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Horns Rev 3 Offshore Wind Farm

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COMMERCIAL FISHERIES

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COMMERCIAL FISHERIES

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SUMMARY

The Horns Rev 3 Offshore Wind Farm (OWF) will be established in a designated area situated in the Horns Rev region off the south western coast of Jutland and to the north of the existing offshore wind farms Horns Rev 1 and 2. The aim of this EIS report was to present baseline data on the fisheries in the Horns Rev area and to assess the impacts on the commercial fisheries due to activities and pressures occurring from the construction, operation and decommissioning of the Horns Rev 3 OWF.

The proposed pre-investigation area is 160 km^2 of which approximately 88 km^2 will make up the final wind farm area. Nine different layouts have been suggested for conducting full and detailed environmental impact assessments on potential wind farm project scenarios. The suggested wind farm layouts consisted of three different turbines (3, 8 and 10 MW) with three different locations within the proposed pre-investigation area. However, at present the final location of the Horns Rev 3 OWF turbine area within the pre-investigation area is not known, and thus assessments in this report represent worst-case scenarios by assessing relevant impacts as if they were in the entire Horns Rev 3 pre-investigation area.

The characteristics of the fisheries were described by using official fishery statistics and VMS (Vessel Monitoring System) data from the Danish AgriFish Agency and from interviews with representatives of the Danish Fisherman´s Association and a number of fishermen that undertake their fisheries in and near the project area of the Horns Rev 3 OWF.

The baseline fisheries in the Horns Rev region were presented according to the ICES rectangles 40F7 that contains the Horns Rev 3 pre-investigation area and ICES 40F8 which the cable transect runs through. The Horns Rev 3 pre-investigation area of 160 km^2 makes up approximately 4.6% of the ICES rectangle 40F7, and the final OWF area of 88 km^2 will make up approximately 2.6% of the ICES rectangle 40F7.

The total landings and value of landings of the Danish fisheries from ICES rectangle 40F7 have varied between 3.804–21.000 tons and 12.981.000–41.285.000 DKK, respectively, over the past 11 years. Over the same time period the total landings and value of landings from ICES rectangle 40F8 have varied between 591–5.477 tons and 6.834.000–30.771.000 DKK.

Sandeel, brown shrimp, diverse flatfish species and sprat in recent years make up the majority of the landings and value of the landings from ICES 40F7 which are primarily taken by bottom and pelagic trawlers. Similarly, beam and bottom trawlers and more recently pelagic trawlers account for the majority of catches of Brown shrimp, sprat and diverse flatfish species from the more coastal ICES 40F8 rectangle. Gill nets do not account for much of the landings quantitatively, but because this fishery primarily lands more valuable commercial species, such as diverse flatfish and cod, their landings have a comparatively high value.

Sandeel and Brown shrimp are by far the most economically important commercial species caught within the Horns Rev 3 pre-investigation area. This is followed by sprat in more recent years. The distribution of sandeel is along a belt in the western part of the pre-investigation area whereas the beam trawl fishery that targets Brown shrimp indicates this resource is more widely distributed in the middle and eastern part of the Horns Rev 3 pre-investigation area.

Seasonally, the catches of the important commercial species sandeel are primarily undertaken in a 3 month period from May-July while catches of the important and valuable brown shrimp is undertaken year round with peaks primarily in the spring and autumn months. Seasonal catches of flatfish, which is dominated by plaice, indicate these are landed throughout the year. More specifically, plaice is primarily being landed in the first part of the year while dab and flounder are landed in the late autumn and early winter. Catches of cod are also greatest during late autumn and early winter (November-February). The catches of the valuable flatfish turbot and sole are predominantly during the summer months and at the end of the year (November-December).

According to VMS data the distribution of the bottom trawling fishery and the less frequent pelagic trawl fishery in and near the Horns Rev 3 pre-investigation area is primarily undertaken in its western part. In contrast, the distribution of the beam trawling fishery indicate their fishing areas are primarily in the middle and eastern part of the Horns Rev 3 pre-investigation area. The distribution of the gill net fishery in the Horns Rev 3 pre-investigation area is rather diffuse with a tendency of this fishery being undertaken in the eastern part of the project area.

The most important landing and basis harbour i.e. where vessels have their home port, for both ICES 40F7 and 40F8 is Hvide Sande with annual landings amounting to between 59-98% (2231-17726 tonnes) from the catches in ICES 40F7 and between 10-97% (401-2206 tonnes) from ICES 40F8, respectively. Landings are also relatively high in Esbjerg and on occasion Thyborøn and Hanstholm.

Assessment

The primary pressures (temporary and permanent) used for the assessment of impacts to the commercial fisheries from the construction, operation and decommissioning of the Horns Rev 3 OWF were potential loss of fishing grounds, restrictions or disturbances that do not allow or make it difficult to undertake fisheries and effects to the commercial fish stocks and hence indirectly the fishing yield in the region.

Due to potential loss of fishing areas in the Horns Rev 3 OWF area to all trawlers for the life-time of the wind farm, the severity of impact was assessed to be high for the bottom trawl and medium for the beam trawl fisheries and low for the pelagic and seine net fisheries according to the importance of the area for these fisheries and the possibility of using alternative areas.

The high severity of impact to the bottom trawl fishery in the Horns Rev 3 pre-investigation area is because this fishery primarily targets the habitat specific sandeel, which are abundant in the western region of the project area and have a limited distribution in the regional area outside the pre-investigation area. The medium severity of impact to the beam trawl fishery is because this fishery targets brown shrimp which are also associated with sandy bottoms but are less habitat specific than sandeel and have a broader distribution in the regional area, and thus more alternative fishing areas. The low severity of impact to the pelagic trawl and seine net fishery due to permanent loss of fishing areas was low due to the limited importance and relatively low fishing effort undertaken by these fisheries in the Horns Rev 3 Wind Farm pre-investigation area.

It is anticipated that the gill net fishery will be able to continue in the wind farm area after construction is completed thus permanent loss of fishing area to this fishery is only considered to be from turbines, their foundations and the transformer platform which amounts to only a small absolute loss of potential gill net fishing areas and thus a low severity of impact in the Horns Rev Wind Farm area

The laying of the electric cables from the wind farm transformer platform to land will create short-term local restrictions prohibiting any fishery around the cable laying activities and potential disturbance to the fisheries due to added ships traffic. Restrictions will primarily affect the beam trawl and gill net fisheries which are the fisheries that utilize the area along the cable transect. This impact is, however, only short-term and spatially limited thus the severity of impact from restrictions and disturbances of the cable laying activities was assessed to be low for all the fisheries.

Along electrical cables buried in the seabed from the transformer platform to land i.e. outside the OWF turbine area there are general provisions prohibiting fishing with bottom dragging gear such as trawls within a distance of 200 metres on both sides of the cable transect. Disturbances to trawling activities when crossing the cable transect will include trawlers either having to stop their fishing before they cross the transect or undertake time-consuming operations of lifting and lowering their gear as they pass over the transect. In the area along the cable transect these restrictions will primarily affect the beam trawl fishery as the planned cable transect crosses an area with well-used beam trawl routes. The beam trawls are, however, mobile and their resource (brown shrimp) are generally distributed in a broad area in the vicinity of the cable transect. As there will be some fishery restrictions and time-consuming disturbances to the beam trawl fishery the magnitude of these restrictions is considered to be of medium severity.

In other offshore wind farms (for example HR1 and HR2) exemptions to these restrictions have been granted and thus trawling with bottom gear over cables in the seabed is allowed. However, in a worst case scenario in this assessment it is assumed that operations by fishing vessels to avoid the cable transect will need to be undertaken.

The decommissioning phase will include the removal of the wind turbines and possibly all the cables between turbines and from the transformer platform to land. It is anticipated

that activities from this phase will include similar pressures experienced during the construction of the wind farm such as short-term closure of all fishing activities (including gill net fisheries) in the wind farm area and short-term local restrictions forbidding the fisheries along the route of the cable as its being removed. Due to the short-term temporal extent of the decommissioning phase the severity of impact to all the fisheries from the decommissioning activities are considered low. However, if cables are left buried in situ together with added rock dumping to keep them buried, and scour protection is also left in situ, then these solutions could hinder the possibility of restarting of fishing along the bottom with trawls in these areas. Similarly, if cables from the transformer platform to land is allowed to remain in situ and protected by rock dumping then trawling activities will be disturbed when crossing the cable transect.

A potentially positive effect to the gill net fisheries could arise from local increases in some commercial species associated with the establishment of new habitats (artificial reefs) from the turbine foundations and protective scouring material.

Economic estimate

An estimate of the potential economic loss to the commercial fisheries according to gear and the most important commercial species (sandeel, brown shrimp, brisling and plaice) was undertaken using VMS data points as a proxy for the amount of fishing taking place within the Horns Rev 3 pre-investigation area in relation to the ICES rectangle 40F7.

Estimates of the total value of the landings within the Horns Rev 3 Wind Farm pre-investigation area was approximately 1,09 million DKK annually. Bottom trawlers (approximately 614,000 DKK annually) and beam trawlers (390,000 annually) were estimated to be the most economically important fisheries as approximately 5.5% (bottom trawls) and 4.9% (beam trawls) of their fisheries in the ICES 40F7 rectangle are estimated to be undertaken in the pre-investigation area.

Approximately 6.4% (82,000 DKK annually) of the pelagic fishery in the ICES 40F7 rectangle was estimated to be undertaken within the Horns Rev 3 pre-investigation area.

Only 0.11% of the gill net fishery or an estimate of 5.400 DKK in value is estimated to be undertaken inside the Horns Rev 3 pre-investigation area. There has been no VMS registered Danish seine fishery or fishery with other gear in the Horns Rev 3 pre-investigation period since 2005.

It is estimated that the catches of sandeel within the Horns Rev Wind Farm area represent approximately 8% of the trawl fisheries targeting this species or 696,000 DKK of the annual value of the sandeel catches within the ICES 40F7 rectangle. Similarly, the catches of brown shrimp within the Horns Rev Wind Farm area represent approximately 4.9% or 380,000 DKK of the annual landings from the ICES 40F7 rectangle.

For sprat and plaice the estimated catches within the Horns Rev Wind Farm area represent approximately 4.7% (41,000 DKK) and 0.3% (12,000 DKK) of the annual catches (and value) of the within the ICES 40F7 rectangle.

It is important to note that these estimates are potentially filled with biases and uncertainties as mentioned in section 9.2 and should only be used only as an estimate.

Potential mitigation

One of the most important tools of mitigation for the concessionaire will be choosing a wind farm layout to reduce the potential impact to the different fisheries accordingly.

The choice of layout design will have a profound impact on different fisheries because of the different distributions of their resources (commercial species). Thus, the final layout choice can be made with the intention of reducing the magnitude of loss of fishing areas for the different fisheries. The final placement of the Horns Rev 3 OWF will affect the individual fisheries accordingly:

- A layout covering the western part of the pre-investigation area will have the greatest direct impact on the bottom trawl and pelagic trawl fisheries. Much of these fisheries target sandeel in this area and thus a western layout will also have the greatest impact to the sandeel fisheries.

- A layout covering the middle and/or eastern part of the pre-investigation area will have the greatest direct impact on the beam trawl fishery as well as gill net fishery. Beam trawls target the valuable brown shrimp and utilize the middle and eastern part of the pre-investigation area in their fishery. Gill nets are more sporadic in their distribution albeit more common in the eastern part of the pre-investigation area.

Suggested corridor for trawling

Focusing on sandeel, the most important and sensitive commercial species in the Horns Rev 3 pre-investigation area, fishermen and their organization “Danish Fishermen´s Association” suggested choosing a wind farm pattern that takes into consideration to try and keep the important sandeel fishing grounds in the western part of the pre-investigation area open and available to the trawl fisheries. In the event that a wind farm was to be placed in the western part of the Horns Rev project area, it would be beneficial for the fisheries if the layout of the wind farm was set up in a north-south direction in such a way as to form a broad corridor along the sandeel fishing grounds. This would allow the trawl fishery targeting sandeel to continue after the establishment of the OWF.

SAMMENFATNING

Horns Rev 3 havmøllepark vil blive etableret i Horns Rev området ud for den sydvestlige kyst af Jylland, nord for de eksisterende havmølleparker Horns Rev 1 og Horns Rev 2. Formålet med denne EIS rapport er at præsentere baseline data for det kommercielle fiskeri i Horns Rev området og vurdere påvirkninger på det kommercielle fiskeri i forbindelse med aktiviteter under opførelse, drift og nedtagning af Horns Rev 3 havmøllepark.

Det foreslåede undersøgelsesområde er ca. 160 km^2, hvoraf cirka 88 km^2 vil være størrelsen på det endelige mølleparkområde. Ni forskellige mønstre for det endelige mølleområde er blevet foreslået for at gennemføre detaljerede vurderinger af de mest sandsynlig scenarier af Horns Rev 3 havmølleparkens påvirkninger på miljøet. Forslagene består af tre forskellige vindmøllestørrelse (3, 8 og 10 MW) med tre forskellige placeringer inden for det udpegede område. På nuværende tidspunkt er den endelige placering af Horns Rev 3 møllepark inden for undersøgelsesområdet ikke kendt. Vurderingerne af de fiskerimæssige konsekvenser, beskrevet i denne rapport, repræsenterer derfor "worst-case"-scenarier ved at vurdere relevante påvirkninger på det kommercielle fiskeri i forhold til hele Horns Rev 3 undersøgelsesområdet.

Fiskeriets omfang og karakter i og omkring forundersøgelsesområdet er beskrevet ved hjælp af de officielle fiskeristatistikker samt VMS (Vessel Monitering System) data fra NaturErhvervstyrelsen og gennem interviews med repræsentanter for den danske fiskeriforening samt en række fiskere, som udøver deres fiskeri i og nær Horns Rev 3 havmøllepark projektområdet.

Fiskeriet i Horns Rev området er præsenteret i henhold til ICES 40F7, der indeholder Horns Rev 3 forundersøgelsesområdet, og ICES 40F8, som kabeltransektet løber igennem. Horns Rev 3 området udgøre ca. 4.6% af ICES kvadrat 40F7, of den endelig Horns Rev 3 havmøllepark vil udgøre ca. 88 km^2 eller 2.6% af ICES kvadrat 40F7.

Den samlede danske landing og værdien af landingerne fra ICES rektangel 40F7 har varieret mellem henholdsvis 3,804 tons til 21,000 tons og 13 – 41 million DKK i løbet af de sidste 11 år. Over samme periode har de samlede landinger og værdien af landingerne fra ICES rektangel 40F8 varieret mellem 591 tons til 5,477 tons og 6.8 - 30.7 million DKK.

Tobis, hesterejer, diverse fladfisk og brisling udgør de seneste år størstedelen af landingerne og værdien af landingerne fra ICES 40F7, som primært fiskes af bund- og pelagiske trawlere. Ligeledes har bom- og bundtrawlere, og for nyligt pelagiske trawlere, tegnet sig for størstedelen af fangsterne af hesterejer, brisling og diverse fladfisk fra denne mere kystnære ICES 40F8 rektangel. Kvantitativt står fangster med garn ikke for en særlig stor del af landingerne, men fordi denne type fiskeri primært lander mere værdifulde, kommercielle arter, som diverse fladfisk og torsk, har disse landinger en forholdsvis høj værdi.

Tobis og hesterejer er økonomisk set langt de vigtigste kommercielle arter fanget i Horns Rev 3 forundersøgelsesområdet. Dette efterfølges af brisling de senere år. Fiskeriet efter

tobis foregår primært langs den vestlige del af forundersøgelsesområdet, mens bomtrawl fiskeriet, som har hesterejer som deres målart, tyder på, at denne ressource er mere udbredt i midten og den østlige del af Horns Rev 3 forundersøgelsesområde.

Den sæsonmæssige fangst af den vigtige kommercielle fiskeart tobis foregår primært i en 3 måneders periode fra ca. maj - juli, mens fangsterne af de værdifulde hesterejer foretages året rundt med relativt store fangster i forårs- og efterårsmånederne. Sæsonmæssige fangster af fladfisk, som er domineret af rødspætte, viser, at de landes hele året, men at rødspætte primært er landet i den første del af året, mens ising og skrubbe landes i det sene efterår og tidlige vinter. Fangsterne af torsk er ligeledes størst i løbet af efteråret/vinteren (november til februar). Fangsterne af de meste værdifulde fladfisk, såsom pighvar og tunge, foregår overvejende i sommermånederne samt ved udgangen af året (november-december),

Bundtrawl fiskeriet og det mindre hyppige pelagisktrawl fiskeri i og i nærheden af Horns Rev 3 projektområdet foregår primært i den vestlige del af forundersøgelsesområdet. I modsætning hertil foregår fiskeriet med bomtrawl primært i den midterste og østlige del af Horns Rev 3 forundersøgelsesområdet. Fordelingen af garnfiskeri i Horns Rev 3 forundersøgelsesområdet er ret diffus med en tendens til primært at gennemføres i den østlige del af Horns Rev 3 forundersøgelsesområdet.

Den vigtigste landingshavn og hjemmehørende havn for fiskerifartøjer, der har deres fangst i ICES 40F7 og/eller 40F8, er Hvide Sande. Fartøjernes årlige landinger udgør mellem 59-98% (fra 2.231 til 17.726 tons) af fangster fisket i ICES 40F7 og mellem 10-97% (401-2.206 tons) af fangster fisket i ICES 40F8. Landingerne er også af og til relativt høje i Esbjerg, Thyborøn og Hanstholm havne**.**

Konsekvenser for fiskeriet

De primære midlertidige og permanente påvirkninger fra opførelse, drift og nedtagning af Horns Rev 3 Havmøllepark der anvendes til vurdering af forhindringer til fiskeriets udøvelse er potentielle tab af fiskeriområder, restriktioner eller forstyrrelser, som ikke tillader eller gøre det vanskeligt at gennemføre fiskeriet og påvirkninger af de kommercielle fiskebestande og dermed indirekte påvirkning af fiskeri udbytte i regionen. Den sidstenævnte problemstilling er beskrevet/vurderet i Fish Ecology EIS. I denne rapport beskrives primært konsekvenserne for fiskeriets udøvelse.

Der vil muligvis ske et permanent tab af fiskeriområder i Horns Rev 3 havmøllepark, da alt trawlfiskeri i mølleområdet potentielt vil være forbudt i hele havmølleparkens levetid. Dette tab vurderes at være højt for bundtrawl fiskeriet, medium for bomtrawl fiskeriet og lavt for det pelagiske fiskeri og vodfiskeriet, eftersom betydningen af området og muligheden for at anvende alternative områder er forskellige for disse fiskerier.

Den høje påvirkning på bundtrawlfiskeriet i Horns Rev 3 forundersøgelsesområdet skyldes, at bundtrawlfiskeriets primære målart, den habitatspecifikke tobis, har store forekomster i den vestlige region af projektområdet og en begrænset udbredelse i det regio-

nale område udenfor forundersøgelsesområdet. Påvirkning på bomtrawlfiskeriet, som følge af tabt fiskeriområde, er medium, da målarten for dette fiskeri er hesterejer, som findes i hele den midterste og østlige del af forundersøgelsesområdet tilknyttet sandbund, men som i modsætning til tobis har en bredere fordeling i det regionale område, og dermed findes der flere alternative fiskeområder for dette fiskeri. Den lave påvirkningsgrad og indvirkning på pelagisk trawl og vodfiskeri pga. permanent tab af fiskeriområder er på grund af deres relativt lave fiskeriindsats og den begrænset betydning Horns Rev 3 forundersøgelsesområdet har for disse fiskerier.

Det forventes, at garnfiskeriet vil kunne fortsætte i Horns Rev 3 mølleområdet efter byggeriet er afsluttet. Dermed anses de permanent tab af fiskeriområder for dette fiskeri kun at være ved møllefundamenter, transformerstation og deres beskyttelseslag omkring bunden, som kun udgør et forholdsvis lille tab af potentielle garnfiskeriområder, hvorfor påvirkningen vurderes til at være lav.

Kabeludlægning fra vindmølleparken/transformerplatformen ind til land vil skabe kortsigtede lokale restriktioner, der forbyder enhver form for fiskeri omkring anlægsaktiviteter samt potentielle forstyrrelser på fiskeriet på grund forøget skibstrafik. Begrænsningerne vil primært påvirke bomtrawl- og garnfiskeriet, som udnytter fiskeriområderne langs kabeltransektet mest. Men da påvirkningen kun er kortsigtet og begrænset i omfang, er påvirkningen fra restriktioner og forstyrrelser af kabeludlægning vurderet til at være lav for alle fiskerier.

Effekten på fiskeriet som følge af kabeludlægningen mellem havmølleparken/transformerstationen og land vil afhænge af, hvorvidt der vil blive meddelt dispensation fra kabelbekendtgørelsens bestemmelse om forbud mod fiskeri med bundslæbende redskaber inden for en afstand af 200 meter fra kablet. Kablet vil komme til at krydse vigtige trawlruter i farvandet mellem havmølleparken og land, og forbud for krydsning heraf med bundtrawl vil derfor kunne have en betydelig negativ effekt på fiskeriet.

Nedlæggelsesfasen af havmølleparken vil omfatte fjernelse af turbiner og muligvis alle kablerne mellem møllerne og til og fra transformerstationen ind til land. Det forventes, at aktiviteterne i nedlæggelsesfasen vil omfatte lignende påvirkninger på fiskeriet som dem oplevet under opførelsen af vindmølleparken, såsom kortsigtet lukning af alle fiskeriaktiviteter (herunder garnfiskeriet) i mølleområdet og kortfristede lokale restriktioner, der forbyder fiskeri langs kabelføringen ind til land, mens den bliver fjernet. På grund af det korte rumlige og tidslige omfang af påvirkninger under nedlæggelsesfasen er det vurderet, at påvirkning på alle fiskerier betragtes som lav. Men hvis kablerne bliver efterladt begravet i bunden sammen med dumpning af sten til at beskytte dem, samt hvis erosionsbeskyttelse omkring møllefundamenter også efterlades på stedet, vil disse løsninger hindre muligheden for fri fiskeri langs bunden med trawl på disse områder. Ligeledes, hvis kablerne fra transformerplatform til land forbliver på bunden og efterfølgende beskyttes med sten langs transektet, vil alle former for trawlfiskeri blive forstyrret, når de skal passere over kabeltransekten.

En potentielt positiv effekt på fiskeriet kunne opstå lokalt som følge af etableringen af nye levesteder (kunstige rev) for kommercielle fiskearter, såsom torskearter, som følge af nye hårdsubstrater fra turbiner og udlagte sten til beskyttelse af møllefundamenter.

Fiskeriøkonomiske konsekvenser

Et skøn over de potentielle økonomiske tab for det kommercielle fiskeri i forhold til redskaber og de vigtigste kommercielle arter (tobis, hesterejer, brisling og rødspætte) blev foretaget ved hjælp af VMS datapunkter, brugt som et skøn over mængden af fiskeriet, der finder sted indenfor Horns Rev 3 forundersøgelsesområdet i forhold til ICES rektangel 40F7.

Et skøn over den samlede værdi af landingerne indenfor Horns Rev 3 Wind Farm forundersøgelsesområde er ca. 1,09 millioner kroner årligt. Fiskeriet med bundtrawl (ca. 614.000 DKK årligt) og fiskeriet med bomtrawl (390.000 årligt) blev anslået til at være de mest økonomisk vigtige fiskerier, hvor ca. 5,5% (bundtrawl) og 4,9% (bomtrawl) af deres fiskeri i ICES 40F7 rektangel skønnes at ske i forundersøgelsesområdet.

Ca. 6,4% (82.000 kr. årligt) af det pelagiske trawlfiskeri i ICES 40F7 rektangel bliver gennemført indenfor Horns Rev 3 forundersøgelsesområdet.

Kun 0,11% af garnfiskeriet (5.400 kr. i værdi) skønnes at ske i Horns Rev 3 forundersøgelsesområdet. Der har ikke været noget VMS registreret vodfiskeri eller fiskeri med andre redskaber i Horns Rev 3 forundersøgelsesområdet.

Det anslås, at fangsterne af tobis i Horns Rev 3 forundersøgelsesområdet udgør cirka 8% (696.000 kr. af den årlige værdi) af den samlede tobisfangst inden for ICES 40F7. Tilsvarende fangster af hesterejer i Horns Rev forundersøgelsesområdet udgør ca. 4,9% eller 380.000 kroner af de årlige landinger fra ICES 40F7.

For brisling og rødspætte udgør fangster inden for Horns Rev 3 forundersøgelsesområdet ca. 4,7% (41.000 DKK) og 0,3% (12.000 DKK) af de årlige fangster (og værdi) indenfor ICES 40F7.

Det er vigtigt at bemærke, at disse estimater potentielt er fyldt med usikkerheder, som nævnt i afsnit 10.1.1, og kun bør bruges som et skøn.

Afværgeforanstaltninger

Som en følge af at fiskeriet efter de to væsentlige målarter henholdsvis tobis og hesterejer udøves i næsten 2 forskellige områder af projektområdet vil opstillingslokaliteten af møllerne virke forskelligt på de to hovedtyper af fiskeriet.

For eksempel, et opstillingsscenarie hvor et park layout er i den vestlige del af projektområdet vil have den største negativ påvirkning på tobisfiskeriet, mens et parklayout i den østlige del af projektområdet vil være den værste tænkelig for hesterejefiskeriet. Da tobisfiskeriet må anses for det mest følsomme af hensyn til tobisens specifikke udbredelse og

habitatvalg vurderes et layout i den vestlige del af projektområdet som det værste tænkelig.

Korridor for trawlfiskeri

Med fokus på Tobis, som er den vigtigste og mest følsomme kommercielle fiskeart ved Horns Rev 3 havmøllepark, har fiskere samt deres interesseorganisation "Danmarks Fiskeriforening" udarbejdet et forslag til placering af turbiner, så der tages hensyn til at holde de vigtigste tobisfiskepladser i den vestlige del af undersøgelsesområdet åben og tilgængelig for trawlfiskeriet. I tilfælde af, at Horns Rev 3 havvindmøllepark bliver placeret i den vestlige del af projektområdet, vil det være gavnligt for fiskeriet, hvis vindmølleparken blev oprettet i en nord-syd gående retning, således at der dannes en bred korridor langs tobisfiskepladserne. Dette vil gøre det muligt for trawlfiskeriet af tobis, at fortsætte under driftsfasen af vindmølleparken.

Fishery vessel

1. INTRODUCTION

In 1996 the Danish Government passed a new energy plan, ”Energy 21”, that stipulates the need to reduce the emission of the greenhouse gas CO2 by 20% in 2005 compared to 1988. Energy 21 also sets the scene for further reductions after the year 2005 (Miljø- og Energiministeriet, 1996).

The number of offshore wind farms is steadily increasing in Denmark and the rest of Europe due to the high demand both economically and politically, for renewable energy. Denmark plans to establish offshore wind farms with a total capacity of 4,400 MW (Energistyrelsen, 2011). The overall aim is that offshore wind will contribute as much as 50 % of the total national consumption of electricity in 2025. The energy generated from offshore wind farms in 2012 was approximately 665 MW (www.offshorecenter.dk).

On the 22th of March 2011 a broad political majority agreed on the construction of two new offshore wind farms including Horns Reef 3 OWF (400 MW).

With orders from the Danish Energy Agency (ESA), Energinet.dk is to perform and contract the preparation of background reports, impact assessment and environmental impact statements for this wind farm.

The present EIS report comprises an assessment of the possible impacts from the construction, operation and decommissioning of Horns Reef 3 OWF on the Danish commercial fisheries within the planned project area. Baseline commercial fishery data includes official data from the ICES rectangles (40F7 and 40F8) as this offered the best resolution of the distribution and extent of the fisheries in and near the Horns Rev 3 OWF project area. Furthermore, an assessment of the possible impacts on the fish fauna and the fish communities which are the resource to the fisheries within the Horns Rev 3 OWF project area will also be used to assess indirect impacts to the commercial fisheries.

The assessment of the impact to the commercial fisheries is based on available information and data from fishery authorities (primarily the Danish AgriFish Agency), fisherman associations and from the fishermen themselves (interviews).

Interviews with representatives from the Southwest Jutland Fishermen Association and with fishermen in the harbours of Esbjerg and Hvide Sande have provided supplemental information about the distribution and characteristics of the different fisheries in the Horns Rev 3 OWF project area and its region.

Assessment of the effects during construction, the operational phase and during decommissioning of the turbines is included in this report along with an assessment of the cumulative effects of the establishment of a new wind farm.

2. HORNS REEF

Horns Rev is an extension of Blåvands Huk extending more than 40 km to the west into the North Sea. Horns Rev is considered to be a stable landform that has not changed

position since it was formed (DHI, 1999). The width of the reef varies between 1 km and 5 km.

Blåvands Huk is the western most point of Denmark and it forms the northern extremity of the European Wadden Sea, which covers the area within the Wadden Sea islands from Den Helder in Holland to Blåvands Huk. The selected site for the Horns Rev 3 OWF is located just north of Blåvands Huk (Figure 2.1).

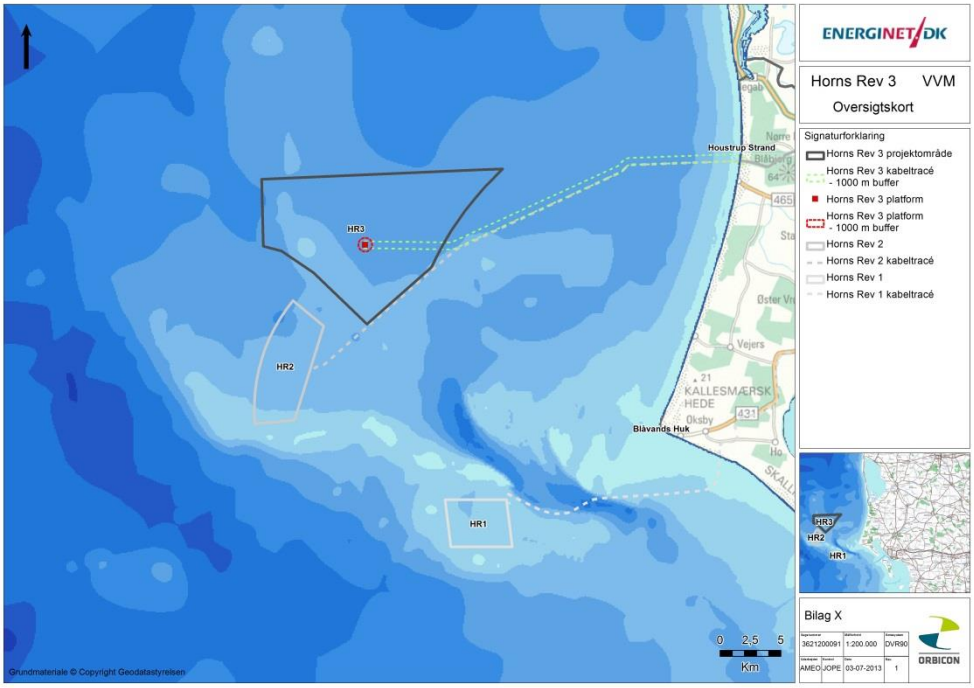


Figure 1. Map of the area around Blåvands Huk with Horns Rev 1 and 2 OWFs and the project area of Horns Rev 3 OWF including the cable transect.

2.1. Topography and sediment

Based on preliminary results from the geophysical survey carried out in 2012, and based on previous geophysical, geological and geotechnical investigations in the region, it can in short be concluded that the seabed in the Horns Rev 3 OWF area exhibits marine sediments deposited during the Holocene with a thickness up to app. 40 m. These generally sandy sediments vary at the seabed surface from gravel to gravelly sand and sand in the southern and western parts of the area, but become finer in grain size towards the coast where the sand becomes silty and clay (Figure 2.2). In the most western area the Seabed Surface Map indicates possible occurrence of stones and boulders on the seabed. Just below the Holocene deposits, Late Glacial (Weichselian), interglacial (Eemian) and Saalian meltwater deposits overlay the glacial Saale landscape, typically clay till that forms a wide depression – a basin - in the area. The Saale glacial surface may come relatively close to the seafloor to the west, which could explain the abundance of boulders in this area.

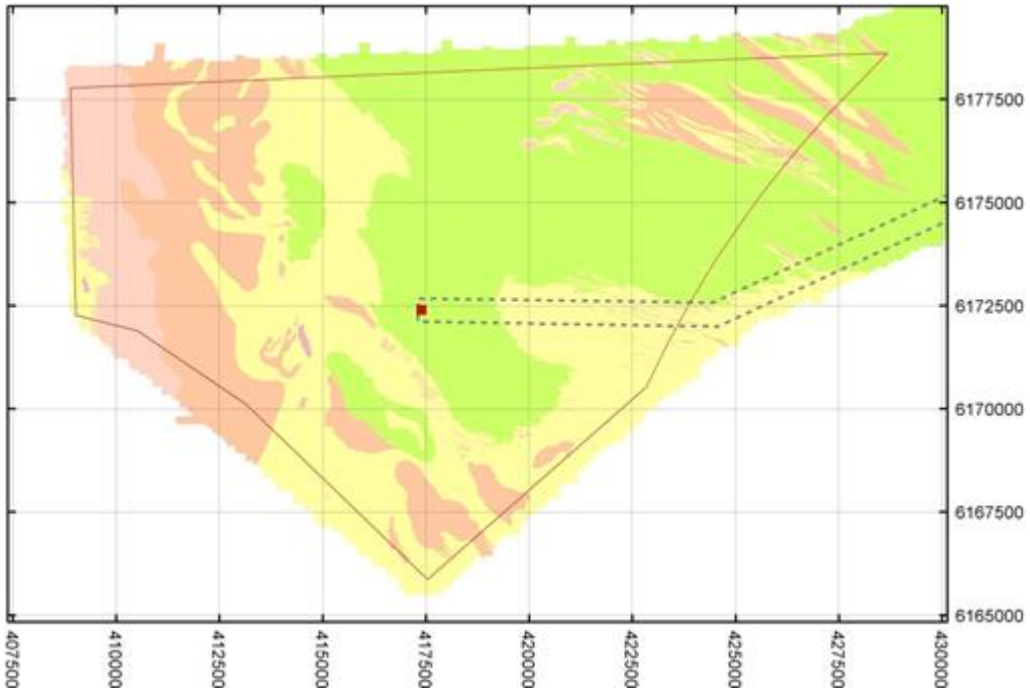


Figure 2.2. Seabed Surface and Feature Map. Only the legend regarding seabed sediments is shown. The map is based upon the Geophysical survey in 2012.

2.2. Hydrography

A comprehensive site specific metocean analysis is currently being conducted (Orbicon, 2014a), but preliminary data is available. Hence, the description below is based on the preliminary data and existing information about site specific metocean characteristics.

In general, the salinity in this part of the North Sea is app. 32-35 PSU (3.2-3.5 %) with only minor spatial and temporal variations.

The area is subject to tide-induced, wind-induced and wave-induced currents, which vary in direction and magnitude according to time of the day and seasonal variations. During meteorologically calm periods, the tide-induced currents dominate with a magnitude of up to 0.5 m/s. The strongest currents occur during storms causing currents considerably larger than the tide-induced.

Directions of the currents vary significantly in the area, but the net directions are north-south or vice versa.

Due to tidal currents, rough waves and mixing water, stratification does not develop in the Horns Rev area and thus oxygen deficiency is not likely to occur (DHI, 1999).

There is a net sedimentation accumulation in the Blåvands Huk - Horns Rev area.

Low transparency due to the high amounts of re-suspended material in the water column is characteristic for the Horns Rev area. High temporal variability is found in the water transparency due to the influence of tidal current, wind induced current, current speed and seasonal plankton dynamics. In general the transparency is low during Spring and higher during Autumn. Pronounced diel variability in transparency is found within a few hours and can be associated with changes in the prevailing current directions (Leonhard and Pedersen, 2006).

The wave sizes in the area are in general significantly influenced by the shallow water at Horns Rev, the waves break on the reef and no waves higher than about Hs = 0.6 m times the local water depth can pass over the reef. This means that Horns Rev significantly limits the near shore wave condition in the leeward area of the reef, especially with waves coming in from south and south-westerly directions.

However, in the Horns Rev 3 area, the reef is expected to have little to no influence when the wind direction is from the north, north-west and directly from west.

The tidal amphidromy along the Danish West Coast is anti-clockwise. The hydrographical effect of Horns Rev is a dampening of the northward travelling tidal wave, which has a drastic effect on the tidal ranges in the region where e.g. Spring Tidal Ranges vary between 0.8 m in Hvide Sande north of Horns Rev, to 1.8 m around Blåvands Huk, and 1.5-1.8 m in Esbjerg south of the Horns Rev area.

The winds at Horns Rev are predominantly westerly throughout the year. Rough wind and wave climates can occur year round, but occur most frequently during the autumn and winter.

3. THE WIND FARM AREA

3.1. Description of the wind farm area

The planned Horns Rev 3 OWF (400 MW) is located north of Horns Reef in a shallow area in the eastern North Sea, about 20-30 km northwest of the westernmost point of Denmark, Blåvands Huk. The pre-investigation area is approximately 160 km^2. To the west it is delineated by gradually deeper waters, to the south/southwest by the existing OWF named Horns Rev 2, to the southeast by the export cable from Horns Rev 2 OWF, and to the north by oil/gas pipelines (Figure 3.1).

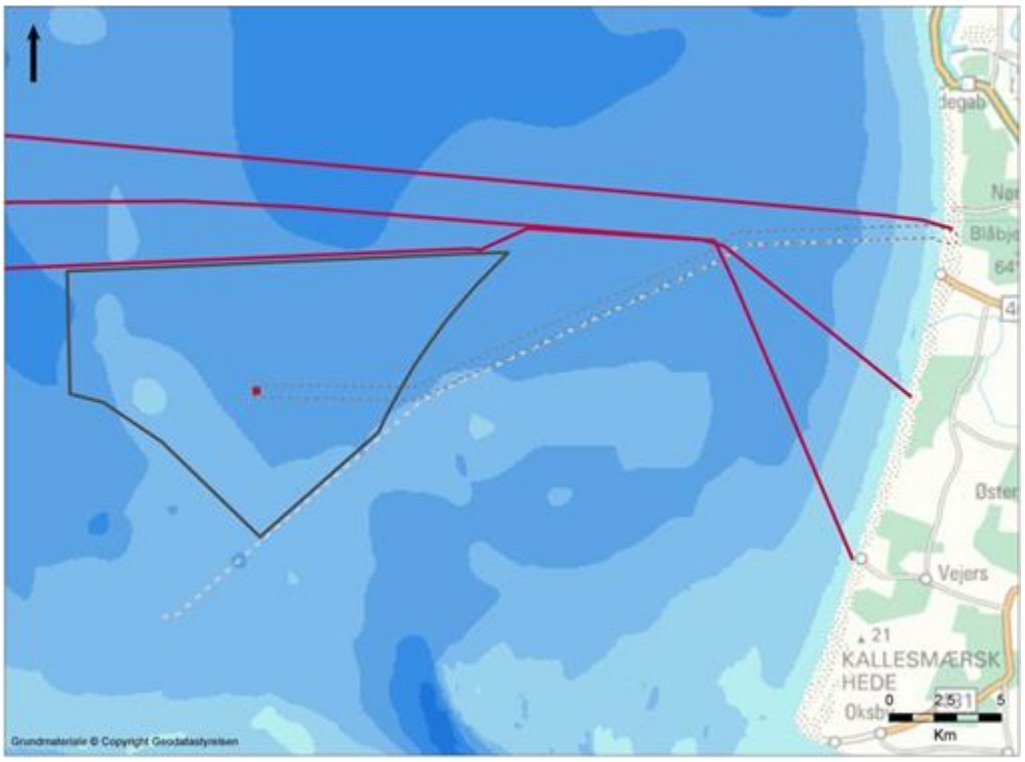


Figure 3.1. Location of the Horns Rev 3 OWF (400 MW) and the projected corridor for export cables towards shore. The area enclosed by the Horns Rev 3 polygon is app. 160 km2. The marked area includes the entire pre-investigation area of approximately 160 km^2.

In the middle of the Horns Rev 3 pre-investigation area there is a zone occupying 30–35 % of the area which is classified as a former WWII minefield and oriented 'no fishing, no anchoring zone'. Also, just south/southeast of the Horns Rev 2 export cable an existing military training field is delineated.

The water depths in the Horns Rev 3 OWF pre-investigation area vary between app. 10-21 m (Figure 3.2). The Bathymetric map of the Horns Rev 3 pre-investigation area showing depths below DVR90 as graded colour. The map is based upon the Geophysical survey in 2012.

The minimum water depth is located on a ridge in the southwest of the site and the maximum water depth lies in the north of the area. Sand waves and mega-ripples are observed across the site.

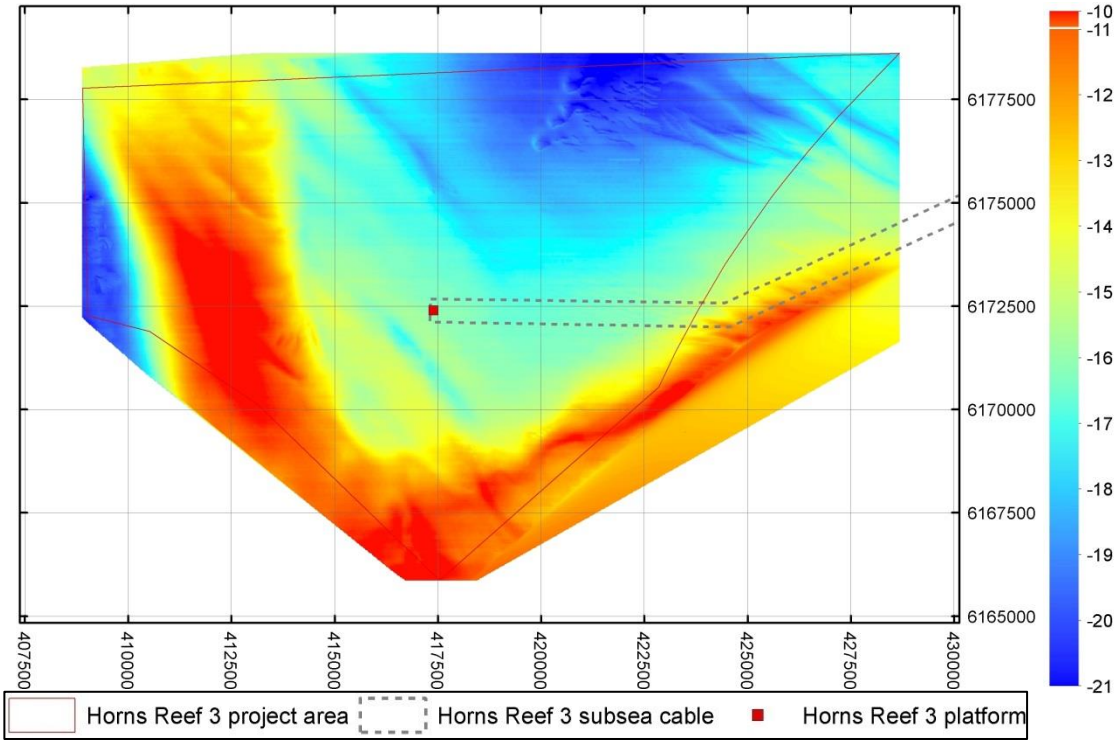


Figure 3.2. Bathymetric map of the Horns Rev 3 pre-investigation area showing depths below DVR90 as graded colour. The map is based upon the Geophysical survey in 2012.

3.2. The turbines

The maximum rated capacity of the wind farm will be limited to 400 MW. The type of turbine and foundation has not yet been decided, however, the farm will feature from 40 to 136 turbines depending on the rated energy of the selected turbines corresponding to the range of 3.0 to 10.0 MW.

The 3 MW turbine was launched in 2009 and is planned to be installed at the Belgium Northwind project. The 3.6 MW turbine was released in 2009 and has since been installed at various wind farms, e.g. Anholt OWF. The 4 MW turbines are gradually taking over from the 3.6 MW on coming offshore wind farm installations. The 6 MW was launched in 2011 and the 8 MW was launched in late 2012, both turbines are being tested and may be relevant for Horns Rev 3 OWF. A 10 MW turbine is under development which may also be relevant for Horns Rev 3 OWF. There is a possibility that more than one turbine model will be installed due to the rapid development of the wind turbine industry and a construction program that might be spread over more than one year.

Suggested layouts for different scenarios are presented in the figures 3.3-3.11 below. The layouts are made for 3 MW, 8 MW and 10 MW, respectively – and for three different locations of the turbines; closest to the shore (easterly in pre-investigation area), in the centre of the pre-investigation area, and in the western part of the pre-investigation area.

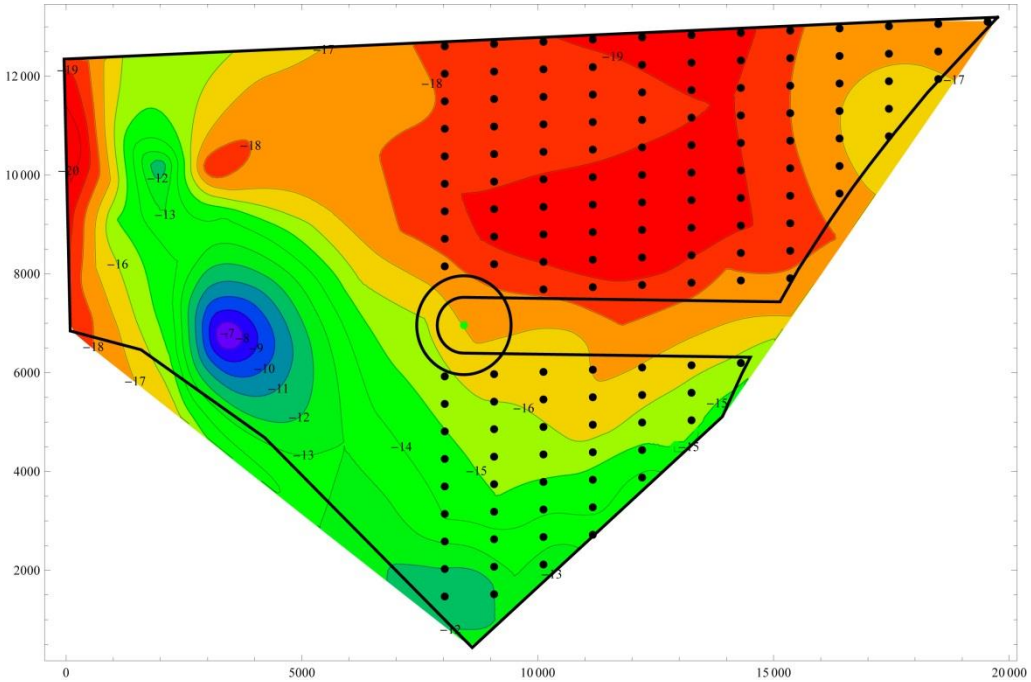


Figure 3.3. Suggested layout for the 3.0 MW wind turbine in Horns Rev 3 pre-investigation area, The scenario in the eastern part closest to shore.

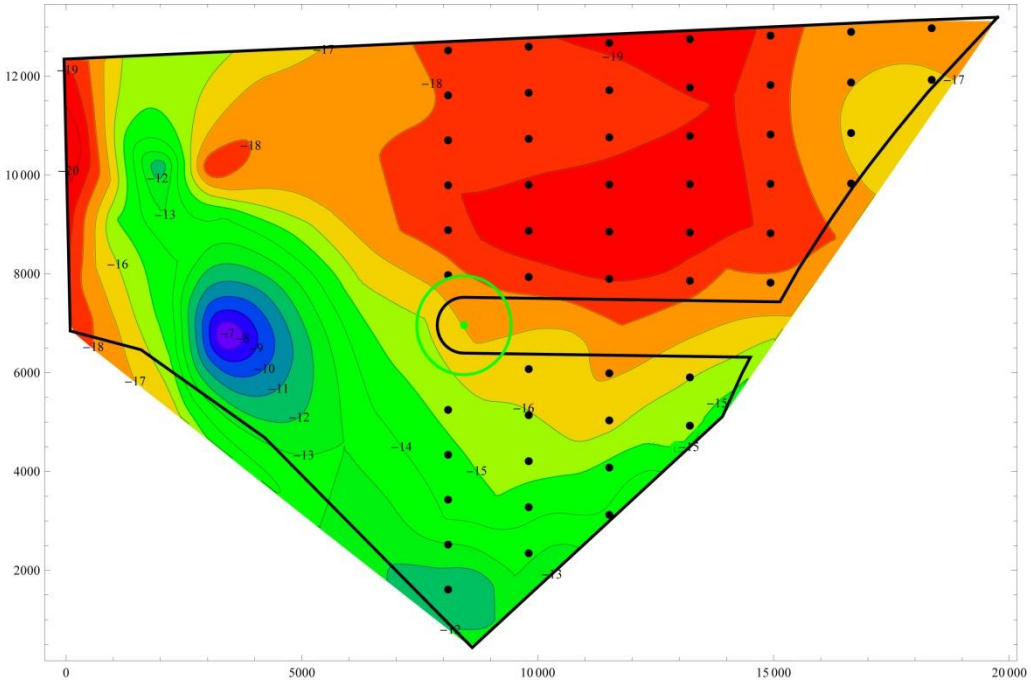


Figure 3.4. Suggested layout for the 8.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the eastern part closest to shore.

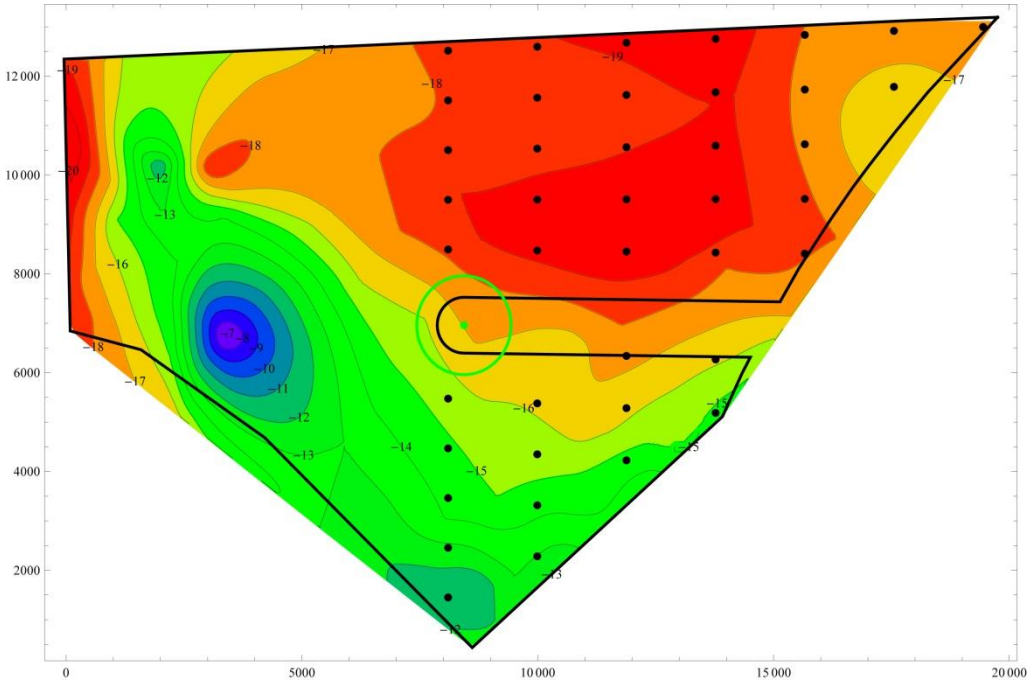


Figure 3.5. Suggested layout for the 10.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenarin the eastern part closest to shore.

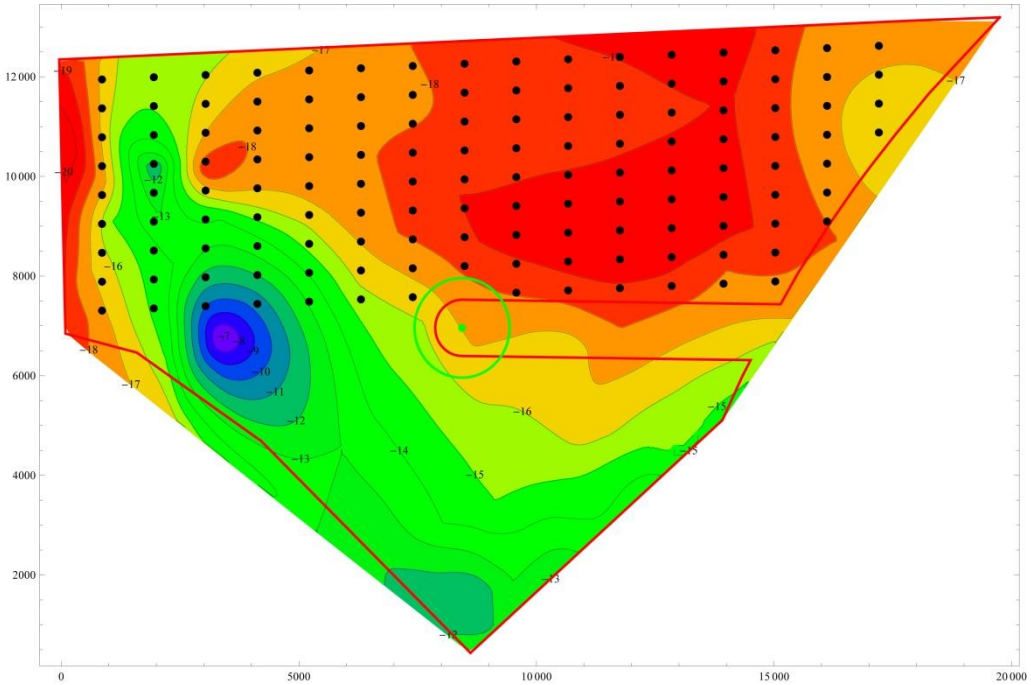


Figure 3.6. Suggested layout for the 3.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the northern part of the area.

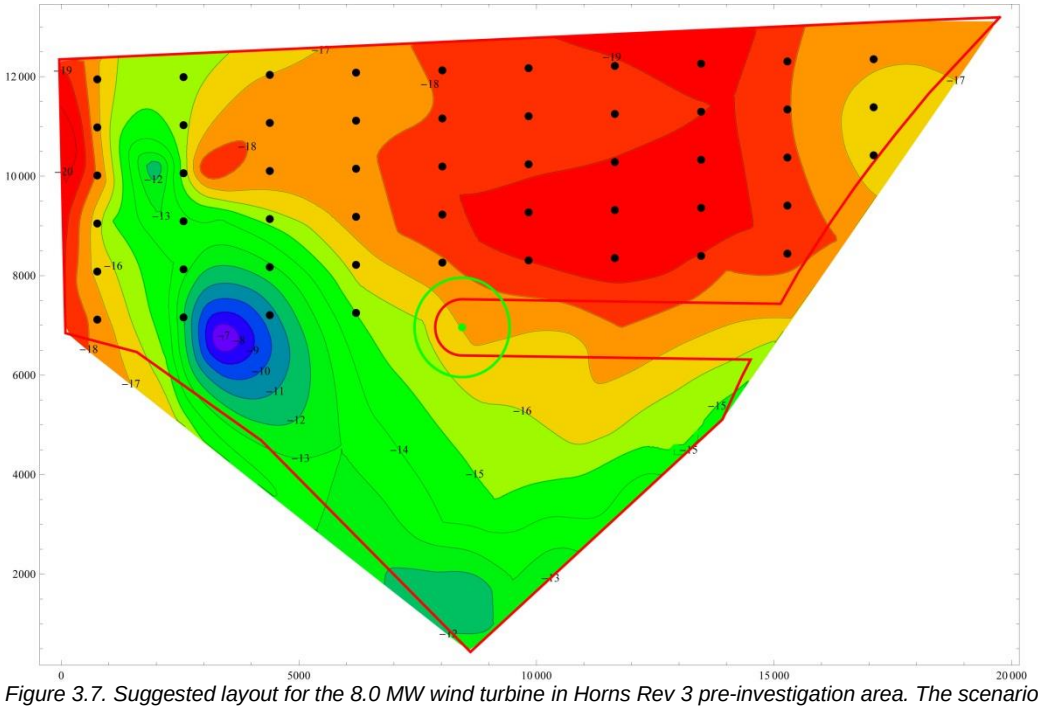


Figure 3.7. Suggested layout for the 8.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the northern part of the area.

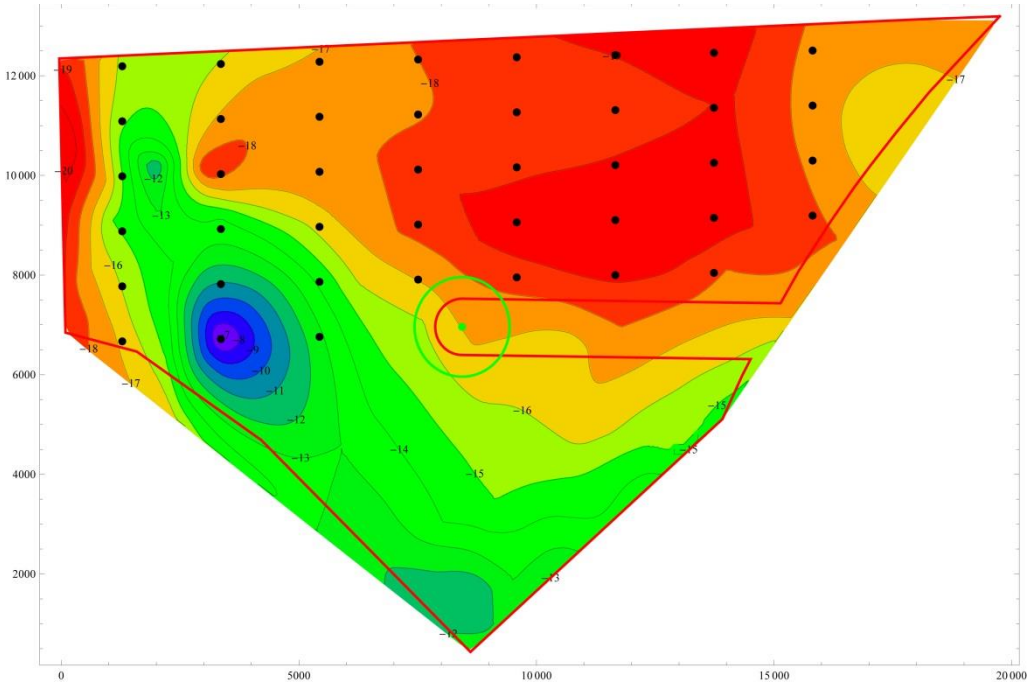


Figure 3.8. Suggested layout for the 10.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the northern part of the area.

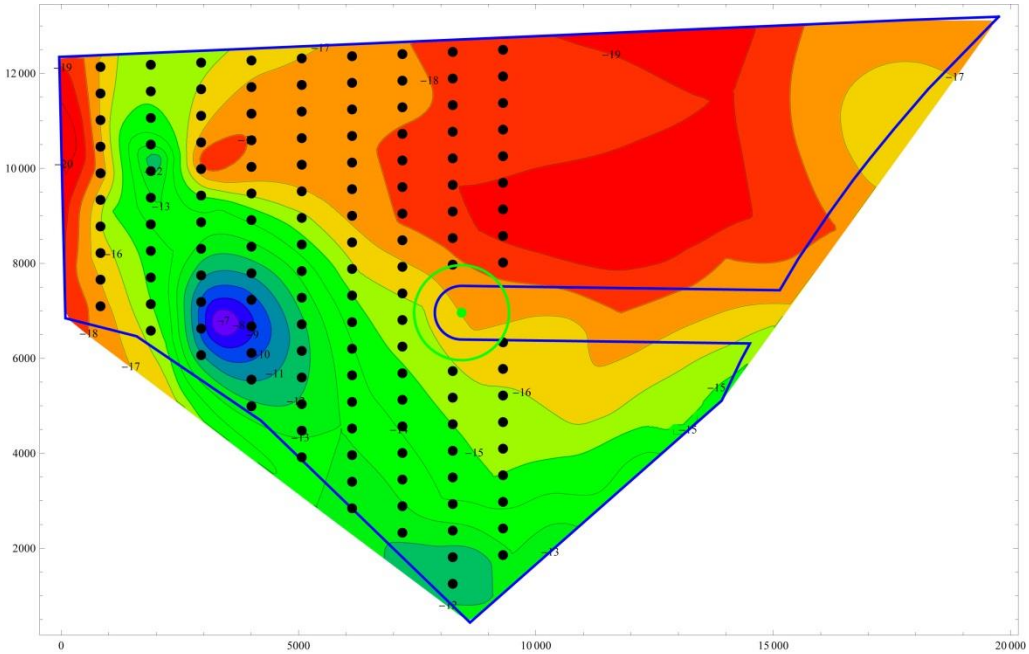


Figure 3.9. Suggested layout for the 3.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the middle and western partof the area.

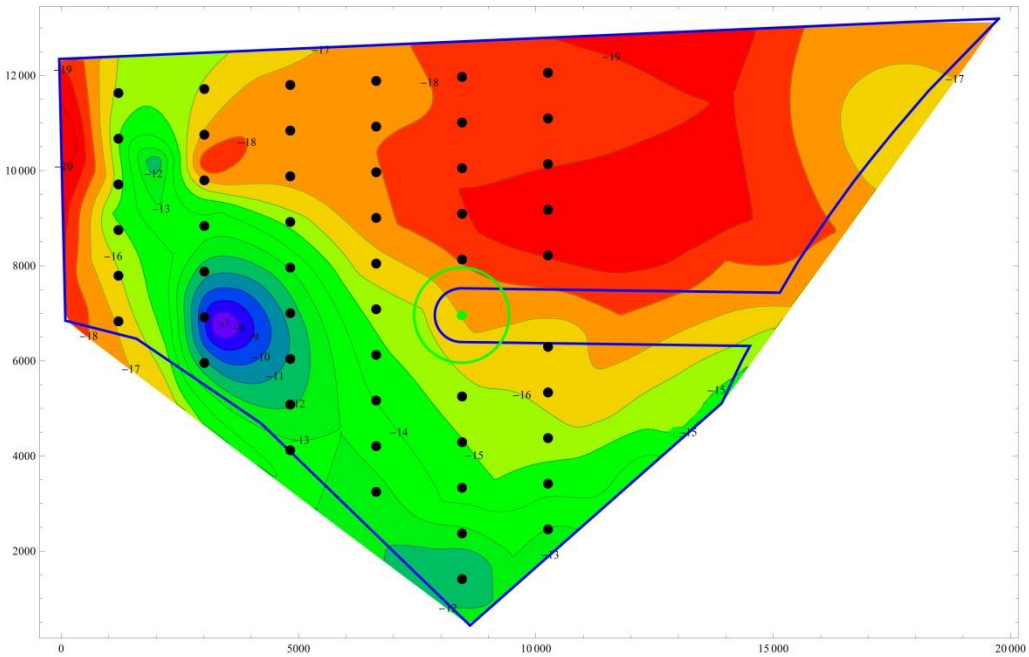


Figure 3.10. Suggested layout for the 8.0 MW wind turbine in Horns Rev 3 pre-investigation area. The scenario in the middle and western part of the area.

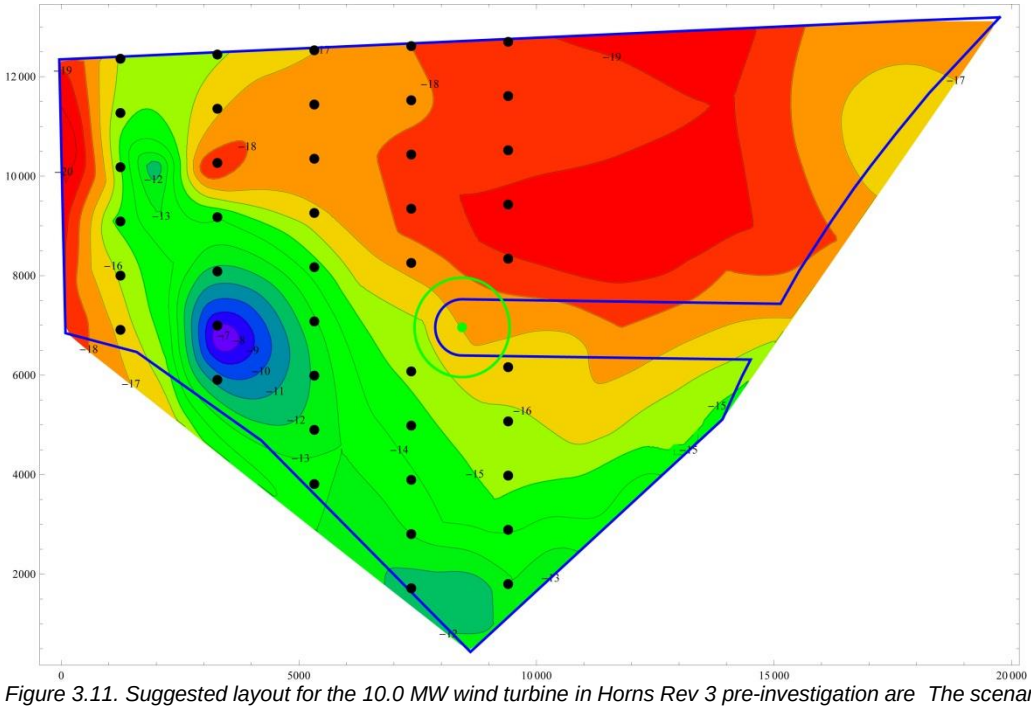


Figure 3.11. Suggested layout for the 10.0 MW wind turbine in Horns Rev 3 pre-investigation are The scenario in the mddle and western partof the area.

It is expected that turbines will be installed at a rate of one every one to two days. The works would be planned for 24 hours per day, with lighting of barges at night, and accommodation for crew on board. The installation is weather dependent so installation time may be prolonged in unstable weather conditions.

3.2.1 Foundations

The wind turbines will be supported by foundations fixed to the seabed. It is expected that the foundations will comprise one of the following options:

- Driven steel monopile
- Concrete gravity base
- Jacket foundations
- Suction buckets

3.2.1.1. Driven steel monopole

Monopiles have been installed at a large number of wind farms in the UK and in Denmark e.g. Horns Rev 1, Horns Rev 2 and Anholt OWF. The solution comprises driving a hollow steel pile into the seabed. The monopile, for the relevant sizes of turbines (3-8 MW), is driven 25 – 35 m into the seabed and has a diameter of 4.5 – 8 m. The pile diameter and the depth of the penetration are determined by the size of the turbine and the sediment characteristics.

A scour protection filter layer may be installed prior to pile driving and after installation of the pile, a second layer of scour protection may be installed. Scour protection of nearby

cables may also be necessary. Scour protection is especially important when the turbine is situated in turbulent areas with high flow velocities.

The underwater noise generated by pile driving during installation has been measured and assessed during construction of wind farms in Denmark, Sweden and England. The noise level and emission will depend among other things on the pile diameter and seabed conditions. An indicative source level of the pile driving operation would be in the range of 220 to 260 dB re 1 µPa at 1 meter.

3.2.1.2. Concrete gravity base

These structures rely on their mass including ballast to withstand the loads generated by the offshore environment and the wind turbine.

The gravity base concept has been used successfully at operating wind farms such as Middelgrund, Nysted, Rødsand II and Sprogø in Denmark, Lillgrund in Sweden and Thornton Bank in Belgium.

Normally, seabed preparation is needed prior to installation, i.e. the top layer of material upon the seafloor is removed and replaced by a stone bed. When the foundation is placed on the seabed, the foundation base is filled with a suitable ballast material, and a steel “skirt” may be installed around the base to penetrate into the seabed and to constrain the seabed underneath the base.

The ballast material is typically sand, which is likely to be obtained from an offshore source. An alternative to sand can be heavy ballast material, which has a higher density than natural sand. For a given ballsat weight, using heavy ballast material will result in a reduction of foundation size, which may be an advantage for the project.

Noise emissions during construction are considered to be small.

3.2.1.3. Jacket foundations

Jacket foundation structures are three or four-legged steel lattice constructions in the shape of a square tower. The jacket structure is supported by piles in each corner of the foundation construction.

The jacket foundation has been used successfully at operating wind farms such as in the East Irish Sea, the North Sea and the Baltic Sea.

The construction is built of steel tubes with varying diameters depending of their location in the lattice structure. The three or four legs of the jacket are interconnected by cross bonds, which provide the construction with sufficient rigidity.

Fastening the jacket with piles in the seabed can be done in several ways:

- Pilling inside the legs

- Pilling through pile sleeves attached to the legs at the bottom of the foundation structure
- Pre-pilling by use of a pile template

Scour protection of the foundation piles and cables may be applied depending on the seabed conditions. In sandy sediments, scour protection is normally considered necessary in order to protect the construction from bearing failure. Scour protection consists of natural well graded stones

3.2.2 Suction Bucket

The suction bucket foundation is a relatively new concept and is a quality proven hybrid design which combines aspects of a gravity base foundation and a monopile in the form of a suction caisson.

The bucket foundation is said to be “universal”, in that it can be applied to and designed for various site conditions. Homogeneous deposits of sand and silts, as well as clays, are ideal for the suction bucket concept.

Layered soils are likewise suitable strata for the bucket foundation. However, installation in hard clays and tills may prove to be challenging and will rely on a meticulous penetration analysis, while rocks are not ideal soil conditions for installing the bucket foundation.

The concept has been used offshore for supporting met masts at Horns Rev 2 OWF and Dogger Bank. Bucket foundations are targeted for 2015/2016 in relation to wind turbines.

As a proven suction bucket design concept for the turbines involved in Horns Rev 3 OWF does not yet exist, suction buckets are here assumed to have same plate diameter as gravity foundations for the respective turbines. However, it is expected that the maximum height of the installed bucket foundation will not rise more than 1m above the surrounding seabed.

3.2.3 Scour protection

Monopile solution

Depending on the hydrodynamic environment, the horizontal extent of the armour layer can be seen according to experiences from former projects in ranges between 10 and 15 meter having thicknesses between 1 and 1.5m. Filter layers are usually of 0.8m thickness and reach up to 2.5m further out than the armour layer. Expected stone sizes range between d_{50} = 0.30m to d_{50} = 0.5m. The total diameter of the scour protection is assumed to be 5 times the pile diameter.

Gravity base solution

Scour protection may be necessary, depending on the sediment properties at the installation location. The envisaged design for scour protection may include a ring of rocks around the structure.

Jacket solution
Scour protection may be installed as appropriate by a Dynamically Positioned Fall Pipe Vessel and/or a Side Dumping vessel. The scour protection may consist of a two layer system comprising filter stones and armour stones. Nearby cables may also be protected with filter and armour stones. The effect of scour may be incorporated into the foundation design, in which case scour protection can be neglected.

Suction bucket solution
Scour protection of the bucket foundations and cables may be necessary, depending on the seabed conditions at the installation locations. Scour protection may consist of natural well graded stones around the structure, but during detailed foundation design, it might be determined that scour protection is unnecessary.

Alternative scour protection solutions
Alternative scour protection systems such as the use of frond mats may be introduced by the contractor. Frond mats contain continuous rows of polypropylene fronds which project up from the mats and reduce scour.

Another alternative scour protection system is the use of sand filled geotextile bags around the foundations. This system is planned to be installed at the Amrumbank West OWF during 2013, where some 50,000t of sand filled bags will be used around the 80 foundations. Each bag will contain around 1.25t of sand. If this scour protection system is to be used at Horns Rev 3 OWF, it will employ around 31,000 to 84,000t of sand for the 50-133 turbine foundations.

3.2.4 Subsea cables

A medium voltage inter-array cable will be connected to each of the wind turbines and for each row of 80-10 wind turbines a medium voltage cable is connected to the transformer platform. The medium voltage is expected to be 33 kV (max. voltage 36 kV), but 66 kV (max. voltage 72 kV) is also possible.

After pulling the cable into the J-tubes on the foundation structure of the wind turbine the cables are fixed to a hang-off flange. At the transformer platform the cables are fixed to a cable deck or similar.

The inter-array cables may be protected with bending restrictors at each J-tube. Scour protection shall also be considered for protecting the cables if exposed.

A 220 kV transmission cable will be installed from the offshore transformer platform and to the connection point on land – landfall – at Blåbjerg Substation. The length of the transmission cable can be up to 34 km depending on the final position of the transformer platform.

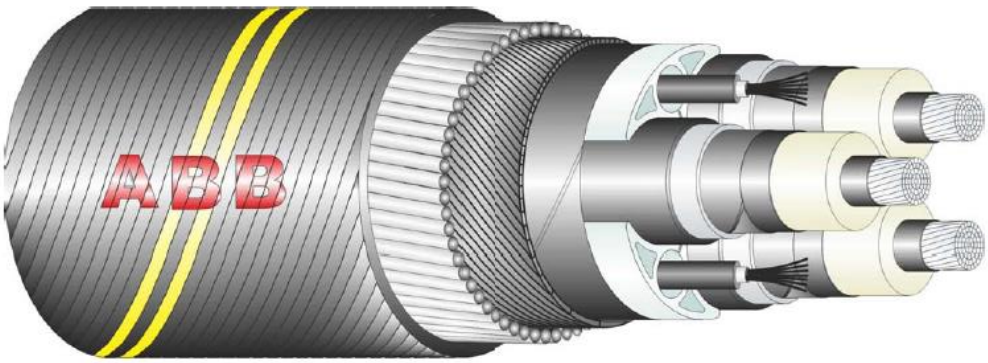
Depending on the final position is it most likely that the transmission cable will follow either the northern border of the park or aligned in parallel with the existing transmis-sion cable from Horns Rev 2.

3.2.4.1. Electromagnetic fields

Transportation of the electric power from the wind farm through cables is associated with formation of electromagnetic fields (EMF) around the cables.

Electromagnetic fields emitted from the cables consist of two constituent fields: an electric field retained within the cables and a magnetic field detectable outside the cables. A second electrical field is induced by the magnetic field. This electrical field is detectable outside the cables (Gill et al., 2005).

The strength of the magnetic field is proportional to the amount of current running in the cable. The windpower production from Horns Rev 3 OWF will display annual and diurnal variations in the current strength. The magnetic field will vary accordingly.



Power cable

4. DATA SOURCES

This chapter gives an overview of the data and information applied to assess the impacts to the Fisheries in the present EIS report.

The characteristics of the fisheries are described by using official fishery statistics obtained from The Danish AgriFish Agency and from interviews with representatives of the Southwest Jutland department of the Danish Fisherman´s Association and a number of fishermen that undertake their fisheries in and near the project area of the Horns Rev 3 OWF.

The fisheries in the North Sea, including the western part of Jutland, are divided by international fishery zones where national and international fishery regulations, requirements and quotas apply and catch data is separated. These zones (ICES rectangles - 30 x 30 nautical miles) are used to set boundaries on the regional fishing area of the Horns Rev 3 OWF project area and form the baseline data of the fisheries to assess the impacts within the Horns Rev 3 OWF area.

More specific baseline data and fisheries information not restricted by the artificial boundaries of the ICES rectangles were obtained from interviews with fishermen and their representatives. This data was differentiated and combined with data within the ICES boundaries as best as possible, according to its resolution.

VMS (Vessel Monitoring System), is a satellite-based global positioning system (GPS) used in commercial fishing to monitor the location of fishing vessels at sea. Since 2005, the use of VMS has applied to all vessels ≥15 m within European waters. Since 2012, VMS monitoring has been applied to vessels ≥12 m. By estimating the period of fishery activity according to vessel speed this data can be used as a proxy to indicate specific distributions of the fisheries according to gear. This offers the potential to increase the spatial resolution of the distribution of the fisheries where fishing vessels with the electronic registration system (VMS) are undertaking their fisheries. Because this data only includes vessels ≥15 m (≥12 m as of 2012) it is not possible to fully determine the distribution of smaller vessels and how often these may be fishing in the Horns Rev 3 OWF pre-investigation area. However, because the OWF site is a considerable distance offshore and the predominant fisheries are by trawlers, which are generally large, the VMS data were considered to represent the fisheries in the area of the wind farm. This information was also presented at meetings and to the fishermen´s association where this assumption was to confirm to be valid (Energinet.dk 2013). Furthermore, the landings by vessels < 10 m are considerably less than from larger vessels and considered of less relevance than those obtained from logbooks (all vessels ≥10 m).

4.1. Official fisheries statistics

The commercial fisheries, fleet statistics and VMS data for the ICES rectangles 40F7 and 40F8 and the harbours in the regional area of Horns Rev 3 OWF project area were obtained from The Danish AgriFish Agency

Only catches from larger vessels (≥10 m) are registered at the ICES rectangle level (30x30 nautical miles or 3450 km^2). Vessels <10 m are only required to fill in so-called "local water declarations" where catches are only attributable to the ICES subareas, in this case ICES subarea IV division IVb. Thus, official fisheries statistics can only be used to give an overall insight into the extent and characteristics of the fisheries for an area that is much larger than the wind farm project area. The size of the proposed Horns Rev 3 OWF pre-investigation area is approximately 160 km², of which only approximately 88 km² will be used for wind turbines. The final wind farm area of 88 km² is equivalent to about 2.6 % of an ICES rectangle.

For better resolution of the specific fishing areas, Danish vessel monitoring system (VMS) data linked to logbook data by time, i.e. correlating the time and dates from fishing trips noted in logbook data with corresponding time and dates of VMS plots of the same vessel was obtained from The Danish AgriFish Agency. This made it possible to associate VMS position points with the distribution of fisheries with specific gear and targeting specific species (for example sandeel or brown shrimp).

Under the assumption that smaller fishing vessels operate in a relatively small radius from their home harbour, the landings data of smaller vessels from the local harbours of Hvide Sande and Esbjerg is presented and used to estimate their contribution to the fisheries which could potentially be affected by the establishment of a wind farm. It should be noted that because the vast majority of the overall landings are made by vessels over 10 metres in length, the importance of the fisheries by small vessels is relatively limited. Furthermore, the pre-investigation area of the Horns Rev 3 OWF is more than 20 km offshore and is likely to be used very little by small vessels (< 10 meters). This assumption is confirmed by interviews and meetings with fishermen and their organisations.

All values of landings and economic calculations are based on the average price per kilo for each commercial species over the last 11 years (2002-2012). The data was obtained from the Danish AgriFish Agency.

4.2. Information from fishermen and their organisations

Fishermen unquestionably have considerable experience and knowledge of the fisheries, in particular of the abundance and distribution of commercial species in specific areas. Usually, this knowledge is not written down and can only be obtained through interviews.

To obtain and confirm baseline data for the fisheries in the present project, a group interview with the local department of the Danish Fishermens Association in Esbjerg, including some local fishermen, and a group interview with local fishermen from Hvide Sande were undertaken. Furthermore, a public meeting was held with fishermen and relevant representatives from the Danish Fishermen´s Association where fishery data was presented and discussed to both correct and confirm assumptions and results. Information from interviews were noted and used as a source of confirmation while information from the public meeting was presented in a document (the minutes) to ENDK.

Map plotter data

Almost all commercial fishing vessels are equipped with electronic map plotters based on GPS systems, thus, most if not all their fishing activities are registered. Map plotter data often includes the location of wrecks, large rocks, stones, etc. on the seabed, which is important information both to determine if fish are present, and whether or not an area can be fished. Fishermen with similar fisheries (gear use) to a large extent, share their electronic map data amongst themselves and thus this information often contains data from the distribution of the fisheries over a long time period. Map plotter data, however, must also be scrutinized as map plotters can potentially record periods when fishing vessels are not actively fishing, such as when they steam from one location to another or to and from harbours. Unlike VMS data, this bias of data cannot be filtered out from map plotter data. Under the right conditions map plotter data can give accurate information on the distribution of the fisheries of smaller vessels not containing VMS equipment, and be used to confirm VMS data and information from interviews with fishermen. In relation to this project, map plotter data was obtained from several fishermen. This information combined with interviews provided detailed insight into the distribution of the fisheries in the regional waters around the Horns Rev 3 project area and was used to help confirm baseline data on the distribution of the fisheries from VMS plots.

4.3. Fisheries control and regulations

4.3.1 The biological advice and fisheries regulations

The fishing effort in a given area is not only dependent on the resources available and the technical ability of the fishermen to undertake fishing, but has increasingly been subject to more comprehensive and detailed regulations, These are predominantly based on the biological advice from the National Institute of Aquatic Resources (DTU Aqua) and International Council for the Exploration of the Sea (ICES), but also takes political and economical factors into consideration. This framework is crucial for the undertaking of the fisheries and composition and amount of the catches, therefore this report also contains a short description of these regulations.

4.3.2 Management

Fisheries management has become increasingly complex since the quota system was introduced in 1983. In general, management is based on various regulations limiting fishing rights: licenses, quotas and days at sea. Overall, this system is too comprehensive to describe in detail in this report, however understanding these regulations, which to a large extent can influence the amount of landings from year to year, is important in understanding the mechanisms that can create fluctuations in the total annual landings and value of the fisheries in the ICES rectangles that contain the Horns Rev 3 OWF and its installations.

Implementation of the so-called "New Regulations" in 2007 has lead to considerable changes in the Danish fisheries (Institute of Food and Resource Economics, 2007). Vessels within the reference period 2003-2005 who have fulfilled the conditions of eligibility to register as commercial, active fishing vessels with catches of demersal species for human consumption, have been allocated fishing rights in the form of vessel quota shares

(FKA). FKA rights can be transferred to other vessels along with the capacity. In addition, groups of vessels can form coalitions and establish a joint quota pool, making it possible for them to fish each other's quota after internal mutual agreements. At the same time the allocation of FKA in the demersal fisheries was implemented, it was decided to continue the system of IOK (individual tradeable quotas) in the herring and mackerel fisheries and to introduce this system to the industrial fisheries. Finally, the so-called coastal vessels, defined as vessels with a length of less than 17 metres, were able to ensure particularly high quotas for cod and sole. These vessels are, however, prohibited from selling their share of quotas to vessels outside the coastal fishing system.

The number of fishing vessels that are covered by the FKA/IOK system represent less than one third of the 2900 vessels registered in Denmark, however, their catches represent approx. 98% of the total catch value (The Danish Agri Agency).

4.4. Impacts to commercial species (the resource of the fisheries)

4.4.1 Existing baseline data and assessment of impacts to commercial fish species

Information about the fish fauna and their communities in and near the Horns Rev area, including commercial fish species of interest, as well as an assessment of the potential impacts to these fish communities due to construction, operation and decommissioning of the Horns Rev 3 OWF is presented in a separate report (Horns Rev 3 OWF - Fish Ecology EIS).

To give a full picture of the potential impacts to the fisheries which include their resources (fish and shellfish) the overall results of the impact to relevant commercial fish species will be summarized in the impact assessment section of this report.

4.5. Assessment methodology

The overall goal of the assessment is to describe the severity of impacts caused by the project. The assessment comprises two steps. The first step is an analysis of the magnitude of the pressure and an analysis of the sensitivity of the environmental factor. Combining the two analyses leads to the degree of impact. In the second step the results from the degree of impact is combined with the importance leading to the severity of impact.

As far as possible the impacts are assessed quantitatively, accompanied by a qualitative argumentation. The assessment steps are shown in Figure 4.1

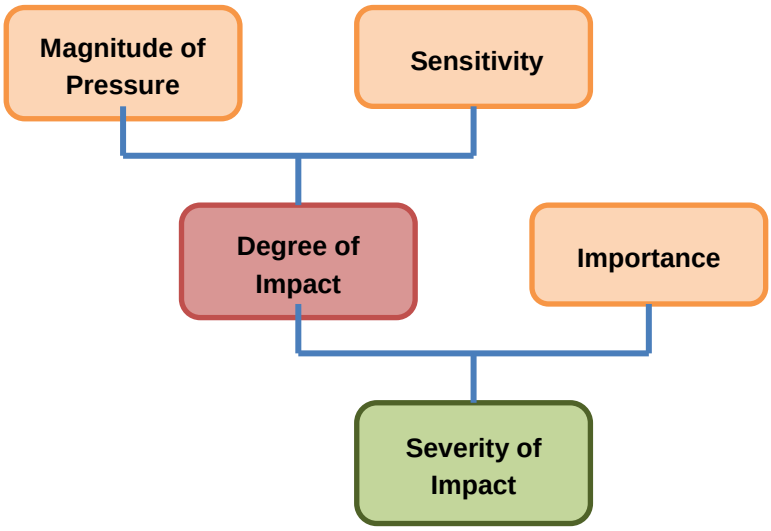


Figure 4.1 Drawing of overall assessment approach

Magnitude of pressure is described by pressure indicators, see Table 4.1. These indicators are based on the modes of action on environmental factors in order to achieve most optimal descriptions of pressure for the individual factors; e.g. mm deposited sediment within a certain period and area.

Table 4.1. Aggregates included in the magnitude of pressure

Magnitude of Pressure		
Intensity	**Duration**	**Range**
Very High	Recovery takes longer than 10 years or is permanent	International
High	Recovered within 10 years after end of construction	National
Medium	Recovered within 5 years after end of construction	Regional
Low	Recovered within 2 year after end of construction	Local

In order to determine the degree of impact; the magnitude of pressure and sensitivity are combined in a matrix (Table 4.2). The degree of impact is the pure description of an impact to a given environmental factor without putting it into a broader perspective (the latter is done by including the importance in the evaluation, see Table 4.3. below).

Table 4.2. The matrix used for the assessment of the degree of impact.

Magnitude of pressure	**Sensitivity**			
	Very high	High	Medium	Low
Very high	Very High	Very High	High	High
High	Very High	High	High	Medium
Medium	High	High	Medium	Low
Low	Medium	Medium	Low	Low

The importance of the environmental factor (fisheries) is assessed for each environmental sub-factor which for the commercial fisheries is their gear use. Some sub-factors are assessed as a whole, but in most cases, the importance assessment is broken down into components (gear types) and/or sub-components in order to conduct a fulfilling environmental impact assessment.

The importance criteria are graded into four tiers, see Table 4.3.

Importance for the commercial fisheries
The components for the fisheries in the Horns Rev area relevant to this report, are represented by the primary gear types utilised within the Horns Rev 3 OWF project area (which includes the pre-investigation area and the area along the electrical cable transect from the transformer platform to land) and its regional area - primarily ICES 40F7 and to some extent ICES 40F8.

The most important components (gear types) represented in the fisheries in the Horns Rev 3 OFW project area and region are Trawls (Bottom, Beam and Pelagic), Gill nets and Danish seine nets.

The importance of these components (gear types) is determined by their importance and value to the fisheries in the local and regional areas of Horns Rev 3 OWF project area as described in Table 4.3..

Table 4.3. The definition of Importance to the fishery components represented by gear.

Importance level	Description
Very high	Horns Rev 3 OWFproject area is specific for the undertaking of the fisheries and is of high importance and value.
High	Horns Rev 3 OWF project area is the primary area for the undertaking of the fisheries and/or this area is of regional importance and value
Medium	Horns Rev 3 OWF project area is an area used for the undertaking of the fisheries and is of some local and regional importance and value
Low	Horns Rev 3 OWF project area is an area only seldom or not used for the undertaking of the fisheries, or is of little local or regional importance and value

Severity of impact is assessed from the grading of degree of impact and importance of the environmental factor using the matrix in Table 4.4. If it is not possible to grade degree of impact and/or importance, an assessment is given based on expert judgment.

Table 4.4. The matrix used for the assessment of the Severity of Impact.

Degree of impact	Importance of the environmental component			
	Very high	High	Medium	Low
Very High	Very High	High	Medium	Low
High	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
Low	Low	Low	Low	Low

Based on the severity of impact, such an expert judgement can state the significance of the impact through the phrases given in Table 4.5. The contents of the table have been defined by Energinet.dk.

Table 4.5. The definition of Impact to an environmental factor. The column to the left is an attempt to include the overall assessment methodology to the scheme defined by Energinet.dk.

Severity of Impact	Relative Impact	Following effects are dominating
Very high	Significant negative impact	Impacts are large in extent and/or duration. Reoccurrence or likelihood is high, and irreversible impacts are possible.
High	Moderate negative impact	Impacts occur, which are either relative large in extent or are long term in nature (lifetime of the project). The occurrence is recurring, or the likelihood for recurrence is relatively high. Irreversible impact may occur, but will be strictly local, on e.g. cultural or natural conservation heritage.
Medium	Minor negative Impact	Impacts occur, which may have a certain extent or complexity. Duration is longer than short term. There is some likelihood of an occurrence but a high likelihood that the impacts are reversible.
Low	Neglegeble negative impact	Small impacts occur, which are only local, uncomplicated, short term or without long term effects and without irreversible effects
Low	Neutral / no impact	No impact compared to status quo
	Positive impacts	Positive impact occurring in one or more of the above statements

For further description of assessment methodology please refer to Horns Rev 3-TM-003.

4.5.1 Assessment of cumulative effects

The aim of the assessment of cumulative impacts is to evaluate the extent of the environmental impact of the project in terms of intensity and geographic extent compared with other projects in the area and the vulnerability of the area. The assessment of the cumulative conditions includes activities associated with existing utilised and unutilised permits or approved plans for projects.

When more projects within the same region affect the same environmental conditions at the same time, they are defined to have cumulative impacts. A project is relevant to include, if the project meets one or more of the following requirements:

- The project and its impacts are within the same geographical area as the Horns Rev 3 OWF project.
- The project affects some of the same or related environmental conditions as the Horns Rev 3 OWF project
- The project has permanent impacts in its operational phase interfering with impacts from the Horns Rev 3 OWF project

For each environmental component it is considered a cumulative impact if the requirements listed above is relevant.

4.5.2 Mitigation and compensation issues

A significant part of the purpose of an EIA is to optimize the project to minimise the environmental impacts of the project applied for, within the legal, technical and economic framework.

Remediation measures are described in the technical background reports. The most important ones are included in the EIA.

Horns Rev 2

5. THE EXTENT AND CHARACTERISTICS OF THE FISHERIES IN ICES RECTANGLES 40F7 AND 40F8

The Danish fisheries in the ICES rectangles 40F7 and 40F8 which includes the Horns Rev 3 OWF project area that includes the Horns Rev 3 pre-investigation area where the turbines will be located and the cable transect from offshore transformer platform to land can be divided into fisheries with trawls (bottom, pelagic and beam), gill nets, Danish seine nets and other gear (small passive gear such as longlines, fyke nets etc.).

Trawl fisheries in and near the Horns Rev 3 OWF project area can be divided into: a) industrial fishery with bottom (benthic) and pelagic trawls primarily targeting sandeel, sprat and herring, and where the mesh size in the codend is small, b) a beam trawl fishery targeting brown shrimp for consumption with gear having a small mesh size and c) a bottom trawl fishery targeting a diverse number of species with flatfish and cod being the most important, and with gear having a mesh size of 90 mm or more.

Trawling can be undertaken from 1 to several hours at a time, although beam trawlers targeting brown shrimp usually trawl a maximum of 4 hours.

Gill net fisheries primarily target flatfish (plaice, turbot and sole etc.) and cod. The mesh size of the nets for these fisheries is between 90-270 mm – the smallest mesh sizes are primarily used to catch sole, and the larger mesh sizes are primarily used to catch turbot. Vessels participating in the gill net fisheries are usually smaller than trawlers.

Gill nets are generally set and retrieved within a time frame of 12-36 hours.

Danish seine net fishing is of relatively limited importance in ICES 40F7 and 40F8 and is responsible for only very few of the registered catches in comparison to trawlers. The primary target species of the Danish seine net fishery consists of flatfish (plaice, dab and flounder).

The vast majority of the catch in ICES 40F7 and ICES 40F8 is landed by large bottom and pelagic trawlers targeting the industrial commercial species sandeel and brisling and the beam trawl fisheries targeting brown shrimp.

5.1. Fishery baseline statistics for ICES 40F7

A map showing the location of the Horns Rev 3 OWF project area including the pre-investigation area where turbindes will be located and the cable transect from the OWF pre-investigation area in to land in relation to the ICES rectangles of relevance for the baseline data and assessment 40F7 and 40F8 (Figure 5.1.)

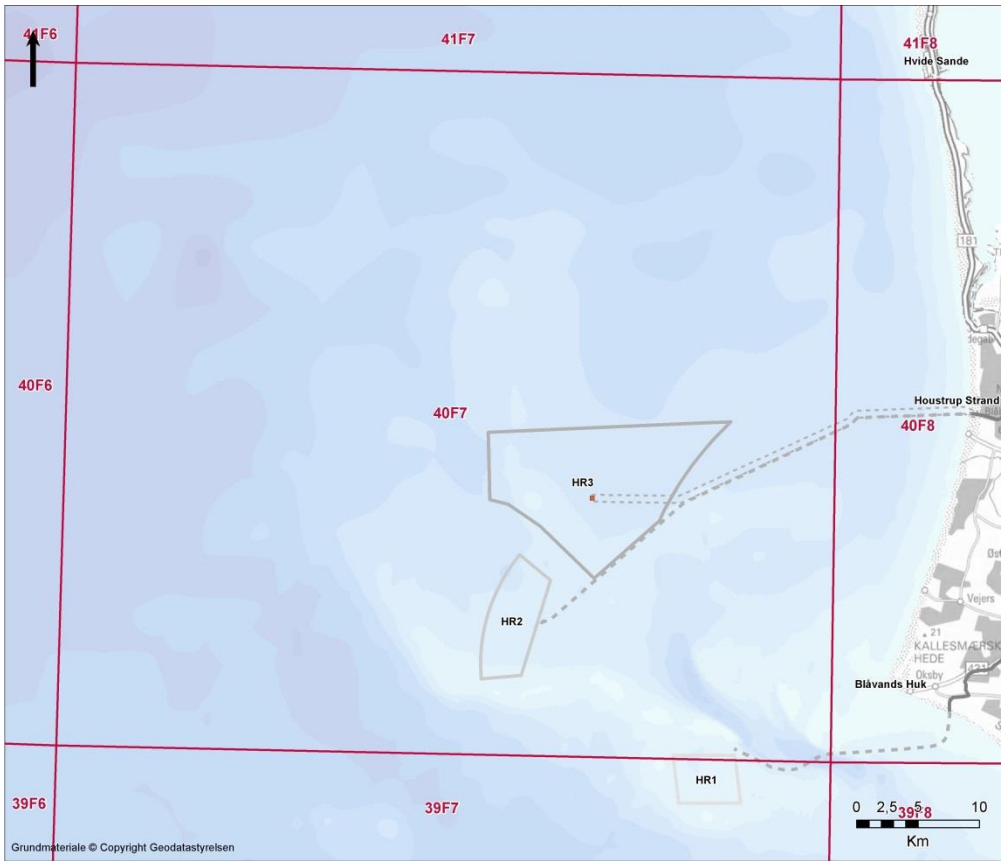


Figure 5.1. A map showing the location of the Horns Rev 3 OWF project area including the pre-investigation area within the ICES rectangle 40F7 and the cable transect from the offshore wind farm in to land passing through ICES rectangle 40F8.

5.1.1 Landings and value of the fisheries in ICES 40F7

The total landings and value of landings of the Danish fisheries from ICES rectangle 40F7 have varied between 3.804–21.000 tons and 12.981.000 – 41.285.000 DKK, respectively, over the past 11 years (see Figure 5.2).

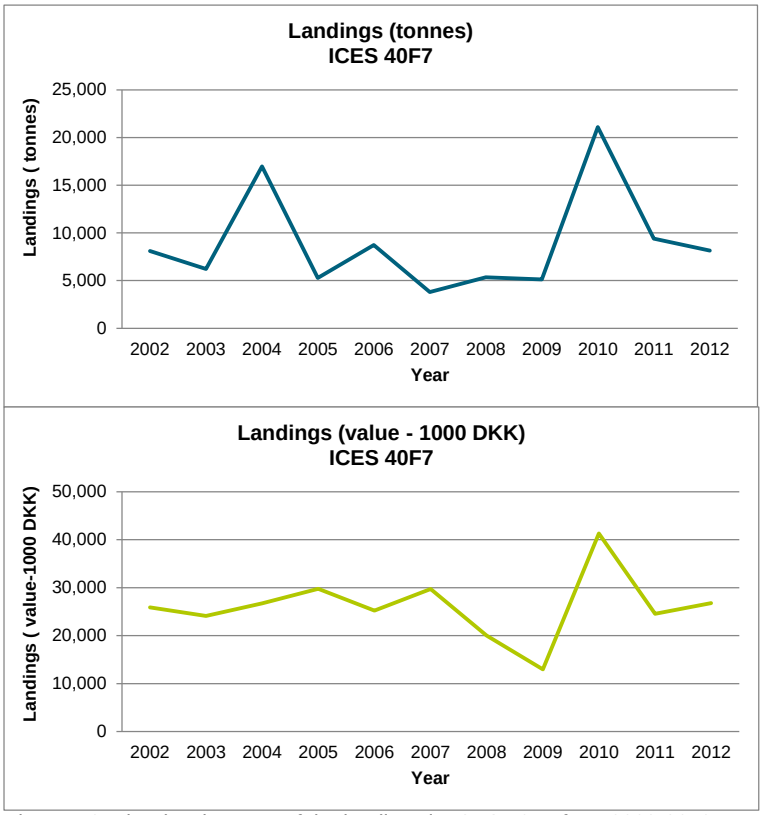


Figure 5.2. The development of the landings in ICES 40F7 from 2002-2012. Data from logbooks, which include vessels ≥10 m. Source: The Danish AgriFish Agency

Annual fluctuations in weight typically follow the landings of sandeel which is the most abundant commercial species that is fished in ICES 40F7 (Table 5.1). Other important commercial species that are landed from this ICES area in considerable amounts are sprat, brown shrimp and plaice (Table 5.1). Sandeel, cod and a number of flatfish species (plaice, turbot, sole and dab) typically make up the most economically important species. For sandeel and sprat, the low price per kilo is compensated for by the large amounts that are landed. For cod, brown shrimp and flatfish species it is both a combination of relatively higher price per kilo combined with good landings that make them economically valuable. Landings of 3 flatfish species, turbot, sole and brill are generally low but because of their high value (price per kilo) they can periodically make up a substantial contribution to the overall value of the landings. The landings of these 3 species have fluctuated considerably over the years.

There is a general downward trend in the landings of cod, plaice and dab from 2002-2012. For cod the current landings are only 20-25% of what they were approximately 5 to 10 years ago. Similarly, plaice has decreased from 10-20% of what landings were before 2006 and landings of dab even more so. The landings of sprat and brown shrimp have been more stable, albeit fluctuating considerably from year to year. On occasion, herring has only been landed in large amounts (2002, 2004 and 2007) but have not been landed since. The shellfish surf clam (*Spisula solida*) was represented by large amounts in the landings from 2002-2004, but has not been registered in any landings since.

Table 5.1. Landings (in tons) and value (1000 DKK) of commercial species from ICES rectangle 40F7 from 2002-2012 by Danish fishermen and vessels >10 m. (Source: The Danish AgriFish Agency).

40F7 - Landings (tonnes)

Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sandeel	6070,0	4475,5	14689,6	1038,0	7546,1	1981,5	4308,5	3841,0	20232,2	8293,5	6557,4
Sprat	422,5	455,0	909,5	2762,0	209,0	415,0	404,0	735,5	449,0	429,0	1120,2
Herring	139,8	0,0	310,0	0,0	0,0	250,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	103,5	33,4	54,1	36,6	27,2	42,9	30,0	12,5	15,7	8,0	5,4
Plaice	442,9	620,0	462,6	760,3	412,6	192,1	229,9	221,6	42,1	104,4	45,9
Turbot	20,0	6,1	7,9	19,2	16,5	7,9	43,4	25,3	6,9	14,6	4,0
Common sole	51,2	17,7	21,8	15,5	6,1	15,1	12,8	11,5	9,5	11,1	1,7
European flounder	2,5	3,1	2,9	9,3	10,3	2,1	16,3	2,0	0,1	0,5	1,0
Dab	6,0	30,2	34,5	48,8	26,7	17,5	35,9	14,5	1,8	5,3	2,0
Brill	0,8	0,1	0,7	0,9	0,9	0,4	0,0	0,0	0,3	2,6	0,7
Witch flounder	0,0	3,7	0,0	0,5	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,0	2,0	1,9	1,1	0,7	0,5	0,0	0,0	0,0	0,1	0,1
Grey gurnard	2,5	1,9	4,4	3,1	4,4	1,2	6,7	2,8	1,0	0,8	0,2
Yellow gurnard	0,4	0,1	0,2	0,2	0,2	0,0	2,7	0,1	0,5	0,2	0,2
Hake	2,9	7,6	3,9	4,6	3,9	0,4	3,5	0,5	0,0	0,1	0,1
Haddock	1,1	27,7	0,8	0,0	2,0	0,0	0,0	0,3	0,0	0,0	0,0
Whiting	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0	0,0	0,0	0,0
Saithe	0,0	3,8	0,1	0,0	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Horse Mackerel	0,0	0,0	5,0	0,0	30,0	0,0	0,0	0,0	0,1	0,0	0,0
Brown shrimp	162,8	332,6	260,9	566,2	406,3	858,5	252,4	240,5	326,3	519,8	411,5
Other shellfish	661,6	178,7	200,8	9,0	10,6	3,5	1,9	1,8	0,3	0,4	1,0
Unspecified	17,5	15,9	13,4	15,7	9,1	15,4	8,8	4,0	2,1	2,3	0,7
Total (tonnes)	8108,0	6215,2	16985,2	5290,9	8722,7	3804,9	5357,0	5113,9	21088,0	9392,7	8152,1

40F7 - Value (1000 DKK)

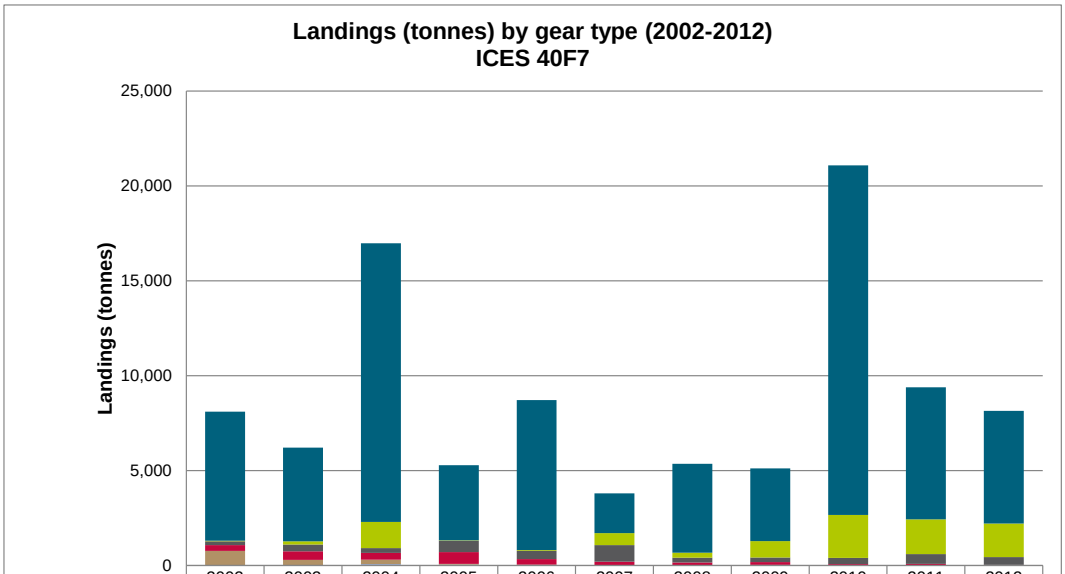
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sandeel	5220.2	3580.4	10282.7	726.6	7923.4	2377.8	3877.7	3341.7	32776.1	13352.5	11934.5
Sprat	443.6	395.9	673.0	2264.8	227.8	427.5	448.4	698.7	736.4	690.7	2565.3
Herring	376.2	0.0	561.1	0.0	0.0	632.5	0.0	0.0	0.0	0.0	0.0
Atlantic cod	2490.5	823.2	1306.2	923.3	781.5	1383.0	874.0	286.6	399.5	228.1	144.0
Plaice	5864.1	9132.6	6217.7	11009.0	6072.9	2819.7	3107.7	2225.0	413.3	1110.2	476.9
Turbot	1251.6	456.6	529.8	1488.0	1334.3	618.5	3127.0	1548.4	484.3	1138.9	276.7
Common sole	3445.6	1241.3	1482.3	1150.3	547.9	1333.3	999.9	766.7	794.6	964.6	130.7
European flounder	26.9	29.4	30.2	75.4	99.7	19.5	145.4	20.5	1.4	6.5	11.6
Dab	49.0	240.7	255.3	390.3	206.3	131.3	238.9	101.4	11.8	40.7	14.7
Brill	40.8	4.2	28.5	40.1	51.2	18.3	0.7	1.3	17.1	132.3	30.2
Witch flounder	0.0	30.8	0.0	3.2	0.8	0.4	0.0	0.5	0.0	0.0	0.0
Lemon sole	0.1	16.6	6.5	7.1	4.9	2.3	0.2	0.5	0.1	1.2	0.6
Grey gurnard	8.1	16.0	15.1	20.6	29.8	5.0	53.3	37.2	7.0	10.3	2.8
Yellow gurnard	1.2	0.9	0.8	1.3	1.3	0.0	21.0	1.3	3.5	2.9	2.7
Hake	9.5	63.3	13.4	30.5	26.4	1.8	28.0	6.4	0.0	0.7	1.3
Haddock	3.5	230.0	2.6	0.0	13.3	0.0	0.0	3.5	0.0	0.0	0.0
Whiting	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	0.0	0.0
Saithe	0.0	31.6	0.5	0.0	0.7	0.2	0.0	0.0	0.0	0.0	0.0
Horse mackerel	0.0	0.0	17.3	0.0	201.6	0.0	0.0	0.0	0.5	0.0	0.0
Brown shrimp	3790.3	5428.0	4369.5	11079.9	6999.9	19710.4	6994.9	3845.9	5622.5	6840.8	11169.3
Other shellfish	2814.5	2230.3	914.4	441.7	654.1	179.0	37.8	41.6	2.1	5.2	12.1
Unspecified	57.4	132.3	46.4	103.7	61.1	66.4	69.6	54.5	15.2	30.9	7.8
Total Value	25893.1	24121.6	26753.4	29755.8	25239.0	29730.1	20024.6	12981.6	41285.5	24556.5	26781.2

Landings and value in 40F7 by gear type

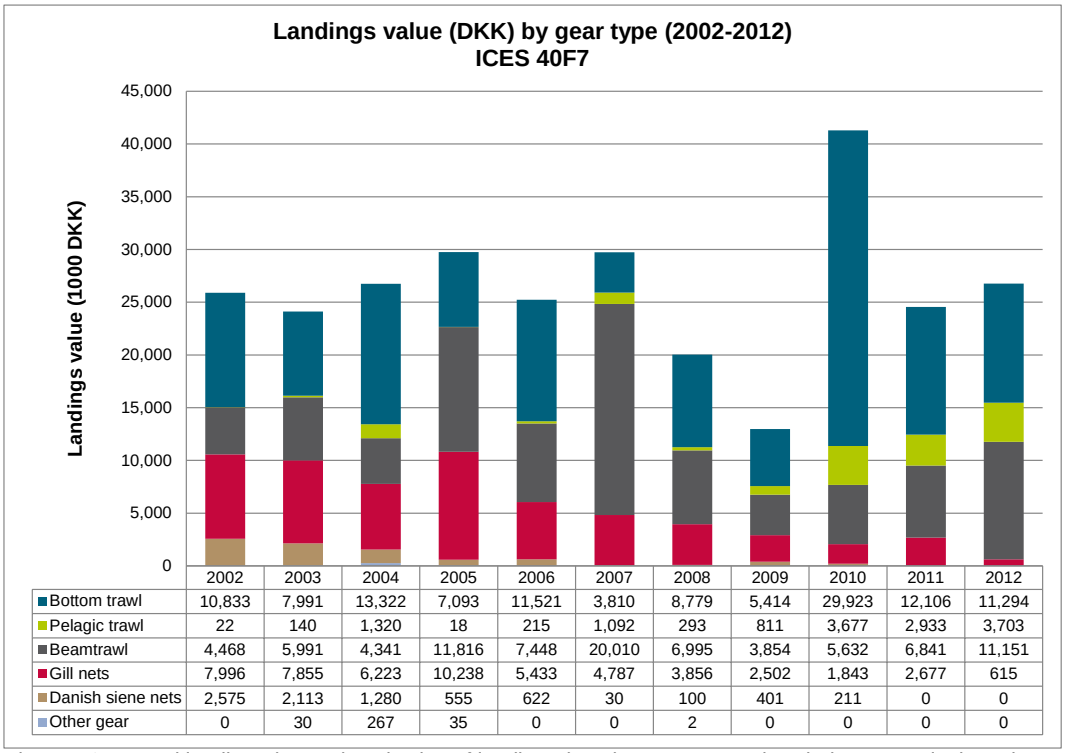
The amount (tonnes) and value (DKK) of the landings from ICES 40F7 according to the primary gear are shown in Figure 5.3.

In ICES 40F7, landings by bottom trawlers and pelagic trawlers from 2002-2012 accounted for approximately 82% and 9.4% of the total landings by weight, respectively. By far the most important species in the landings of bottom trawlers, by weight, is sandeel followed by registered landings of sprat, a number of flatfish species and cod. For pelagic trawls the most important species in the registered landings was sandeel, sprat and herring. In recent years sprat has been the dominant species in the landings. The landings in the beam trawl fishery (4.6% in all) is primarily made up of brown shrimp (97% of the landings), which this fishery specifically targets. The gill net fishery targets cod and flatfish and made up approximately 3% of the landings in ICES 40F7 over the last 10 years (2002-2012). The remaining part of the landings in ICES 40F7 has been made up of the Danish seine net fishery (1.5%) and “other gear” (0,1%).

Economically, the value of the landings by bottom trawls (43%), beam trawls (31%) and gill nets (19%) have been the most dominant from 2002-2012 (Figure 5.2). The high economical value of the bottom trawl fishery is due to the large amount of landings of sandeel supplemented by a variety of other commercial species. Although landings from beam trawls and gill nets account for much less of the total landings in 40F7 by weight, the landings by these gear are typically made up of more valuable commercial species, such as brown shrimp for beam trawls and cod and the majority of flatfish species for gill nets. Thus, beam trawls and gill nets account for a substantial amount of the economical value of the fisheries in ICES 40F7 (se Figure 5.3 and Table 5.2). In recent years the landings and the concurrent value of the landings from the gill net fishery has been declining whereas the landings and value of the landings by pelagic trawls has increased.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	6,804	4,935	14,688	3,960	7,913	2,101	4,684	3,827	18,424	6,963	5,941
Pelagic trawl	25	171	1,375	21	43	632	264	869	2,264	1,822	1,771
Beamtrawl	207	361	259	605	429	868	252	241	327	520	412
Gill nets	302	454	359	613	291	201	148	138	51	88	29
Danish siene nets	769	281	228	41	46	3	8	39	22	0	0
Other gear	0	13	76	50	0	0	0	0	0	0	0



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	10,833	7,991	13,322	7,093	11,521	3,810	8,779	5,414	29,923	12,106	11,294
Pelagic trawl	22	140	1,320	18	215	1,092	293	811	3,677	2,933	3,703
Beamtrawl	4,468	5,991	4,341	11,816	7,448	20,010	6,995	3,854	5,632	6,841	11,151
Gill nets	7,996	7,855	6,223	10,238	5,433	4,787	3,856	2,502	1,843	2,677	615
Danish siene nets	2,575	2,113	1,280	555	622	30	100	401	211	0	0
Other gear	0	30	267	35	0	0	2	0	0	0	0

Figure 5.3. Annual landings (tonnes) and value of landings (DKK) per gear type (trawl - bottom, pelagic and beam, gill nets and other gear (longlines, fykenets etc.) from the ICES rectangle 40F7.

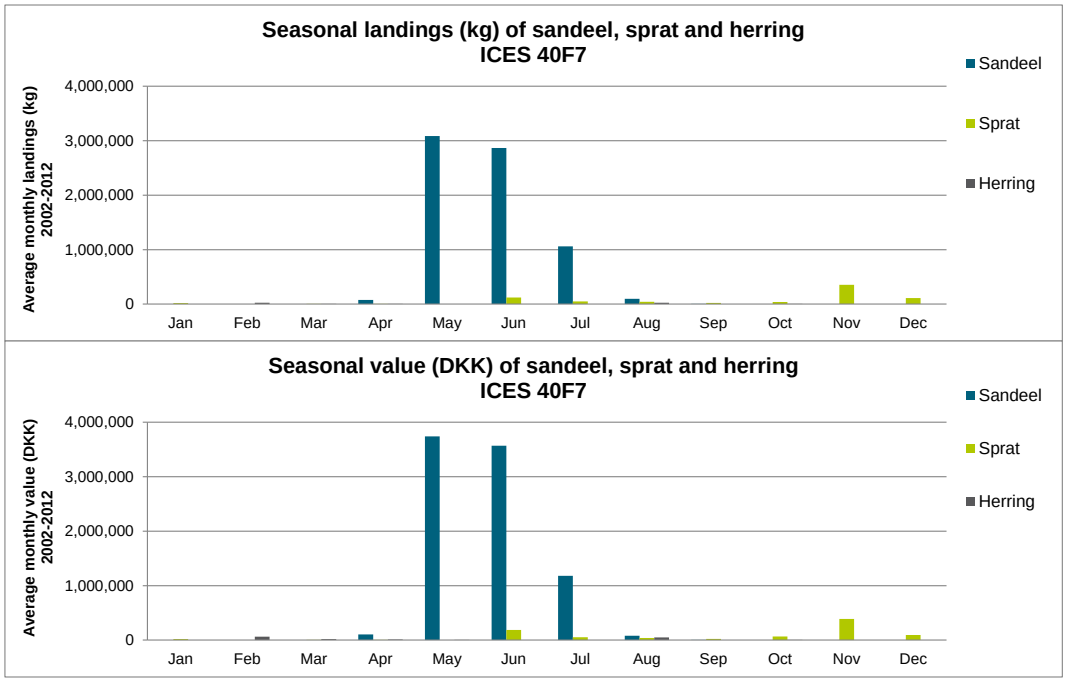
Table 5.2. The total Danish landings (kg) from ICES rectangle 40F7 during the period 2002-2012 distributed between gear types (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear. The overall landings and their value are probably slightly underestimated because vessels less than ≤10 m are not represented as they are not required to declare their landings in ICES rectangles.

40F7 - Landings (kg) of species by gear type

Species	Bottom trawl	Pelagic trawl	Beamtrawl	Gill nets	Danish seine nets	Other gear
Sandeel	73503292	5457000				73000
Sprat	5107200	3191500				12000
Herring	139810	560000		40		
Atlantic cod	77204	80	16063	264189	10200	1503
Plaice	979081	200	117406	2013560	414460	9700
Turbot	86332	20	6112	79465		
Common sole	10619		953	162597		
European flounder	39448		812	5004	4738	
Dab	137898	40	2322	70420	12015	500
Brill	987	20	568	5858		
Witch flounder	735				3705	
Lemon sole	5862		21	201	364	
Grey gurnard	12734		15	67	15625	500
Yellow gurnard	3417			50	1325	
Hake	11742	20	15	12296	3430	
Haddock	5292		335	465	25610	50
Whiting	25				805	
Saithe	125			170	3800	
Horse Mackerel	75	35000				
Brown shrimp			4334245	1725		1825
Other shellfish	81920	300	1005	11884	934250	40290
Unspecified	37606	11000	2130	45826	8234	175
Total (kg)	80241404	9255180	4481338	2673817	1438561	139543

5.1.2 Seasonal landings and value

The seasonal distribution of catches of the main species is shown in Figure 5.4. Results show that catches of sandeel which is regulated by a seasonal fishery which starts in April are mainly caught over a period of 3 months in late spring and early summer. The seasonal trend in the landings of diverse flatfish dominated by catches of plaice shows they are also primarily landed during the early spring (March–April) and through the summer and early autumn months (May-October). During the late spring and summer months the fisheries (primarily gill nets) often target the more valuable flatfish species turbot and sole, which is reflected in their comparatively greater contribution to the value of the landings during this time of year, despite their relatively small landings. Landings of cod are more or less all year round. Seasonal trends in the landings of brown shrimp indicate this commercial species is caught all year round with peaks during the Spring and Autumn (Figure 5.5).



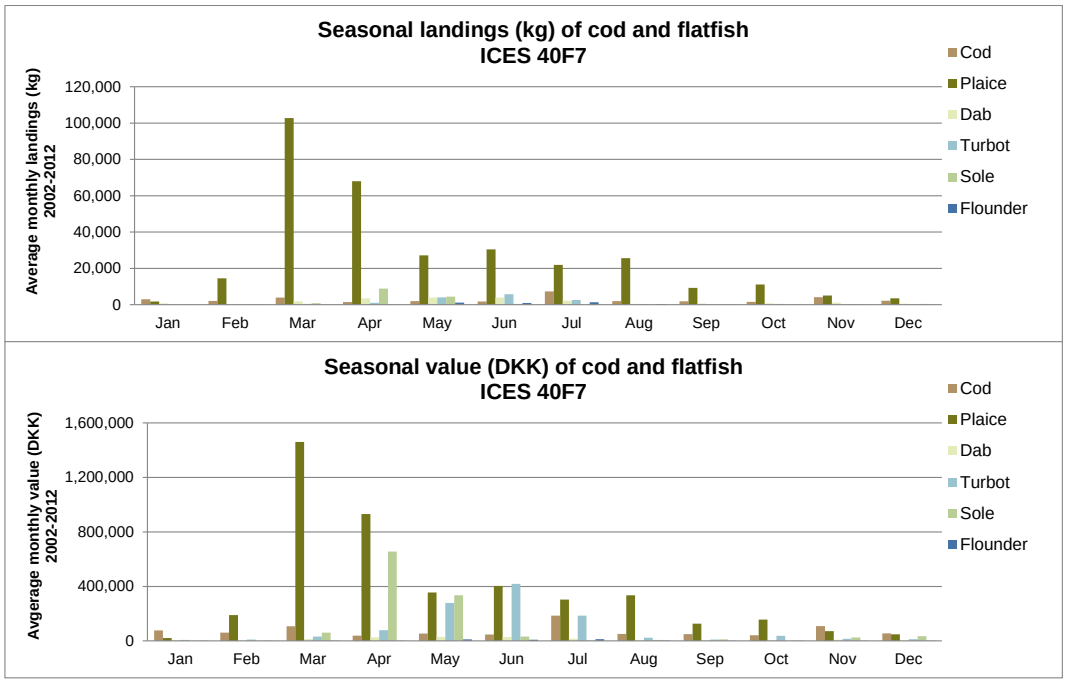


Figure 5.4. Monthly landings (kg) and value (DKK) for the most important commercial species (sandeel, sprat and herring) as well as cod and flatfish species (flounder, dab, plaice, sole, turbot and brill) in ICES rectangle 40F7. Based on trends in landings from 2002-2012.

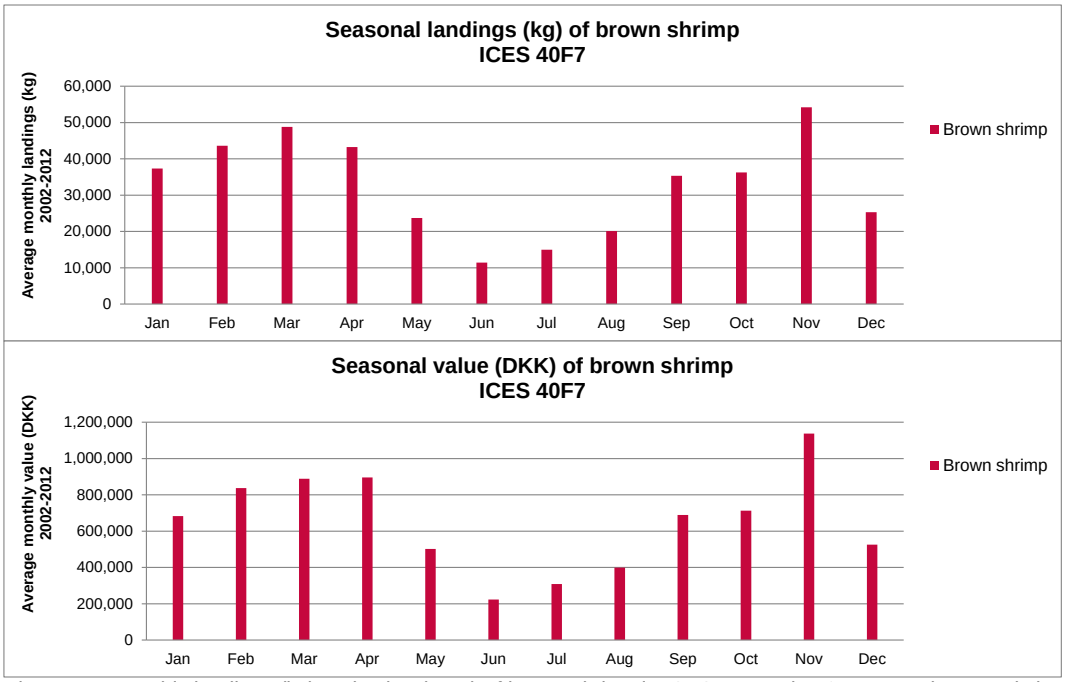


Figure 5.5. Monthly landings (kg) and value (DKK) of brown shrimp in ICES rectangle 40F7. Based on trends in landings from 2002-2012.

The overall seasonal development of the values follows the seasonal patterns in their landings. For some periods, the monthly value of the landings is strongly influenced by the higher value of some flatfish species (turbot, sole and brill) and cod.

5.1.3 Fleet statistics and fishing effort

In the period 2002-2012, the total number of vessels (>10 m) registering landings from ICES rectangle 40F7 decreased from a maximum of 186 in 2004 to between 73-104 over the last 6 years (2007-2012) (Figure 5.6). This decline is primarily attributable to a decline in the number of vessels using bottom trawls which is the most common gear used by fishing vessels in 40F7, gill nets and Danish seine nets (Table 5.3). In contrast, the number of vessels using pelagic trawls has increased from 1 in 2005 to between 17-21 since 2009. The number of vessels using beam trawls that have registered catches in 40F7 has varied between 17-27 throughout the period of 2002-2012 (Table 5.3). There is only a total of 28 beam trawl vessels in the entire Danish fishery so ICES 40F7 can be considered a primary area for this fishery. Only been between 2-3 fishing vessels using Danish seine nets have fished in ICES 40F7 since 2007 and none over the last 2 years (2011-2012).

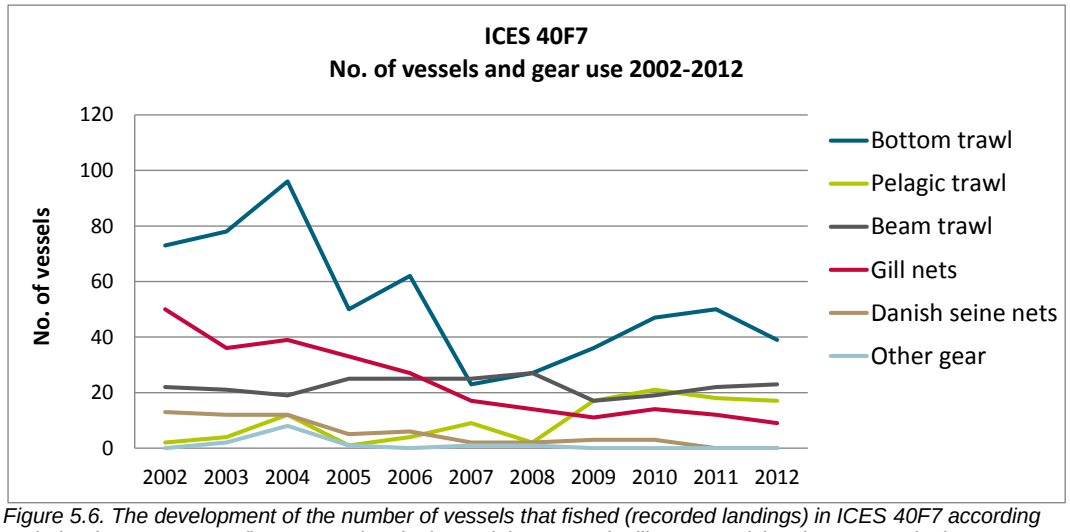
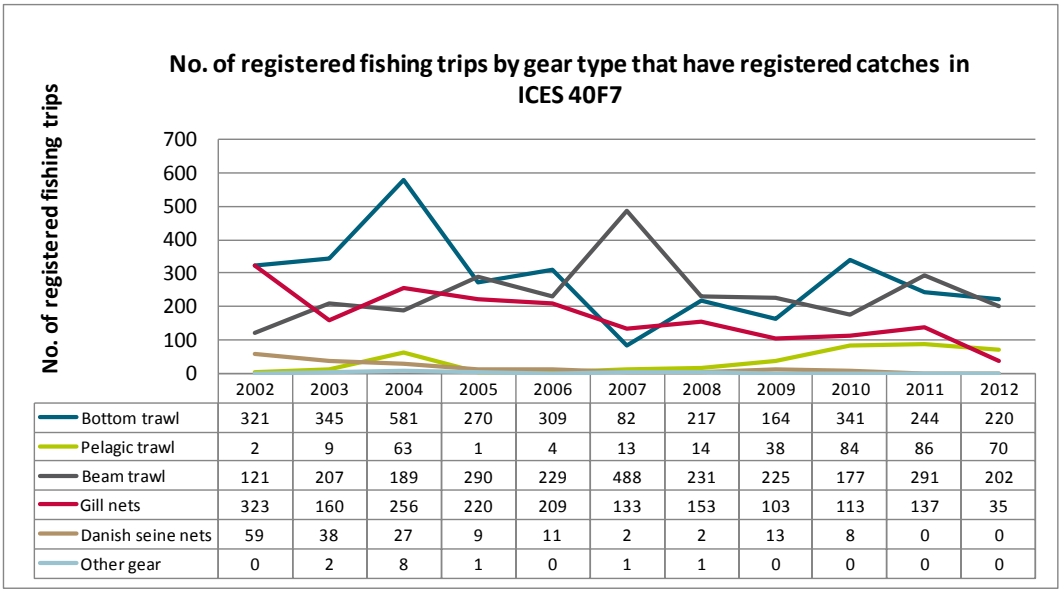


Figure 5.6. The development of the number of vessels that fished (recorded landings) in ICES 40F7 according to their primary gear use (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear (longlines, fyke-nets etc.) from 2002-2012. This data includes vessels ≥10 m.

Table 5.3. The number of vessels in different length groups (10-11.9 m, 12-14.9 and ≥15 m) and according to primary gear types (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear that have registered catches from ICES rectangle 40F7.

ICES 40F7		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Vessel length	Geartype	**160**	**153**	**186**	**115**	**124**	**77**	**73**	**84**	**104**	**102**	**88**
>15 m	Bottom trawl	60	61	82	39	54	16	22	30	38	42	29
	Pelagic trawl	2	4	11		3	7		14	17	14	13
	Beam trawl	20	19	17	23	23	24	25	16	19	22	23
	Gill nets	35	24	25	24	16	12	8	7	9	8	6
	Danish seine nets	13	12	11	4	5	2	2	2	2		
	Other gear		1	7	1							
	Total	**130**	**121**	**153**	**91**	**101**	**61**	**57**	**69**	**85**	**86**	**71**
12-14,9 m	Bottom trawl	11	12	13	10	8	6	5	6	9	5	9
	Pelagic trawl			1	1	1	2	2	3	4	4	2
	Beam trawl	2	2	2	2	2	1	2	1			
	Gill nets	8	6	9	5	6	3	4	1		1	
	Danish seine nets			1	1	1			1	1		
	Other gear			1			1	1				
	Total	**21**	**20**	**27**	**19**	**18**	**13**	**14**	**12**	**14**	**10**	**11**
10-11,9 m	Bottom trawl	2	5	1	1		1				3	1
	Pelagic trawl											2
	Gill nets	7	6	5	4	5	2	2	3	5	3	3
	Other gear		1									
	Total	**9**	**12**	**6**	**5**	**5**	**3**	**2**	**3**	**5**	**6**	**6**



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	321	345	581	270	309	82	217	164	341	244	220
Pelagic trawl	2	9	63	1	4	13	14	38	84	86	70
Beam trawl	121	207	189	290	229	488	231	225	177	291	202
Gill nets	323	160	256	220	209	133	153	103	113	137	35
Danish seine nets	59	38	27	9	11	2	2	13	8	0	0
Other gear	0	2	8	1	0	1	1	0	0	0	0

Figure 5.7. The number of fishing trips undertaken in ICES 40F7 from 2002-2012 according to primary gear types of vessels.

Although a fishing trip can represent from one to several days of fishing for the different vessels, it can be used as a proxy for the amount of effort used for the different fisheries in the ICES rectangle 40F7.

The number of fishing trips where catches from ICES rectangle 40F7 have been registered for bottom trawls has varied between a low of 82 trips in 2007 to a high of 581 in 2004 and has fluctuated between 164-244 and over the last 5 years (Figure 5.7). The number of fishing trips registered for pelagic trawls has been increasing in recent years, which follows the increasing number of vessels fishing with pelagic gear. For gill nets and Danish seine nets there has been a considerable decrease in the number of fishing trips over the last 11 years resulting in a low of 35 fishing trips undertaken by vessels using gill nets in 2012 and no registered fishing trips by vessels using Danish seine nets over the last 2 years (2011-2012) (see Figure 5.7). The number of fishing trips registered by the beam trawl fishery has varied between 121-488 from 2002-2012 with numbers fluctuating between 177-291 since 2008.

5.2. Fishery statistics for ICES 40F8

5.2.1 Landings and value

The total Danish landings and value of landings from ICES rectangle 40F8 have varied between 591–5.477 tons and 6.834.000 – 30.771.000 DKK, respectively, over the past 11 years (see Figure 5.8).

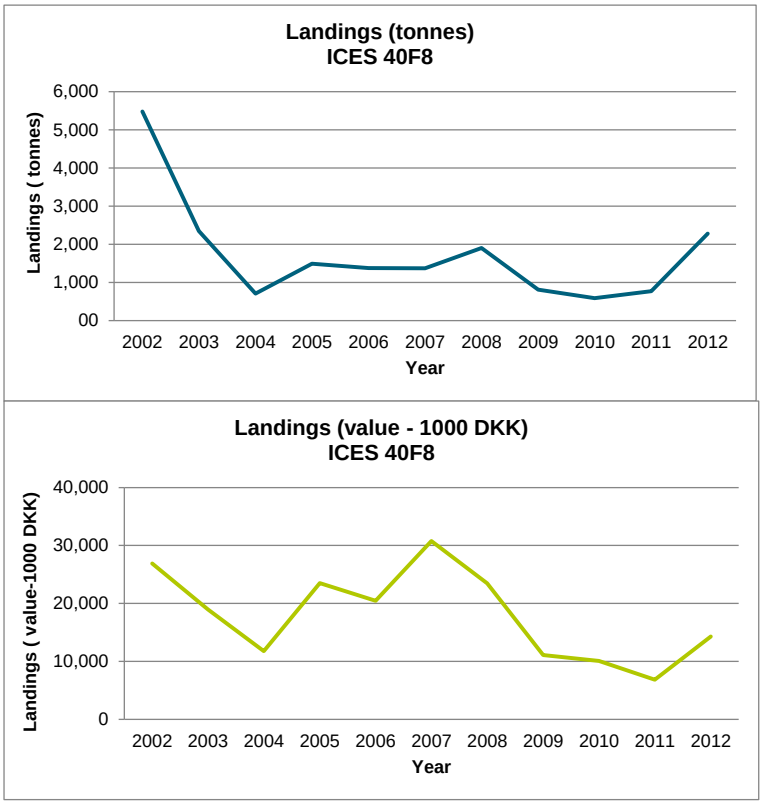


Figure 5.8. The development of the landings in ICES 40F8 from 2002-2012. Data from logbooks, which include vessels ≥10 m. Source: The Danish AgriFish Agency

Annual fluctuations in weight typically follow the landings of brown shrimp, which is consistently the most abundant commercial species that is fished in ICES 40F8 (Table 5.4), Other important commercial species that are landed from ICES 40F8 area are sprat, which was landed in large amounts (1.894 tons) in 2012, as well as some flatfish species (plaice, turbot, dab and flounder) and sandeel (Table 5.4). In the years 2002, 2003 and 2008 there were registered landings of blue mussels (shellfish) in large amounts.

Economically, brown shrimp is the most important commercial species with the value of their landings reaching between 6.2-29.8 million DKK from 2002-2012. Other species of economical importance for this fishing area are a number of flatfish species with the most important being plaice, turbot and sole. Because of the large landings of sprat in 2012 the value of these landings was 4.3 million DKK. In earlier years the landings of cod also made up a substantial economical supplement to the landings in this ICES rectangle, but landings have been very low since 2008.

Table 5.4. Landings (in tons) and value (1000 DKK) of commercial species from ICES rectangle 40F8 from 2002-2012 by Danish fishermen and vessels >10 m. (Source: The Danish AgriFish Agency).

40F8 - Landings (tonnes)

Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sandeel	107.0	625.0	20.0	0.0	141.5	0.0	270.0	73.0	20.0	74.0	0.0
Sprat	0.0	50.0	0.0	153.0	65.0	28.0	67.0	52.0	0.0	220.0	1894.0
Herring	0.0	0.0	0.0	168.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0
Atlantic cod	9.2	3.2	26.5	36.0	26.6	14.3	0.9	0.1	0.0	0.1	0.1
Plaice	9.3	21.6	6.4	10.2	2.3	6.3	4.7	10.0	7.6	1.0	35.1
Turbot	2.1	0.2	0.4	2.6	0.3	1.6	0.2	0.4	4.8	0.7	3.3
Common sole	0.7	0.5	0.3	0.9	0.1	1.1	0.0	2.2	0.2	0.0	0.7
European flounder	0.3	0.3	1.1	5.8	0.5	0.3	0.0	9.4	0.1	0.0	1.5
Dab	0.2	0.5	0.3	10.3	3.1	2.6	0.4	0.5	0.4	0.0	6.8
Brill	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
Witch flounder	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lemon sole	0.8	0.4	0.4	0.1	0.1	0.0	0.1	0.1	0.2	0.0	0.0
Grey gurnard	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Hake	0.6	0.4	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.2	0.0
Haddock	0.9	1.3	1.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Whiting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saithe	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown shrimp	866.6	1033.4	648.0	1100.8	1120.7	1301.4	804.3	661.3	556.4	473.4	338.7
Shellfish	4477.2	606.2	1.6	0.1	0.0	13.9	753.0	0.0	0.0	0.8	0.1
Unspecified	1.0	3.3	5.3	1.8	0.9	0.4	0.1	0.2	1.8	0.1	1.2
Total (tonnes)	5477.3	2346.8	711.6	1489.7	1378.2	1370.0	1901.6	809.7	591.5	770.6	2282.1

40F8 - Value (1000 DKK)

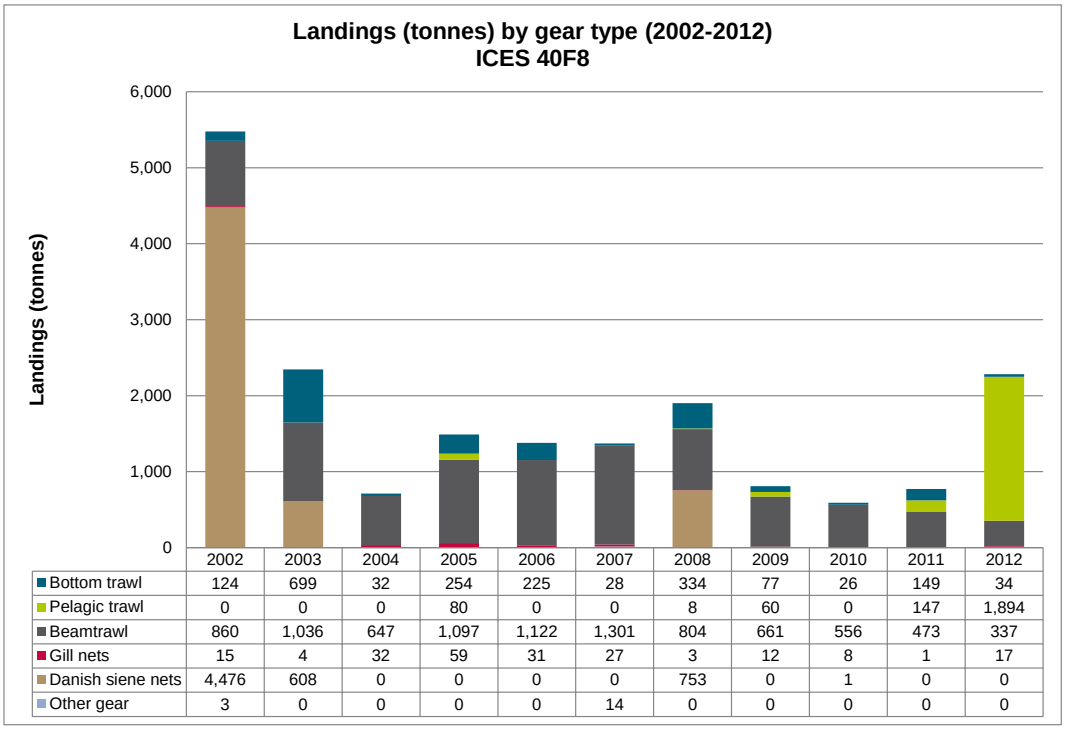
Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sandeel	92.0	500.0	14.0	0.0	148.6	0.0	243.0	63.5	32.4	119.1	0.0
Sprat	0.0	43.5	0.0	125.5	70.9	28.8	74.4	49.4	0.0	354.2	4337.3
Herring	0.0	0.0	0.0	383.0	46.8	0.0	0.0	0.0	0.0	0.0	0.0
Atlantic cod	220.8	79.3	639.8	908.1	764.9	461.6	24.7	1.4	0.4	3.3	3.2
Plaice	123.7	318.2	85.7	147.7	34.1	93.2	63.5	100.3	74.9	10.3	364.7
Turbot	129.0	17.2	25.4	201.3	27.0	123.5	10.8	24.7	334.5	55.4	233.6
Common sole	46.9	37.8	18.6	67.1	7.7	100.4	0.0	147.5	16.8	0.0	52.6
European flounder	3.3	3.0	11.5	46.8	5.2	2.7	0.0	97.9	1.9	0.0	17.5
Dab	1.9	4.2	2.5	82.1	24.1	19.2	2.7	3.4	2.3	0.2	50.0
Brill	9.5	3.9	0.0	1.4	0.0	0.0	0.9	0.0	0.0	15.3	22.7
Witch flounder	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lemon sole	2.7	3.3	1.4	0.8	0.6	0.0	0.4	0.8	1.4	0.6	0.0
Grey gurnard	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Yellow gurnard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hake	1.9	3.0	0.0	0.0	0.0	0.1	7.9	6.7	0.2	2.6	0.1
Haddock	2.9	10.8	4.4	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Whiting	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saithe	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horse mackerel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown shrimp	20175.4	16864.8	10854.4	21543.1	19309.6	29879.5	22287.5	10574.7	9586.3	6229.5	9191.4
Other shellfish	6087.3	1050.0	82.1	6.4	0.0	59.6	738.1	0.3	0.0	42.8	1.0
Unspecified	3.4	27.8	18.4	12.1	6.2	1.7	1.0	3.1	12.7	1.2	14.5
Total Value (1000 DKK)	26904.6	18969.3	11758.3	23525.9	20445.7	30770.8	23455.0	11073.8	10063.9	6834.4	14289.6

Landings and value in 40F8 by gear type

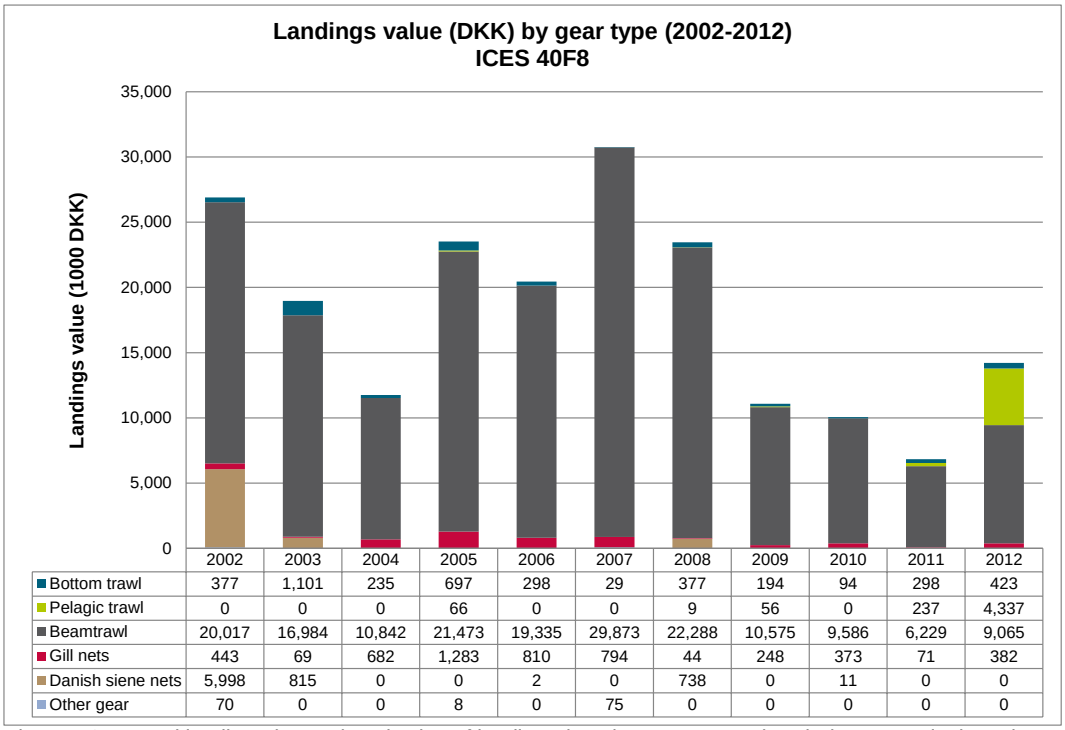
The amount (tonnes) and value (DKK) of the landings from ICES 40F8 according to the primary gear are shown in Figure 5.9..

In ICES 40F8, landings by beam trawlers which target brown shrimp is the most dominant and consistent in the landings and value of the landings in this ICES area from 2002-2012 accounting for approximately 47% (15-95%) of the landings by weight and 89% (64-97%) of the value of the landings. In 2002, 2003 and 2008 the registered landings of Danish seine nets by weight were substantial. According to their registered landings these peaks were made up blue mussel. This is an unusual catch for Danish seine nets and it is assumed that the vessels either have used their secondary gear or there was a writing mistake in logbook notations. Regardless, because of the low Dkk per kg price these landings, with the exception of 2002 (22% value of landings) only amounted to between 0.1-4% of the value of landings in these years.

Bottom trawlers accounted for approximately 2-29.8% of the landings by weight and 0.1-6% and of the value of the landings primarily due to catches of a large variety of different commercial species including industrial fish such as sandeel, sprat and herring as well as many species strongly associated with the bottom (flatfish, codfish etc.) (Table 5.5). Gill net fishermen accounted for approximately 0.1-5% of the landings by weight and 0.2-6% of the value of the landings primarily due to catches of cod and diverse flatfish species (Table 5.5)



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	124	699	32	254	225	28	334	77	26	149	34
Pelagic trawl	0	0	0	80	0	0	8	60	0	147	1,894
Beamtrawl	860	1,036	647	1,097	1,122	1,301	804	661	556	473	337
Gill nets	15	4	32	59	31	27	3	12	8	1	17
Danish siene nets	4,476	608	0	0	0	0	753	0	1	0	0
Other gear	3	0	0	0	0	14	0	0	0	0	0



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	377	1,101	235	697	298	29	377	194	94	298	423
Pelagic trawl	0	0	0	66	0	0	9	56	0	237	4,337
Beamtrawl	20,017	16,984	10,842	21,473	19,335	29,873	22,288	10,575	9,586	6,229	9,065
Gill nets	443	69	682	1,283	810	794	44	248	373	71	382
Danish siene nets	5,998	815	0	0	2	0	738	0	11	0	0
Other gear	70	0	0	8	0	75	0	0	0	0	0

Figure 5.9. Annual landings (tonnes) and value of landings (DKK) per gear type (trawl - bottom, pelagic and beam, gill nets and other gear (longlines, fykenets etc.) from the ICES rectangle 40F8.

Table 5.5. The total landings (kg) from ICES rectangle 40F8 during the period 2002-2012 distributed between gear types (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear. The overall landings and their value are probably slightly underestimated because vessels less than ≤10 m are not represented because they are not required to declare their landings in ICES rectangles.

40F8 - Landings (kg) of species by gear

Species	Bottom trawl	Pelagic trawl	Beamtrawl	Gill nets	Danish seine nets	Other gear
Sandeel	1322500	8000				
Sprat	347000	2181000	1000			
Herring	185000					
Atlantic cod	6036		7505	101517	1910	
Plaice	76125		2049	30837	5575	
Turbot	2038		15	14539		
Common sole	42			6712	1	
European flounder	817		10	18508		
Dab	6632		355	17934	150	
Brill	113			1026		
Witch flounder	150					
Lemon sole	2126		90			
Grey gurnard	95				270	
Hake	1814			605	270	
Haddock	2250		450	110	700	
Whiting	30					
Saithe	1050					
Brown shrimp	18600		8881708	580		4100
Other shellfish	7000	0	1700	1534	5829000	
Unspecified	2614	0	155	13197	340	
Total (kg)	1982032	2189000	8895037	207099	5838216	17745

5.2.2 Seasonal landings and value

The seasonal distribution of catches of the main species is shown in Figure 5.10. Results show that the sporadic catches of sprat, sandeel and herring are primarily caught in the latter part of the year from the summer months and thereafter.

The seasonal trend in the landings of diverse flatfish, which is dominated by catches of plaice, shows flatfish are landed throughout the year but with trends such as plaice primarily being landed in the first part of the year while dab and flounder are landed in the late autumn and early winter. During this time (November-February) catches of cod are greatest, suggesting that the increased landings of dab and flounder during this time are probably a result of these flatfish species being a bycatch of the fishery targeting cod. The catches of the valuable flatfish turbot and sole are predominantly during the summer months and at the end of the year (November-December).

Seasonal trends in the landings of brown shrimp indicate this commercial species is caught from March/April to October/November with peaks during the Spring and Autumn in ICES 40F8 (Figure 5.11), which is fairly close to the coast). The decrease in landings of Brown shrimp in the winter months from this area reflects the migration of Brown shrimp to deeper waters as the water temperature decreases. This is supports the trends of greater catches of Brown shrimp in the adjacent ICES 40F7 during the winter months (Figure 5.5).

The seasonal trends in the value of the landings for industrial species (sandeel, sprat and herring) as well as brown shrimp follow the seasonal landing patterns. For other commercial fish species the seasonal trends in the value of the landings is associated with the more valuable commercial species such as cod as well as the flatfish species sole and turbot playing a more dominant role in the overall value of the landings when they are landed in greater numbers (Figure 5.10).

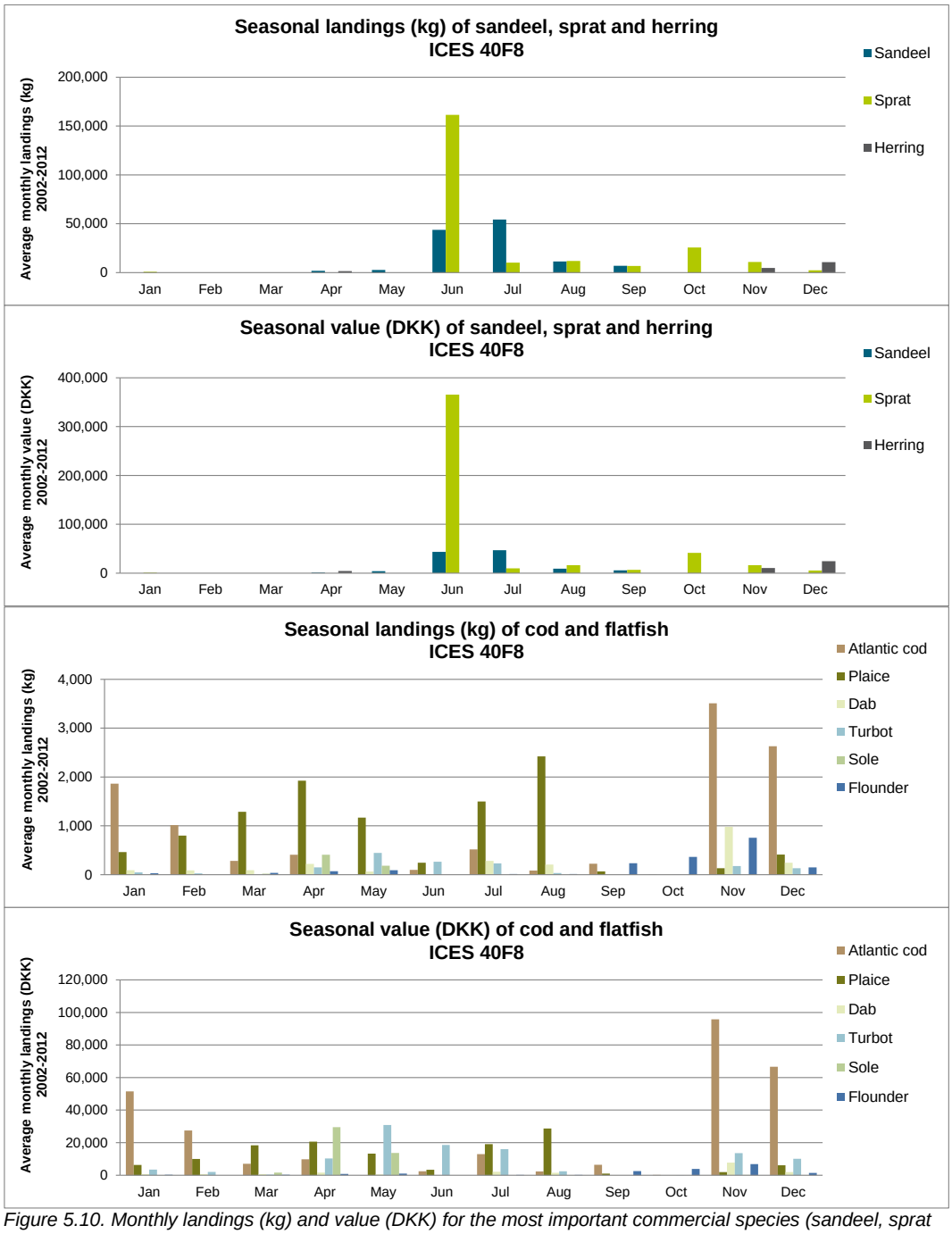


Figure 5.10. Monthly landings (kg) and value (DKK) for the most important commercial species (sandeel, sprat and herring) as well as cod and the flatfish species (flounder, dab, plaice, sole, turbot and brill) in ICES rectangle 40F8. Based on trends in landings from 2002-2012.

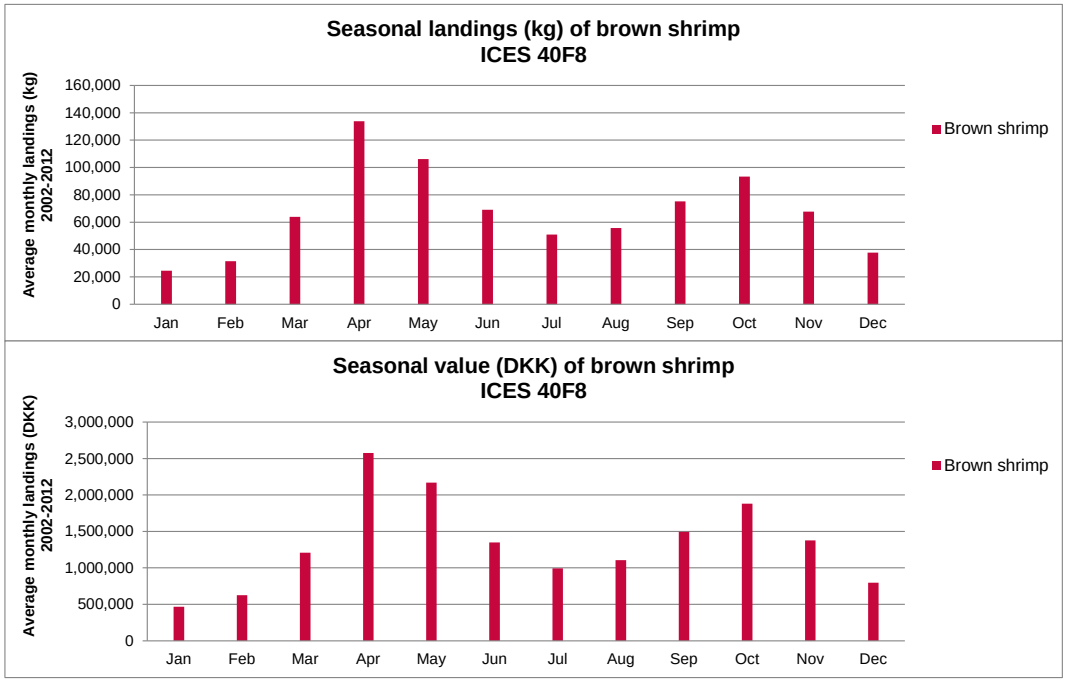


Figure 5.11. Monthly landings (kg) and value (DKK) of brown shrimp in ICES rectangle 40F8. Based on trends in landings from 2002-2012.

5.2.3 Fleet statistics and fishing effort

In the period 2002-2012, the total number of vessels (>10 m) registering landings from ICES rectangle 40F8 has fluctuated between 29-55 with a maximum of 55 in 2005 and a low of 29 in 2010 (Figure 5.12 and Table 5.6). Beam trawlers are the most common vessels consistently fishing in this ICES area with numbers fluctuating between 21-26 vessels on an annual basis. This is a substantial number of the total fleet of 28 Danish beam trawlers. There has been a general decline in the number of bottom trawlers and especially gill net fishing vessels fishing in ICES 40F8 since 2005. The number of bottom trawlers has declined by more than 50% or from 10 vessels in 2005 to between 2-5 vessels per year since 2007. Similarly, the number of gill net fishing vessels has declined from a high of 19 in 2005 to between 1-3 from 2008-2012 which is decline of more than 80%.

In contrast, the number of vessels using pelagic trawls increased considerably in 2012 from numbers between 0-4 vessels between the years 2002 to 2011 to a high of 14 vessels in 2012. The number of Danish seine nets and “vessels using “other gear” has fluctuated between 0-2 vessels and 0-3 vessels since 2002, respectively (Figure 5.12 and Table 5.6).

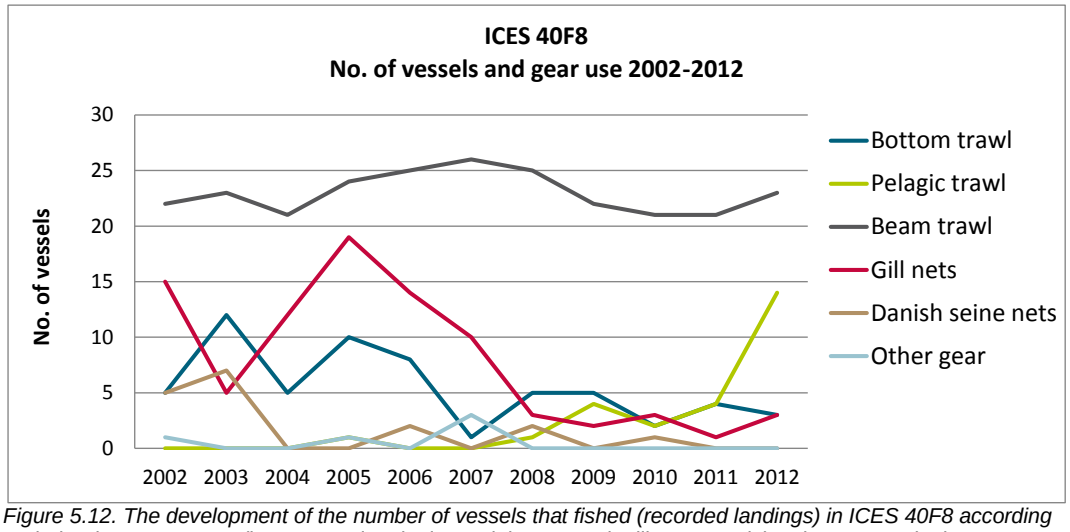


Figure 5.12. The development of the number of vessels that fished (recorded landings) in ICES 40F8 according to their primary gear use (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear (longlines, fyke-nets etc.) from 2002-2012. This data includes vessels ≥10 m.

Table 5.6. The number of vessels in different length groups (10-11.9 m, 12-14.9 and ≥15 m) and according to primary gear types (bottom trawl, pelagic trawl, beam trawl, gill nets, Danish seine nets and other gear that have registered catches from ICES rectangle 40F8.

ICES 40F8		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Vessel length	Geartype	**48**	**47**	**38**	**55**	**49**	**40**	**36**	**33**	**29**	**30**	**43**
>15 m	Bottom trawl	4	10	5	6	6		3	4	2	4	1
	Pelagic trawl				1				4	2	4	12
	Beam trawl	20	21	19	22	23	24	23	21	21	21	23
	Gill nets	8	2	6	15	12	8	3	1		1	2
	Danish seine nets	4	6			2		1				
	Other gear	1			1		1					
	Total	**37**	**39**	**30**	**45**	**43**	**33**	**30**	**30**	**25**	**30**	**38**
12-14,99 m	Bottom trawl		1		3	2	1	2	1			2
	Pelagic trawl							1				2
	Beam trawl	2	2	2	2	2	2	2	1			
	Gill nets	2		5	2	2	2					
	Danish seine nets	1	1					1				
	Other gear						2					
	Total	**5**	**4**	**7**	**7**	**6**	**7**	**6**	**2**			**4**
10-11,99 m	Bottom trawl	1	1		1							
	Gill nets	5	3	1	2				1	3		1
	Danish seine nets									1		
	Total	**6**	**4**	**1**	**3**				**1**	**4**		**1**

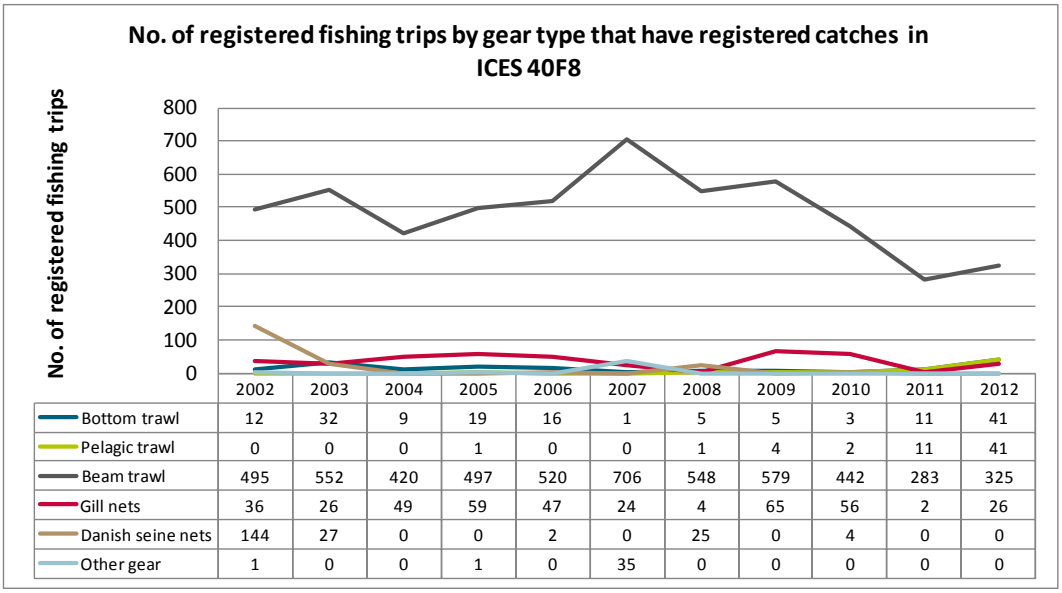
Although a fishing trip can represent from one to several days of fishing for the different vessels, it can be used as a proxy for the amount of effort used for the different fisheries in the ICES rectangle 40F8.

The overall number of fishing trips where catches have been registered from ICES rectangle 40F8 has varied between a high of 766 in 2007 to a low of 307 in 2011 (Figure 5.13). Fishing with beam trawl is by far the most active form of fishery undertaken in ICES 40F8 as the number of fishing trips from these vessels has fluctuated between 283-706.

Since 2007, however, the number of beam trawl fishing trips has generally decreased and has been around 300 trips the last 2 years (2011-2012).

The number of fishing trips registered for bottom trawls and pelagic trawls has been higher the last 2 years, which for bottom trawlers appears to reflect greater effort in this area by 3 vessels whereas there has been a greater number of pelagic trawlers fishing in this ICES area. Similarly, an increase in the number of fishing trips by gill net fishing vessels in 2009 and 2010 also reflects an increase in effort by the 2-3 gill net vessels fishing in ICES 40F8 (Figure 5.13 and Table 5.6).

Figure 5.13. The number of fishing trips undertaken in ICES 40F8 from 2002-2012 according to a vessels primary gear type (Botton trawl, pelagic trawl, beam trawl, Danish seine nets or "other gear" (longlines, fyke-nets etc).



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bottom trawl	12	32	9	19	16	1	5	5	3	11	41
Pelagic trawl	0	0	0	1	0	0	1	4	2	11	41
Beam trawl	495	552	420	497	520	706	548	579	442	283	325
Gill nets	36	26	49	59	47	24	4	65	56	2	26
Danish seine nets	144	27	0	0	2	0	25	0	4	0	0
Other gear	1	0	0	1	0	35	0	0	0	0	0

6. THE EXTENT AND DISTRIBUTION OF THE FISHERIES IN THE PROJECT AREA

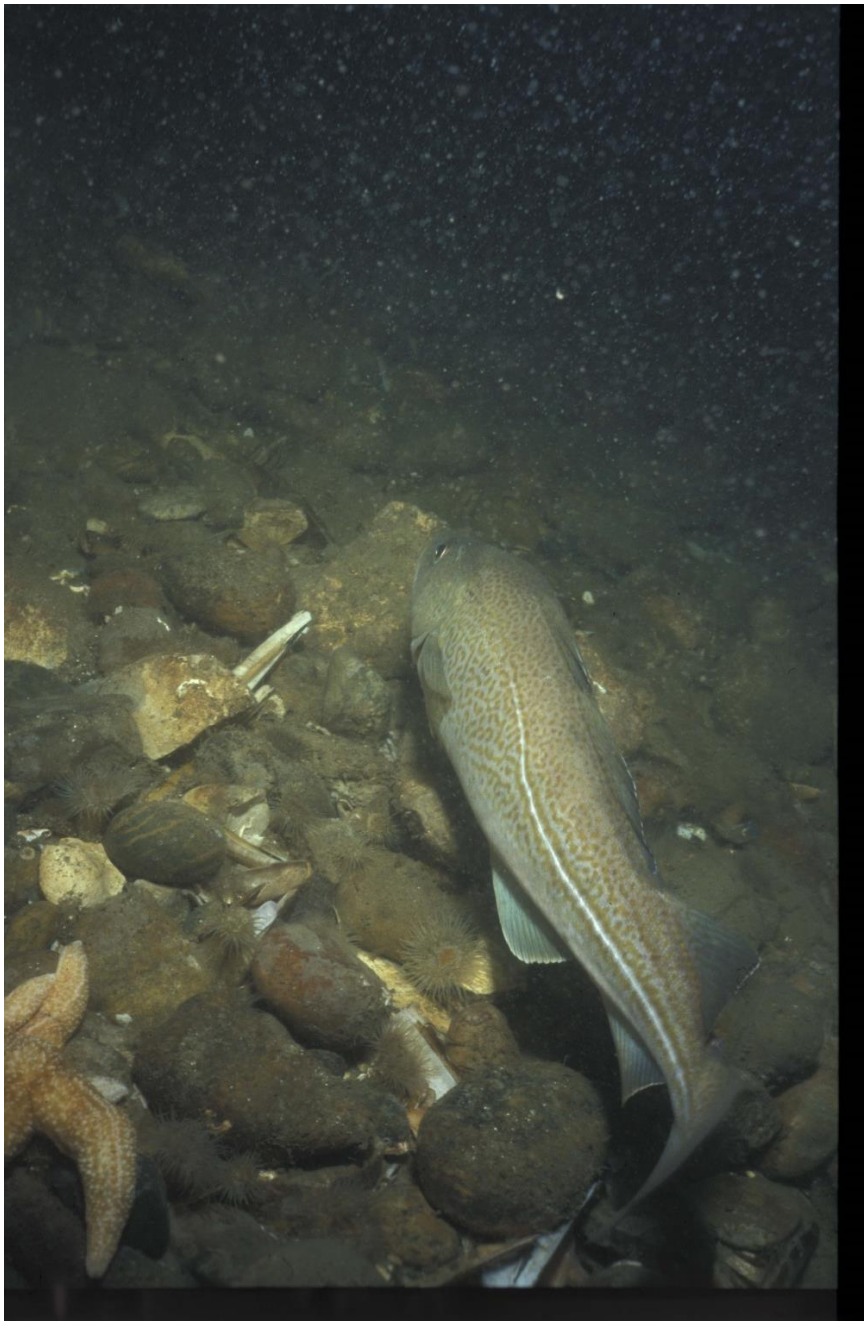
It is anticipated that the planned wind farm area will cover approximately 88 km² of the 160 km² that has been designated as the pre-investigation area. This is equivalent to approximately 2,6% of the ICES rectangle 40F7. Further potential impacts to the fisheries will be along the transect where electrical cables from the wind farm/transformer platform are led into land. The potential impact along the cable transect is from general provisions prohibiting fishing with bottom gear such as trawls from crossing or fishing within a distance of 200 metres on both sides of a submerged electrical cable (Order 939 of 1992). The cable transect is approximately 34 km in total length and outside the pre-investigation area the cable transect runs approximately 15.5 km through ICES rectangle 40F7 and approximately 11.5 km through ICES rectangle 40F8.

To assess the direct impact to the fisheries there is a need for more accurate data concerning the fishing activities in the Horns Rev 3 OWF pre-investigation area than can be obtained from official catch statistics. To accommodate this need, information is used from the mapping of the distribution of the large vessels (>15 m) according to gear types in the entire ICES areas by using the so-called VMS data (Vessel Monitoring System) and supplemented by information collected from fishermen in the area, including some electronic map plotter data showing their fish tracks and fishing grounds.

6.1. The distribution of the fisheries - VMS tracking of fishing vessels

VMS data was obtained for fishing vessels from The Danish AgriFish Agency (NaturErhvervsstyrelsen). Although vessels with a length equal to or more than 15 meters have been required to carry an electronic vessel monitoring system (VMS) since 2002, only VMS data from 2005-2012 are used in this investigation because of implementation problems during the first years. Vessels equal to or greater than 12 meters are required to carry VMS systems as of 2012.

VMS data can be used both to locate the vessel, and to determine the speed with which vessels travel. Estimated vessel speeds, are used to indicate when vessels using different gear are assumed to be undertaking fishing activities. This can be derived from speed frequency diagrams (Fig 6.1.) and confirmed by interviews with fishermen. Based on the assumptions about the speed with which vessels normally undertake certain fisheries (Table 6.1) it is possible to plot where fishing vessels are actively fishing. Furthermore, by combining VMS data with logbook data it is possible to get an indication which commercial species are being fished in particular areas.



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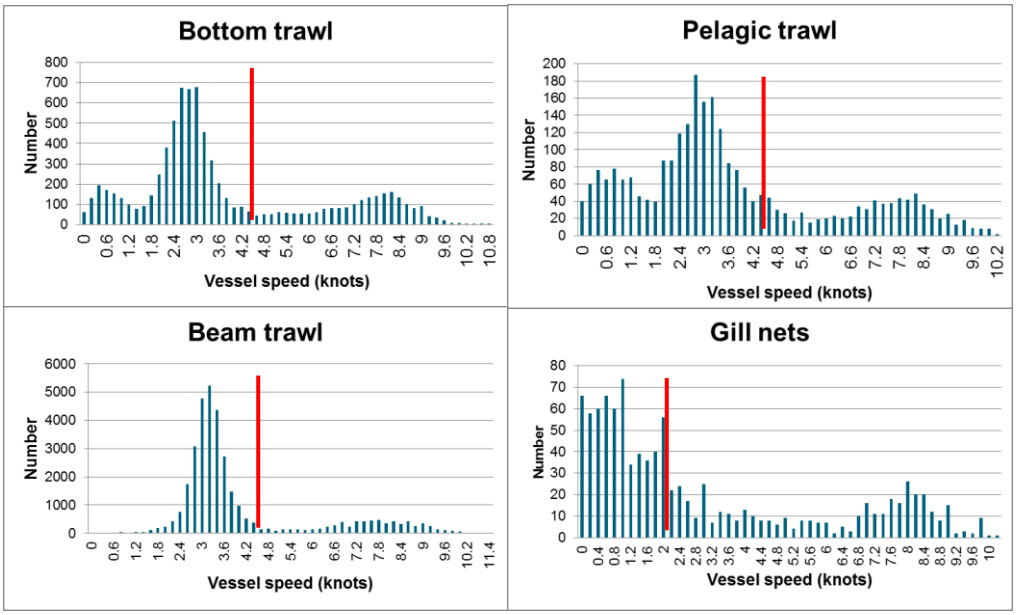

Figure 6.1. Speed frequency diagrams of vessels using different gear (bottom trawl, pelagic trawl, beam trawl and gill nets). Vessel speed is derived from the distance between 2 VMS signals which are received at fixed intervals (typically 1 hour between signals).The frequency pattern is used to determine which speeds vessels are actively fishing such as setting gear or making a haul (lower speeds – left of the red bar) and at which speeds vessels are steaming to and from fishing grounds or ports (higher speeds – right of the red bar).These speeds are confirmed by interviews with fishermen.

All trawling vessels were assumed to be fishing when their speed was between 0.1-4.5 knots. Vessels using gill nets were assumed to be fishing (retrieving nets) when their speed was 2 knots or less. Vessels using seine nets were assumed to be fishing when their speed was 3 knots or less – the speed frequency graph for this gear is not shown in Figure 6.1.

Table 6.1. Vessel speeds during different fishing activities: trawling (bottom, pelagic, beam), Danish seine nets and gill nets.

Gear Type	Vessel speeds during fishing activities
Trawl (bottom, pelagic, beam)	0,1-4,5 knots
Seine nets	< 3 knots
Gill nets	< 2 knots

6.1.1 Bottom trawling

VMS data shows the distribution of the bottom trawling fisheries (primarily targeting sandeel) in the project area designated to contain the Horns Rev 3 OWF is primarily undertaken in the western part of the pre-investigation area. The bottom trawling fishery extends to the north of the Horns Rev 3 pre-investigation area where the distribution is more diffuse, and further offshore to the west and to the south of the Horns Rev 3 pre-investigation area where the sandeel banks are traditionally located (Figure 6.2). In the Horns Rev 3 pre-investigation there is considerably less bottom trawling in the middle and eastern parts (Figure 6.2).

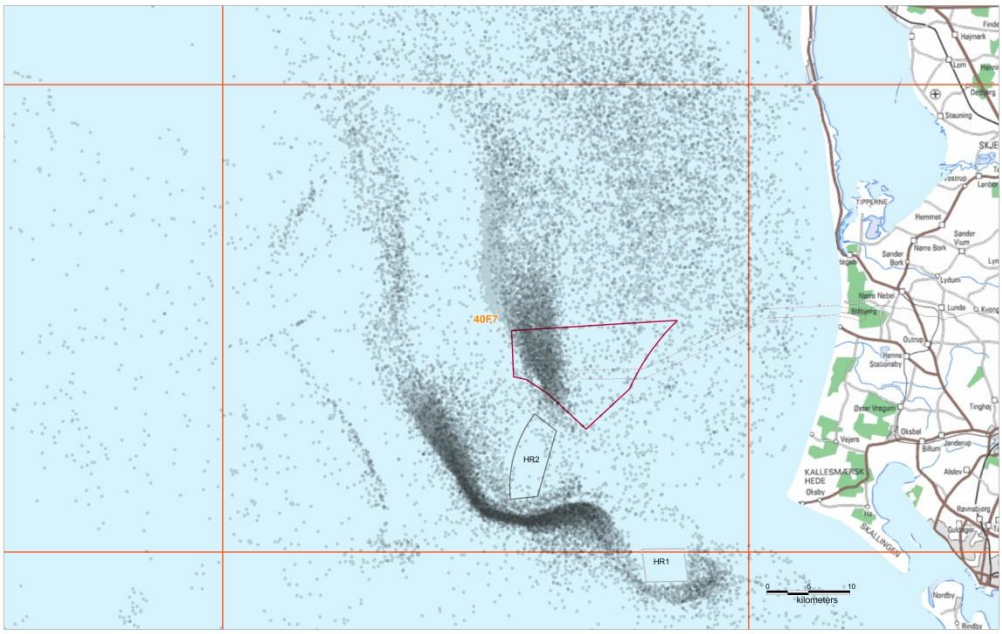

Figure 6.2. The distribution of bottom trawling in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

Data indicate that there is some bottom trawl fishing activity along the cable transect into land, but this is somewhat diffuse in its distribution and can be considered a more random fishing activity.

6.1.2 Beam trawling

According to VMS data the distribution of the beam trawling fishery that almost exclusively target brown shrimp indicate these fishing areas are primarily in the middle and eastern part of the Horns Rev 3 OWF project area. In the regional area of ICES 40F7 and 40F8 the beam trawl fishery is undertaken in a wide area along most of the near coastal areas close to the shores and in an area to the west of the Horns Rev 3 pre-investigation area (Figure 6.3). This indicates that there is quite a lot of beam trawl fishing activity that is undertaken along the cable transect that runs from the transformer platform into land.

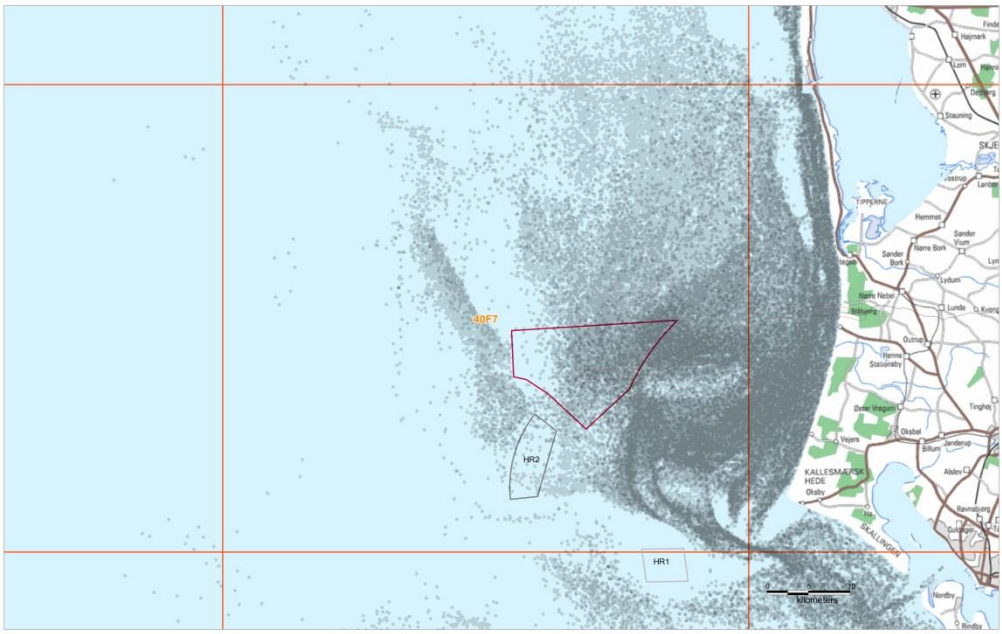

Figure 6.3. The distribution of beam trawl fishery in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

There is almost no beam trawl fishery being undertaken further out to sea in the far western part of the ICES 40F7 rectangle.

Seasonally the beam trawl fishery (targeting brown shrimp) is primarily undertaken in deeper waters (further offshore) during the winter months while the beam trawl fishery is primarily undertaken in shallower waters during warmer periods of the year.

6.1.3 Pelagic trawling

The distribution of the pelagic trawling fisheries that target pelagic fish such as sprat and herring and which have also registered sandeel in their landings, indicate that this fishery is primarily represented in the western part of the Horns Rev 3 pre-investigation area (Figure 6.4) as well as in the northeastern and northern part of ICES 40F7 and 40F8, respectively, and south and southwest of the Horns Rev 3 pre-investigation area. Catch statistics (logbook data coupled to VMS data) indicate that sandeel is the primary catch by pelagic trawls in the western part of the Horns Rev 3 pre-investigation area (see Figure 6.4) and to the south and southwest of the Horns Rev 3 pre-investigation area where traditional sandeel fishing areas are located.

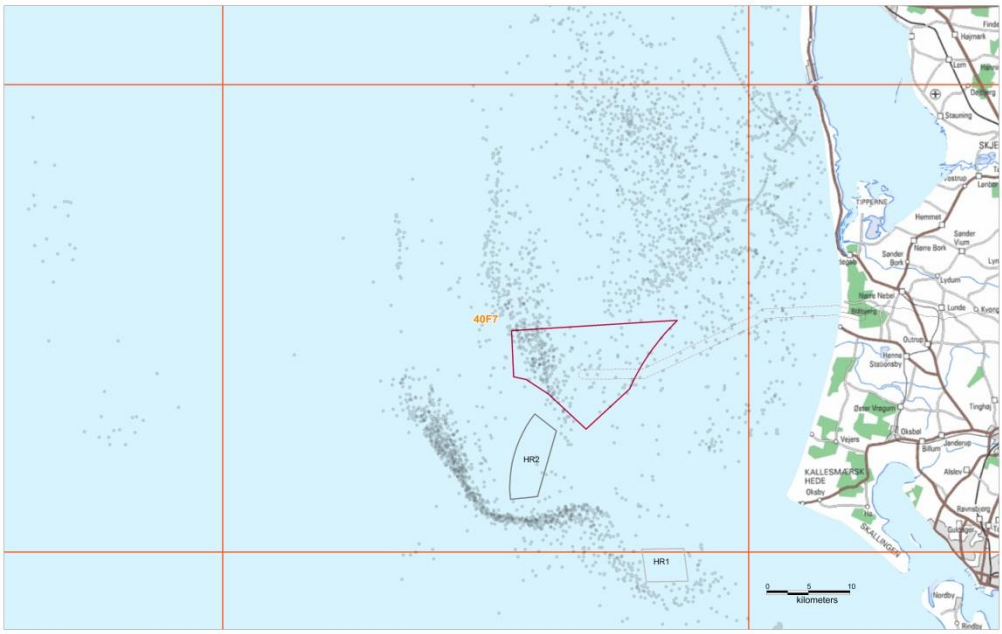

Figure 6.4. The distribution of pelagic trawl fishery in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

6.1.4 Gill nets fishery

The gill net fisheries primarily target cod and different flatfish species on the sea bottom. The distribution of the net fisheries from vessels >15 m (>12 m in 2012) indicate that this fishery is not represented in great abundance within the Horns Rev 3 wind farm area (Figure 6.5). The primary area for the net fisheries in the ICES 40F7 appears to be in northwestern and northern areas. However, it is important to note that the length of many of the net fishing vessels is less than 15m and thus this fishery is not as fully represented in VMS data (vessels >15 m before 2012) as the trawl and seine net fisheries, which are generally conducted from larger vessels.

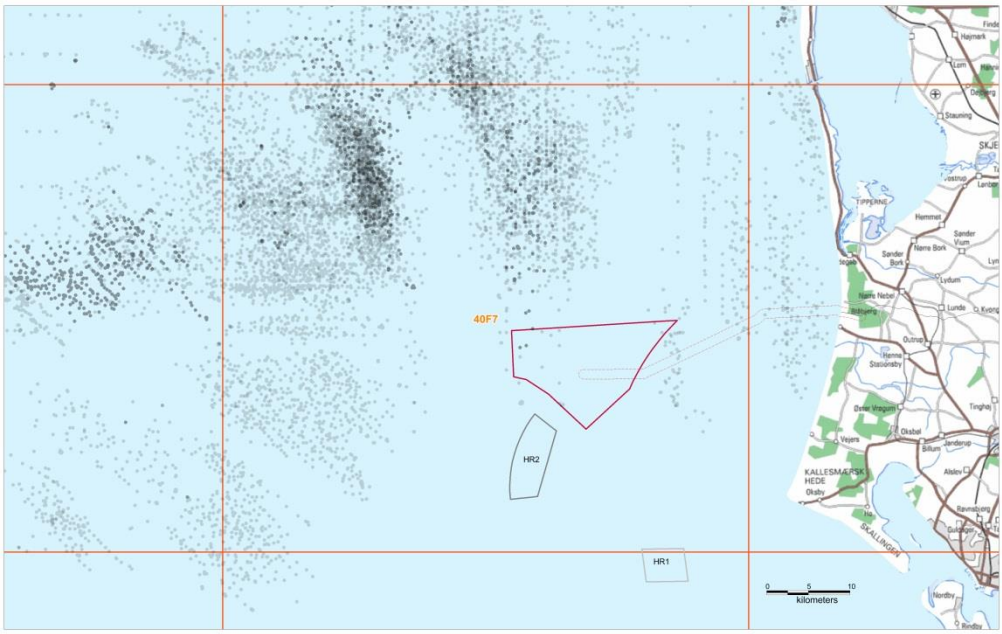

Figure 6,5. The distribution of the gill net fishery in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

6.1.5 Danish seine nets fishery

The Danish seine net fisheries primarily target flatfish and other benthic fish and have not been represented in the fisheries in ICES 40F7 since 2010 and only by a few vessels (2-4 vessels) since 2005. The distribution of their fisheries according to VMS data indicates that this fishery has primarily been undertaken north of the Horns Rev 3 OWF (Figure 6.6) and has not been registered in the Horns Rev 3 OWF project area at any time from 2005 to 2012.

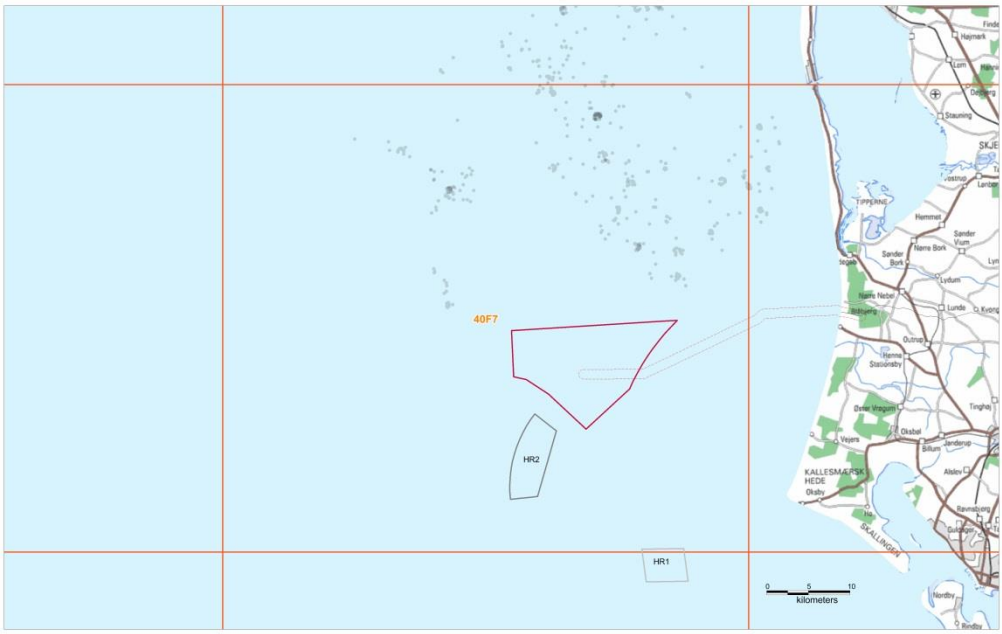

Figure 6.6. The distribution of the Danish seine net fishery in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

6.1.6 Sandeel fishing areas and habitats

The distribution of all the fisheries targeting sandeel indicate that the sandeel fishing areas and sandeel habitats are found in specific areas in the Horns Rev region and only in the western part of the Horns Rev 3 pre-investigation area (Figure 6.7). This data strongly indicates that there is no sandeel fishing in the middle or in the eastern part of the Horns Rev 3 pre-investigation area.

The distribution patterns indicated in the VMS data correlate very well with some previous information on the distribution of the sandeel habitats in the Horns Rev area which is dealt with in greater detail in the following section.

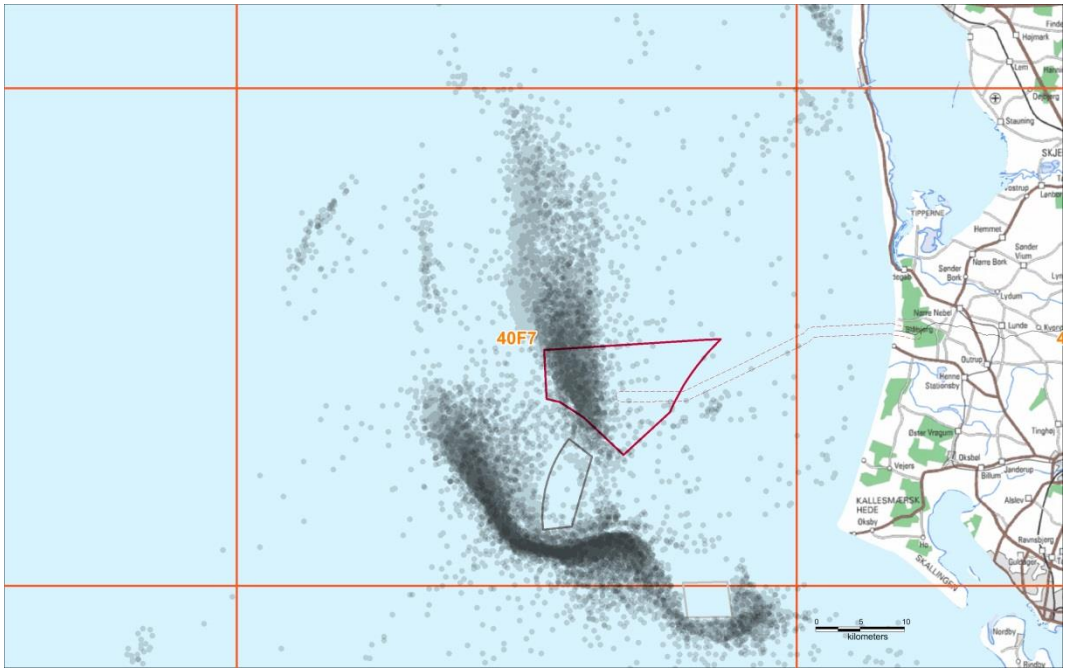

Figure 6.7. The distribution of the fishery (all gear) where sandeel are registered in the catches in ICES 40F7 and 40F8 as derived from VMS data for vessels >15 m (>12 m in 2012) from the years 2005-2012.

6.1.7 Mapping of sandeel fisheries and their distribution

There are 5 species of sandeel that live in the North Sea and all are found in the Horns Rev area (Jensen et al., 2006). Of these there are primarily 2 species (*Ammodytes marinus* and *Ammodytes tobianus*) that are of particular importance to the fisheries in the Horns Rev area.

Sandeel have very specific demands on its habitat as they live much of their adult life partially buried in the sediment only swimming up to feed and spawn. Because of their particular habitat demands sandeel are found almost exclusively in habitats with strong water currents and where the seabed material is primarily sand with only a small amount or almost no finer silt (<6 %). Adult sandeels migrate very little and thus areas where sandeel are found or utilized by the fisheries are often very distinct with more or less distinct boundaries.

The Horns Rev area is an important fishing area for sandeel. Thus, these commercial species have been in considerable focus during the establishment of 2 other offshore wind farms (Horns Rev 1 og Horns Rev 2) in the Horns Rev area. In the assessment of the impacts to sandeel fishing areas during the establishment of these offshore wind farms, there have been several attempts at mapping the distribution of sandeel fishing areas or suitable habitats. This has included using fishery based information by combining the location of fishing vessels when targeting sandeel (DTU Aqua - National Institute of Aquatic resources) as well as modeling information of hydrographic and sediment characteristics to outline probable areas of suitable habitats (Jensen et al. 2006).

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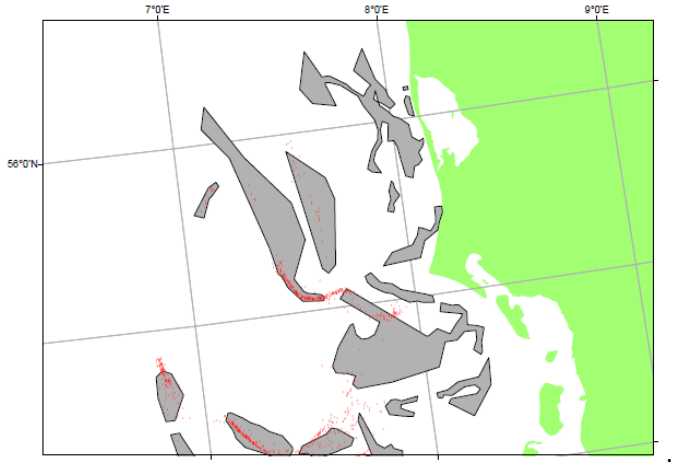

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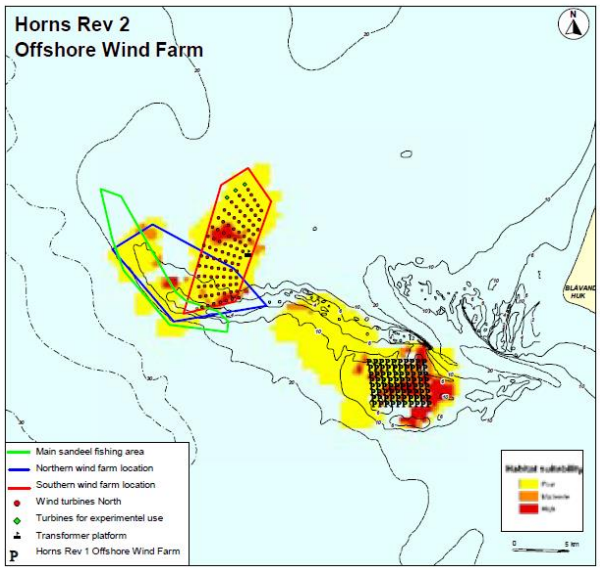


Figure 6. 8. Outlines of the sandeel fishing grounds in the region of Horns Rev derived from VMS data by the DTU Aqua (figure A) and by the modelling of habitat suitability for sandeel (figure B.). Map A. is taken from Krog 2009 and Map B taken from Jensen et. al. (2006).

Although both maps have some common areas of sandeel distribution these results were reviewed by fishermen and fishery organisations and concluded as not being entirely correct. The DTU Aqua maps based on fishery data also included fishing areas for sprat and were lacking some of the sandeel fishing areas, and the map by DHI based on modeling of suitable habitats did not correlate very well with the actual sandeel fishing grounds according to fishermen (Krog 2009). Thus these maps were revised by mapping sandeel fishing areas based on map plotter data showing the location of numerous trawl tracks obtained from 4 experienced sandeel fishermen (Krog 2009) (Figure 6.8.).

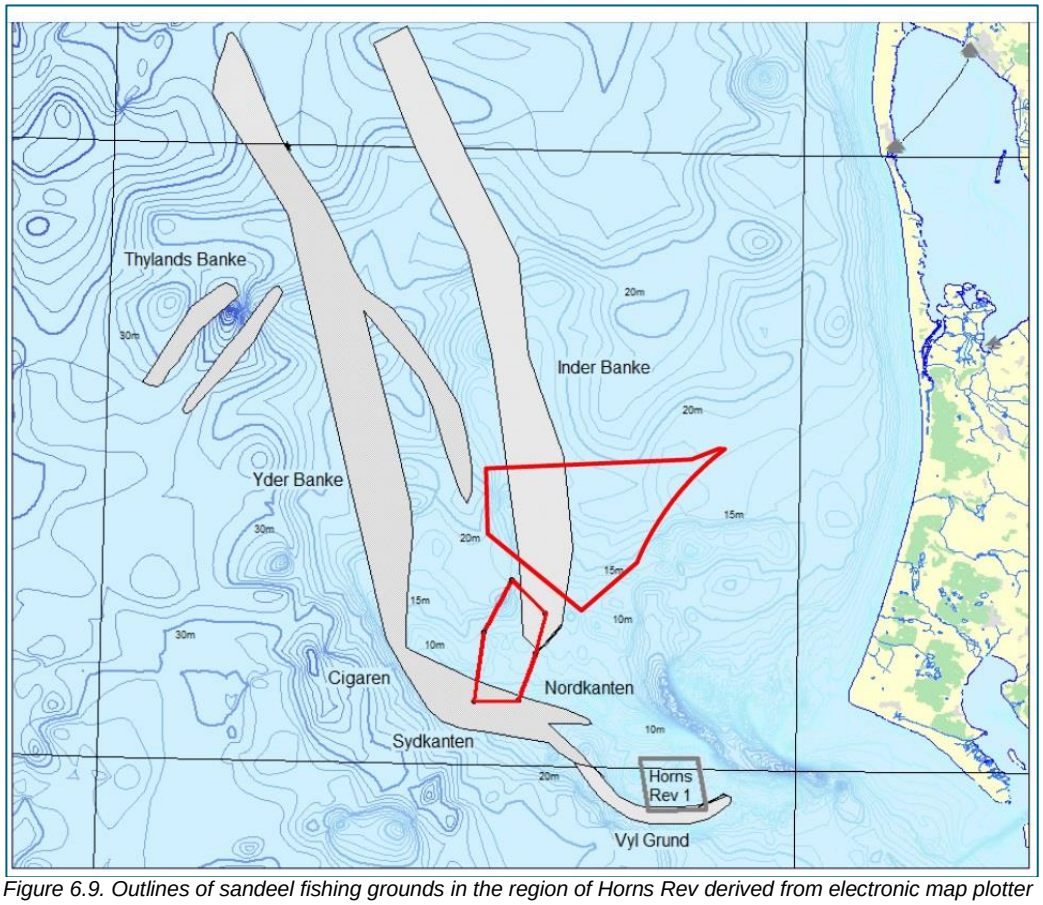


Figure 6.9. Outlines of sandeel fishing grounds in the region of Horns Rev derived from electronic map plotter data from 4 experienced fishermen. The Horns Rev 3 pre-investigation area is the largest area outlined in red to the north of the smaller HR2 area – also outlined in red (modified from Krog 2009).

This map outlined the sandeel fishing grounds representing suitable habitats more clearly and was at the time, considered to be the most thorough description of the fishing areas. Common for the distribution of sandeel fishing areas from fishery data used by DTU Aqua and map plotter data is an area called the Inder Banke which appears to pass through the pre-investigation area of the Horns Rev 3 OWF project area (Figure 6.9).

Since these attempts at mapping the sandeel fishing areas were undertaken, the amount of available VMS data indicating the position of fishery vessels when fishing has increased considerably. This has allowed the possibility of making a map outlining the fisheries from VMS data over a period of 8 years (2005-2012) where only sandeel has been regstered in catches (Figure 6.10.).

These results show a clear outline of where the sandeel fishing areas are located throughout the Horns Rev region, including confirmation that the far western part of the Horns Rev 3 pre-investigation area appears to be a significant fishing ground for the sandeel fisheries. Under the assumption that the fisheries represent a form of sampling of the entire Horns Rev region it is suggested that this fishery data can be used as a proxy for pointing out the areas where specific habitats suitable for sandeel are also located. This information will be used to both assess the impacts to this important fishery in rela-

tion to the establishiment of the Horns Rev 3 OWF in this report, as well as assessing the impacts to sandeel and their habitats in the EIS report assessing impacts to fish (Fish Ecology EIS).

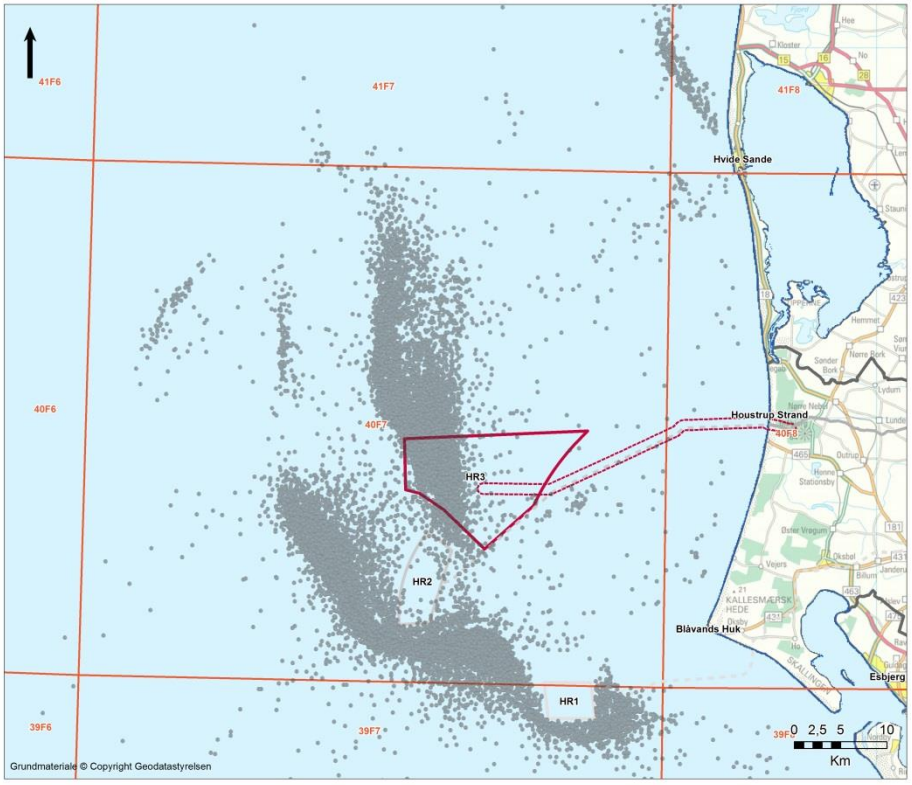


Figure 6.10. Sandeel fishing grounds in the region of Horns Rev including the Horns Rev 3 pre-investigation area derived from VMS data linked to logbook data showing the position of fishing vessels with only sandeel in their catch.

6.2. Mapping of the fishing distribution from map plotter data

Brown shrimp fishery

The trawl tracks on map plotter data from brown shrimp fishermen indicate that their distribution extends over a wide area, but apparently does not occur as often in the far western part of the Horns Rev 3 wind farm area (Figure 6.11). Thus, the distribution of the shrimp fisheries from this map plotter map supports the same distribution of the shrimp fisheries demonstrated from analysis of the VMS data (Figure 6.3). It should be noted that this map plotter data is only a sample of the trawl tracks from the shrimp fisheries and does not represent all the fishing areas utilized by this fishery.

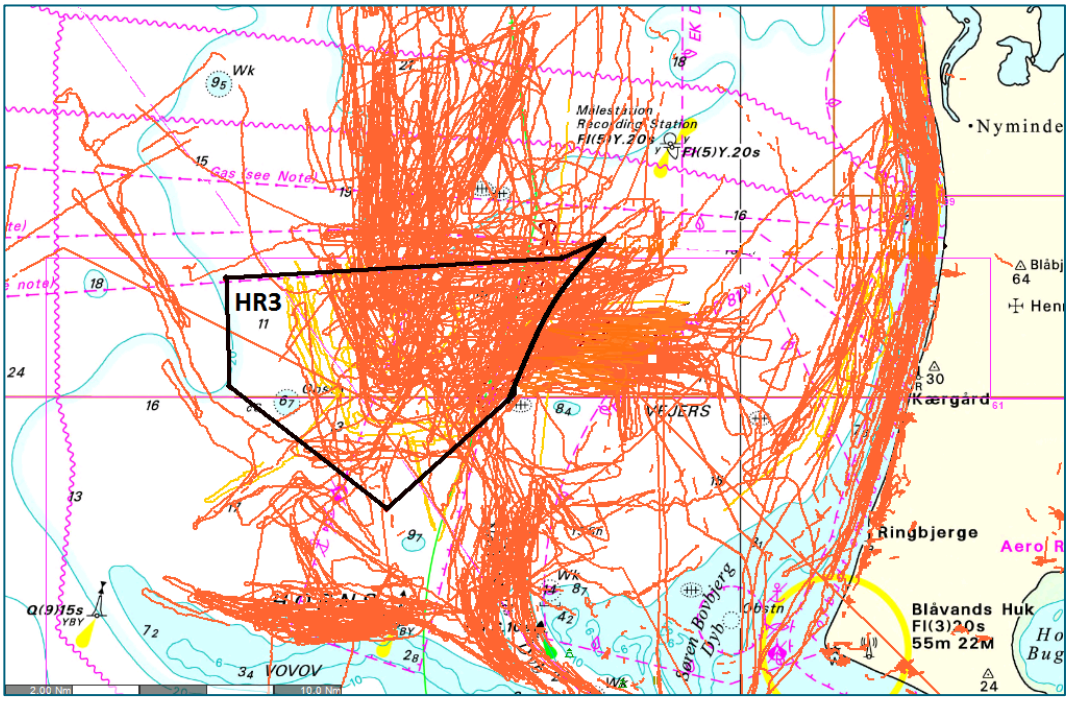


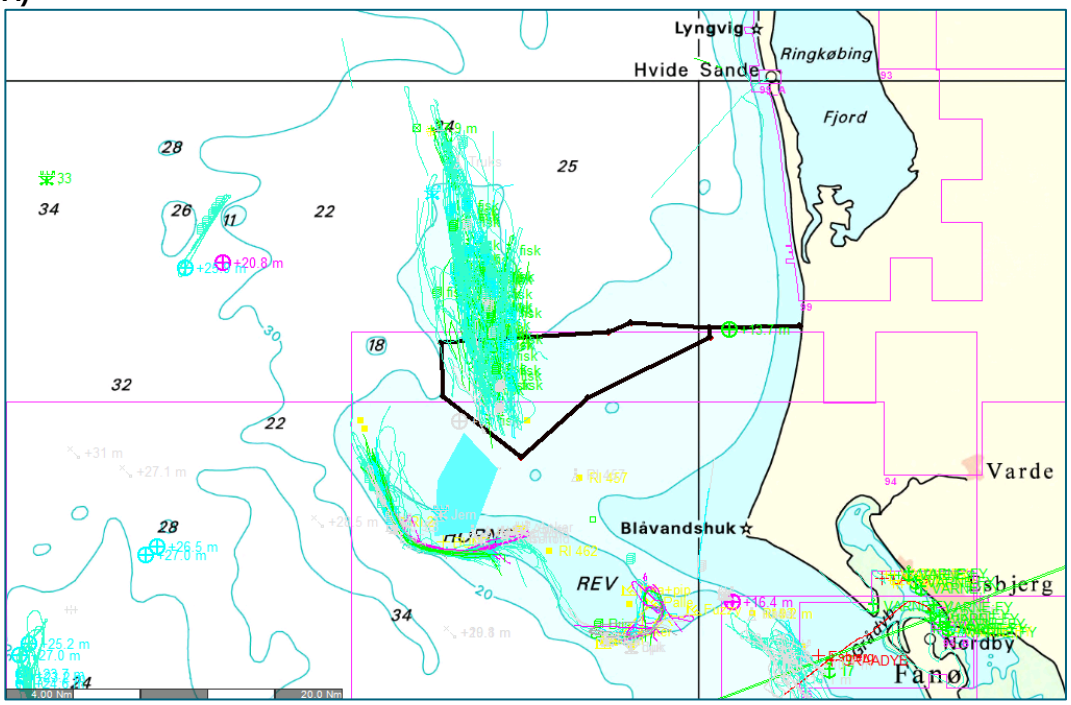
Figure 6.11. Map plotter data from fishermen in Hvide Sande and Esbjerg showing trawl tracks from beam trawls (brown shrimp fishery).

Sandeel fishery

The trawl tracks from map plotter data showing the areas where sandeel have been caught are shown in Figure 6.12 A and B. The map plotter from Figure 6.12 A indicates that the fisheries targeting sandeel are undertaken almost exclusively in the western part of the Horns Rev 3 pre-investigation area. A similar distribution of the sandeel fishery primarily is also shown in Figure 6.12 B although with much more “noise”. This data generally supports the same distribution of the fisheries targeting sandeel in Horns Rev 3 pre-investigation area as observed by the bottom and pelagic trawl fisheries targeting this species (shown in Figure 6.4 and Figure 6.7).

Map plotter data is often shared between fishermen targeting similar species and using the same gear types. However, although this data can give a good indication of where vessels fish and their routes to and from fishing grounds, if plotters are running continuously, map plotter data will show not only where vessels are actively fishing, but also location data for the period when vessels are steaming to and from fishing grounds and ports. Furthermore, it is not possible to determine precisely which species are being targeted during the fishing activity and thus some map plotter tracks may indicate more than one fishing activity.

A)



B)

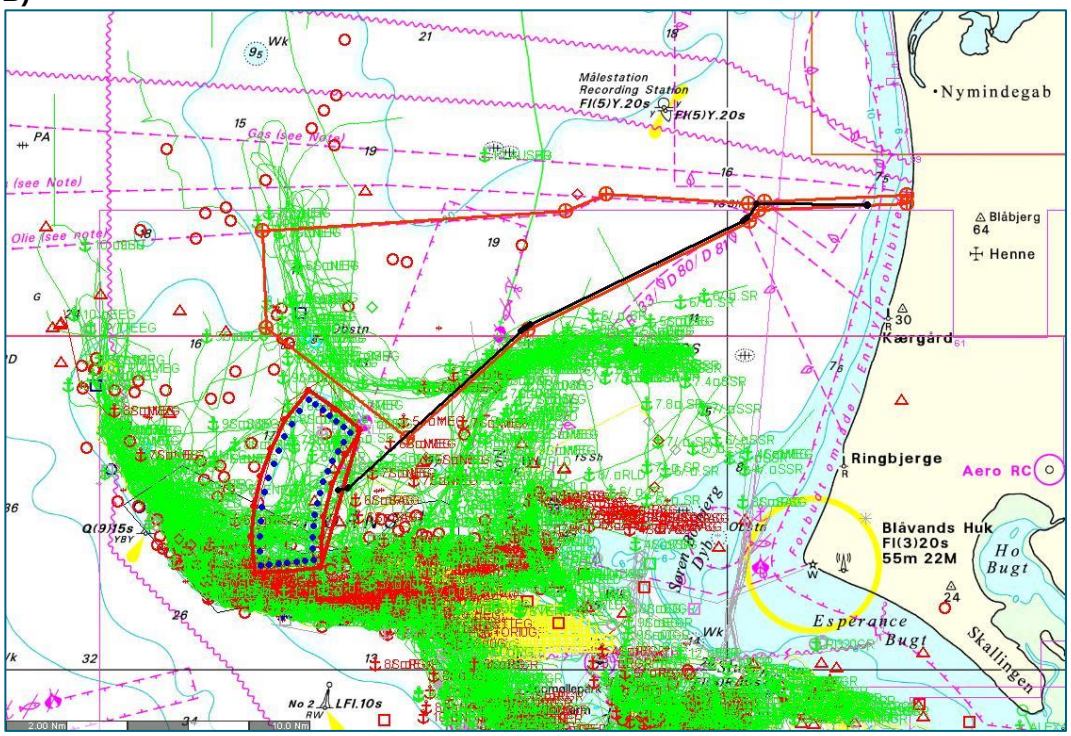


Figure 6.12. Map plotter data from a fishermen (A) and material from the Danish Fishermen´s Association (B) showing trawl tracks from the fisheries targeting sandeel.

7. FISHERY STATISTICS IN HARBOURS NEAR HORNS REV 3 PROJECT AREA

Catches from ICES 40F7 and 40F8 from Danish fishing vessels are landed in numerous harbours throughout Denmark (Table 7.1). The catches from ICES 40F7 are, however, primarily landed in the harbours of Hvide Sande, Esbjerg, Thyborøn. Hanstholm and Hirtshals whereas catches from ICES 40F8 are primarily landed in the harbours of Hvide Sande and Esbjerg (Table 7.1).

The most important landing harbour for both ICES areas is Hvide Sande with annual landings amounting to between 59-98% (2231-17726 tonnes) from the catches in ICES 40F7 and between 10-97% (401-2206 tonnes) from ICES 40F8, respectively. Landings are also relatively high in Esbjerg and on occasion Thyborøn and Hanstholm (Table 7.1).

Table 7.1. The harbours where the catch (tonnes) from ICES 40F7 and ICES 40F8 of Danish vessels ≥10 meters are landed in the period 2002–2012.

ICES 40F7 - Landings (tonnes) in harbours

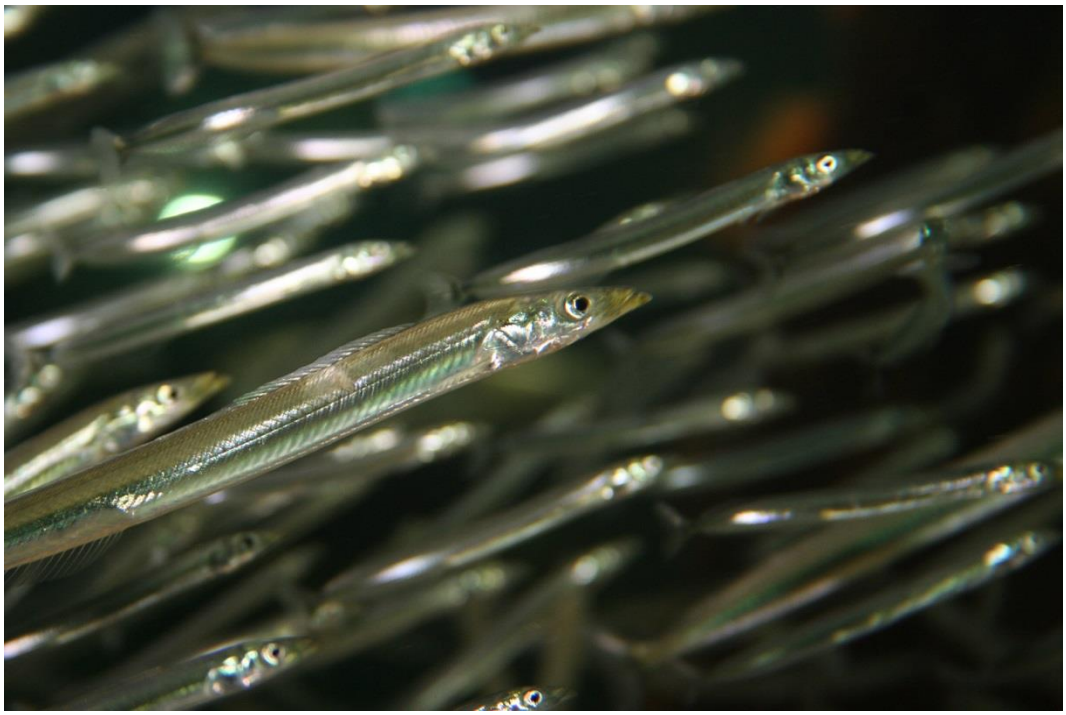
Landing harbour	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hvide Sande	5919,0	4915,0	13127,0	4432,7	7413,8	2230,9	5240,9	4754,7	17726,5	9052,6	7871,9
Esbjerg	1265,4	529,1	1918,8	268,9	509,9	1483,0	44,8	31,6	40,5	99,2	83,2
Thyborøn	796,9	459,7	1731,6	295,7	692,1	6,7	34,4	7,7	1666,0	9,7	40,5
Hanstholm	9,5	138,8	81,8	32,6	21,6	0,4		265,0	1063,4	177,0	105,5
Hirtshals	3,1	6,5	36,1					5,0	581,5	46,5	11,0
Havneby	40,6	75,2	9,2	49,7	47,1	77,4	7,4	1,2	3,3	5,8	
Thorsminde	8,0	30,1	70,8	207,6	38,2	3,9	2,2		6,7		
Lemvig	62,7	9,5	7,7	3,4							
Skagen		29,1									
Lauwersoog		22,1				0,6	27,3	48,4		1,8	
Strandby (nordjylland)			1,3								5,0
Den helder									0,2		
Gilleleje		0,1									
Harlingen						2,0					
Hundested	1,8										
Klegod	0,9										
Schevingen			1,1								
Sønderborg											35,0
Søndervig				0,3							
Urk								0,3			

ICES 40F8 - Landings (tonnes) in harbours

Landing harbour	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hvide Sande	559,5	640,6	400,6	1068,4	1091,9	927,7	649,5	628,8	432,8	670,2	2205,6
Esbjerg	4837,6	1018,7	283,0	261,6	244,8	391,4	954,7	160,1	115,8	95,0	66,6
Thyborøn	10,0	4,7	1,3		0,2	3,1	274,8		3,0	2,0	
Hanstholm	0,9	622,4	0,3	97,0		0,3		0,2	20,0	2,0	
Hirtshals		7,4	9,5								
Havneby	63,8	40,8	13,8	60,7	41,3	46,7	22,1	20,6	11,6	1,5	4,6
Thorsminde	3,4	10,7	0,4	1,8		0,8	0,6		1,9		
Lauwersoog	2,1								6,5		
Falen		0,1									
Lerwick				0,2							
Ringkøbing		1,4	2,8								
Spodsbjerg											5,2

According to basis harbour statistics, the catches from ICES 40F7 and 40F8 (the Horns Rev 3 region) are landed by Danish vessels that have their home in a large number of harbours (Table 7.2). However, the majority of the catches from ICES 40F7 and ICES

40F8 are also from Danish vessels that have their home (basis) harbour near the planned offshore wind farm in either Hvide Sande (between 32-84%) or Esbjerg (1-71%) (Table 7.2). There are however, some vessels from distant harbours, such as vessels from Sønderborg, that occasionally catch a large proportion (between 8-20% over the last 4 years) of the landings from ICES 40F7 (Table 7.2). These large catches are primarily of industrial fish (sprat and tobis), which was the case for the fishing vessel or vessels from Sønderborg.



Sandeels

Table 7.2. Landings (tonnes) from ICES 40F7 and 40F8 distributed according to the basis harbours of the fishing vessels (≥10 meters).

ICES 40F7 - Landings (tonnes) according to basis harbours

Basis harbour	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hvide Sande	5084.8	3221.3	7821.2	3725.9	5000.8	1753.4	4510.0	2495.4	9626.0	3043.8	2878.7
Esbjerg	890.2	262.3	727.6	201.6	364.2	1508.9	28.9	34.4	465.4	472.7	242.8
Thyborøn	869.1	808.6	1798.9	276.7	1006.6	220.6	117.1	250.2	1759.5	369.9	414.9
Thorsminde	8.4	32.2	86.4	217.4	54.8	42.4	17.4	9.5	13.8	62.7	36.5
Hanstholm	19.5	112.6	81.0	47.2	28.6	0.4	37.0	35.2	1575.4	940.7	964.0
Havneby	43.8	48.3	20.4	81.2	44.8	92.5	16.2		3.6	5.8	
Oddesund nord	22.1	22.0	86.2	64.4	117.5	89.3	39.5	20.3	30.0	91.4	53.3
Sønderborg	2.5		684.0		272.0		387.0	1007.0	2111.0	1097.0	620.0
Hirtshals		6.5	40.0			0.6		220.5	966.0	95.5	142.5
Strandby (nordjylland)		162.0	100.0	1.3	175.0			559.0	1483.5	1395.0	642.6
Gilleleje	147.0	498.1	1568.0	590.0	785.0	85.0	195.0	204.0	323.0	473.0	244.0
Lemvig	11.7	9.7	5.4	16.6	0.2				38.9	15.2	32.7
Kerteminde	170.8	28.6	658.3	26.1	410.5			46.0	441.0	271.0	388.0
Bønnerup	253.0	247.0	455.6	6.1	10.1				161.0	9.0	17.0
Hundested	213.7	25.6	137.0								
Nexø	11.9	61.1	16.0	11.6	24.3	2.9		127.5	337.0	242.0	
Grenå		148.8	723.3	5.3	259.0					148.0	239.0
Skagen											302.0
Bogense	268.7	360.0	568.9		38.0		0.0				
Fejø		3.0	14.0	15.6	13.0	7.9	9.0				
Ebeltoft	20.5	93.0	393.6								
Klintholm havn			405.0								
Bagenkop	2.0								30.0		
Frederikshavn										116.5	142.0
Glyngøre									188.0	7.0	
Hals		58.1	241.2								
Havnsø	17.9										
Kalvø			136.0					105.0			509.0
Karrebæksminde	0.4				5.6					59.5	
Køge	4.8	1.1									
Lundeborg		0.1							248.0	121.0	111.0
Rødvig				3.9	71.6				690.5	56.0	172.0
Spodsbjerg			0.7		0.8				0.5		
Tejn	44.0								280.0	52.0	
Østerby	0.0	2.8	56.0								
Årø	0.0		155.0		39.0				316.0	248.0	

ICES 40F8 - Landings (tonnes) according to basis harbours

Basis harbour	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hvide Sande	340.8	418.0	318.8	852.1	660.7	551.8	463.1	459.8	308.7	368.9	1025.8
Esbjerg	3872.8	847.3	266.3	234.6	210.7	442.8	1211.8	114.0	110.2	128.6	32.0
Thyborøn	80.7	55.5	2.3	47.8	160.3	146.0	98.0	71.0	45.6	63.7	49.3
Thorsminde		104.7	86.1	109.1	107.1	109.1	64.0	49.6	69.2	48.9	13.2
Hanstholm	0.9	622.4		80.0		0.3				2.0	145.0
Havneby	1062.0	236.8	26.5	88.8	27.7	47.5	24.5	2.9	2.5	1.5	
Oddesund nord	9.4	44.4	1.7	76.4	69.9	55.5	40.3	31.6	18.9	40.0	39.0
Sønderborg	0.3							65.0		8.0	565.0
Hirtshals		7.1	9.5								
Strandby (nordjylland)						13.6		8.0	20.0	70.0	
Lemvig					0.2				16.5	16.1	13.4
Kerteminde					65.0						
Bønnerup				0.8						23.0	
Nexø	1.6							7.8			
Grenå	1.2										199.0
Skagen	0.1										70.0
Bogense	107.0	10.0									
Kalvø											60.0
Rødvig				0.1	76.5						54.0
Spodsbjerg						3.4					16.3

For more details on the catches of specific commercial species for the 2 main harbours Hvide Sande and Esbjerg see the following section on landing statistics for these 2 harbours in the near vicinity of the Horns Rev 3 OWF area.

7.1. HVIDE SANDE

Hvide Sande is one of the most important fishing harbours with regards to the region (ICES 40F7 and 40F8) around Horns Rev 3 pre-investigation area and have a significant number of associated fishing vessels (see Table 7.1). Since 2002, however, the number of large vessels (>10 meters) has decreased by more than 50%, and over the last 4 years have fluctuated between 45-48. The number of small vessels (<10 meters, typically gill net boats) that are registered in Hvide Sande has ranged between 89-130 vessels and is currently at 121 (2012).

Table 7.3. Number of vessels registered in Hvide Sande from 2002-2012 by size groups (<10 m and >10 m).

Hvide Sande no. of vessels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<10 meter	130	115	98	90	89	97	102	109	116	113	121
>10 meter	101	84	85	87	79	71	65	48	47	47	45

The total landings and value from the landings in Hvide Sande by vessels fishing in the ICES 40F7 amounted to between 2,200-17,700 tonnes and 11.6 – 34.7 million DKK from 2002-2012. Landings and value of landings in Hvide Sande from vessels fishing in ICES 40F8 amounted to 400-2,200 tonnes and 5.4 – 20.6 million DKK from 2002-2012 (Table 7.4 and Table 7.5). Landings of the industrial fish sandeel and sprat along with the shellfish brown shrimp from ICES 40F7 and 40F8 and the Horns Rev 3 region dominate the landings and value of landings in the harbour of Hvide Sande. These are supplemented by a broad variety of flatfish species with plaice generally being the most dominant and the valuable flatfish species of turbot and sole. These valuable flatfish species add to the total value of the landings because of their high price per kilo.

The landings (kg) by small fishing vessels <10 m in Hvide Sande from 2002-2012 is given in Table 7.6. Landings by small vessels (<10 m) in Hvide Sande comprise a large variety of both marine and freshwater fish species. The total annual amount of landings have varied between 28 to 46.7 tonnes from 2002-2012, which is less than 1 % of the total landings by fishing vessels in Hvide Sande. Landings are consistently represented by a variety of flatfish species, cod probably because this fleet is strongly represented by gill net fishermen. Furthermore, there are a number of freshwater species in the landings where whitefish, perch and silver eel are some of the most dominating. These represent the fisheries in the nearby brackish fjords.

Table 7.4. Total landings (tonnes) in Hvide Sande from ICES 40F7 and 40F8 in the period from 2002-2012 by vessels >10 meters.

Landings (tonnes) Hvide Sande	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
40F7	5919,0	4915,0	13127,0	4432,7	7413,8	2230,9	5240,9	4754,7	17726,5	9052,6	7871,9
Sandeel	4897,0	3850,5	11587,1	643,0	6401,1	886,5	4283,5	3576,0	16939,7	8070,0	6396,9
Sprat	377,5	296,0	909,5	2762,0	209,0	415,0	404,0	730,5	449,0	429,0	1085,2
Herring	129,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	93,9	24,0	47,9	34,5	24,9	40,4	24,1	12,5	15,7	7,8	5,4
Plaice	253,0	461,8	316,3	514,3	339,5	184,8	204,5	168,4	22,8	94,6	45,9
Turbot	16,1	3,0	6,6	18,1	15,7	7,8	42,4	25,0	6,6	14,4	4,0
Common sole	48,9	15,8	12,6	13,2	5,5	12,8	12,1	11,4	7,5	10,8	1,7
European flounder	2,0	3,1	2,9	9,3	10,3	1,9	16,2	2,0	0,0	0,5	1,0
Dab	4,7	18,8	32,3	45,0	24,9	16,7	34,4	13,8	1,2	4,6	2,0
Brill	0,7	0,1	0,6	0,8	0,9	0,3	0,0	0,0	0,0	2,5	0,7
Witch flounder	0,0	0,0	0,0	0,5	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,0	1,7	1,7	0,8	0,7	0,2	0,0	0,0	0,0	0,0	0,1
Grey gurnard	0,0	0,1	1,7	1,6	2,8	0,7	6,1	2,4	0,2	0,8	0,2
Yellow gurnard	0,2	0,1	0,2	0,2	0,2	0,0	1,7	0,1	0,5	0,2	0,2
Hake	2,6	4,0	2,0	3,7	3,7	0,3	3,5	0,5	0,0	0,1	0,1
Haddock	0,9	1,9	0,5	0,0	2,0	0,0	0,0	0,3	0,0	0,0	0,0
Whiting	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Saithe	0,0	0,0	0,1	0,0	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Horse mackerel	0,0	0,0	0,0	0,0	30,0	0,0	0,0	0,0	0,1	0,0	0,0
Brown shrimp	63,3	207,1	190,1	365,5	325,0	656,3	198,8	206,4	281,3	414,8	326,8
Other shellfish	16,3	16,5	7,0	7,9	9,8	3,1	1,4	1,6	0,3	0,4	1,0
Unspecified	12,2	10,6	7,9	12,2	7,4	4,0	8,1	3,9	1,9	2,2	0,7
40F8	**559,5**	**640,6**	**400,6**	**1068,4**	**1091,9**	**927,7**	**649,5**	**628,8**	**432,8**	**670,2**	**2205,6**
Sandeel	107,0	10,0	0,0	0,0	123,5	0,0	0,0	73,0	0,0	74,0	0,0
Sprat	0,0	50,0	0,0	73,0	65,0	28,0	67,0	52,0	0,0	220,0	1894,0
Herring	0,0	0,0	0,0	151,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	4,7	1,1	25,8	36,0	26,6	14,1	0,9	0,1	0,0	0,0	0,1
Plaice	5,4	11,6	0,1	9,9	2,1	6,2	1,2	9,9	1,4	0,2	30,6
Turbot	1,8	0,0	0,3	2,6	0,3	1,6	0,0	0,4	4,8	0,7	3,2
Common sole	0,7	0,5	0,2	0,5	0,1	0,7	0,0	2,2	0,1	0,0	0,6
European flounder	0,3	0,3	1,0	5,8	0,5	0,3	0,0	9,4	0,1	0,0	1,5
Dab	0,0	0,3	0,3	10,3	3,1	2,5	0,4	0,4	0,0	0,0	6,4
Brill	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,5
Lemon sole	0,0	0,3	0,1	0,1	0,1	0,0	0,0	0,1	0,0	0,0	0,0
Grey gurnard	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1
Hake	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0
Haddock	0,0	0,5	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	437,4	562,9	369,6	777,5	869,7	860,0	580,0	480,6	425,1	374,9	267,4
Other shellfish	1,2	1,7	0,0	0,0	0,0	13,9	0,0	0,0	0,0	0,1	0,1
Unspecified	0,8	1,2	2,3	1,6	0,9	0,4	0,1	0,2	1,4	0,0	1,2

Table 7.5. Total value (1000 DKK) of the landings (tonnes) in Hvide Sande from ICES 40F7 and 40F8 in the period from 2002-2012 by vessels >10 meters.

Value (1000 DKK) Hvide Sande	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
40F7	17859,5	16808,6	19256,7	21548,6	21311,9	22644,6	17842,4	11622,0	34758,5	22654,2	24110,1
Sandeel	4211,4	3080,4	8111,0	450,1	6721,2	1063,8	3855,2	3111,1	27442,3	12992,7	11642,4
Sprat	396,4	257,5	673,0	2264,8	227,8	427,5	448,4	694,0	736,4	690,7	2485,1
Herring	349,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	2259,5	592,8	1155,1	869,8	716,9	1302,6	701,0	286,6	398,3	220,6	144,0
Plaice	3350,3	6802,0	4251,0	7446,4	4997,6	2713,1	2765,0	1690,8	223,5	1005,4	476,9
Turbot	1006,5	258,3	440,1	1397,5	1270,8	609,1	3059,4	1527,9	459,0	1121,4	276,7
Common sole	3287,0	1107,8	855,4	984,9	501,7	1123,8	942,8	758,9	621,9	944,6	130,7
European flounder	21,2	29,4	30,2	75,4	99,6	17,9	144,5	20,5	0,5	6,5	11,6
Dab	38,5	149,5	238,9	359,8	192,4	125,2	228,8	96,3	7,7	35,1	14,7
Brill	38,2	2,8	22,8	35,9	49,9	16,3	0,7	0,0	2,0	129,0	30,2
Witch flounder	0,0	0,0	0,0	3,2	0,8	0,4	0,0	0,5	0,0	0,0	0,0
Lemon sole	0,1	14,0	5,8	5,5	4,9	1,0	0,2	0,5	0,0	0,3	0,6
Grey gurnard	0,0	1,0	5,8	10,5	19,1	3,2	48,0	31,7	1,2	10,3	2,8
Yellow gurnard	0,6	0,9	0,8	1,3	1,3	0,0	13,1	1,3	3,5	2,9	2,7
Hake	8,4	33,5	6,9	24,6	25,1	1,4	27,5	6,4	0,0	0,7	1,3
Haddock	2,9	15,4	1,6	0,0	13,3	0,0	0,0	3,5	0,0	0,0	0,0
Whiting	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0
Saithe	0,0	0,0	0,3	0,0	0,7	0,2	0,0	0,0	0,0	0,0	0,0
Horse mackerel	0,0	0,0	0,0	0,0	201,6	0,0	0,0	0,0	0,5	0,0	0,0
Brown shrimp	1472,7	3380,2	3184,4	7153,3	5599,8	15067,8	5509,9	3300,7	4846,1	5459,0	8870,6
Other shellfish	1376,5	994,8	246,0	384,6	617,5	154,0	33,7	38,4	2,1	5,2	12,1
Unspecified	40,0	88,3	27,3	81,0	50,0	17,3	64,1	53,0	13,4	29,9	7,8
40F8	10725,7	9605,9	6871,4	17054,1	16051,2	20587,7	16189,2	8182,2	7689,5	5477,7	12287,1
Sandeel	92,0	8,0	0,0	0,0	129,7	0,0	0,0	63,5	0,0	119,1	0,0
Sprat	0,0	43,5	0,0	59,9	70,9	28,8	74,4	49,4	0,0	354,2	4337,3
Herring	0,0	0,0	0,0	344,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	114,0	26,9	623,0	908,1	764,9	454,4	24,7	1,4	0,4	0,0	1,8
Plaice	71,4	170,8	1,0	143,6	31,1	91,7	16,2	99,0	13,4	2,0	317,9
Turbot	114,4	2,3	16,7	201,3	27,0	123,5	0,0	24,7	334,5	51,5	224,2
Common sole	46,9	36,9	15,6	39,3	7,7	60,8	0,0	147,5	5,6	0,0	44,0
European flounder	3,3	3,0	9,8	46,8	5,2	2,7	0,0	97,9	1,9	0,0	17,4
Dab	0,2	2,8	2,5	82,1	24,1	19,0	2,5	3,0	0,0	0,2	47,0
Brill	7,9	0,0	0,0	1,4	0,0	0,0	0,0	0,0	0,0	15,3	22,7
Lemon sole	0,0	2,2	0,2	0,8	0,6	0,0	0,0	0,8	0,0	0,0	0,0
Grey gurnard	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,1
Hake	0,0	0,7	0,0	0,0	0,0	0,0	0,0	6,7	0,0	0,0	0,1
Haddock	0,0	3,8	3,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	10183,5	9186,4	6191,1	15215,8	14984,1	19745,4	16070,5	7684,8	7323,9	4933,7	7258,3
Other shellfish	89,5	108,4	0,0	0,1	0,0	59,6	0,2	0,3	0,0	1,4	1,0
Unspecified	2,6	10,2	8,0	10,7	5,8	1,7	0,8	3,1	9,8	0,3	14,5

Table 7.6. Total landings (kg) in Hvide Sande from small fishing vessels (<10 m) in the period from 2002-2012.

Hvide Sande	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total (kg)	35039	34955	40886	42439	43991	46712	44125	28681	30229	33285	35996
Atlantic cod	1789	1984	459	832	2438	1707	2197	2516	1374	1075	1219
Haddock	1396	112	63	3	0	2	0	0	0	6	0
Plaice	2393	2195	753	3615	1584	664	3202	671	3795	2027	1597
Dab	2751	2996	2292	3097	4341	2650	2532	3633	1698	2500	4020
Flounder	4783	4667	6107	5511	3442	2931	1040	1814	3555	6629	5426
Sole	3445	2965	2740	1607	1635	2735	1222	1065	856	1643	1368
Turbot	1629	1861	2213	2093	1870	1270	1471	3258	1613	928	1677
Brill	2470	731	1343	2220	2056	1829	2128	890	2237	638	1131
Lemon sole	596	1448	791	380	345	504	89	69	435	33	619
Halibut	249	11	11	6	13	4	15	3	17	0	7
Hake	653	938	429	1229	655	448	593	150	853	69	49
Herring	880	442	1883	985	2258	1614	2735	2413	3383	992	2838
Sea trout	1	31	68	38	64	1186	636	20	126	9	0
Crab	1652	3164	2553	1277	3375	2944	4041	2043	2365	2185	1764
Brown shrimp	468	671	1307	1391	897	520	738	1385	503	87	0
Lobster	74	31	73	44	32	13	14	9	24	512	110
Silver eel	0	163	126	140	15	133	191	202	1013	634	1975
Gule Ål	1	8	37	287	49	242	327	28	166	60	383
Garfish	215	162	847	414	2705	866	1118	118	905	561	1188
Lumpsucker	21	475	94	241	175	142	13	21	296	280	100
Lumpsucker_male	43	855	78	733	505	194	10	16	789	654	133
Knurhane	405	384	284	79	33	1043	424	0	0	4	39
Rød Knurhane	1	0	0	10	0	81	12	391	454	363	124
Pike	174	210	1512	1349	987	1712	1472	793	324	456	711
Skalle	843	68	3391	2996	2690	3277	2792	29	0	206	784
Whiting	3465	5985	2294	2086	986	4063	3667	3349	2148	5735	1275
Perch	1122	386	4735	6803	6150	7974	8494	2485	467	3843	4682
Smelt	394	1115	3585	2676	4134	4507	2116	77	39	209	1932
Unspecified	3126	896	818	299	556	1457	836	1233	794	947	844

7.2. ESBJERG

Esbjerg is the main fishing harbor to the south of the pre-investigation area. Over the last decade there has been a significant decline (approximately 75%) in the total number of large (>10 meters) fishing vessels from Esbjerg from 78 in 2002 to 19 vessels in 2012 (Table 7.7). The number of small vessels has fluctuated between 7-13 (11vessels in 2012) during the same period (2002-2012).

Table 7.7. Number of vessels registered in Esbjerg from 2002-2012 by size groups (<10 m and >10 m).

Esbjerg no. of vessels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<10 meter	8	7	8	9	8	10	8	9	13	13	11
>10 meter	78	71	67	57	53	39	30	29	24	21	19

The total landings and value from the landings in Esbjerg by vessels fishing in the ICES 40F7 amounted to between 32-1.918 tonnes and 504.000-4.2 million DKK from 2002-2012. Landings and value of landings in Esbjerg from vessels fishing in ICES 40F8 amounted to 66-4800 tonnes and 1.2 – 14 million DKK from 2002-2012 (Table 7.8 and

Table 7.9). In recent years almost the only commercial species from the regional fishing areas (ICES 40F7 and ICES 40F8) around the Horns Rev 3 pre-investigation area that is landed in Esbjerg is Brown shrimp (Table 7.8). Prior to 2008 sandeel from ICES 40F7 was also landed in Esbjerg but at a much lower quantity than in Hvide Sande.

The landings (kg) by small fishing vessels <10 m in Esbjerg from 2002-2012 is given in Table 7.10. Landings comprise very few species from 2002-2006. Since then there have been no registered landings by the 8-13 vessel (<10 m) that are registered in Esbjerg.

Table 7.8. Total landings (tonnes) in Esbjerg from ICES 40F7 and 40F8 in the period from 2002-2012 by vessels >10 meters.

Landings (tonnes)											
Esbjerg	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
40F7	1265,4	529,1	1918,8	268,9	509,9	1483,0	44,8	31,6	40,5	99,2	83,2
Sandeel	481,0	248,0	1335,0	115,0	460,0	1095,0	0,0	0,0	0,0	0,0	0,0
Herring	0,0	0,0	310,0	0,0	0,0	250,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	4,8	0,5	1,3	0,1	0,0	2,0	0,0	0,0	0,0	0,0	0,0
Plaice	73,4	17,3	9,5	1,9	0,5	0,1	0,1	0,0	0,0	0,0	0,0
Turbot	1,8	1,1	0,4	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0
Common sole	1,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Dab	0,5	1,3	0,3	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Brill	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Grey gurnard	2,1	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Yellow gurnard	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hake	0,0	1,7	0,7	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Haddock	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Horse mackerel	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	55,2	99,2	63,1	150,5	49,3	124,8	44,7	31,6	40,5	99,2	83,2
Other shellfish	643,3	158,8	192,5	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unspecified	1,8	0,8	0,6	0,2	0,0	11,0	0,0	0,0	0,0	0,0	0,0
40F8	4837,6	1018,7	283,0	261,6	244,8	391,4	954,7	160,1	115,8	95,0	66,6
Sandeel	0,0	0,0	20,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Herring	0,0	0,0	0,0	0,0	17,0	0,0	0,0	0,0	0,0	0,0	0,0
Plaice	0,8	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0
Witch flounder	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	360,0	418,5	262,9	261,6	227,7	391,4	201,7	160,1	115,8	95,0	66,6
Other shellfish	4476,0	600,2	0,0	0,0	0,0	0,0	753,0	0,0	0,0	0,0	0,0
Unspecified	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Table 7.9. Total value (1000 DKK) of the landings (tonnes) in Esbjerg from ICES 40F7 and 40F8 in the period from 2002-2012 by vessels >10 meters.

Value (1000 DKK)

Esbjerg	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
40F7	4269,6	3229,4	3361,6	3122,0	1344,4	4927,4	1240,8	504,7	697,5	1305,8	2258,1
Sandeel	413,7	198,4	934,5	80,5	483,0	1314,0	0,0	0,0	0,0	0,0	0,0
Herring	0,0	0,0	561,1	0,0	0,0	632,5	0,0	0,0	0,0	0,0	0,0
Atlantic cod	115,5	12,0	30,3	2,0	0,0	64,0	0,0	0,0	0,0	0,0	0,0
Plaice	972,2	254,4	128,2	27,6	7,1	1,7	1,2	0,0	0,0	0,0	0,0
Turbot	115,3	84,6	28,8	7,8	5,2	1,6	0,4	0,0	0,0	0,0	0,0
Common sole	80,7	5,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Dab	3,9	10,1	2,4	0,6	0,4	0,4	0,0	0,0	0,0	0,0	0,0
Brill	2,0	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Grey gurnard	7,0	0,0	1,3	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Yellow gurnard	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hake	0,0	14,2	2,4	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Haddock	0,0	1,4	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Horse mackerel	0,0	0,0	17,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	1285,6	1619,7	1056,6	2944,7	848,7	2865,8	1239,2	504,7	697,5	1305,8	2258,1
Other shellfish	1267,0	1020,2	596,6	56,2	0,0	0,1	0,0	0,0	0,0	0,0	0,0
Unspecified	5,9	6,5	2,0	1,0	0,0	47,3	0,0	0,0	0,0	0,0	0,0
40F8	14394,1	7534,2	4420,1	5119,9	3971,7	8985,5	6326,5	2560,0	1995,0	1249,8	1808,2
Sandeel	0,0	0,0	14,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Herring	0,0	0,0	0,0	0,0	46,8	0,0	0,0	0,0	0,0	0,0	0,0
Plaice	9,9	0,4	0,1	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0
Witch flounder	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	2,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	8381,4	6829,1	4403,6	5119,9	3923,4	8985,5	5588,6	2560,0	1995,0	1249,8	1808,2
Other shellfish	5997,8	703,7	0,0	0,0	0,0	0,0	737,9	0,0	0,0	0,0	0,0
Unspecified	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Table 7.10. Total landings (kg) in Esbjerg from small fishing vessels (<10 m) in the period from 2002-2012.

Esbjerg	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total (kg)	1092	1347	234	1768	477	0	0	0	0	0	0
Atlantic cod	595	0	0	663	280	0	0	0	0	0	0
Plaice	67	816	149	405	6	0	0	0	0	0	0
Dab	53	87	85	351	25	0	0	0	0	0	0
Flounder	47	401	0	145	30	0	0	0	0	0	0
Sole	16	0	0	0	0	0	0	0	0	0	0
Turbot	5	2	0	79	40	0	0	0	0	0	0
Brill	0	13	0	38	95	0	0	0	0	0	0
Lumpsucker	297	0	0	6	0	0	0	0	0	0	0
Lumpsucker_male	11	0	0	0	0	0	0	0	0	0	0
Grey gurnard	0	0	0	48	0	0	0	0	0	0	0
Edible crab	0	19	0	0	0	0	0	0	0	0	0
Crab	0	0	0	24	0	0	0	0	0	0	0
Eelpout	0	0	0	9	0	0	0	0	0	0	0
Lemon sole	0	9	0	0	1	0	0	0	0	0	0
Unspecified	1	0	0	0	0	0	0	0	0	0	0

7.3. THYBORØN, HANSTHOLM AND HAVNEBY

Landings from ICES 40F7 and 40F8 and the Horns Rev 3 region in the more distant harbours of Thyborøn, Hanstholm and Havneby (Rømø) along the west coast of Jutland are not consistent on an annual basis and are primarily made up of the industrial species sandeel and flatfish species (Table 7.11).

This suggests that these harbours are not important landing harbours for vessels fishing in the Horns Rev project area.

Fishery vessel at Horns Rev 1 © Fiskeriforum

Table 7.11. Total landings (tonnes) in Thyborøn, Hanstholm and Havneby from ICES 40F7 and 40F8 in the period from 2002-2012 by vessels >10 meters.

Landings (tonnes)											
Thyborøn	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
40F7	796,9	459,7	1731,6	295,7	692,1	6,7	34,4	7,7	1666,0	9,7	40,5
Sandeel	684,0	328,0	1655,0	255,0	650,0	0,0	25,0	0,0	1648,0	0,0	39,0
Sprat	45,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Herring	10,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	1,0	3,4	1,4	0,6	0,1	0,2	0,0	0,0	0,0	0,3	0,0
Plaice	48,5	91,6	64,2	33,8	38,3	3,5	5,6	5,9	13,6	8,7	0,0
Turbot	2,1	1,7	0,8	0,8	0,2	0,1	0,6	0,0	0,3	0,1	0,0
Common sole	0,2	0,1	2,8	0,2	0,4	1,7	0,0	0,0	1,4	0,2	0,0
European flounder	0,5	0,0	0,0	0,0	0,0	0,2	0,1	0,0	0,0	0,0	0,0
Dab	0,7	9,2	0,8	1,6	0,6	0,4	0,7	0,1	0,3	0,3	0,0
Brill	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,0	0,1	0,2	0,2	0,0	0,0	0,0	0,0	0,0	0,1	0,0
Grey gurnard	0,4	1,8	2,3	1,5	1,6	0,4	0,6	0,4	0,8	0,0	0,0
Hake	0,1	1,5	1,0	0,7	0,2	0,1	0,1	0,0	0,0	0,0	0,0
Haddock	0,1	17,3	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Saithe	0,0	0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	3,7	0,0	0,0	0,5	0,0	0,0	1,5	1,3	1,3	0,0	1,5
Other shellfish	0,1	3,0	1,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unspecified	0,7	2,0	1,6	0,8	0,8	0,3	0,2	0,1	0,2	0,0	0,0
40F8	10,0	4,7	1,3	0,0	0,2	3,1	274,8	0,0	3,0	2,0	0,0
Sandeel	0,0	0,0	0,0	0,0	0,0	0,0	270,0	0,0	0,0	0,0	0,0
Atlantic cod	4,3	1,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Plaice	1,2	1,7	0,0	0,0	0,1	0,1	3,5	0,0	0,0	0,0	0,0
Turbot	0,2	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0
Common sole	0,0	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0
Dab	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brill	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lemon sole	0,2	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0
Hake	0,0	0,3	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Haddock	0,8	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Saithe	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	2,0	0,5	1,3	0,0	0,0	2,5	0,0	0,0	3,0	2,0	0,0
Unspecified	0,1	0,2	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0

Landings (tonnes)

Hanstholm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
40F7	9,5	138,8	81,8	32,6	21,6	0,4	0,0	265,0	1063,4	177,0	105,5
Sandeel	8,0	7,0	76,0	25,0	20,0	0,0	0,0	265,0	1063,0	177,0	105,5
Sprat	0,0	110,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	0,8	2,0	0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Plaice	0,1	7,0	0,7	7,1	0,8	0,3	0,0	0,0	0,2	0,0	0,0
Turbot	0,0	0,3	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Common sole	0,0	0,0	3,7	0,1	0,0	0,0	0,0	0,0	0,2	0,0	0,0
European flounder	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Dab	0,0	0,4	0,1	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,0
Brill	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Witch flounder	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hake	0,1	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Haddock	0,2	4,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Saithe	0,0	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Norway lobster	0,0	0,0	0,1	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0
Greater weever	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pollack	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unspecified	0,3	1,0	0,4	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0
40F8	0,9	622,4	0,3	97,0	0,0	0,3	0,0	0,2	20,0	2,0	0,0
Sandeel	0,0	615,0	0,0	0,0	0,0	0,0	0,0	0,0	20,0	0,0	0,0
Sprat	0,0	0,0	0,0	80,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Herring	0,0	0,0	0,0	17,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Atlantic cod	0,2	0,5	0,1	0,0	0,0	0,2	0,0	0,0	0,0	0,1	0,0
Plaice	0,0	4,1	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,8	0,0
Turbot	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
Dab	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0
Grey gurnard	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hake	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0
Haddock	0,0	0,2	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0
Norway lobster	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,7	0,0
Angler	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0
Unspecified	0,1	0,3	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Landings (tonnes)

Havneby	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
40F7	40,6	75,2	9,2	49,7	47,1	77,4	7,4	1,2	3,3	5,8	0,0
Sandeel	0,0	0,0	1,5	0,0	15,0	0,0	0,0	0,0	0,0	0,0	0,0
Sprat	0,0	49,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Plaice	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0
Turbot	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Common sole	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
European flounder	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brill	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	40,6	26,2	7,7	49,7	32,0	77,4	7,4	1,2	3,3	5,8	0,0
40F8	63,8	40,8	13,8	60,7	41,3	46,7	22,1	20,6	11,6	1,5	4,6
Sandeel	0,0	0,0	0,0	0,0	18,0	0,0	0,0	0,0	0,0	0,0	0,0
Brown shrimp	63,8	40,8	13,8	60,7	23,3	46,7	22,1	20,6	11,6	1,5	4,6

8. IMPORTANCE OF THE FISHERIES

According to the assessment method (Horns Rev 3-TM-003) the importance of the fishery components (determined by gear) is to be determined. A description of the background used to determine the importance of each component is described in this chapter.

The most important commercial fishery components (gear types) represented in the fisheries in the Horns Rev 3 project area and region are Trawls (Bottom, Beam and Pelagic), Gill nets and Danish seine nets. There are no pound net fisheries in the region of the Horns Rev 3 OWF project and thus this component is not included.

The importance of these components (gear types) is determined by their importance and value to the fisheries in the local and regional areas of the Horns Rev 3 pre-investigation area as described in the following:

Bottom trawls – Bottom trawling is consistently undertaken annually in a substantial part of Horns Rev 3 pre-investigation area as well as in the greater regional area. Because sandeel, which is a fish strongly associated with particular sand habitats that are limited to particular areas in the Horns Rev region, is the primary target species of bottom trawls in the Horns Rev 3 pre-investigation area, the importance of this area to this component is considered to be “High”

Beam trawls – Beam trawling which is dominated by the brown shrimp fishery is consistently undertaken annually in a substantial part of Horns Rev 3 OWF project area includeng the pre-investigation area as well as in the greater regional area. Beam trawls exclusively target brown shrimp in the Horns Rev 3 pre-investigation area and its region, thus the importance of this area to this fishery component is considered to be “Medium”

Pelagic trawls – Pelagic trawling is undertaken in parts of Horns Rev 3 pre-investigation area, however the majority of the distribution and effort of this fishery is cated in the greater regional area primarily to the north of the Horns Rev 3 OWF project area. Thus the importance of the Horns Rev 3 pre-investigation area to this component is considered to be “Low”

Gill nets - The gill net fishery is only occasionally undertaken in the Horns Rev 3 pre-investigation area, and only with a low effort. The majority of the gill net fishery is undertaken primarily to the north of the Horns Rev 3 pre-investigation area and east along the coastal areas, thus the Horns Rev 3 pre-investigation area is considered to be only of “Low” importance to this fishery.

Danish seine nets - The Danish seine net fishery has not been registered fishing in the Horns Rev 3 OWF project area including the pre-investigation area over the past 8 years and only sporadically in the Horns Rev 3 regional area with low effort. The majority of the seine net fisheries are undertaken in the north of the regional area of the Horns Rev 3 project area and thus the Horns Rev 3 pre-investigation area is only of “Low” importance to this fishery.

Table 8.1. The importance of the fishery components represented by the primary fishing gear in the Horns Rev area.

Fishery component	Importance
Bottom Trawl	High
Beam Trawl	Medium
Pelagic Trawl	Low
Gill nets	Low
Danish seine nets	Low

Beam trawler © ApolloMedia

9. PRESSURES ON FISHERIES FROM HORNS REV 3 OWF

During the construction, operation and decommissioning phases of the Horns Rev 3 OWF there are a series of temporary and permanent operations or activities that potentially effect or put "pressure" on the undertaking of fisheries. These pressures can include loss of fishing areas due to structures and other installations or restrictions to undertaking fishery activities in areas because of safety reasons. The fisheries can also experience disturbances in the event that fishing vessels need to avoid particular transects such as electrical cable routes in to land and thus potentially need to undertake extra time consuming operations such as lifting or resetting gear, which in a worst case scenario would add costs and reduce the net value of their landings.

Furthermore, there are also a number of pressures such as sediment spill from dredging, noise and vibrations from construction work, electromagnetic fields and loss of habitat to fish species. These do not affect the undertaking of the fisheries directly, but potentially affect the distribution or survival of the commercial species or stocks that make up the resources to the commercial fisheries and hence could affect the fishing yield.

The "pressures" affecting the direct undertaking of the fisheries from establishing the Horns Rev 3 OWF are described in greater detail in the following sections.

The "pressures" effecting commercial fish species (noise and vibrations, suspended sediment and sedimentation, electromagnetic fields and habitat changes) and thus indirectly the fisheries, are given in detail in Orbicon, 2014b and will only be dealt with in the impacts to the commercial fish species given in the impact summary section of this report.

Main pressures

The main pressures or sources of impacts to the commercial fisheries associated to the different phases of establishing an offshore wind farm (construction, operation and decommissioning) are listed in Table 8.2. The main pressures potentially affecting the undertaking of the fisheries are described in greater detail in the following section. The main pressures affecting the commercial fish species which are the resources to the fisheries are described in Orbicon, 2014b.

Table 8. 2. Overview of the main sources of impacts to the fisheries and their resource (commercial fish species) associated with the different phases of an offshore wind farm. The sources are listed without indication of relative importance.

Source of impact directly effecting the fisheries	Phase		
	Construction	Operation	Decommissioning
Footprints – seabed reclamation and loss of fishing area	X	X	
Restrictions in fishing areas	X	X	X
	X		X

Disturbances to under-taking of the fisheries			

9.1.1 Footprints - loss of fishing area

The pre-investigation area for the Horns Rev 3 OWF is approximately 160km^2 in size, however the final area will be between less (approximately 70-90 km^2) depending on the number of turbines that are needed to attain the maximum rated capacity of 400 MW for the wind farm and the required distances between the turbines to avoid shadowing effects.

During the construction phase no form of fisheries will be allowed to be undertaken in the Horns Rev 3 OWF project area because of safety reasons and to minimize disturbances to construction activities and work vessels. This is analogous with total loss of the fishing areas during the construction phase in an area of 70-90 km^2 for all the fishery components (trawls, gill nets and Danish seine nets) that undertake their fisheries in the area.

During the operational phase of the wind farm, all fisheries using “active” gear i.e. trawls (bottom, pelagic and beam trawl) or Danish seine nets potentially will still be forbidden in the entire Horns Rev 3 OWF area. Thus the entire wind farm area will potentially be lost to the trawling fisheries for the lifetime of the Horns Rev 3 OWF, which is estimated to be around 25 years. This “worst case” scenario is the foundation for assessing the loss of fishing area for fisheries using the trawls.

In contrast, experience from other wind farms (Horns Rev 2 and Rødsand OWF´s etc) in Denmark suggest that the fisheries with passive gear such as gill nets etc. will be allowed to once again utilize the area within the wind farm and fish between and around the turbines after the construction phase is completed i.e. during operation phase.

Within the Horns Rev 3 OWF, areas of the seabed will be lost to structures such as turbine foundations, their associated protective scour material and the transformer platform. These physical structures will cover areas of the seabed in the wind farm area in different amounts according to which turbine solution is chosen (see Figures 3.3-3.11 and section 3.2) and their placement and pattern.

These areas will be lost to the gill net fisheries and in practice could be extended further than the base of the turbine foundations if expanded protective zones around the turbines are established within which gill netting is not allowed to be undertaken.

Potential loss of fishing area (the gill net fisheries) to these foundations, scouring protective material and potential protective zones will depend on the overlap of area lost with previous gill net fishing grounds.

9.1.2 Restrictions and disturbances in fishing areas

As mentioned, the gill net fishery will most likely be allowed to fish once again in the Horns Rev 3 OWF area in the operational phase. However, this fishery could be under specific guidelines set forth by the concessionaire. At present it is not known what, if any, guidelines for net fisheries will be implemented in the future Horns Rev 3 OWF area. Any specific guidelines for the net fisheries within the Horns Rev 3 OWF area could lead to temporal and spatial constraints to where and when the gill net fisheries may undertake their fishery in the wind farm area. Potential constraints could lead to added pressures to this fishery within the OWF.

The activities associated with cable-laying between the offshore transformer platform and land will create a period of local restrictions prohibiting any fishery around the cable laying activities and potential disturbance to the fisheries due to added ships traffic. It is anticipated that these pressures will be short-term and will primarily be limited to affecting the beam trawl and gill net fisheries as the planned cable transect will cross well-used beam trawl routes and areas where some gill net fisheries are also undertaken.

Along an electrical cable in the seabed there are general provisions prohibiting fishing with bottom gear such as beam trawls within a distance of 200 metres on both sides (Order 939 of 1992). These restrictions will cause time consuming operations where trawlers interested in continuing their hauls on the other side of the cable transect will have to retrieve their gear cross the transect and then deploy their gear again.

The decommissioning phase includes removal of the wind turbines and possibly all the foundations and cables, however it is not decided at present, whether all the foundations and cables will be removed. The impacts from this phase will include more or less similar pressures experienced during the construction of the wind farm. For the commercial fisheries these amount to short-term restrictions to the beam trawl and gill net fisheries around decommissioning activities.

There is also a possibility that the wind farm area may be repowered, resulting in an exchange of turbines and foundations with larger and more efficient turbines. The precise activities for this are not known.

9.2. Sensitivity

The sensitivity of the fishery components (gear types) to a pressure is different for each component depending on the distribution of their fishery, the distribution of its resource (commercial species), the mobility of the fishery in relation to a pressure, and the potential of the fishery component to use alternative areas.

Loss of fishing areas or the ability to undertake fisheries due to footprints where space is occupied by structures or installations, areas of reclamation, and areas subjected to regulations forbidding commercial fisheries can be of considerable magnitude depending on the spatial and temporal extent of loss to the individual fisheries.

On a temporal and spatial scale all the trawl fisheries (bottom trawl, beam trawl and pelagic) will lose their fishing grounds in the entire wind farm project area for approximately 25 years or the life-time of the Horns Rev 3 OWF.

Bottom trawling is undertaken consistently in the pre-investigation area of Horns Rev 3 OWF and its regional area primarily to the north. Because the bottom trawl fishery in the Horns Rev 3 pre-investigation area primarily targets sandeel, which is a fish strongly associated with particular sand habitats and limited to particular areas in the Horns Rev 3 area, this fishery is highly sensitive to the loss of these fishing grounds.

Beam trawling which specifically targets brown shrimp is also consistently undertaken in a substantial part of Horns Rev 3 pre-investigation area as well as in the greater regional area. The resource (brown shrimp) for beam trawls are more widely distributed and more mobile in the Horns Rev region than for example, sandeel, which creates a more moderate (medium) sensitivity of the beam trawl fishery to losing fishing grounds in the Horns Rev 3 pre-investigation area.

Although there is some effort of the pelagic trawl fishery in the Horns Rev 3 pre-investigation area the sensitivity of this fishery to losing fishing grounds due to restrictions in this area is considered low as the general effort of this fishery is located in the regional area primarily to the north of the Horns Rev pre-investigation area. Pelagic trawls have also been registered as catching the commercially important and stationary sandeel in the Horns Rev 3 pre-investigation area, but this fishery is not considered as prominent and important for the pelagic trawlers as it is for the bottom trawlers.

The loss of fishing area for the gill net fishery will only be during the construction phase of the Horns Rev Wind Farm as it is anticipated that the gill net fisheries will be allowed to resume after the construction phase is over.

The sensitivity of the gill net fisheries to losing fishing areas in the Horns Rev 3 area only during the construction phase is considered to be low" as the this fishery is only observed using the Horns Rev 3 pre-investigation area for their fisheries occasionally and only with a low effort. This fishery is mobile and utilizes other fishing areas close to the coast, and to the north and northeast of the Horns Rev pre-investigation area.

No Danish seine net fishing has been registered in project area over the last 8 years (according to VMS and logbook data) and thus this fishery is not sensitive to the loss of fishing areas in the Horns Rev pre-investigation area.

In the operation phase, some areas of previously untouched seabed will be covered by structures, scour protection etc. and will – at least for the operational lifespan of the OWF – be lost to the gill net fishery.

Sensitivity of the fishery components to temporary short-term restrictions and disturbances to the fisheries associated with activities and pressures from cable laying such as

dredging and areas prohibiting fishing around the cable laying vessel, are dependent on the importance of the unavailable fishing grounds, the fisheries mobility and possibility for avoiding these pressures and the availability of alternative fishing grounds. The fisheries most sensitive to the cable laying are the beam trawl fishery which trawl throughout the area along the planned cable transect, and the gill net fishery which utilise fishing areas along the transect and closer to shore.

The sensitivity of other fishery resources (commercial fish species) to pressures from the establishment of the Horns Rev 3 Wind Farm (i.e. loss of habitat, sediment spillage or increased noise levels etc.) is dependent on species specific habitat requirements, dose-response relationships that can trigger an avoidance response, or in worst case scenarios mortality due to extreme situations. For fish, including relevant commercial fish species, detailed information on the sensitivity of commercial species to pressures related to the construction, operation and decommissioning of the Horns Rev 3 OWF is presented in detail in the Fish Ecology EIS – Horns Rev 3 OWF.

Trawler

10. ASSESSMENT OF IMPACTS TO FISHERIES

The establishment of the Horns Rev 3 OWF, including cable laying, will potentially have a negative impact on the commercial fisheries due to potential loss of fishing grounds, restrictions or disturbances that do not allow or make it difficult to undertake fisheries or by effecting commercial fish stocks and hence indirectly the fishing yield in the region.

The assessment of impacts on the fishery resource (fish and shellfish) from the Horns Rev 3 Wind Farm is described in detail in the Fish EIS report (Energinet 2013b) and summarized in the final section of this report.

At present the final location of the Horns Rev 3 OWF within the pre-investigation area is not known, and thus the following assessments will represent worst-case scenarios by assessing relevant impacts as if they were in the entire Horns Rev 3 pre-investigation area.

The following section gives an overview of the general effects of the main pressures to the commercial fisheries that are used as a reference or background information in making the assessments for each of the main impacts. This assessment will be made according to the magnitude of the pressure, sensitivity of the fishery component to the pressure and the importance of the area lost or impaired to the individual fisheries in the construction, operation and decommissioning phases. This information will be summarized in the degree and severity of impact tables.

10.1. LOSS OF FISHING AREAS DUE TO RESTRICTIONS TO THE FISHERIES AND FOOTPRINTS

During the construction phase no form of fisheries will be allowed in the Horns Rev 3 OWF area. This will amount to a total loss of area to all the fisheries during this time of approximately 70-90 km^2 in size, depending on the size of the turbines and their placement. For the trawl fisheries, it may still be forbidden to undertake these fisheries in the operational phase of the wind farm, and thus the potential loss of trawl fishing areas in the Horns Rev wind farm area in a “worst case” scenario could be for the life-time of the Horns Rev 3 OWF, which is approximately 25 years. All 3 types of primary trawls (bottom, beam and pelagic) undertake hauls in the Horns Rev 3 pre-investigation area and will be impacted by losing the right to fish in this area. The severity of this impact to the different types of trawl fisheries depends on the importance of the Horns Rev Wind Farm project area to their fisheries.

In contrast, the loss of fishing area for the gill net fishery will most likely only be during the construction phase of the Horns Rev Wind Farm as it is anticipated that the gill net fisheries will be allowed to resume after the construction phase is completed.

The severity of the impacts to the fishery components (bottom trawls, beam trawls, pelagic trawls, gill nets and Danish seine nets) from restrictions to the fisheries in the Horns Rev 3 project area during the construction and operation phase is presented in Table 10.1 and Table 10.2.

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Construction phase

Bottom trawl

For bottom trawlers, the western part of the pre-investigation area is very important as this fishery intensively undertakes hauls in this area where they target the important commercial species sandeel. The commercial trawl fisheries targeting sandeel are one of the most sensitive to loss, restriction to their fishery or disturbances to their fishing grounds because of the limited distribution and area their fishery resource (sandeel) is found. Sandeel have very specific habitat demands and are only found in areas where the seabed and environmental conditions complies with these needs. Thus, the distribution and extent of sandeel fishing grounds is consistently within or in the near region of suitable habitats and thus the availability of this resource is spatially limited. A major part of the western part of the Horns Rev 3 pre-investigation area is an important sandeel fishing ground and in the event that this area is used for establishing the Horn Rev 3 OWF, these fishing grounds will be lost. Because trawling will not be allowed within the wind farm during the lifetime of the project and there is only a limited area of fishing grounds in the Horns Rev region where sandeel are present, the loss of these fishing grounds will constitute a permanent direct reduction in the availability of this resource to the trawl fisheries and thus a “high” severity of impact on these fisheries.

Pelagic trawls

Pelagic trawlers also primarily fish in the western part of the Horns Rev 3 pre-investigation area where they also catch sandeel, however their primary target species in the Horns Rev area is sprat when in season. The pelagic trawl fishery in the Horns Rev 3 pre-investiagation area is not very intense suggesting that the the Horns Rev 3 pre-investigation area is of low importance to this fishery. Distribution data suggests that the pelagic trawl fishery fish after sprat with more effort in areas north of the Horns Rev 3 OWF project area. Sprat is a pelagic species moving more randomly around the regional area when in season. Thus, although the magnitude of losing the right to fish in the Horns Rev OWF is very high, the low sensitivity of this impact and the low importance of the area to this fishery leads to a “low” severity of impact to the pelagic fishery in The Horns Rev 3 OWF pre-investigation area (Table 10.1).

Beam trawls

Beam trawlers undertake a considerable amount of hauls primarily in the middle and eastern section of the Horns Rev 3 pre-investigation area as well as a large part of the entire Horns Rev 3 project area where vessels with this gear almost exclusively target brown shrimp. The beam trawl fishery targeting brown shrimp is also sensitive to loss and restrictions to their fishing grounds in the Horns Rev 3 OWF project area. Brown shrimp have a preference for specific habitats that are dominated by sandy bottoms, however their demands are less specific than sandeel and although brown shrimp are primarily found on the sandy bottoms of the Horns Rev region they have a broad distribution as they move around during the seasons, which is reflected in the broader distribution of the beam trawl fishery. Thus, despite a loss of fishing area to beam trawlers which will not be

able to undertake their fisheries in the Horns Rev 3 OWF area, this fishery component has a number of alternative areas it can utilise a well as a more mobile resource. The Horns Rev 3 pre-investigation area is of medium importance to this fishery and the severity of impact to the beam trawl fishery is “medium” because their resource (brown shrimp) are widely distributed and beam trawlers can utilize alternative fishing grounds in the regional area (Table 10.1).

Gill nets

As mentioned, the gill net fishery will most probably only be impacted by the loss of fishing areas during the construction period, thus this loss will only be temporary. The gill net fishery often targets benthic or near bottom species such as cod and different flatfish species and is not very intense in the pre-investigation area. Furthermore, the potential mobility of this fishery to other nearby gill net fishing areas supports a low impact to the gill net fisheries. Overall, the short time-frame of the loss of fishing area combined with the limited importance of the Horns Rev 3 pre-investigation area and low sensitivity to the loss of fishing area in the planned wind farm pre-investigation leads to a low severity of impact to this fishery in the construction phase (Table 10.1).

Layout design scenarios and impacts

The full significance and severity of the impact to the different fisheries will be strongly determined by which specific area within the Horns Rev 3 pre-investigation area of 160 km^2 will be used to establish the Horns Rev 3 OWF i.e. the area use and layout of the turbines. The precise location used for the Horns Rev OWF in the pre-investigation area is at present not known. Thus, to illustrate the differences in the potential impacts of different wind farm layouts, 3 turbine layouts which accommodate between 40-136 wind turbines depending on their output were presented. These layouts (shown in section 3.2) cover an area between 70-90 km^2 and can be located in 1 of 3 suggested locations; closest to the shore (easterly in Horns Rev 3 pre-investigation area), across the northern part of the Horns Rev 3 pre-investigation area, and in the western part of the Horns Rev 3 pre-investigation area.

The following level of impacts can be expected in a worst case scenario for the different fisheries in the Horns Rev 3 pre-investigation area according to the suggested layouts:

Bottom trawl - much of this fishery in the Horns Rev 3 pre-investigation area targets sandeel which is distributed from north to south in the western part of the Horns Rev pre-investigation area (see Figure 6.7). Thus a layout covering the western part of the pre-investigation area will have the greatest direct impact on the bottom trawl fisheries.

Beam trawl (shrimp fishery) - this fishery is distributed throughout much of the Horns Rev 3 OWF area, however with most fishing activity occurring in the middle and eastern part of the pre-investigation area (see Figure 6.3). Thus a layout covering the middle and eastern part of the pre-investigation area will have the greatest direct impact on the beam trawl fisheries.

Pelagic trawl – this fishery often targets the pelagic species sprat, but also sandeel in the Horns Rev 3 OWF pre-investigation area. The pelagic fishery is not very intense and is rather diffuse throughout the pre-investigation area, however with a slightly higher intensity in the western part of the area (see Figure 6.4). This suggests a layout covering the western part of the pre-investigation area will have the greatest direct impact on the pelagic trawl fisheries.

Gill nets – this fishery often targets benthic or near bottom species such as cod and different flatfish and does not appear to be very intense in the pre-investigation (Figure 6.5). The spread distribution of the gill net fishery appears to be primarily in the eastern part of the pre-investigation area suggesting that a layout design covering the middle and eastern part of pre-investigation area will have the greatest impact to this fishery.

Seine nets – this fishery has not been undertaken in the entire pre-investigation area since at least 2005 (Figure 6.6). This fishery is generally undertaken to the north of the pre-investigation area and will not be affected by any of the wind farm plan designs.

Cable laying

The laying of the electric cables from the wind farm transformer platform to land will create short-term local restrictions prohibiting all fishery around the cable laying activities and potential disturbance to the fisheries due to added ships traffic. These restrictions will primarily affect the beam trawl and gill net fisheries which utilize the area to the east of the Horns Rev OWF area considerably more than other fisheries. This is particularly true for the beam trawl fishery as the planned cable transect will cross an area with well-used beam trawl routes. However, both the beam trawl and gill net fisheries are mobile and have other fishing grounds in the near vicinity of the cable transect so although there will be some fishery restrictions and disturbances to primarily the beam trawl and gill net fisheries this will only be short-term and spatially limited. Thus the magnitude of the impact on the commercial fisheries during the cable laying from the Horns Rev 3 OWF to land is considered low for all fisheries. Thus this short-term closure of local areas and disturbances to the fisheries is considered to be of low severity (Table 10.2).

Operation phase

During the operation phase, it will still be forbidden to undertake any form for trawl fisheries in the Horns Rev 3 OWF area and thus there will be a continued loss of fishing areas to these fisheries which will lead to similar severity of impairments already mentioned in the previous section (see Table 10.1 and Table 10.4).

Gill nets

The availability of the wind farm area to gill net fisheries is up to the future concessionaire, however, if experiences from other wind farms are guidelines then it is anticipated that gill netters will be allowed to fish within the wind farm area after completion of the construction phase. In the event that gill net fisheries are allowed to undertake their fisheries in the wind farm area, the loss of area potentially affecting their fisheries will be due

to footprints from turbines, their foundations and scouring material as well as the area taken up by the transformer platform.

Within the Horns Rev Wind Farm, the precise amount and number of seabed areas lost is dependent on which turbine solution is chosen (see section 3.2 for different scenarios) and their placement and pattern. The largest area of seabed will be lost in a scenario of 3 MW turbines with monopiles, while the least amount of seabed will be lost in a scenario consisting of 10 MW turbines with jacket foundations. Thus, the above worst case and best case scenarios will cause losses of seabed totaling less than 0.1 % and 0.3 % of the Horns Rev 3 OWF area, respectively. A small amount of seabed area (600-1500 m^2, depending on foundation type) will also be lost to the offshore transformer platform. Considering the low absolute loss of potential gill net fishing area due to footprints from turbine foundations and their protective material around their foundations, this low degree of impact along with the low importance of the Horns Rev 3 project area to the gill net fisheries leads to a low severity of impact from loss of gill net fishing areas in the Horns Rev Wind Farm area (Table 10.4).

Another potentially more detrimental impact to the gill net fishery in the wind farm area could come from specific guidelines to this fishery from the concessionaire if they are to use the wind farm area for their fishery. At present it is not known what, if any, guidelines for net fisheries will be implemented in the future Horns Rev 3 Wind Farm area, but it is anticipated that these could be similar to guidelines set forth for the fisheries in the Horns Rev 2 Wind Farm area. Guidelines such as informing concession authorities as to precisely when and where nets will be set and retrieved and complying with time schedules set extra demands on fishermen. Because of unforeseeable circumstances such as bad weather and not knowing whether it will be possible to retrieve nets when expected etc., guidelines of this nature can create a situation where undertaking gill net fisheries is not always feasible because of these uncertainties. According to net fishermen this has created a situation where the gill net fisheries in the Horns Rev 2 Wind Farm are almost not undertaken anymore.

A potentially positive effect to the gill net fisheries could arise from local increases in some commercial species associated with the establishment of new habitats (artificial reefs). Hard bottom structures such as scour material and turbine foundations may act individually and collectively as an artificial reef providing habitats for commercial species such as cod etc. This so-called “reef effect” involves changes of the faunal communities with an increase in the establishment of epifauna and flora due to a more heterogeneous environment. This in turn will increase the food and protective environment to fish on a local scale, which could lead to higher local densities of commercial species and thus potentially better catches to the gill net (or other passive gear) fishery undertaking their fisheries near these “reef” habitats.

Cable transect

Along an electrical cable in the seabed there are general provisions prohibiting fishing with bottom-dragging gear such as trawls within a distance of 200 metres on both sides

(Order 939 of 1992) of the cable transect. These restrictions will disturb trawling activities when crossing the cable transect as trawlers would either have to stop their fishing before they cross the transect or undertake time-consuming operations of lifting and lowering their gear as they pass over the transect. In the area along the cable transect these restrictions will primarily affect the beam trawl fishery as the planned cable transect crosses an area with well-used beam trawl routes. The beam trawls are, however, mobile and their resource (brown shrimp) are generally distributed in a broad area in the vicinity of the cable transect. As there will be some fishery restrictions and time-consuming disturbances to the beam trawl fishery the magnitude of these restrictions is considered to be of medium severity

There have been granted exemptions from these provisions prohibiting trawling with bottom gear over cables in the seabed in for example the Horns Rev 2 OWF area, however, in a worst case scenario it is assumed that operations by fishing vessels to avoid the cable transect will need to be undertaken.

Construction phase table

Table 10.1. Degree of impact and severity of impact from loss of fishing grounds due to restrictions forbidding the fisheries in the Horns Rev 3 project area during the construction phase.

Total restrictions of fishery activities	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	Gill nets	Danish seine nets
Magnitude of Pressure	Very high	Very high	Very high	Low	Low
Sensitivity	High	Medium	Low	Low	Low
Degree of impact	**Very high**	**High**	**High**	**Low**	**Low**
Importance	High	Medium	Low	Low	Low
Severity of impact	**High**	**Medium**	**Low**	**Low**	**Low**

Table 10.2. Degree of impact and severity of impact from restriction and disturbances to the fisheries during cable laying activities from the Horns Rev 3 project area in to land during the construction phase.

Cable laying activities - restrictions of fishing activities	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	Gill nets	Danish seine
Magnitude of Pressure	Low	Low	Low	Low	Low
Sensitivity	Low	Medium	Low	Medium	Low
Degree of impact	**Low**	**Low**	**Low**	**Low**	**Low**
Importance	High	Medium	Low	Low	Low
Severity of impact	**Low**	**Low**	**Low**	**Low**	**Low**

Operation phase table

*Table 10.3. Degree of impact and severity of impact from continued loss of fishing grounds due to restrictions to the fisheries in the Horns Rev 3 Wind Farm Area during the operation phase. Lost area due to footprints potentially effecting the gill net fisheries. * The ability to undertake their fisheries will be dependent on the regulations by the concessionaire governing their fisheries – see text for more details.*

Total restrictions of fishing activities and Footprints - Loss of fishing areas (gill nets)	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	*Gill nets	Danish seine
Magnitude of Pressure	Very high	Very high	Very high	Low	Low
Sensitivity	High	Medium	Low	Low	Low
Degree of impact	**Very high**	**High**	**High**	**Low**	**Low**
Importance	High	Medium	Low	Low	Low
Severity of impact	**High**	**Medium**	**Low**	**Low**	**Low**

Table 10.4. Degree of impact and severity of impact from loss of gill net fishing area grounds due to footprints from turbine foundations and scouring material taking up seabed area in the Horns Rev 3 wind farm area in the operation phase.

Footprints - Loss of fishing areas (gill nets)	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	*Gill nets	Danish seine
Magnitude of Pressure	-	-	-	Low	-
Sensitivity	-	-	-	Low	-
Degree of impact	-	-	-	**Low**	-
Importance	-	-	-	Low	-
Severity of impact	-	-	-	**Low**	-

Table 10.5. Degree of impact and severity of impact from restriction and disturbances to the fisheries from general provisions prohibiting fishing with bottom-dragging gear such as trawls within a distance of 200 metres on both sides (Order 939 of 1992) of the cable transect from the Horns Rev 3 OWF in to land.

Provisions prohib-iting fishing with bottom-dragging gear across cable transect (Order 939 of 1992)	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	Gill nets	Danish seine
Magnitude of Pressure	Low	Medium	Low	-	Low
Sensitivity	Low	Medium	Low	-	Low
Degree of impact	**Low**	**Medium**	**Low**	**-**	**Low**
Importance	Low	Medium	Low	-	Low
Severity of impact	**Low**	**Medium**	**Low**	**-**	**Low**

Decommissioning phase

The procedure for decommissioning has not yet been defined. The wind farm may be repowered, perhaps resulting in an exchange of turbines and foundations with larger and more efficient turbines at that time.

Based on the current available information and technology the following level of decommissioning is anticipated:

- Wind turbines – removed completely
- Structures and substructures – removed to natural seabed level or partly left in situ
- Infield cables – removed (if they have been unburied) or left safely in situ, buried below the natural seabed level or protected by rock-dump
- Export cables – left safely in situ, buried to below the natural seabed level or protected by rock-dump
- Cable shore landing – safely removed or in situ, with particular respect to the natural sediment movement along the shore
- Scour protection – left in situ

For more technical details see the “Technical project description for the large-scale offshore wind farm (400 MW) at Horns Rev 3”.

Thus, the decommissioning phase will include the removal of the wind turbines and possibly all the cables, although this is not definitely decided. During the removal of wind turbines it is anticipated that activities from this phase will include similar pressures experienced during the construction of the wind farm which includes closure of all fishing activities (including gill net fisheries) in the wind farm area. Due to the anticipated short-term temporal extent of the decommissioning phase, and the present and continued anticipation of only limited gill net fisheries in the wind farm area, the severity of the temporary loss of the gill net fishing areas during decommissioning is considered low (Table 10.5).

Furthermore, if cables are left buried in situ together with added rock dumping to keep them buried, and scour protection is also left in situ, then the seabed will continue to have heterogeneous rock material along the bottom creating “reef” habitats. Thus, old and potentially new reef habitats will continue to promote the increase in reef associated commercial fish such as cod, which will be beneficial to the gill nets fisheries when this fishery is once again allowed in these areas. In contrast, stones, rocks and reef like habitats could hinder the possibility of fishing along the bottom with trawls in these areas once these fisheries are allowed to fish in the area once again. It is however difficult to determine what this impact will have when the area has not been used by trawlers for more than 25 years.

If subsea cabling from the transformer platform to land is required to be removed during decommissioning, the disturbances to the seabed are expected to be approximately equal to those of the construction phase where there will be short-term local restrictions

forbidding the fisheries along the route of the cable as its being removed that will predominantly effect the beam trawl and gill net fisheries in the local region of the decommissioning activities. Because of the short temporal and spatial extent of these activities the severity of impact from the decommissioning activities are considered low or negligible (Table 10.6).

If cabling from the transformer platform to land is allowed to remain in situ and protected by rock dumping than trawling activities could be considerably disturbed when crossing the cable transect as they would have to either stop trawling before they cross the transect or undertake operations of lifting and lowering their gear as they pass over the protective rock material to potentially avoid damage to gear.

There is also a possibility that the wind farm area may be repowered. This would result in an exchange of turbines and foundations with larger and more efficient turbines without large changes in the physical conditions of the wind farm area. The precise activities if this is done are, however, not known.

Decommissioning phase table

Table 10.5. Degree of impact and severity of impact from restrictions forbidding the gill net fishing in the Horns Rev 3 Wind farm area during the decommissioning phase.

Restrictions to undertaking the gill net fisheries during removal of turbines	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	*Gill nets	Danish seine
Magnitude of Pressure	-	-	-	Low	-
Sensitivity	-	-	-	Low	-
Degree of impact	-	-	-	**Low**	-
Importance	-	-	-	Low	-
Severity of impact	-	-	-	**Low**	-

Table 10.6. Degree of impact and severity of impact from restriction and disturbances to the fisheries during cable removal or protection activities from the Horns Rev 3 project area in to land during the decommissioning phase.

Cable laying activities - restrictions of fishing activities	**Fishery components**				
	Bottom trawl	Beam trawl	Pelagic trawl	Gill nets	Danish seine
Magnitude of Pressure	Low	Low	Low	Low	Low
Sensitivity	Low	Medium	Low	Medium	Low
Degree of impact	**Low**	**Low**	**Low**	**Low**	**Low**
Importance	High	Medium	Low	Low	Low
Severity of impact	**Low**	**Low**	**Low**	**Low**	**Low**

10.1.1 Estimate of the economic impact to the commercial fisheries

An estimate of the economic impact (potential loss) to the commercial fisheries according to gear (bottom trawl, beam trawl, pelagic trawl, gill nets and Danish seine nets and other gear) and the most important commercial species (sandeel, brown shrimp, brisling and plaice) in terms of weight and value is described in this section. Specifically, this was done by estimating loss (tonnes and value) of the fisheries within the Horns Rev 3 pre-investigation due to the establishment of the wind farm. Calculations are based on using VMS data points associated with landings from the ICES 40F7 area as a proxy for effort from the fisheries. The percentage of landings and value was estimated by using the relationship of effort (number of VMS plots) within the Horns Rev 3 pre-investigation area according to gear, and effort (number of VMS plots) outside the pre-investigation area for all VMS plots from 2005-2012. Similarly, the VMS data associated with the catches of the individual species within and outside the Horns Rev 3 pre-investigation area was used for estimates of the loss (tonnes and value) of the important commercial species. These percentages were multiplied by the mean annual landings and value of landings from 2002-2012 reported from vessels >10 m within the ICES 40F7 area. It should be noted that this section does not include an assessment of the impact to the fisheries due to laying a cable from the wind farm to land or economic implications from blocking trawl routes or disturbing fisheries outside the wind farm pre-investigation area.

The total estimated annual value of the catches in the fisheries in ICES 40F7 from 2002-2012 is estimated to be approximately 25 million DKK. Of this, the estimates indicate bottom trawlers (approximately 11 million DKK annually), beam trawlers (8 million annual-

ly) and the gill net fishery (4.9 million) are economically the most important fisheries in the ICES 40F7 rectangle.

Estimates of the total value of the landings within the Horns Rev 3 Wind Farm pre-investigation area was approximately 1,09 million DKK annually. Estimates indicate that bottom trawlers (approximately 614,000 DKK annually) and beam trawlers (390,000 annually) are economically the most important fisheries as approximately 5.5% (bottom trawls) and 4.9% (beam trawls) of these fisheries in the ICES 40F7 rectangle are estimated to be undertaken in the pre-investigation area (Table 10.7).

For pelagic trawlers approximately 6.4% of their fishery in the ICES 40F7 rectangle was estimated to be undertaken within the Horns Rev 3 pre-investigation area. This fishery is, however, quantitatively not as large as the bottom trawling fishery, or as valuable as the beam trawl fishery which target the valuable brown shrimp. The pelagic fishery in the Horns Rev 3 pre-investigation area is estimated to be 82,000 DKK annually (Table 10.7).

It is estimated that the catches of sandeel within the Horns Rev Wind Farm area represent approximately 8% or 696,000 DKK of the annual value of the sandeel catches within the ICES 40F7 rectangle (Table 10.8). Similarly, the catches of brown shrimp within the Horns Rev Wind Farm area represent approximately 4.9% or 380,000 DKK of the annual landings from the ICES 40F7 rectangle (Table 10.8).

For sprat and plaice the next estimated catches within the Horns Rev Wind Farm area represent approximately 4.7% (41,000 DKK) and 0.3% (12,000 DKK) of the annual catches (and value) of the within the ICES 40F7 rectangle (Table 10.8).

Table 10.7. An estimate of the % of fishing effort and potential loss in landings (tonnes) and value (DKK) in the Horns Rev 3 pre-investigation area in relation to the fisheries according to gear in ICES 40F7. Estimates are based on the number of VMS position points in Horns Rev 3 in relation to the total number of VMS position points associated with landing book data registering catches from the 40F7 ICES rectangle.

Gear	% of fishing effort in Horns Rev 3 pre-investigation area	Mean annual landings (tonnes)	Mean annual value (1000 DKK)	Potential annual loss of landings (tonnes)	Potential annual loss of value (1000 DKK)
Bottom trawl	5.53	7295	11099	403	614
Beam trawl	4.85	407	8050	20	390
Pelagic trawl	6.35	841	1293	53	82
Gill nets	0.11	243	4911	0.3	5.4
Danish seine nets	0.00	131	717	0	0
Other gear	0.00	13	30	0	0

Table 10.8. An estimate of the % of fishing effort and potential loss in landings (tonnes) and value (DKK) in the Horns Rev 3 pre-investigation area in relation to the fisheries of the most important commercial species in ICES 40F7. Estimates are based on the number of VMS position points within the pre-investigation area in relation to the total number og VMS position points associated with landing book data registering catches from the 40F7 ICES rectangle.

Commercial species	% of fishing effort of these target species in Horns Rev 3 pre-investigation area	Mean annual landings (tonnes)	Mean annual value (1000 DKK)	Potential annual loss of landings (tonnes)	Potential annual loss of value (1000 DKK)
Sandeel	8.03	7185	8672	577	696
Brown shrimp	4.9	394	7805	19	380
Sprat	4.7	756	870	36	41
Plaice	0.3	321	4404	1	12

Uncertainties with economic calculations

These calculations are based on the assumption that the catch per unit effort for both gear and the commercial species are evenly distributed throughout the fishing areas. Thus, these estimates do not take into consideration that the density of commercial species in catches from different fishing grounds will be different. This could be particularly true for sandeel as this species are highly associated with specific habitats and their density within in area will most probably depend on the habitat quality and suitability of a particular area to these demands. This was strongly evident in a description of the impact to the sandeel fishery due to the Horns Rev 2 Wind Farm where en estimate of 80% of the total catches of sandeel were taken in 10% of the total fishing grounds used to catch sandeel (Krog 2009).

In an attempt to estimate a catch per unit effort for the individual VMS points in this assessment, the associated amount of landings and value in a fishing trip was linked to the VMS plots. Unfortunately there were some significant outliers that made these estimates uncertain and thus this data was not reliable and thus not used in this report.

To find the total value of the profits to the fisheries that could be affected by the establishment of the wind farm only the estimated loss according to the total value of the landings was taken into consideration in this report. If operating expenses and costs to labor in the fisheries were subtracted, the maximum amount of estimated loss would be considerably less. Thus an estimate of the annual loss and eventually a loss over the lifetime (25-year period) of the wind farm would also be considerably less. Furthermore, the estimated losses in this report are filled with biases and uncertainties as already mentioned and should be used only as an estimate. Other biases include, for example, the price per kilo of the landings was based on an average price over a period of 11 years (2002-2012) and thus does not take into consideration trends that could make the current kilo price considerably different. There is also an assumption that the catches from the wind farm area cannot be taken (caught) in other areas. This is most probably true for the important sandeel fishery, but for the fisheries with more mobile resources this may not be true. Similarly, if fishing effort can be reallocated to other fishing grounds such that catches will remain same, then direct losses to the fisheries will only be linked to an increase in the running costs and will be significantly less. Other biases include the assumption of uniformity in the catch amounts already mentioned, as well as fishery statistics are only available for the entire ICES rectangle 40F7, where the area of the wind farm only represents a very small part (approximately 2.6 %). Finally, only detailed catch data

from vessels larger than 10 metres is available – smaller vessels can potentially fish in the pre-investigation area and although, there is catch data from vessels less than 10 metres, this is only linked to harbours and does not indicate the relevant catches for the potential areas of impact. This information is, however, considered to be of less importance because smaller vessels generally fish with nets, and it is anticipated that these fisheries are closer to shore and can continue after the wind farm is established.

Thus, for several reasons, there is considerable uncertainty associated with quantifying the economic impact to the fisheries by establishing an offshore wind farm in Horns Rev area.

10.1.2 Cumulative effects

When other projects within the same region affect the same environmental conditions simultaneously, they are defined as having cumulative impacts. Cumulative effects can potentially occur on a local scale, such as within the Horns Rev 3 Wind farm area, as well as on a regional scale covering the entire Horns Rev / Blåvands Huk area. A project is relevant to include, if the project meets one or more of the following requirements:

Other projects are defined as projects with existing utilised or unutilised permits or with approved plans, which have activities in the same area. A project is relevant to include in an assessment of cumulative impacts, if it meets one or more of the following requirements:

- The project and its impacts are within the same geographical area as the Horns Rev 3 OWF.
- The project affects the same or related environmental conditions as the Horns Rev 3 OWF.
- The project has permanent impacts in its operation phase interfering with impacts from the Horns Rev 3 OWF.

Based on the above criteria the following projects can be considered relevant to assess in relation to cumulative impacts on different fishery components:

Horns Rev 1 & 2 OWFs

- Loss of fishing areas
- Increased fishing vessel traffic
- Effects on the distribution of commercial fish species (indirect effects to the fisheries)

A summary of potential overlapping effects between the pressures to the commercial fisheries from establishing the Horns Rev 3 and pressures from other projects in the Horns Rev area (Table 10.9).

Table X. Potential overlaps in pressures from other projects potentially causing impacts to the commercial fisheries in the Horns Rev 3 Wind Farm Area during the 1. Construction phase, 2. Operational phase, and 3. Decommissioning phase.

Source of pressure	Potential Overlap
	Horns Rev 1 & 2
Loss of fishing area	1, 2, 3
Increased fishing vessels traffic	1, 2, 3

The potential loss of fishing area due to the establishment of the Horns Rev 3 Wind Farm will decrease the fishing area available to the fisheries in the regional area. This will potentially impact the commercial fisheries targeting both sandeel (primarily bottom trawls) and brown shrimp (primarily beam trawls) the most, as these fisheries have extensive and important fishing grounds within the Horns Rev 3 pre-investigation area that will be lost. Similarly, similar fishing areas were lost in the HR2 and HR1 wind farms, albeit not as extensive for the brown shrimp, thus decreasing the fishing area available in the Horns Rev region to these fisheries.

Similarly, the close proximity of the Horns Rev 2 OWF 2.5 km to the south of the Horns Rev 3 pre-investigation area might create limitation to the trawl fisheries that try to utilize the corridor between the two wind farms for undertaking their fisheries both due to potentially increased vessel traffic but also because of the narrow area for passage while trawling.

10.1.3 Transboundary impacts

Concerns about transboundary impacts from development projects generating tensions and even conflicts between countries led to the forming of the Convention on Environmental Impact Assessment in a Transboundary Context also known as the Espoo Convention (Espoo Convention 1991). The Convention was adopted with the support of the United Nations Economic Commission for Europe (UNECE) and implemented in 1997 with the general aim of “ensuring environmentally sound and sustainable development in potentially transboundary projects” through open communication and if necessary international cooperation.

It is recognized that other countries also undertake commercial fisheries in the Horns Rev 3 area outside the 12 mile limits off the coast. Similarly, a number of the commercial fish species present in the Horns Rev 3 OWF area also migrate over large distances between spawning grounds, nursery areas and feeding grounds. During these migrations these commercial species come to pass through or reside in national waters of other countries or in international waters and will be available to their respective fisheries.

To take into the considerations of the fisheries of other countries an ESPOO notification was made available and responses pertaining to possible transboundary impacts were

addressed by questions regarding the contents in the EIA. The course of action regarding this is the following:

In accordance with Article 3 of the Convention on Environmental Impact Assessment (EIA) in a Transboundary Context and Article 7 of the EU Directive 85/337 the Danish Nature Agency initialised an ESPOO-convention notification of the planned construction of offshore wind turbines at Horns Rev 3 with an initial EIA and related environmental surveys. This was on request of the Danish Energy Agency.

The ESPOO-convention notification was distributed to Germany prior to July 2012 with deadline of response by the 2. September 2012. Hereafter, responses from the notified countries were distributed by the Danish Energy Agency to Energinet.dk (the Transmission System Operator, TSO in Denmark). Energinet. who is responsible for compiling the EIA, thereby supports the Danish authorities in answering responses from the ESPOO-convention notification.

The responses were thoroughly examined with respect to the planned scope of the EIA, as well as the relevant Danish legislations.

Regarding the commercial fisheries, there were no responses to the notification regarding assessment of impacts to the commercial fisheries or commercial fish species that may have a transboundary impacts.

10.2. IMPACTS TO COMMERCIAL FISH SPECIES – RESOURCE TO THE FISHERIES

The establishment of the Horns Rev 3 OWF, including cable-laying could potentially effect the distribution of fish stocks and thus indirectly impact the commercial fisheries. This assessment is briefly summarized in this section and described in detail in the Fish Ecology EIS.

The primary pressures used for the assessment of commercial fish were noise and vibrations, suspended sediment and sedimentation, electromagnetic fields and habitat changes including loss of habitat. For each of these specific pressures the different phases (construction, operation and decommissioning) of the establishment of the Horns Rev Wind Farm have been treated separately when relevant.

A summary of impact assessment shown as the highest expected severity of impact to fish for each of the main potential pressures from the establishment of the Horns Rev 3 OWF is presented in Table 10.10.

Table 10.10. Summary of Impact assessment shown as the highest expected severity of impact to fish for each of the main potential pressures from the establishment of the Horns Rev 3 OWF.

Severity of impact	Source of Pressure			
	Noise & vibrations	Suspended sediment and sedimentation	Electromagnetic fields	Habitat changes
Sandeel	Medium	Low	Low	Medium
Flatfish	Medium	Low	Low	Medium
Sand goby	Medium	Low	Low	Low
Common dragonet	Medium	Low	Low	Low
Atlantic cod	Low	Low	Low	Low
Sprat	Low	Low	Low	Low
Brown shrimp	Medium	Low	Low	Low

Pressures on fish are described as having temporary and permanent effects. Temporary effects occur over a short time-span during the project and impacted components are expected to recover within the life-time of the project. The effects within this category are primarily those associated with construction and decommissioning. Permanent effects can last for the life-time of the wind farm and possibly beyond, depending on decommissioning procedures. The severity of impact from all the main pressures was assessed to be from low to medium in all cases (Table 10.10).

Temporary effects

There will be temporary noises and vibrations during construction and decommissioning phases however, the largest effect is expected to be from ramming monopile foundations for turbines during the construction phase. Extreme noise and vibration will primarily cause commercial species to flee from an area which would displace the fishery resource The Severity of impact on local commercial fish species such as sandeels, flatfish and the shellfish brown shrimp was assessed to be minor negative during the construction phase. For the commercial species Atlantic cod and sprat the noise was assessed to be negligible due to their low importance and abundance in the area. During the construction phase no fishing is allowed in the wind farm area thus any displacement of commercial species that could impact the fisheries would have to be at a greater distance to the turbines. The ranges of the modeled noise are expected to be greatest during piling and only when the piling is undertaken at maximum blow energy. Generally, this is not a common occurrence, with a pile is typically driven at much lower blow energies for the majority of time and thus the range where sound from ramming has the potential to displace fish will not be outside the near vicinity of the ramming activities.

Suspension and redistribution of the sediment has been modelled for installation of gravitation foundations and inter-array cabling. The sediment within the Horns Rev 3 project area consists of clean fine to coarse sand with a low content of silt and clay. The model shows that the seabed sediment is unlikely to contribute to significant increases in suspended sediment during construction activities. Along the cable corridor, sediments are slightly finer, but the area that is disturbed during cabling dredging is very small and will not significantly impact the fish species in the area. It is assessed, that no significant impacts on fish communities and thus commercial species will occur during construction and decommissioning.

Physical disturbances of the seabed during construction and decommissioning will at most equate to 0.5 - 0.9 % of the Horns Rev 3 project area, dependant on the number of turbines installed. The impact on the local fish fauna including commercial species is expected to be negligible.

Permanent effects

Operational noise from the wind farms is low especially compared to the construction noise. Thus the effect from operational noise on commercial species is assessed as negligible. Furthermore, fish appear to be attracted to the foundations of wind turbines indicating that operational noise and vibration do not have a detrimental effect on their distribution.

Electromagnetic fields (EMF) along the subsea cables are expected to have minor negative impact on fish in the Horns Rev 3 project area. The general knowledge of the impact from EMF's on commercial fish species is very limited and the sensitivity, in the present EIS, is thus assessed conservatively. Furthermore, the impact area is very limited and the few sensitive species might just avoid these areas (Leonhard et al., 2011).

Loss of seabed areas due to placement of wind farm infrastructure is expected to be 0.1 – 0.3 % of the Horns Rev 3 project area depending on the number of turbines installed. Thus, the effect from loss of seabed on the commercial fish is assessed to be negligible. Depending on the decommissioning method the permanent effect may extend beyond the operational phase.

The structures of the wind farm will lead to another habitat changes which are introduction of hard substrates which will occupy 0.1 – 0.3 % of the project area. The hard bottom structures may act both individually and collectively as an artificial reef, which will provide habitats for hard substrate species, which were not previously present in the area. However, this effect depends on the type of scour protection. Boulders are expected to have a significant effect whereas e.g. sand bags will have a low effect (reference).The establishment of epifauna and flora on the hard substrates will increase the food available to commercial fish species and act as a refuge area for fish in close vicinity of the wind turbines. Studies indicated the introduction of hard substrate was neither a detriment nor a direct benefit to the important commercial species sandeels (Leonhard et al. 2011).

11. SUMMARY OF IMPACT ASSESSMENT

At present the final location of the Horns Rev 3 Wind Farm area within the pre-investigation area is not known, and thus assessments represent worst-case scenarios by assessing relevant impacts as if they were in the entire Horns Rev 3 pre-investigation area.

The primary temporary and permanent pressures used for the assessment of impacts to the commercial fisheries from the construction, operation and decommissioning of the Horns Rev 3 OWF are potential loss of fishing grounds, restrictions or disturbances that do not allow or make it difficult to undertake fisheries or by effecting commercial fish stocks and hence indirectly the fishing yield in the region.

A summary of the impact assessment shown as the expected severity of impact to the commercial fisheries for each of the main potential pressures from the establishment of the Horns Rev 3 OWF is presented in Table 11.1.

Due to potential loss of fishing areas in the Horns Rev 3 Wind Farm area for the life-time of the wind farm, the severity of impact was assessed to be high for the bottom trawl and medium for the beam trawl fisheries and low for the pelagic, gill net and seine net fisheries.

The high severity of impact due to the potential permanent loss of the bottom trawl fishery is because this fishery utilises the Horns Rev 3 pre-investigation area considerably for their fishery and this fishery primarily targets the important commercial fish sandeel in the wind farm area. The fishery after sandeel is limited by the distribution of this resource and limitations to its abundance within very specific areas where the habitat is suitable, thus the loss of this fishery in the wind farm area cannot be replaced.

The medium severity of impact from potential permanent loss of beam trawl fishing areas in the Horns Rev 3 pre-investigation area is due to the importance of the Horns Rev 3 pre-investigation area to this fishery which is consistently undertaken throughout much of the area. Beam trawlers specifically target brown shrimp which have a preference for sandy bottom habitats, but which habitat demands are less specific than for example sandeel. Thus although, the beam trawl fishery would lose a large fishing area due to restrictions to this fishery in the Horns Rev 3 Wind Farm area, their resource (brown shrimp) have a broad distribution in the regional area and the beam trawl fishery have a greater number of alternative areas it can utilise outside the wind farm area.

The severity of impact to the pelagic trawl and seine net fishery due to potential permanent loss of fishing areas was low due to the limited importance and relatively low fishing effort undertaken by these fisheries in the Horns Rev 3 Wind Farm pre-investigation area.

Permanent loss of fishing area to the gill net fishery is only considered to be from footprints from turbines, their foundations and the transformer platform as it is anticipated that this fishery will be able to continue in the wind farm area after construction is completed.

The small absolute loss of potential gill net fishing areas from these installations along with the low importance of the Horns Rev 3 pre-investigation area to the gill net fishery leads to a low severity of impact from loss of gill net fishing areas in the Horns Rev Wind Farm area.

A potentially limiting factor to the gill net fishery in the wind farm area could arise if there comes guidelines to the gill net fishery , such as informing concession authorities as to precisely when and where nets will be set and retrieved and complying with time schedules. This could make it more difficult for the few gill net fishermen that may fish in the Horns Rev 3 Wind Farm area to undertake their fishery. Because of unforeseeable circumstances such as bad weather and not knowing whether it will be possible to retrieve nets when expected etc., guidelines of this nature could create a situation where undertaking gill net fisheries in the Horns Rev 3 OWF may not be feasible because of these uncertainties.

A potentially positive effect to the gill net fisheries could arise from local increases in some commercial species associated with the establishment of new habitats (artificial reefs). Hard bottom structures such as scour material and turbine foundations may act individually and collectively as an artificial reef. This so-called “reef effect” involves changes of the faunal communities due to a more heterogeneous environment which in turn will increase the food and protective environment to fish on a local scale, which could lead to higher local densities of commercial species and thus potentially better catches to the gill net (or other passive gear) fishery undertaking their fisheries near these “reef” habitats.

Table 11.1. Summary of impact assessment shown as the highest expected severity of impact to the fishery components (gear) for each of the main potential pressures from the establishment of the Horns Rev 3 OWF.

Severity of impact	Source of Pressure		
	Loss of fishing area – foot-prints/seabed reclamation and restrictions forbidding fishery activities	**Cable laying activities – short-term disturbances and restrictions of fish-ing activities**	**Decommissioning activities – Removal of turbines and bottom cables – short-term re-strictions of fishing activities**
Bottom trawl	High	Low	Low
Beam trawl	Medium	Medium	Low
Pelagic trawl	Low	Low	Low
Gill nets	Low	Low	Low
Danish seine nets	Low	Low	Low
Other gear	Low	Low	Low

The laying of the electric cables from the wind farm transformer platform to land will create short-term local restrictions prohibiting any fishery around the cable laying activities and potential disturbance to the fisheries due to added ships traffic. Restrictions will primarily affect the beam trawl and gill net fisheries which utilize the area to the east of the Horns Rev Wind Farm area considerably more than other fisheries. However, both these and other fisheries potentially affected by this impact are mobile and have other fishing grounds in the near vicinity of the cable transect. Furthermore, this impact is only short-term and spatially limited thus the severity of impact from restrictions and disturbances of the cable laying activities was assessed to be low for all the fisheries (Table 11.1).

Along an electrical cable in the seabed there are general provisions prohibiting fishing with bottom gear such as trawls within a distance of 200 metres on both sides. In the area along the cable transect these restrictions will primarily affect the beam trawl fishery as the planned cable transect crosses an area with well-used beam trawl routes. When approaching the cable transect beam trawlers would either have to stop their fishing before they cross the transect or undertake time-consuming operations of lifting and lowering their gear as they pass over the transect. Previous experience from the nearby Horns Rev 2 Wind Farm indicates that there will granted exemptions from these provisions, however in a worst case scenario these provisions will create a disturbance and and impact, primarily to the beam trawl fisheries.

The procedure for decommissioning has not yet been defined but based on available information and assessment for the decommissioning phase was made. The decommis-

sioning phase will include the removal of the wind turbines and possibly all the cables between turbines and from the wind farm transformer platform to land. During turbine and cable removal it is anticipated that activities from this phase will include similar pressures experienced during the construction of the wind farm such as short-term closure of all fishing activities (including gill net fisheries) in the wind farm area and short-term local restrictions forbidding the fisheries along the route of the cable as its being removed. Due to the short-term temporal extent of the decommissioning phase the severity of impact to all the fisheries from the decommissioning activities are considered low. However, if cables are left buried in situ together with added rock dumping to keep them buried, and scour protection is also left in situ, then these solutions could hinder the possibility of restarting of fishing along the bottom with trawls in these areas once these fisheries are allowed to fish in the area once again. Similarly, if cables from the transformer platform to land is allowed to remain in situ and protected by rock dumping than trawling activities will be disturbed when crossing the cable transect.

In contrast, old and potentially new reef habitats will continue to promote the increase in reef associated commercial fish such as cod, which will be beneficial to the gill nets fisheries when this fishery is once again allowed in these areas.

Sandeel and Brown shrimp are by far the most economically important commercial species caught within the Horns Rev 3 pre-investigation area. This is followed by sprat in more recent years. The distribution of sandeel is along a belt in the western part of the pre-investigation area whereas the beam trawl fishery that targets Brown shrimp indicates that this resource is more widely distributed in the middle and eastern part of the Horns Rev 3 pre-investigation area.

The most important landing and basis harbour where vessels have their home port for both ICES 40F7 and 40F8 is Hvide Sande with annual landings amounting to between 59-98% (2231-17726 tonnes) from the catches in ICES 40F7 and between 10-97% (401-2206 tonnes) from ICES 40F8, respectively. Landings are also relatively high in Esbjerg and on occasion Thyborøn and Hanstholm.

Economic estimate

An estimate of the potential economic loss to the commercial fisheries according to gear and the most important commercial species (sandeel, brown shrimp, brisling and plaice) was undertaken using VMS data points as a proxy for the amount of fishing taking place within the Horns Rev 3 pre-investigation area in relation to the ICES rectangle 40F7. This did not include economic implications from blocking trawl routes or disturbing fisheries outside the wind farm pre-investigation area.

Estimates of the total value of the landings within the Horns Rev 3 Wind Farm pre-investigation area was approximately 1,09 million DKK annually. Bottom trawlers (approximately 614,000 DKK annually) and beam trawlers (390,000 annually) were estimated to be the most economically important fisheries as approximately 5.5% (bottom trawls) and

4.9% (beam trawls) of their fisheries in the ICES 40F7 rectangle are estimated to be undertaken in the pre-investigation area.

Approximately 6.4% of the pelagic fishery in the ICES 40F7 rectangle was estimated to be undertaken within the Horns Rev 3 pre-investigation area. Because this fishery is quantitatively not as large as the bottom trawling fishery, or as valuable as the beam trawl fishery the estimated value of this fishery in the Horns Rev 3 pre-investigation area is estimated to be 82,000 DKK annually.

Only 0.11% of the gill net fishery or an estimate of 5.400 DKK in value is estimated to be undertaken in the Horns Rev 3 pre-investigation area. There has been no VMS registered Danish seine fishery or fishery with other gear in the Horns Rev 3 pre-investigation period since 2005.

It is estimated that the catches of sandeel within the Horns Rev Wind Farm area represent approximately 8% of this fishery or 696,000 DKK of the annual value of the sandeel catches within the ICES 40F7 rectangle. Similarly, the catches of brown shrimp within the Horns Rev Wind Farm area represent approximately 4.9% or 380,000 DKK of the annual landings from the ICES 40F7 rectangle.

For sprat and plaice the estimated catches within the Horns Rev Wind Farm area represent approximately 4.7% (41,000 DKK) and 0.3% (12,000 DKK) of the annual catches (and value) of the within the ICES 40F7 rectangle.

It is important to note that these estimates are potentially filled with biases and uncertainties as mentioned in section 9.2 and should only be used only as an estimate

12. MITIGATION

One of the most important tools of mitigation for the concessionaire will be choosing a wind farm layout to reduce the potential impact to the different fisheries accordingly.

As presented in the impact section of this report, the choice of layout design will have a profound impact on different fisheries because of the different distributions of their resources (commercial species). Thus, the final layout choice can be made with the intention of reducing the magnitude of loss of fishing areas for the different fisheries. The layouts that will affect the individual fisheries according to 3 suggested layout designs are described in detail in the assessment section and shortly presented as follows:

- A layout covering the western part of the pre-investigation area will have the greatest direct impact on the bottom trawl and pelagic trawl fisheries. Much of these fisheries target sandeel in this area and thus a western layout will also have the greatest impact to the sandeel fisheries.

- A layout covering the middle and/or eastern part of the pre-investigation area will have the greatest direct impact on the beam trawl fishery as well as gill net fishery. Beam trawls target the valuable brown shrimp and utilize the middle and eastern part of the pre-investigation area in their fishery. Gill nets are more sporadic in their distribution albeit more common in the eastern part of the pre-investigation area.

Corridor for trawling

Focusing on sandeel, the most important and sensitive commercial species in the Horns Rev 3 Wind Farm, fishermen and their organization “Danish Fishermen´s Association” suggested choosing a wind farm pattern that takes into consideration of keeping the important sandeel fishing grounds in the western part of the pre-investigation area open and available to the trawl fisheries. In the event that a wind farm was to be placed in the western part of the Horns Rev project area, it would be beneficial for the fisheries if the layout of the wind farm was set up in a north-south direction in such a way as to form a broad corridor along the sandeel fishing grounds. This would allow the trawl fishery targeting sandeel to continue during the operation period of the wind farm.

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13.1.1 Overview of terminology

Term UK	*Explanation*	*Term DK*	*Term DE*
Environmental factors	The environmental factors are defined in the EU EIA Directive (EU 1985) and comprise: Human beings, Fauna and flora, Soil, Water, Air, Climate, Landscape, Material assets and cultural heritage. In the sections below only the term environmental factor is used; covering all levels (factors, sub-factors, etc.; see below). The relevant level depends on the analysis.	Miljøforhold/-faktor	Schutzgut
Sub-factors	As the project covers both terrestrial and marine sections, each environmental factor has been divided into sub-factors: Marine areas and Terrestrial areas, (e.g. Marine waters and terrestrial water).	Sub-faktor	Teil-Schutzgut
Components and sub-components	To assess the impacts on the sub-factors, a number of components and sub-components are identified. Examples of components are e.g. Surface waters, Groundwater; both belonging to the sub-factor Terrestrial water. The sub-components are the specific indicators selected as best suitable for assessing the impacts of the Project. They may represent different characteristics of the environmental system; from specific species to biological communities or specific themes (e.g. trawl fishery, marine tourism).	Component/sub-komponent	Komponente
Construction phase	The period when the Project is constructed; including permanent and provisional structures.	Anlægsfase	Bauphase
Structures	Constructions that are either a permanent elements of the Project (e.g. bridge pillar for bridge alternative and land reclamation at Lolland for tunnel alternative), or provisional structures such as work harbours and the tunnel trench.	Anlæg	Anlage
Operation phase	The period from end of construction phase until decommissioning.	Driftsfase	Betriebsphase
Permanent	Pressure and impacts lasting for the life time of the Project (until decommissioning).	Permanent	Permanent
Temporary	Pressure and impacts predicted to be recovered within the life time of the project. The recovery time is assessed as precise as possible and is in addition related to Project phases.	Midlertidig	Temporär
Pressures	A pressure is understood as all influences deriving from the Project; both influences deriving from Project activities and influences originating from interactions between the environmental factors. The type of the pressure describes its relation to construction, structures or operation.	Belastning	Wirkfaktoren
Magnitude of pressure	The magnitude of pressure is described by the intensity, duration and range of the pressure. Different methods may be used to arrive at the magnitude; dependent on the type of pressure and the environmental factor to be assessed.	Belastnings-størrelse	Wirkintensität
Footprint	The footprint of the Project comprises the areas occupied by structures. It comprises two types of footprint; the permanent footprint deriving from permanent confiscation of areas to structures, land reclamation etc., and provisional footprint which are areas recovered after decommissioning of provisional structures. The recovery may be due to natural processes or Project aided re-establishment of the area.	Arealinddragelse	Flächeninanspruchnahme
Assessment criteria and Grading	Assessment criteria are applied to grade the components of the assessment schemes. Grading is done according to a four grade scale: very high, high, medium, Low. In some cases grading is not doable. Grading of magnitude of pressure and sensitivity is method dependent. Grading of importance and impairment is as far as possible done for all factors.	Vurderingskriterier og graduering	Bewertungskriterien und Einstufung
Importance	The importance is defined as the functional values to the natural environment and the landscape.	Betydning	Bedeutung
Sensitivity	The sensitivity describes the environmental factors capability to resist a pressure. Dependent on the subject assessed, the description of the sensitivity may involve intolerance and recovery.	Følsomhed/ Sårbarhed	Empfindlichkeit

Impacts	The impacts of the Project are the effects on the environmental factors.	Virkninger	Auswirkung
Loss	Loss of environmental factors is caused by permanent and provisional loss of area due to the footprint of the Project; meaning that loss may be permanent or provisional. The degree of loss is described by the intensity, the duration and if feasible, the range.	Tab af areal	Flächenverlust
Impairment	Impairment is a change in the function of an environmental factor.	Forringelse	Funktionsbeeinträchtigung
Degree of impact	The degree of impact is assessed by combining magnitude of pressure and sensitivity. Different methods may be used to arrive at the degree. The degree of impact is described by the intensity, the duration and if feasible, the range.	Omfang/grad af forringelser	Schwere der Funktionsbeeinträchtigung
Severity of impact	Severity of impact expresses the consequences of the Project taking the importance of the environmental factor into consideration; i.e. by combining the degree of impact with importance.	Virkningens væsentlighed	Erheblichkeit
Significance	The significance is the concluding evaluation of the impacts from the Project on the environmental factors and the ecosystem. It is an expert judgment based on the results of all analyses.		