and into the net. Pulse beam trawl uses less fuel and cause less seabed disturbance as drag wires do not penetrate the seabed.

3.2.6.3 Catches with beam trawl form a small portion of annual landings (2% by weight) from the study area. Fishing effort for the target flatfish species is spread over a wide area and across various grounds throughout the North Sea.

Table 7: Profile of typical beam trawling vessels active across the study area.

Parameter	Indicative details
Main target species	Plaice and sole
Nationality	UK, Dutch, Anglo Dutch and Belgian
Vessel length	25 m to 45m
Horsepower	500 hp to 2,000 hp
Typical towing speed	3.5 to 8 knots
Typical gear	Twin beam, maximum length 12 m each beam Each beam weighing <10 tonnes Chain matting or individual chains attached to underside

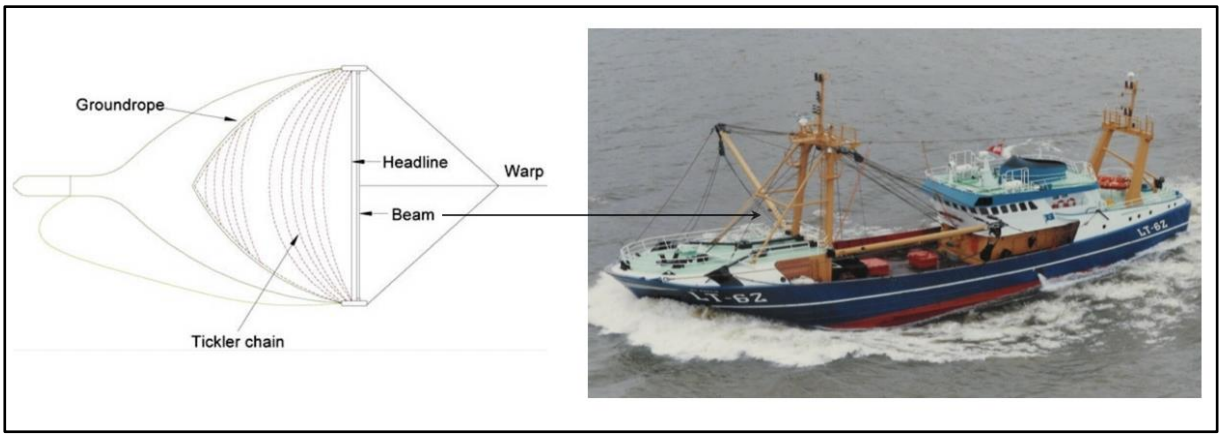

Figure 27: Typical beam trawler vessel and gear diagram (Sources: Visserijnieuws, 2010; FAO, 2005).

3.2.7 Industrial trawl

3.2.7.1 Industrial trawling is predominately defined by vessels targeting species that are used in animal feed, such as sandeels and sprat. Figure 28 shows a typical Danish industrial trawler and Table 8 describes the profile of industrial trawling vessels active across the study area.

Table 8: Profile of typical industrial trawling vessels active across the study area.

Parameter	Indicative details
Main target species	Sandeel
Nationality	Predominantly Danish, some UK
Vessel length	30 m to 50 m
Horsepower	500 hp to 1200 hp
Typical towing speed	2.5 to 5 knots
Typical gear	Demersal otter trawl Large net with a small mesh Two trawl doors approximately 1.25 tonnes each hold the net open

Figure 28: Typical industrial trawler vessel (Source: Visserijnieuws, 2010).

4 Fisheries Activity Assessment

4.1 Fishing intensity based on VMS analysis, historic grounds and surveillance sightings

4.1.1.1 Locations of fishing grounds in the study areas and surrounding region are depicted in Figure 29 to Figure 39. These present the value of catches by different gear types and cover all countries operating in the OSPAR regions II (Greater North Sea) and III (Celtic Seas). The countries that submitted data and are represented within these figures include: UK, Belgium, Denmark, France, Germany, Ireland, The Netherlands, Norway and Sweden. All vessels 12 m in length and above are included within the dataset.

4.1.1.2 VMS data and logbook data are analysed to determine the value of specific locations for the following gears:

- Beam trawl vessels ≥12 m in length from 2013-2017 (Figure 29 and Figure 30; Data source: ICES, 2019);
- Dredge vessels ≥12 m in length from 2013-2017 (Figure 31 and Figure 32; Data source: ICES, 2019);

- Otter trawl vessels ≥12 m in length from 2013-2017 (**Figure 33** and **Figure 34**; Data source: ICES, 2019);
- Scottish seine (also known as fly shooting) ≥12 m in length in 2017 (**Figure 36**; Data source: ICES, 2019), 2013-2016 is not analysed based on lack of landings by this gear over that period; and
- Danish seine (also known as fly shooting) ≥12 m in length in 2017 (**Figure 37**; Data source: ICES, 2019), 2013-2016 is not analysed based on lack of landings by this gear over that period.

4.1.1.3 Vessel Monitoring System has been analysed for the UK potting fleet based on data available from the MMO for vessels 15 m in length and above. Based on this length categorisation, the large majority of potting effort is not available for mapping analysis:

- UK potting vessels ≥15 m in length in 2016 (**Figure 35**; Data source: MMO, 2019), data for 2017 is not available, date from 2013-2015 is not available by gear type and therefore not included within the data analysis.

4.1.1.4 Sightings data has been mapped for UK vessels operating a range of gears in waters out to 12 nm and are depicted in the following figure:

- Sightings data for UK vessels across all gears from 2011-2016 (**Figure 38**; Data source: NE IFCA, 2019).

4.1.1.5 Sandeel grounds targeted across the North Sea have been mapped based on historical records from numerous vessels and are depicted in the following figure:

- Key North Sea sandeel fishing grounds targeted by EU Member States and Norway (**Figure 39**; Data source: DTU Aqua, 2010).

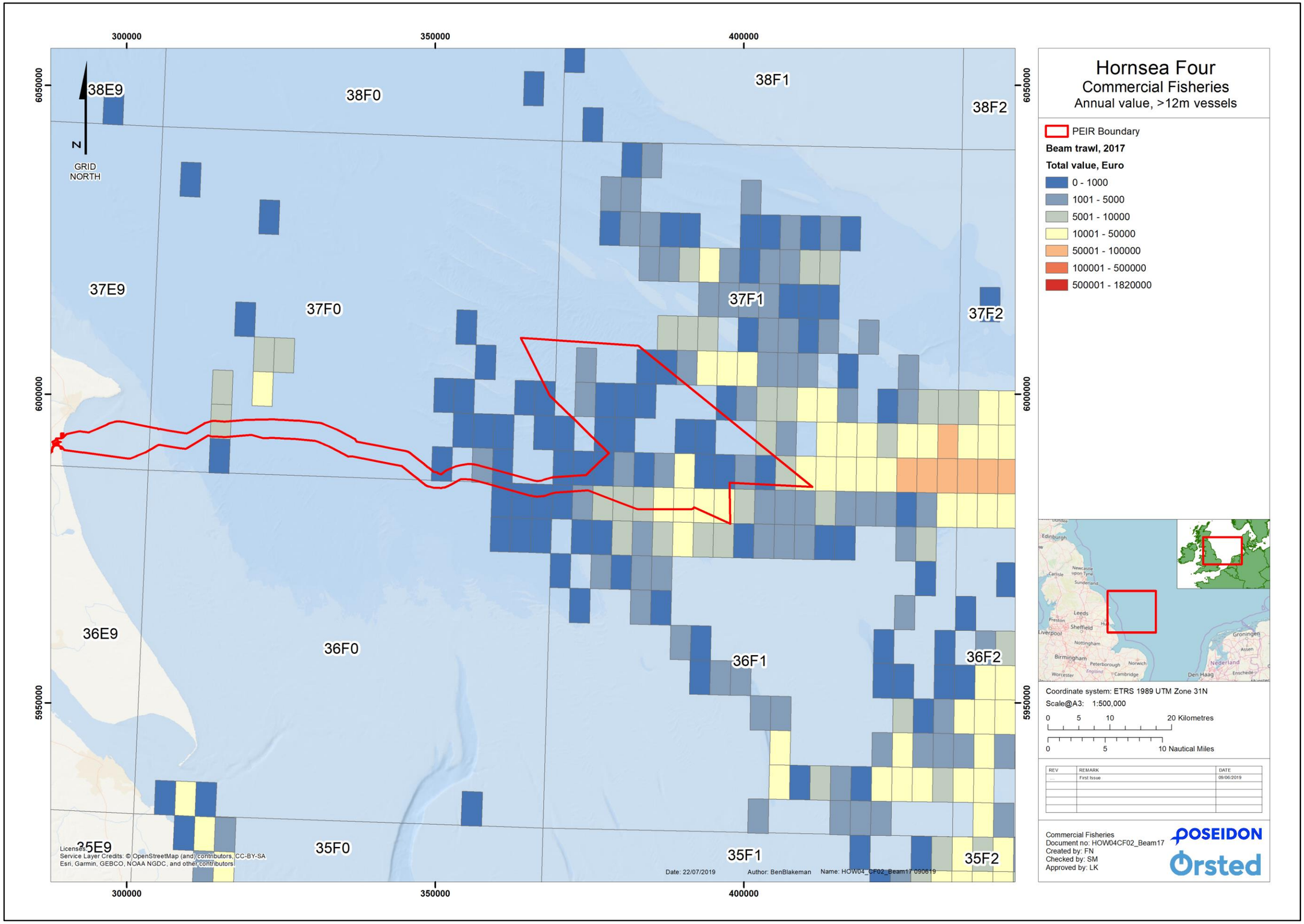

Figure 29: Value of catches made in 2017 by all EU (including UK) beam trawl vessels ≥12m in length (ICES, 2019) (not to scale).

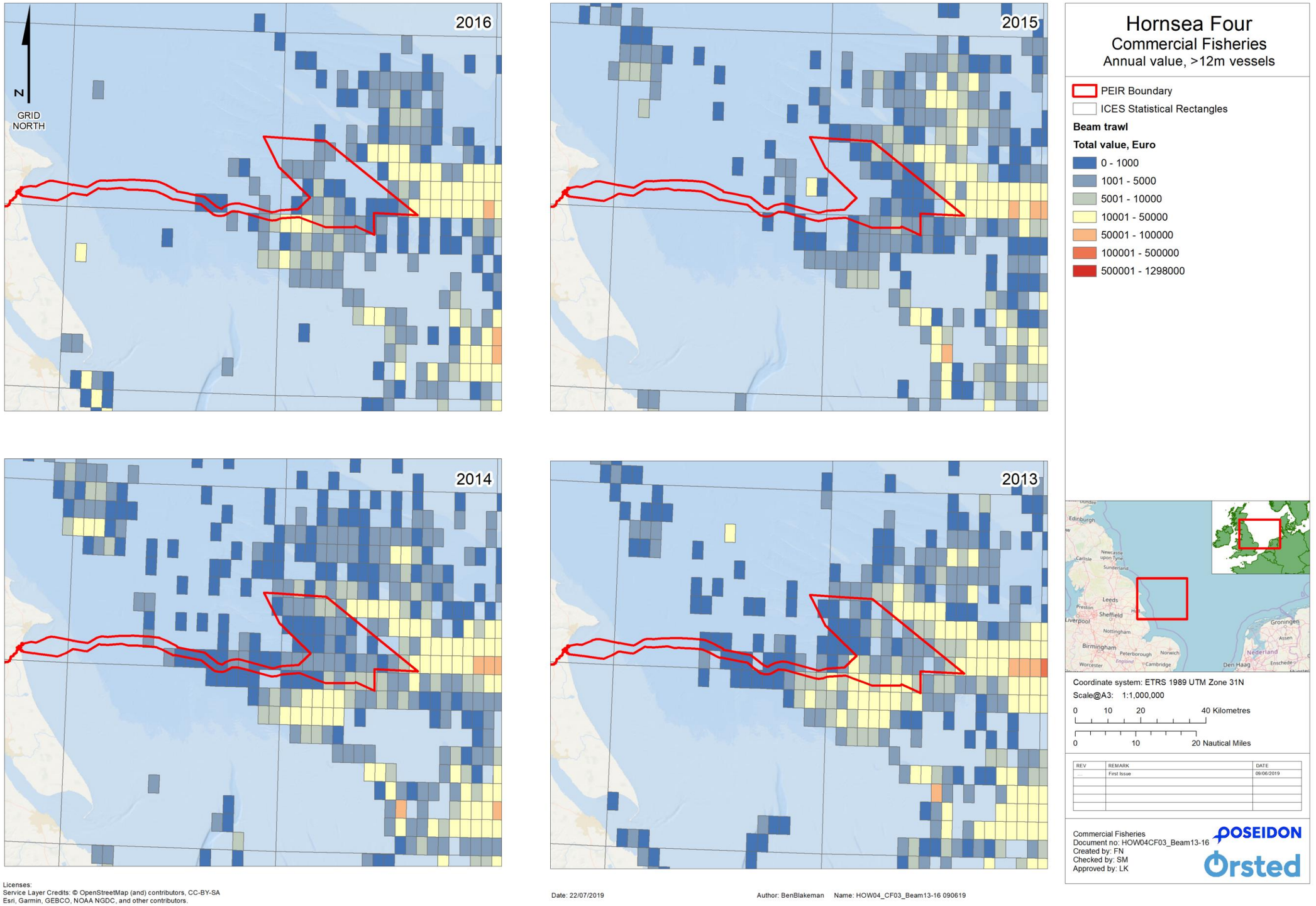

Figure 30: Value of catches made in 2013-2016 by all EU (including UK) beam trawl vessels ≥12m in length (ICES, 2019) (not to scale).

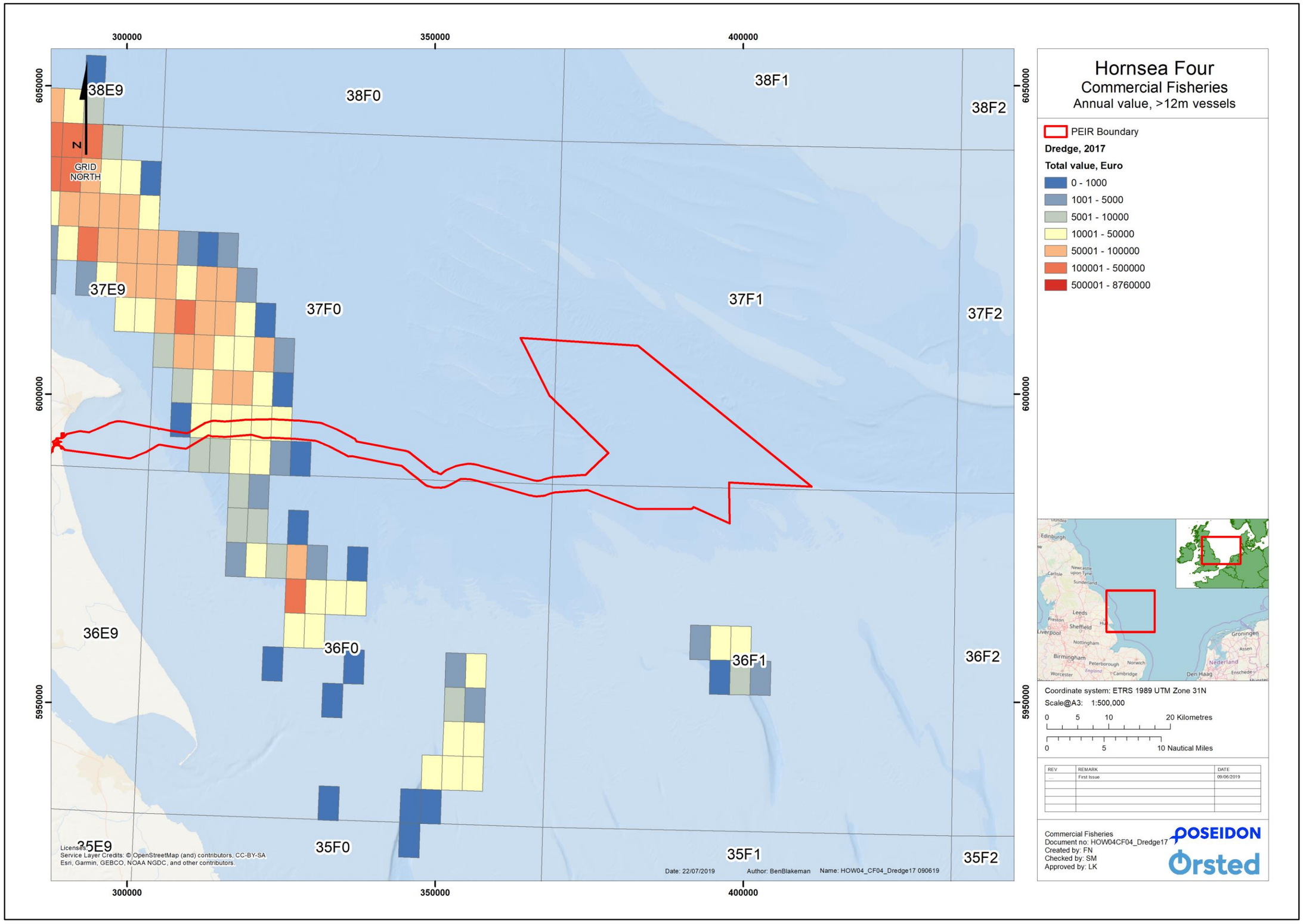

Figure 31: Value of catches made in 2017 by all EU (including UK) dredge vessels ≥12m in length (ICES, 2019) (not to scale).

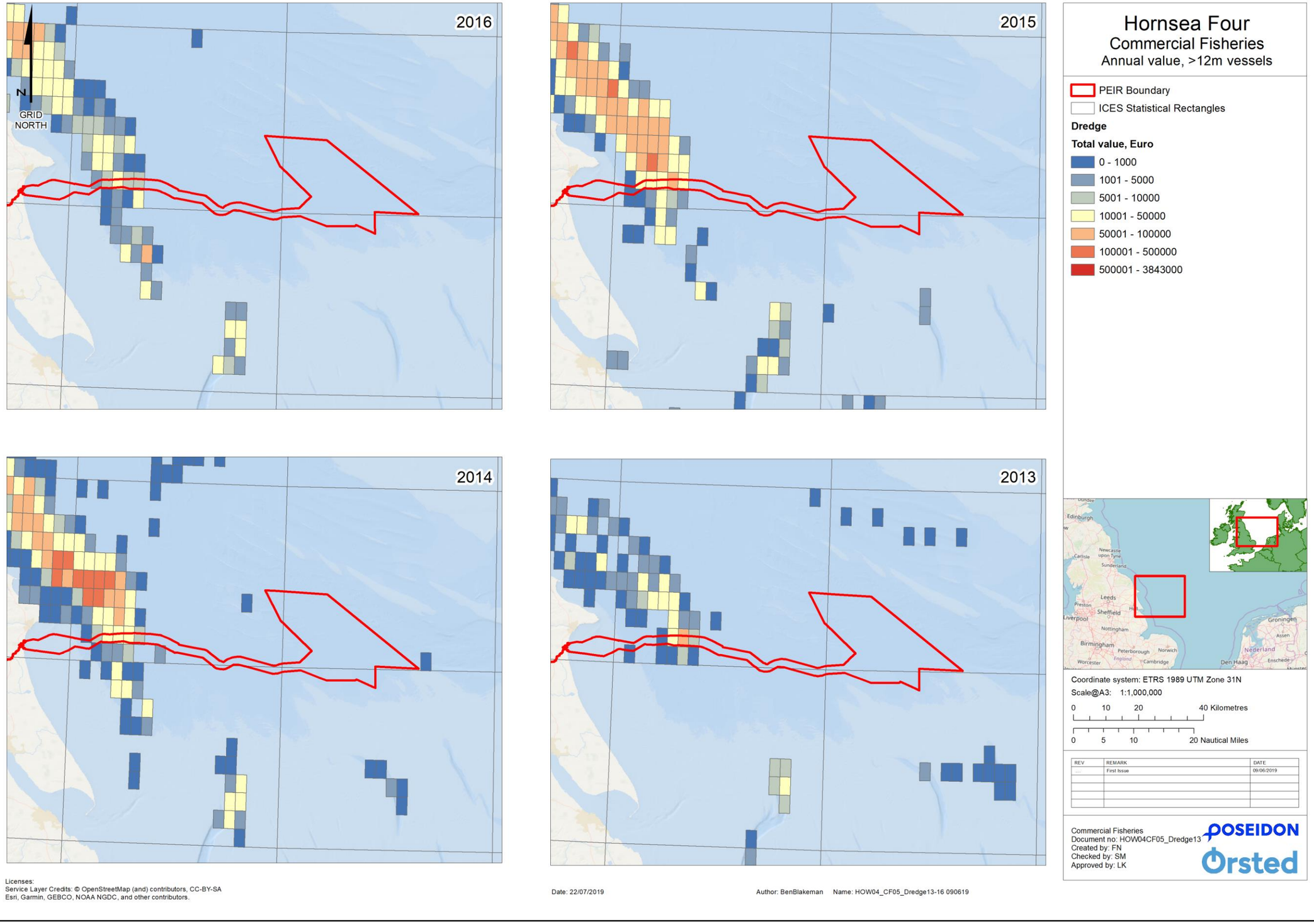

Figure 32: Value of catches made in 2013-2016 by all EU (including UK) dredge vessels ≥12m in length (ICES, 2019) (not to scale).

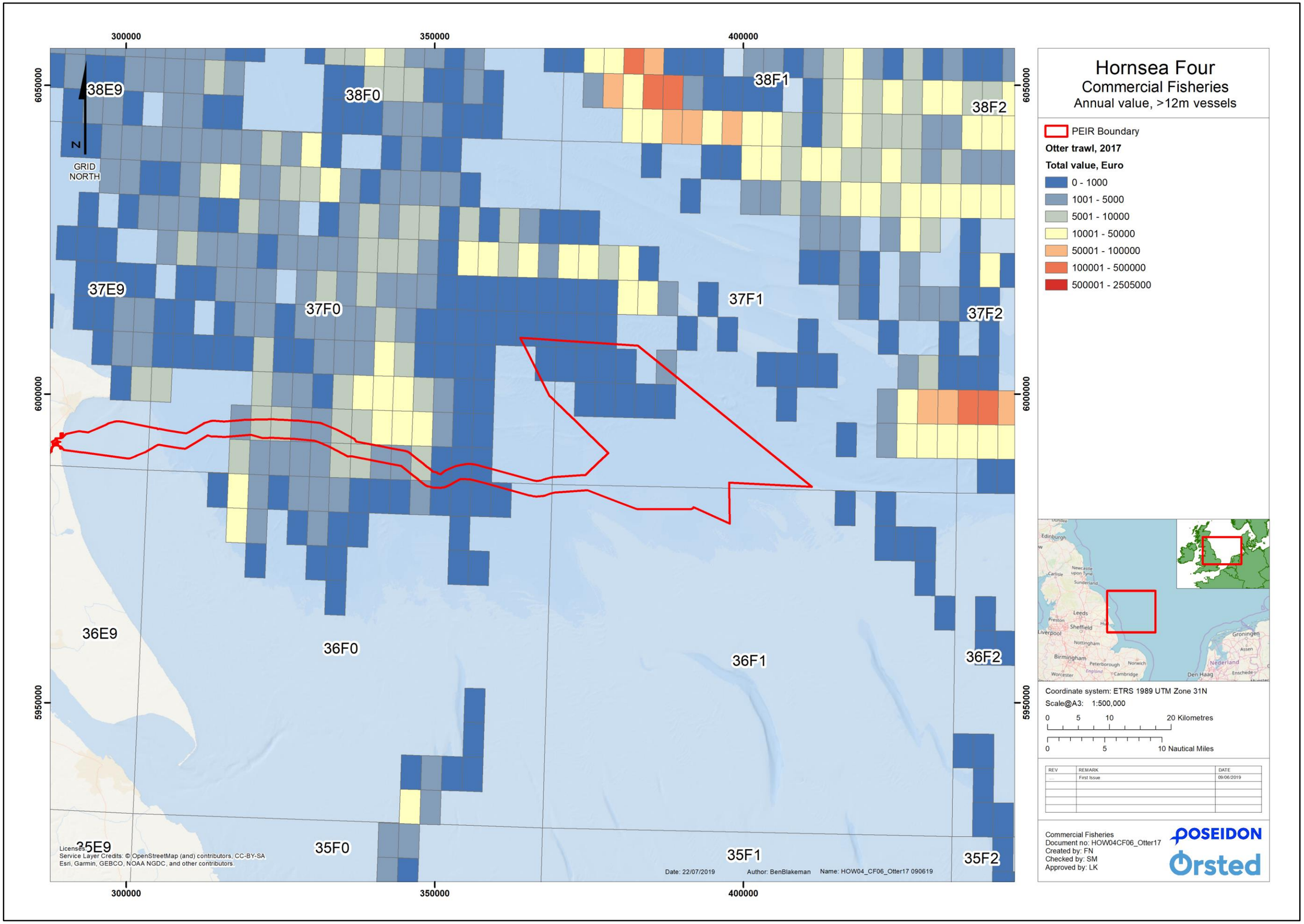

Figure 33: Value of catches made in 2017 by all EU (including UK) otter trawl vessels ≥12m in length (ICES, 2019) (not to scale).

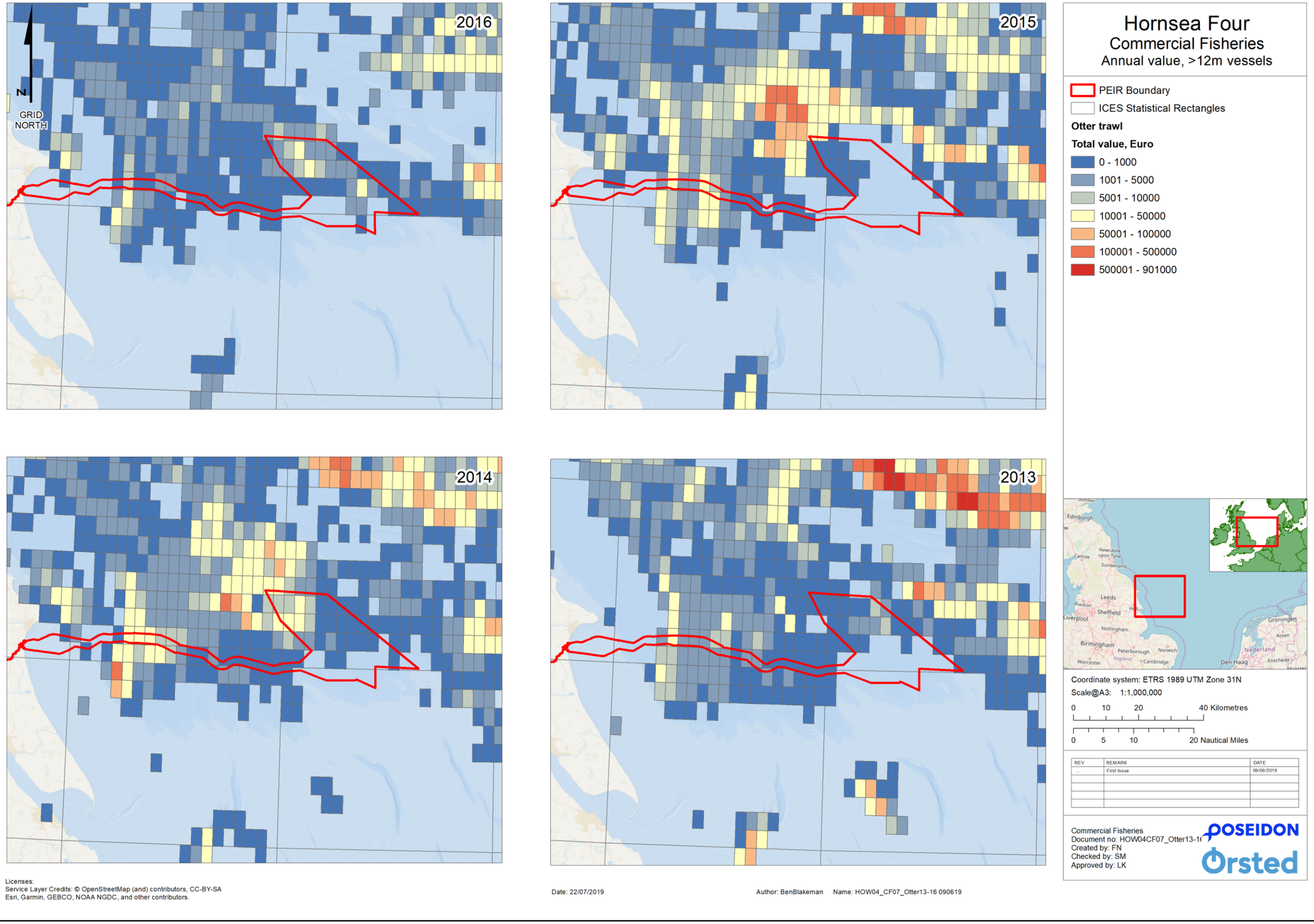

Figure 34: Value of catches made in 2013-2016 by all EU (including UK) otter trawl vessels ≥12m in length (ICES, 2019) (not to scale).

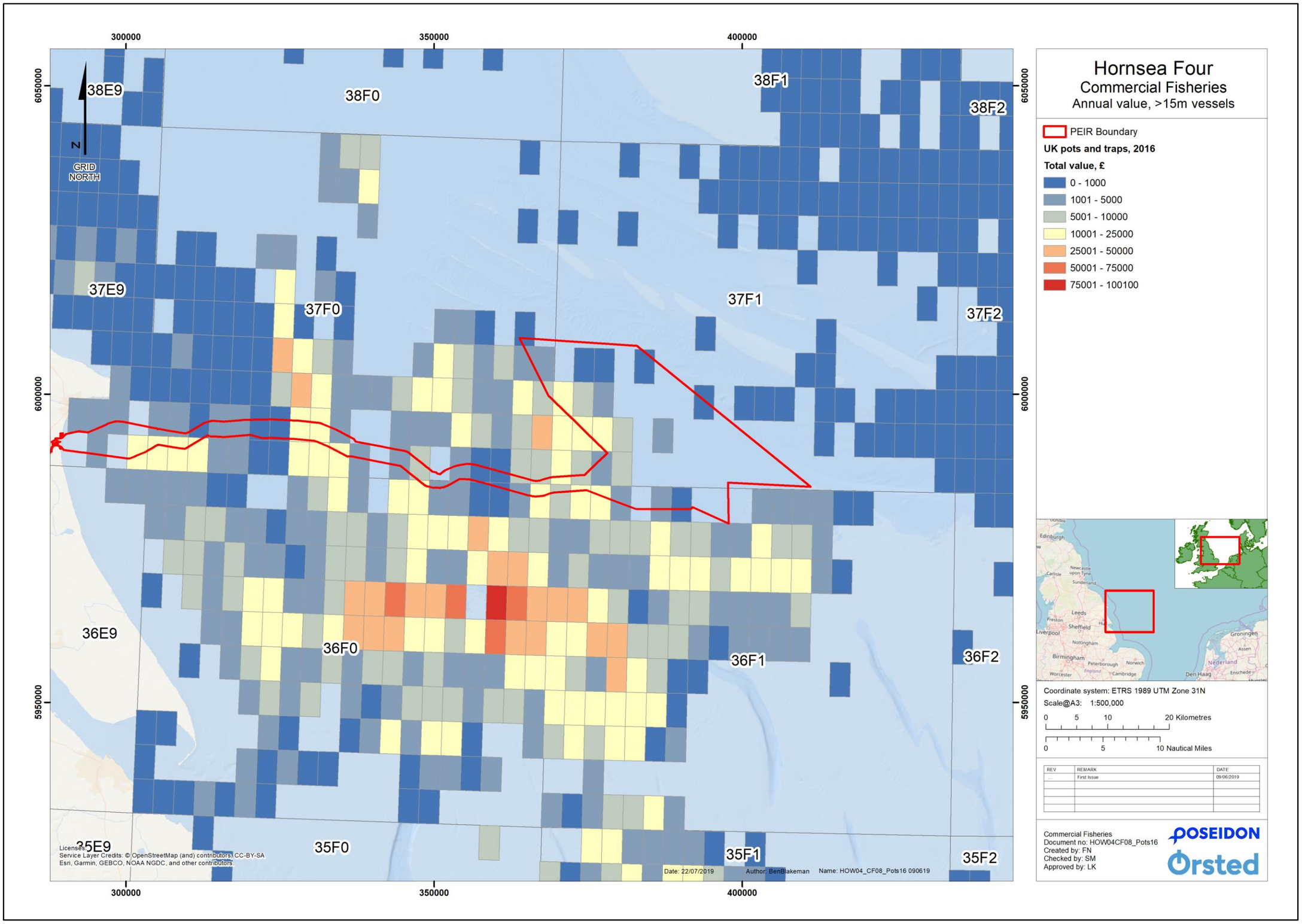

Figure 35: Value of catches made in 2016 by all UK potting vessels ≥15m in length (MMO, 2019) (not to scale).

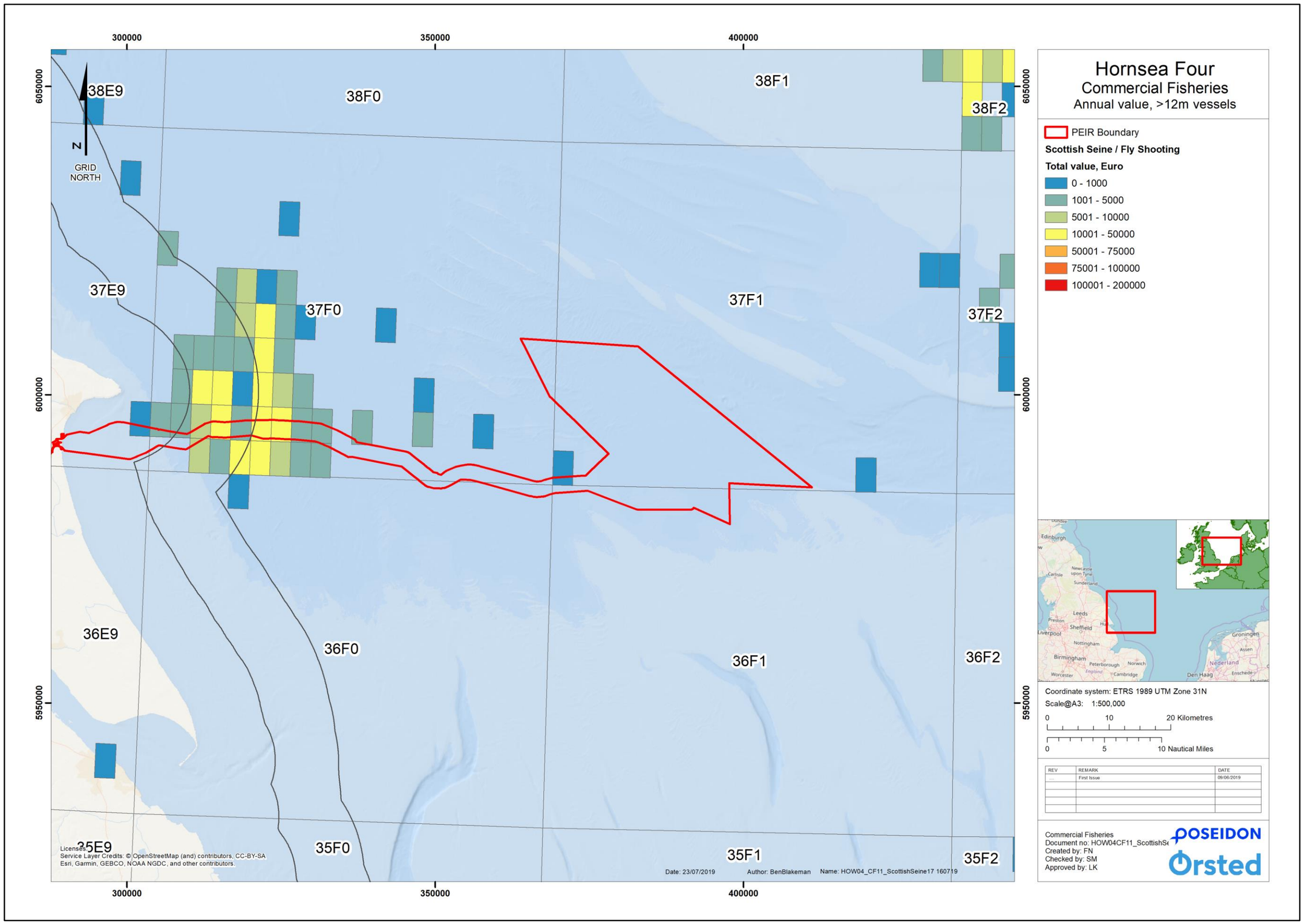

Figure 36: Value of catches made in 2017 by all EU (including UK) Scottish seine (also known as fly shooting) vessels ≥12m in length (ICES, 2019) (not to scale).

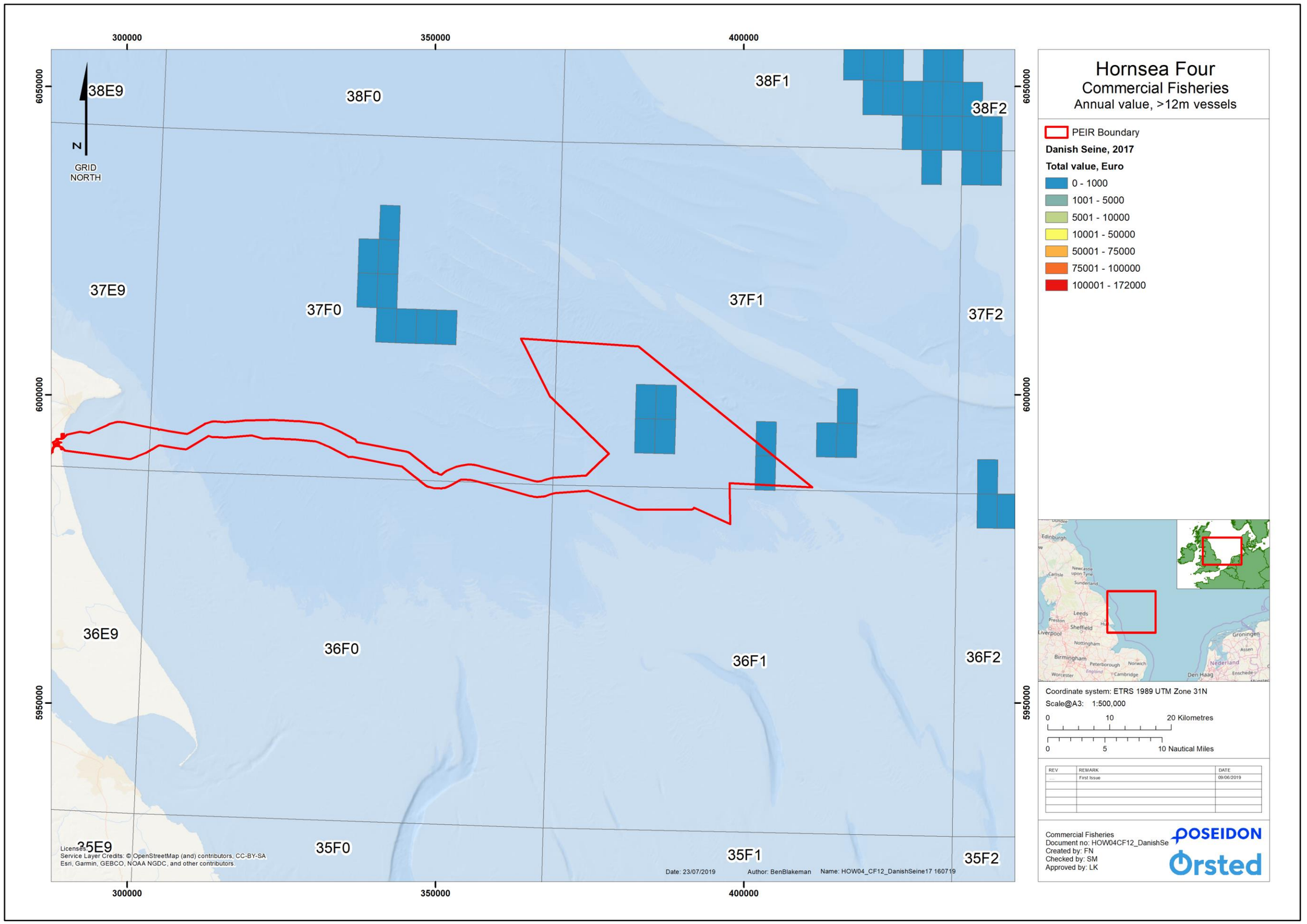

Figure 37: Value of catches made in 2017 by all EU (including UK) Danish seine vessels ≥12m in length (ICES, 2019) (not to scale).

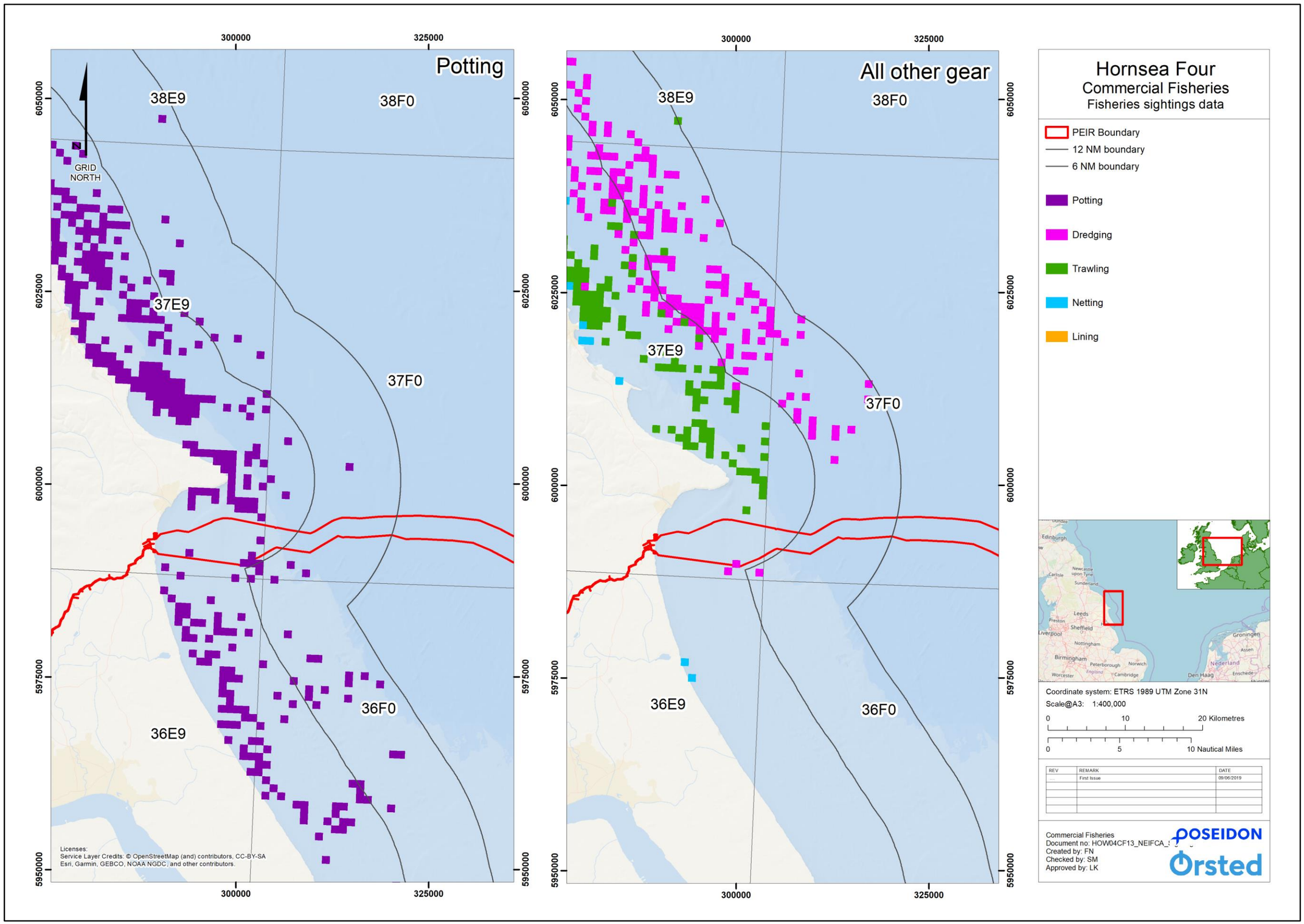

Figure 38: Sightings data for UK vessels across all gears from 2011-2016 (NE IFCA, 2019) (not to scale).

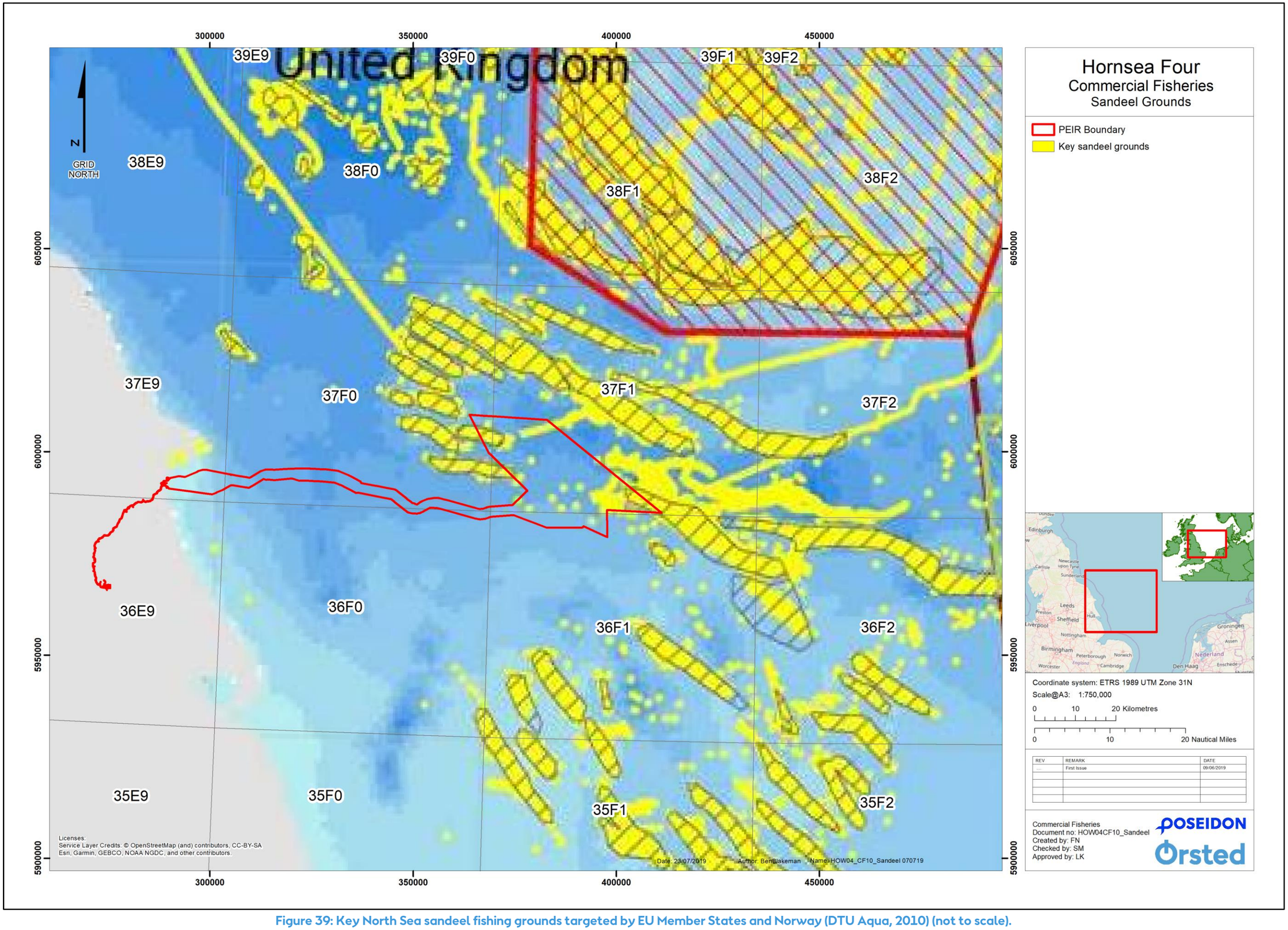

Figure 39: Key North Sea sandeel fishing grounds targeted by EU Member States and Norway (DTU Aqua, 2010) (not to scale).

4.2 UK Fisheries Activity Assessment

4.2.1.1 UK registered vessels operate across all ICES rectangles overlapping the study area. The highest weight is landed from 36F0 (Figure 40), which overlaps with a small section of the offshore ECC. Landings are consistently made from 37E9 and 37F0, with smaller quantities taken from 37F1 (which overlap the array area).

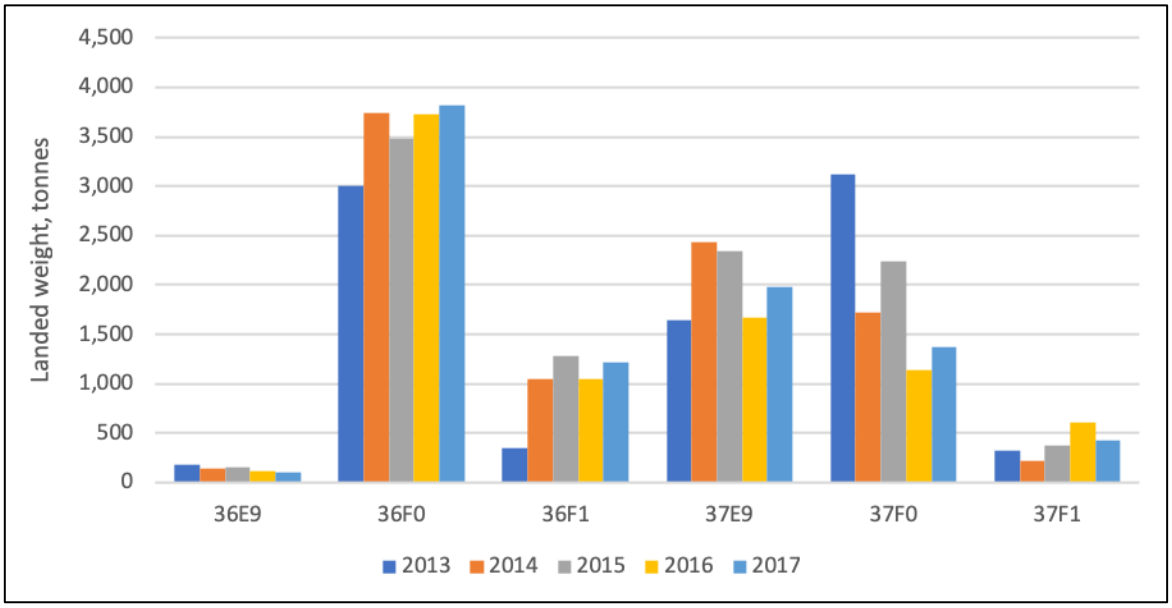

Figure 40: Landed weight (tonnes) of all landings from the study area by UK registered vessels, indicating ICES rectangles (MMO, 2019).

4.2.2 Hornsea Four array area

Landing trends, fishing grounds and key species

4.2.2.1 The trends in weight landed by UK vessels from the array study area are presented in Figure 41 for gear type and species. The array study area is defined as ICES rectangles 37F0, 37F1 and 36F1; therefore, this section refers to landings data from this area, which is considerably larger than the Hornsea Four array area boundaries. It should be noted that the majority (>75%) of the array is located within ICES rectangle 37F1.

4.2.2.2 UK landings from the array study area are dominated by potting vessels targeting brown crab and lobster and dredge vessels targeting scallops; some demersal trawl activity targeting a mixed demersal fishery (including *Nephrops*, plaice, whiting, cod), is also noted (Figure 41).

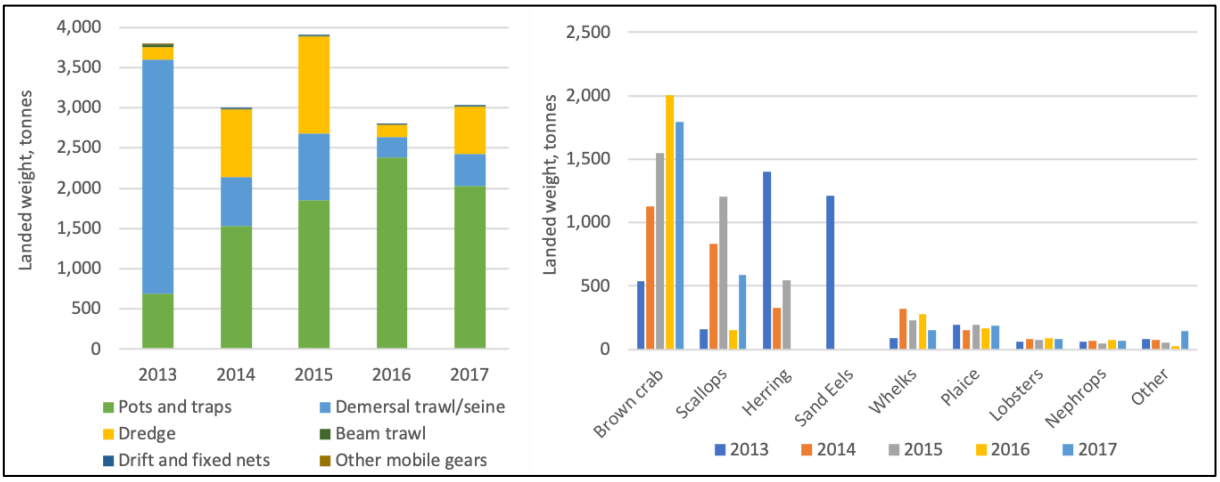

Figure 41: Landed weight of all landings by UK registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (MMO, 2019).

4.2.2.3 Landings of brown crab peaked in 2016, while landings of scallops were highest in 2015 and dropped significantly in 2016. Lobster landings from the array study area have been consistent across 2014-2017.

4.2.2.4 The average annual first sales value of UK landings from the array study area is just under £5 million; including brown crab worth £1.8 million, scallops £1.2 million, lobster £960,000 and *Nephrops* £274,000 (Figure 42).

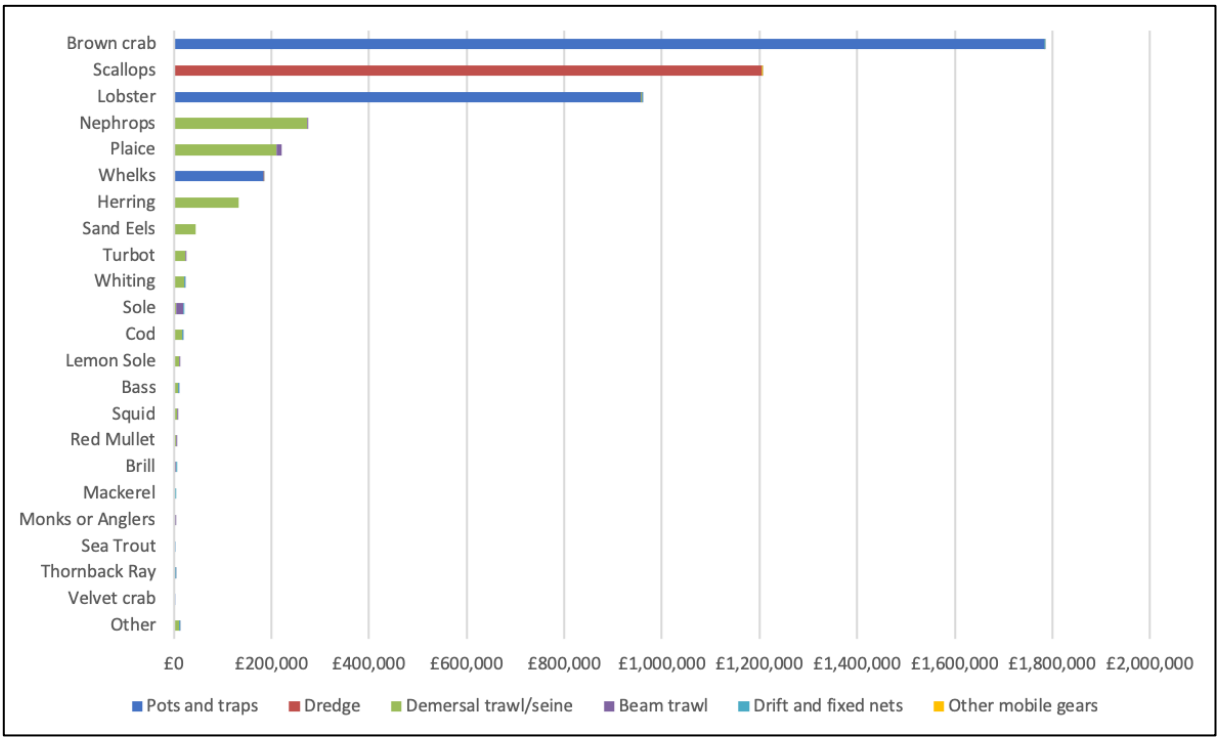

Figure 42: Average annual value of landings by UK registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type and species (based on five-year average from 2013-2017) (MMO, 2019).

4.2.3 Hornsea Four offshore ECC

Landing trends, fishing grounds and key species

4.2.3.1 The trends in weight landed by UK vessels from the offshore ECC study area are presented in **Figure 43** for gear type and species. The offshore ECC study area is defined as ICES rectangles 36E9-F1 and 37E9-F1; therefore, this section refers to landings data from this area, which is considerably larger than the offshore ECC area boundaries. It should be noted that the majority (>70%) of the offshore ECC is located within ICES rectangle 37F0.

4.2.3.2 UK activity within the offshore ECC study area is dominated by potting vessels targeting brown crab, lobster and whelk and dredge vessels targeting scallops (**Figure 43**). Lobster is the most valuable species in this area, with approximately 750 tonnes landed annually with a first sales value of £8.5 million (based on five-year average from 2013-2017; **Figure 44**). The lobster fishery is estimated to generate £35m a year to the region's economy and support 250 fishermen and 200 onshore jobs (Oliver, 2018). The market for lobster has recently seen improved prices, with a sharp increase from 2015 to 2016 and continued growth in 2017 (**Figure 45**).

4.2.3.3 Brown crab is the second most valuable species in the offshore ECC study area, with 4,700 tonnes landed annually, worth £5.9 million in first sales (based on five-year average from 2013-2017, **Figure 43** and **Figure 44**). Prices in crab have also increased from 2016 to 2017, but not as dramatically as lobster (**Figure 45**).

4.2.3.4 The majority of potting vessels are <15m in length and therefore VMS data (shown in **Figure 35**) is less representative of actual activity based on this dataset covering only vessels 15m and over. Surveillance sightings data (**Figure 38**) includes all vessel lengths and indicates activity across the entire inshore area (out to 6 nm).

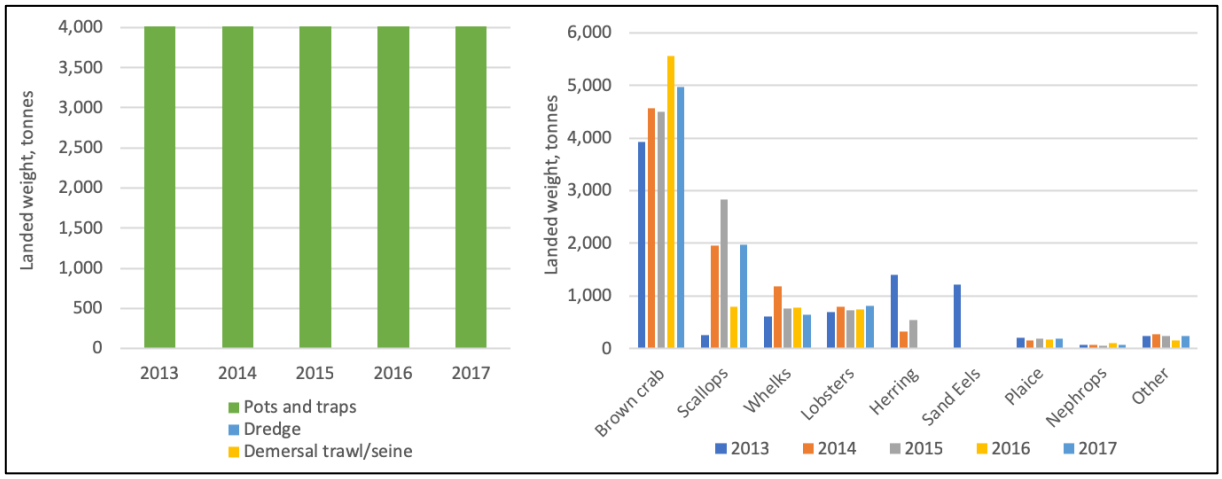

Figure 43: Landed weight of all landings by UK registered vessels from ICES rectangles 36F0-F1 and 37E9-F1 (offshore ECC study area) indicating gear type (left) and species (right) (MMO, 2019).

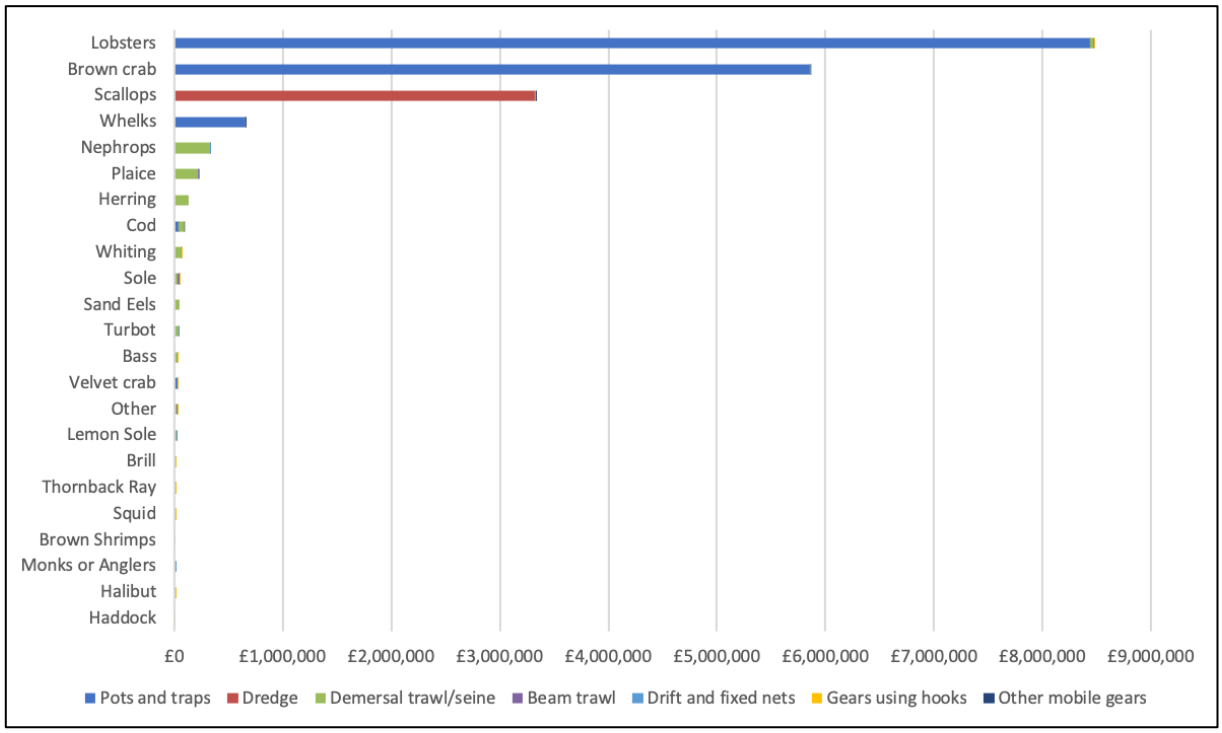

Figure 44: Average annual value of landings by UK registered vessels from ICES rectangles 36F0-F1 and 37E9-F1 (ECC study area) indicating gear type and species (based on five-year average from 2013-2017) (MMO, 2019). (MMO, 2019).

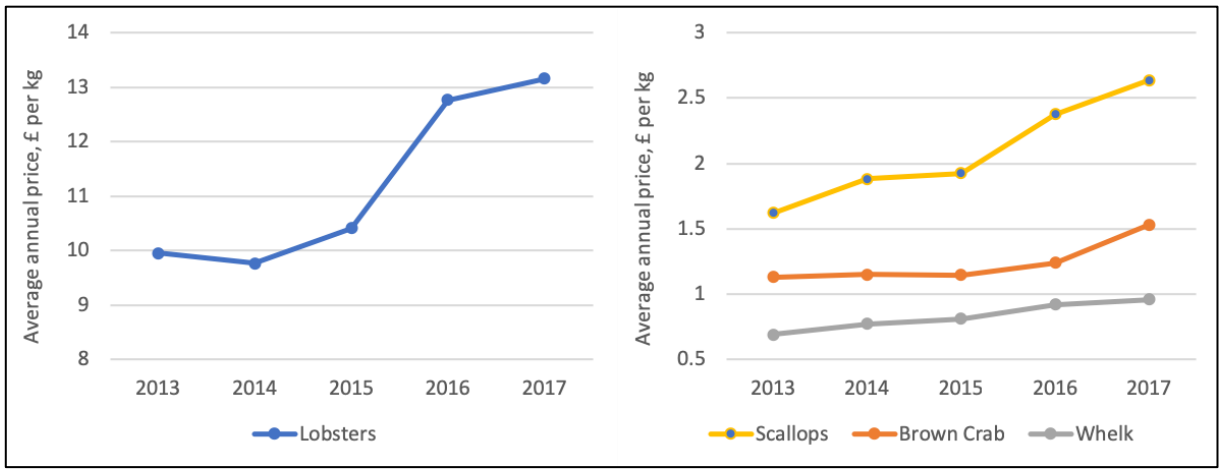

Figure 45: Average annual price of lobster (left) and scallops, brown crab and whelk (right) landed by UK registered vessels from ICES rectangles 36F0-F1 and 37E9-F1 (ECC study area) (MMO, 2019).

4.2.3.5 Significant landings of scallops are made by UK vessels from the offshore ECC study area, with 1,600 tonnes landed annually, worth £3.3 million in first sales (based on five-year average from 2013-2017, Figure 43 and Figure 44). Key scallop grounds, which are targeted by vessels operating mechanical dredge gear, are presented in Figure 31 and Figure 32. These scallop grounds are approximately 5-10 NM from shore and run parallel to the coast, with one end of the targeted grounds running through the offshore ECC. The

majority of effort is focused north of the offshore ECC, which is corroborated by sightings data in Figure 38.

4.2.3.6 Other fisheries noted across the offshore ECC study area include whelks (worth £656,000 annually), *Nephrops* (£332,000) and plaice (£228,000).

4.2.4 Ports and vessel fleets

4.2.4.1 A number of organisations represent UK vessels operating across the commercial fisheries study areas including: The National Federation of Fishermen's Organisation (NFFO), Holderness Fishing Industry Group (HFIG), Eastern England Fish Producers Organisation (EEFPO), and the UK Scallop Industry Consultation Group (SICG).

4.2.4.2 The HFIG represents the fishing industry along the coast from Spurn Point to Flamborough Head with key landings ports at Bridlington, Withernsea, Spurn Point and Flamborough Head. Sixty-five vessels operate out of the main port of Bridlington and along the Holderness coast down to the Humber. Lobster and brown crab are predominately landed into Bridlington, as well as Grimsby, Wells, Hornsea, Arbroath and Withernsea. The Holderness coast region of East Yorkshire is one the most important shellfish fishing regions in Europe, and exports more than 80% of its catch to the EU (Oliver, 2018).

4.2.4.3 The EEFPO represents 48 members including approximately five UK registered Dutch owned vessels and approximately ten lobster and crab vessels.

4.2.4.4 The SICG is a grouping of industry, Producer Organisations (POs), scientists and fishery managers involved in the UK scallop fishery. Members of the SICG have links with around 90% of UK scallop production, and around 40% of vessels targeting scallops around the UK. Scallop vessels typically operate around the UK, targeting different scallop grounds on a cyclable basis, leading to the peaks and troughs seen in landing trends.

4.3 Netherlands Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.3.1.1 All landings by Dutch registered vessels across the study areas are caught within the ICES rectangles 37F0, 37F1 and 36F1. The large majority is taken from 37F0 (Figure 46), which is part of both the array area and offshore ECC study areas.

4.3.1.2 Landings are predominately by pelagic trawls targeting herring. Landings are sporadic, reflecting the nature of pelagic fisheries, which are not associated with specific habitat types, and therefore are targeted across a wide area. The average annual value of herring taken by the Dutch fleet across the study area is €3.8 million.

4.3.1.3 Smaller quantities of sole and plaice are caught by beam trawls across 37F0, 37F1 and 36F1, with a combined average annual value of €1.2 million.

4.3.1.4 VisNed is an umbrella organization for several Dutch Producer Organizations (POs) and represents two-thirds of the Dutch fishing fleet, in numbers and supply value. VisNed is the

largest representative of the fishing sector in the Netherlands and represents the interests of fishermen from the southwest and northern Netherlands, including Urk and Texel.

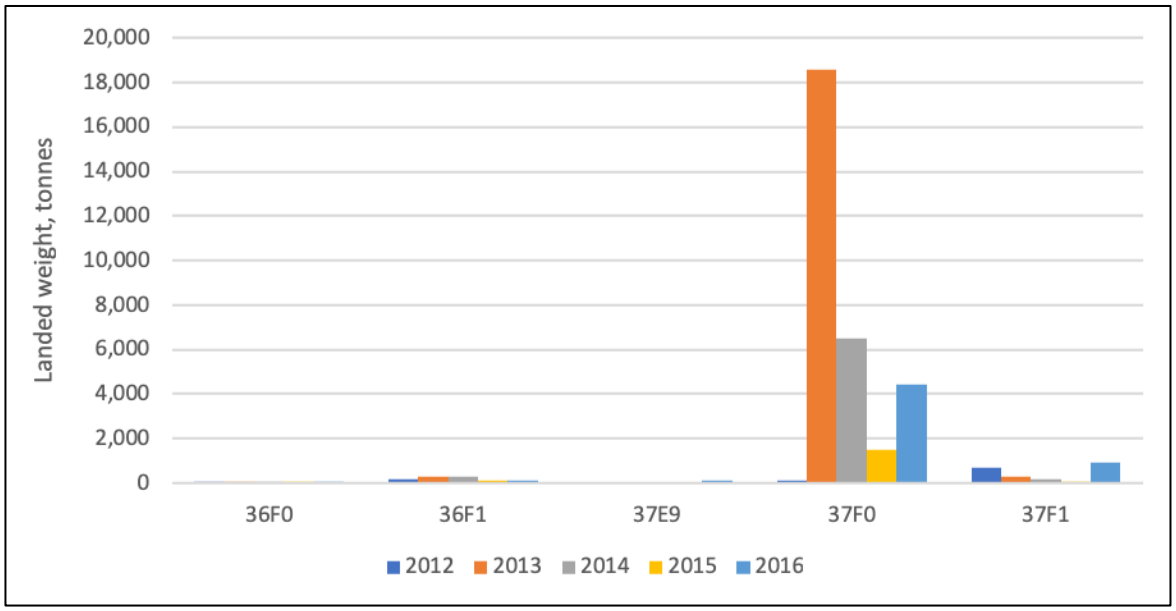

Figure 46: Landed weight (tonnes) of all landings from the study area by Dutch registered vessels, indicating ICES rectangles (EU DCF, 2019).

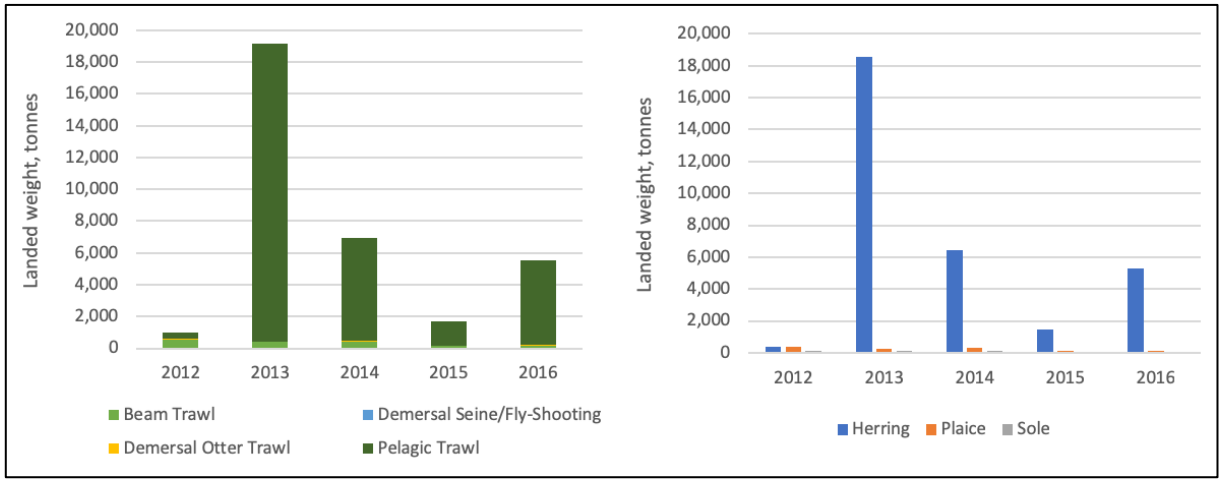

Figure 47: Landed weight of all landings by Dutch registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.4 France Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.4.1.1 French registered vessels operate across all ICES rectangles within the study areas, with the majority of catches taken from 37F0, followed by 36F0 and 37F1 (Figure 48).

4.4.1.2 Landings are predominately by pelagic trawls targeting herring and have consistently occurred each year from 2012 to 2016. The average annual value of herring taken by the

Dutch fleet across the study area is €737,000. Mackerel is also caught, worth €714,000 annually from this area.

4.4.1.3 A French demersal otter trawl fishery targets whiting in the study area, worth €1.1 million annually. Sole and plaice are also caught as part of this mixed demersal fishery, worth €10,000 annually.

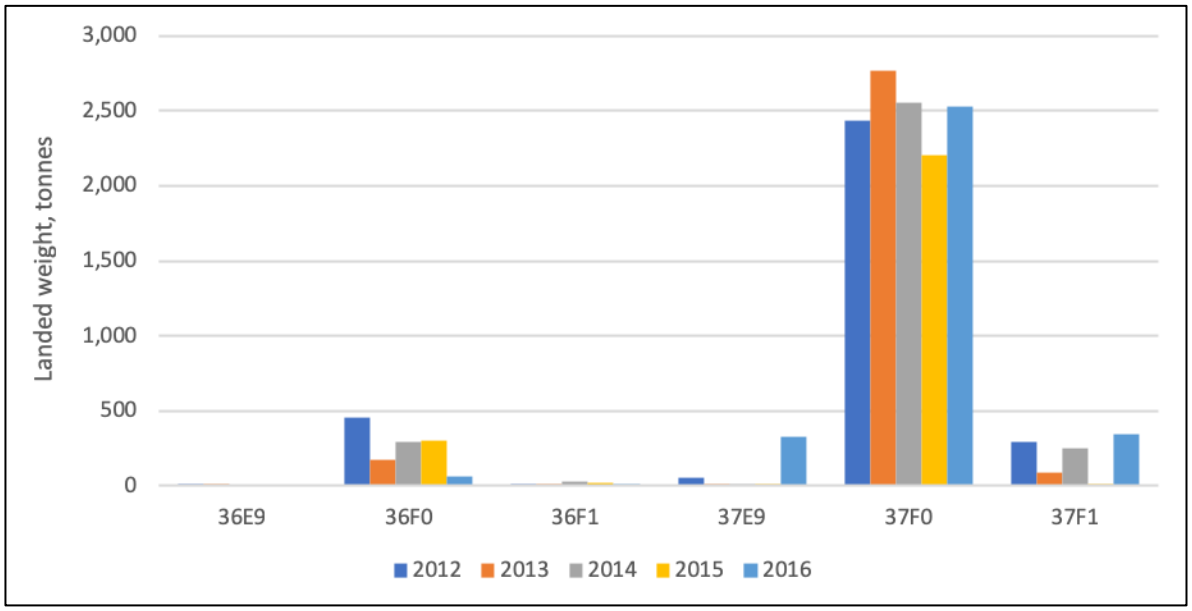

Figure 48: Landed weight (tonnes) of all landings from the study area by French registered vessels, indicating ICES rectangles (EU DCF, 2019).

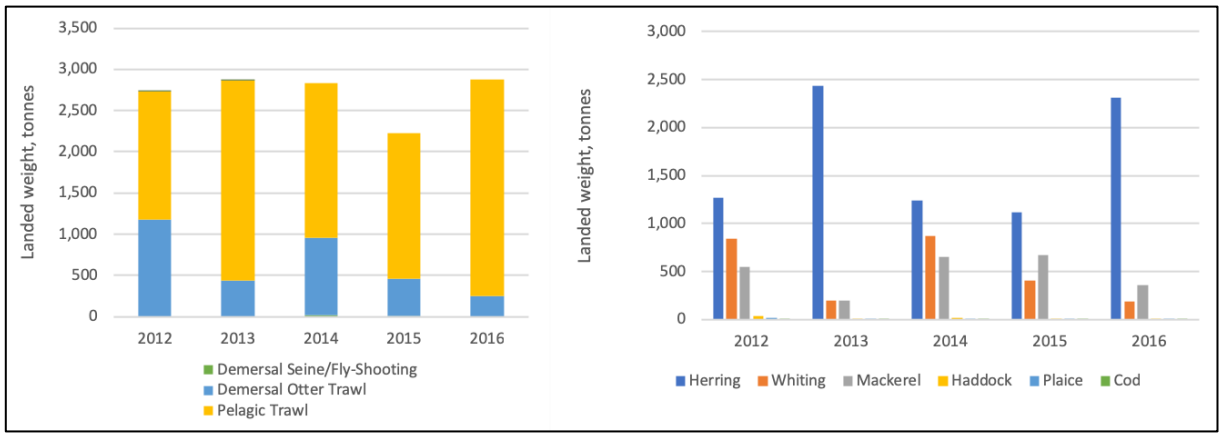

Figure 49: Landed weight of all landings by French registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.4.1.4 Two French Producer Organisations represent French vessel owners that operate throughout the North Sea: From Nord and Cooperative Maritime Etaploise (C.M.E.). Approximately two vessels within From Nord and 20 vessels from C.M.E. have the potential to fish across the study area.

4.5 Belgium Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.5.1.1 Belgian registered vessels operate across all F0 and F1 ICES rectangles within the study areas (but not 36E9 or 37E9, which are closer to shore). The majority of catches are taken from 37F1, followed by 36F1, indicating that the Belgian effort is focused in the more offshore parts of the study area (Figure 50).

4.5.1.2 Landings are predominately by beam trawls targeting plaice and sole (Figure 51), as well as mixed demersal species including cod, lemon sole, brill and turbot. The average annual value of plaice and sole taken by the Belgian fleet across the study area is €477,000.

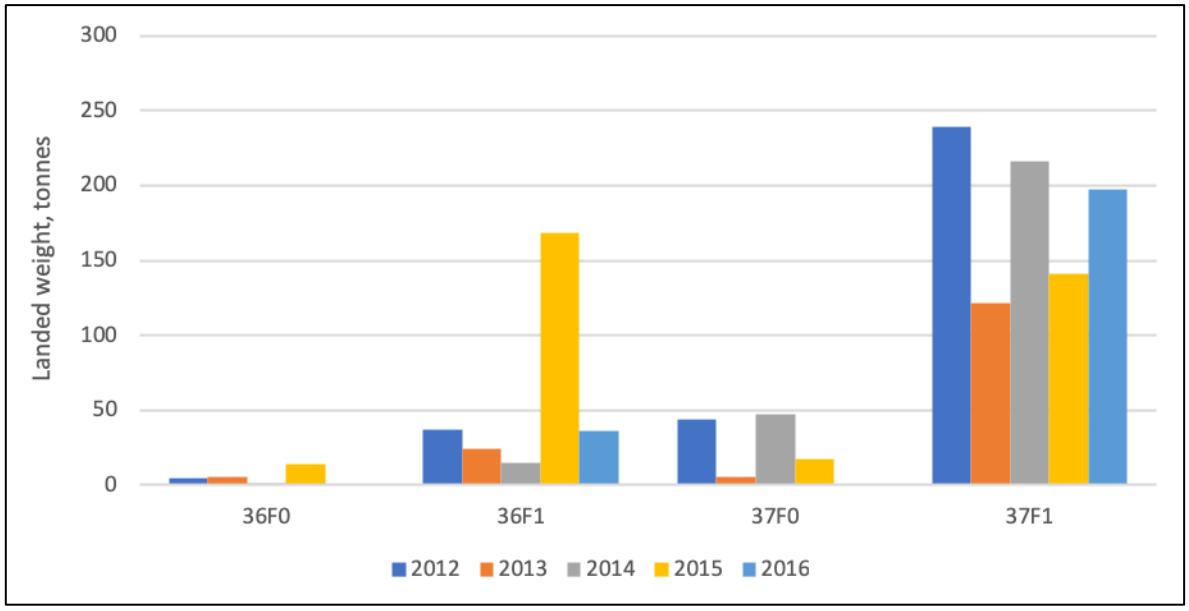

Figure 50: Landed weight (tonnes) of all landings from the study area by Belgian registered vessels, indicating ICES rectangles (EU DCF, 2019).

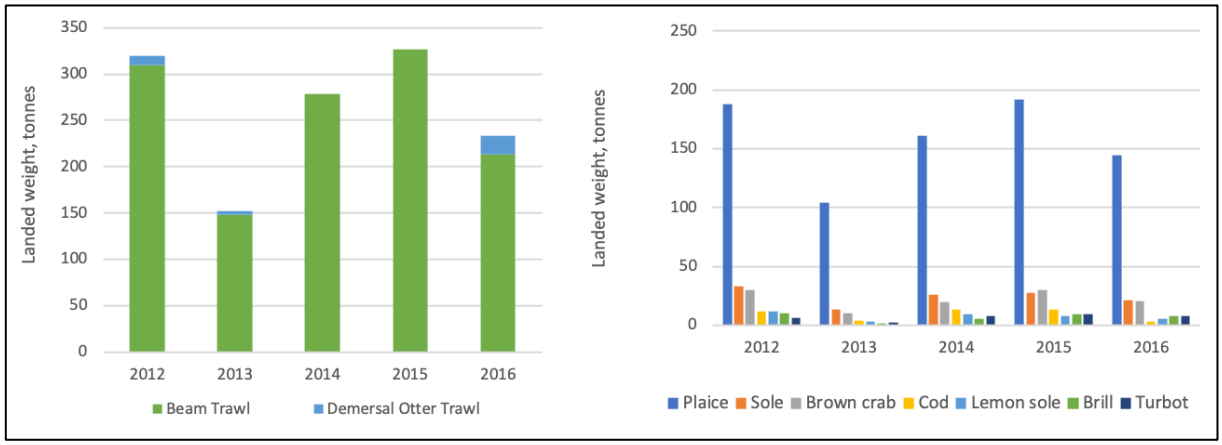

Figure 51: Landed weight of all landings by Belgian registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.5.1.3 There are 80 vessels within the Belgian fleet represented by the only Belgian Producer Organisation, Rederscentrale. Of the 80 vessels, approximately ten vessels are not expected to be able to steam as far north as the study areas. Of the remainder, 20 to 70 vessels have the potential to operate across the array and offshore ECC study areas.

4.6 Denmark Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.6.1.1 Danish registered vessels operate across 37F0 and 37F1, with limited activity in the remaining study area ICES rectangles (Figure 52).

4.6.1.2 Landings are predominately by otter trawls targeting sandeel (Figure 53), as well as some activity by pelagic trawls targeting herring, sprat and mackerel. No sandeel catches were taken from the study areas in 2012 and 2016. For the period 2013-2015, the average annual value of sandeel taken by the Danish fleet from the study area was €3 million.

4.6.1.3 Mapping of sandeel grounds shown in Figure 39 indicate that only limited grounds overlap with the array area and offshore ECC boundaries, with key fishery locations located elsewhere within ICES rectangles 37F0 and 37F1.

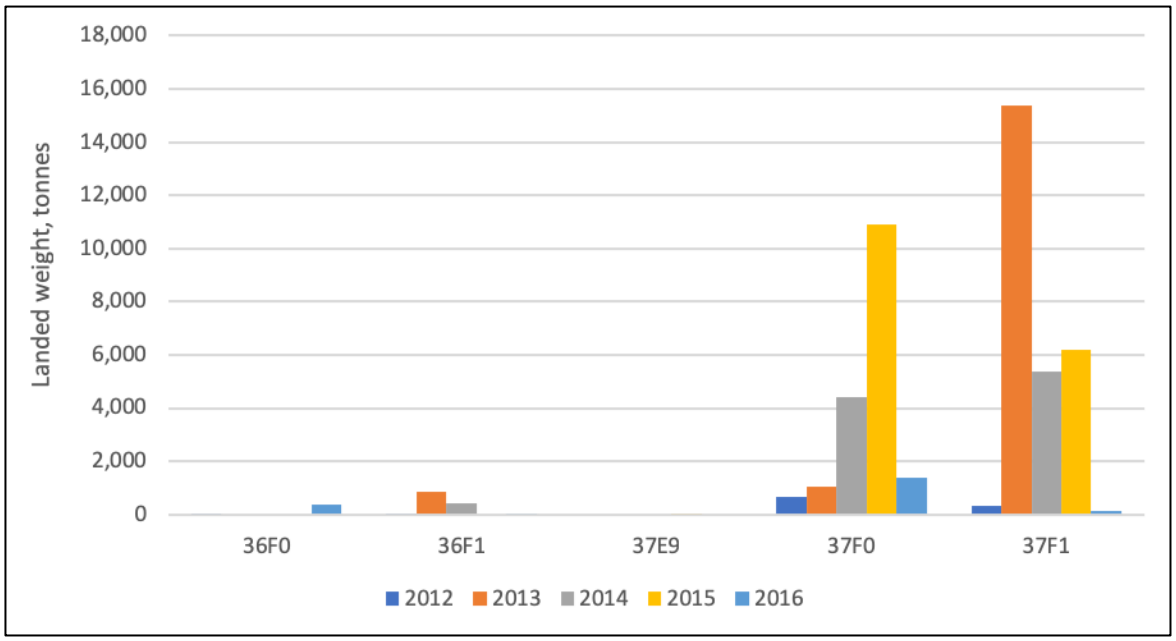

Figure 52: Landed weight (tonnes) of all landings from the study area by Danish registered vessels, indicating ICES rectangles (EU DCF, 2019).

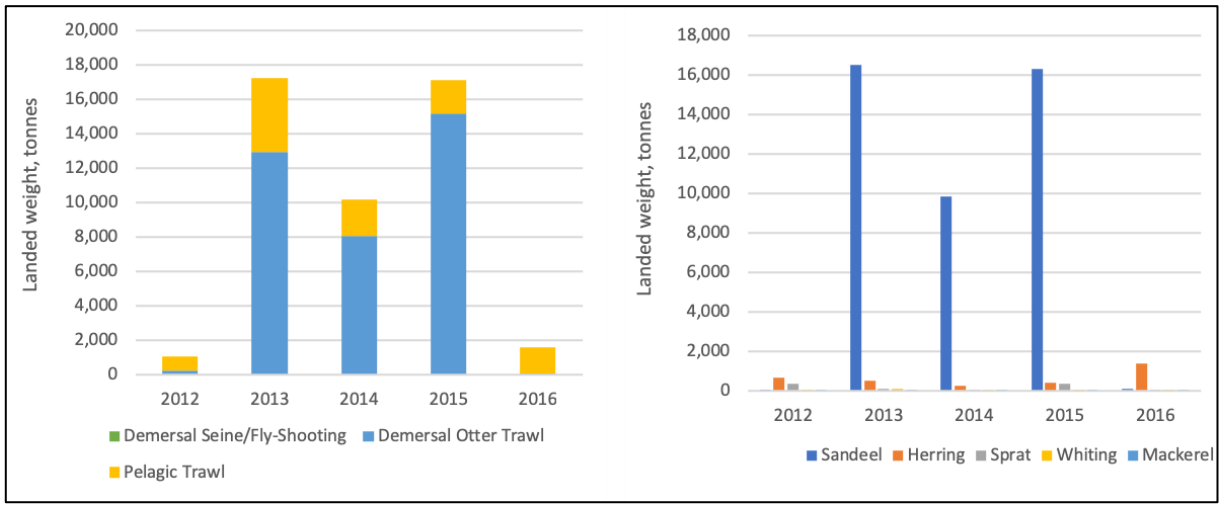

Figure 53: Landed weight of all landings by Danish registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.6.1.4 Approximately 30 to 40 Danish vessels (demersal and semi-pelagic otter trawlers), 35 to 75 m in length, targeting sandeels are capable of fishing across the study area.

4.6.1.5 The Danish Pelagic Producers Organisation (DPPO) is the main organization for Danish fishing vessels targeting pelagic fish species such as herring, mackerel and horse mackerel for the consumer market, as well as sandeel, sprat, blue whiting and Norway pout for the production of fishmeal and fish oil. The DPPO has 11 vessel members, all of which are greater than 40m in length and operate throughout the North Sea and wider North East Atlantic.

4.6.1.6 The Danish Fishermen Producers Organisation (DFPO) is a nationwide organization for 32 Danish fishermen's associations, including vessels operating from large and small ports, and fishing inshore and offshore grounds. The DFPO represent vessels targeting all fisheries, including demersal trawl e.g., for sandeel and mixed demersal species, as well as pelagic vessels e.g., for herring and other pelagic species.

4.7 Germany Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.7.1.1 German registered vessels operate across 37F0 and 37F1, with limited activity in the remaining study area ICES rectangles (Figure 54).

4.7.1.2 Landings are predominately by pelagic trawls targeting herring (Figure 55), which is a pelagic species caught in the mid-water column. Landings are sporadic, reflecting the nature of pelagic fisheries, which are not associated with specific habitat types, and therefore are targeted across a wide area. The average annual value of herring taken by the German fleet across the study area is €1.3 million, with a significant peak noted in 2013 of €5.1 million.

4.7.1.3 A small quantity of sandeel caught by otter trawl is noted in 2013, which was worth €184,000.

4.7.1.4 Erzeugergemeinschaft der Nord- und Osteefischer GmbH is a German Fish Producers Organisation (PO) with approximately 120 members who are located in the ports of Cuxhaven, Sassnitz, Fehmarn, Travemünde and Kiel. Vessels target the North Sea, Baltic Sea and wider North East Atlantic.

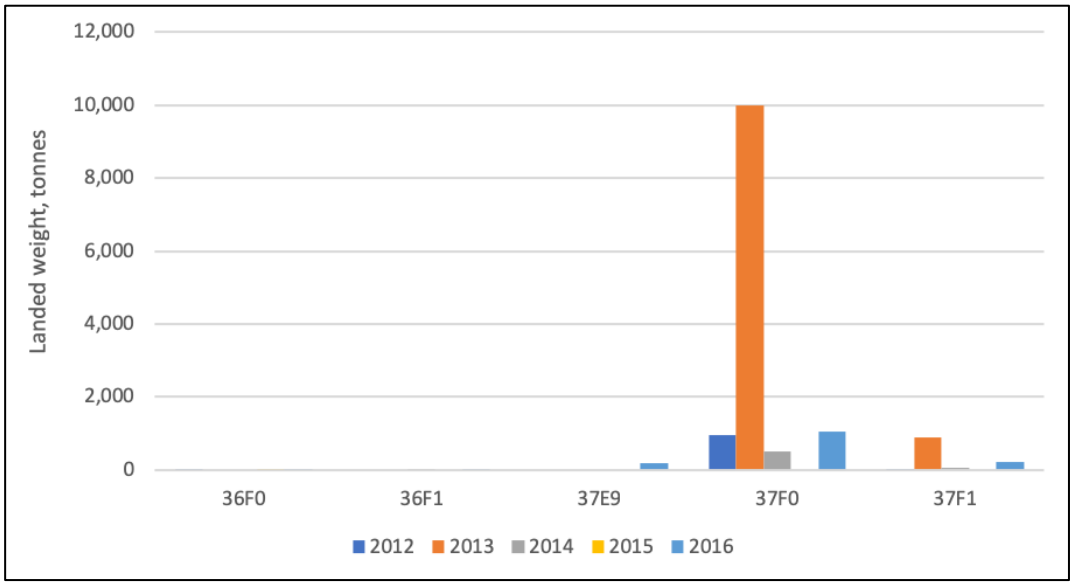

Figure 54: Landed weight (tonnes) of all landings from the study area by German registered vessels, indicating ICES rectangles (EU DCF, 2019).

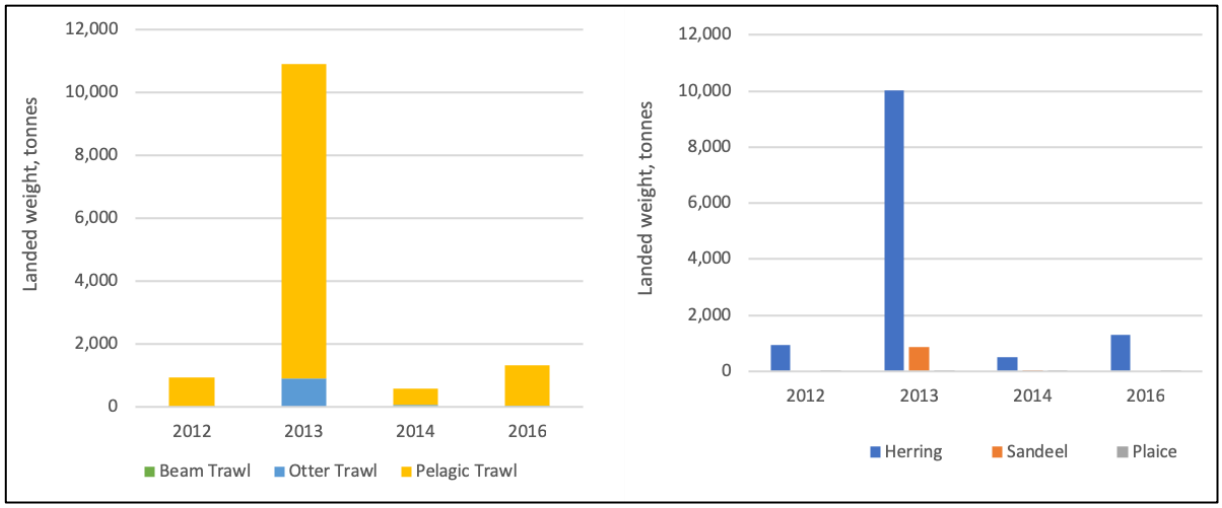

Figure 55: Landed weight of all landings by German registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.8 Sweden Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.8.1.1 Swedish registered vessels operate across 37F0 and 37F1, with no activity in the remaining study area ICES rectangles (Figure 56).

4.8.1.2 Landings are predominately by pelagic trawls targeting herring and otter trawls targeting sandeel (Figure 57). Landings of herring occurred in 2012 (worth €903,000) and 2016 (worth €138,000), while sandeels were landed from 2013 to 2015, with an average annual value of €200,000 over this three-year period.

4.8.1.3 Mapping of sandeel grounds shown in Figure 39 indicate that only limited grounds overlap with the array area and offshore ECC boundaries, with key fishery locations located elsewhere within ICES rectangles 37F0 and 37F1.

4.8.1.4 The Swedish Pelagic Producer Organisation represents approximately 16 vessels operating pelagic trawl and purse seine and targeting herring and other pelagic species across the North Sea and wider North East Atlantic.

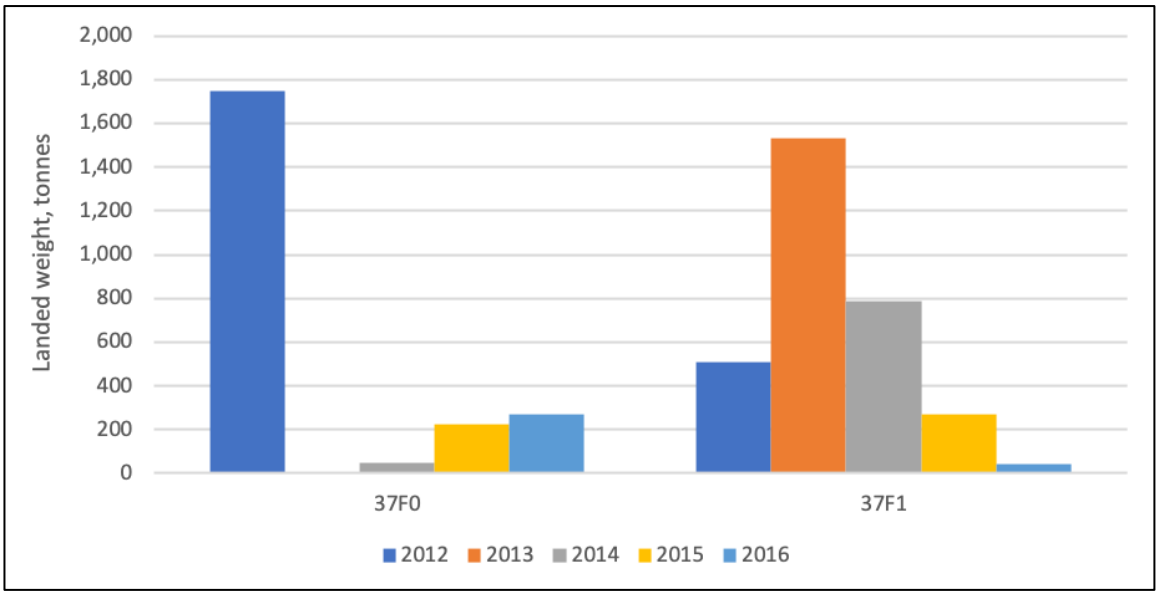

Figure 56: Landed weight (tonnes) of all landings from the study area by Swedish registered vessels, indicating ICES rectangles (EU DCF, 2019).

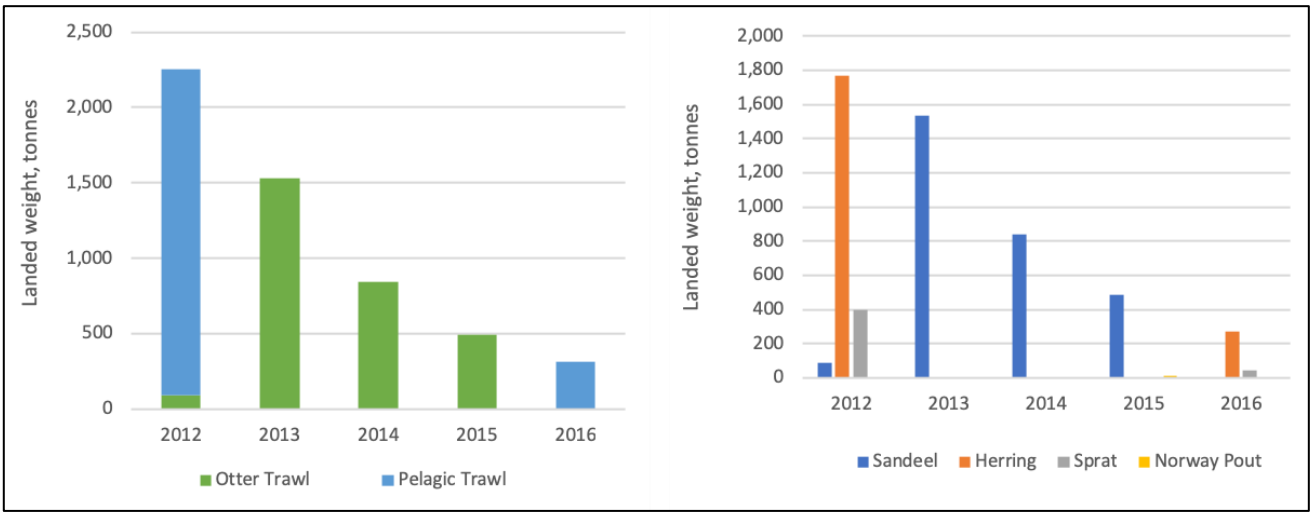

Figure 57: Landed weight of all landings by Swedish registered vessels from ICES rectangles 37F0, 37F1 and 36F1 (array study area) indicating gear type (left) and species (right) (EU DCF, 2019).

4.9 Norway Fisheries Activity Assessment

Landing trends, fishing grounds and key species

4.9.1.1 Norwegian industrial trawlers operate within the North Sea targeting sandeel with demersal trawls and pelagic species (herring, sprat and mackerel) with pelagic trawls and purse seine gear. From time to time they may enter the study area, but significant activity within the array area and offshore ECC is not likely.

5 Summary

5.1.1.1 This technical annex has presented baseline activity data for the following countries: UK, Netherlands, France, Belgium, Denmark, Germany, Sweden and Norway. Based on quota allocations and landing statistics it is understood that vessels registered to other countries do not operate across the Hornsea Four array area and offshore ECC study areas.

5.1.1.2 The key fleet metiers operating across the Hornsea Four array area and offshore ECC study areas include (in no particular order):

- UK potters targeting brown crab, lobster and whelk, operating across the offshore ECC and array area, with most significant effort across the offshore ECC;
- UK scallop dredgers targeting scallop, operating north of the offshore ECC and across parts of the offshore ECC;
- UK beam trawlers targeting sole and plaice (vessels >25 m in length);
- UK demersal otter trawlers targeting *Nephrops* and mixed demersal species (vessels 12 to 27 m in length);
- Dutch beam trawlers targeting plaice and sole, operating across the study areas;
- French demersal trawlers targeting whiting (vessels 15 to 25 m in length), operating across the study areas;
- Belgian beam trawlers targeting sole, plaice, *Nephrops* and mixed demersal species (vessels >25 m in length), operating across the regional commercial fisheries study area;

- Dutch, German, Danish, French and Swedish pelagic trawlers (vessels 15 to 25 m in length), targeting highly mobile species (herring and/or mackerel) that consistently move/shoal throughout the wider southern North Sea; and
- Danish, Swedish and Norwegian demersal trawlers targeting sandeel throughout the North Sea with occasional effort within the commercial fisheries study areas.

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