East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Appendix 11.2

Fish and Shellfish Characterisation Report

Environmental Statement
Volume 3
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The following annexes accompany this Appendix

Annex number	Title
11.2 (1)	Fish and Shellfish Survey, 16th to 26th February 2013
11.2 (2)	Fish and Shellfish Survey, 15th to 27th May 2013

11.2 FISH AND SHELLFISH ECOLOGY

11.2.1 Introduction

1. The following document describes the fish and shellfish ecology baseline in areas relevant to the East Anglia THREE site and offshore cable corridor. The impact assessment presented in Volume 1 of the Environmental Statement (Chapter 11 Fish and Shellfish Ecology) includes a summary of this baseline.

11.2.2 Guidance

2. The principle guidance sources used are as follows:

- Draft East Inshore and East Offshore Marine Plan (MMO 2013);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects. Centre for Environment, Fisheries and Aquaculture Science (Cefas) contract report: ME5403, (Cefas 2012);
- Guidance note for Environmental Impact Assessment in respect to food and environment Protection Act (FEPA) and Coast Protection Act (CPA) requirements. Version 2. (Cefas 2004);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd 2012);
- Overarching National Policy Statement for Energy (EN-1) (Department of Energy and Climate Change (DECC 2011a); and
- National Policy Statement (NPS) for Renewable Energy Infrastructure (EN-3) (DECC 2011b).

3. The specific guidance contained within EN-3 relevant to fish and shellfish ecology are summarised in *Table 0.1* below.

Table 0.1 NPS assessment requirements

NPS Requirement	NPS Reference
There is the potential for the construction and decommissioning phases, including activities occurring both above and below the sea bed, to interact with seabed sediments and therefore have the potential to impact fish communities, migration routes, spawning activities and nursery areas of particular species. In addition, there are potential noise impacts, which could affect fish during construction and decommissioning and to a lesser extent during operation.	EN-3 section 2.6.73
The applicant should identify fish species that are the most likely receptors of impacts with respect to: • spawning grounds; • nursery grounds; • feeding grounds; • over-wintering areas for crustaceans; and • migration routes.	EN-3 section 2.6.74
Where it is proposed that mitigation measures of the type set out in paragraph 2.6.76 below are applied to offshore export cables to reduce electromagnetic fields (EMF) the residual effects of EMF on sensitive species from cable infrastructure during operation are not likely to be significant. Once installed, operational EMF impacts are unlikely to be of sufficient range or strength to create a barrier to fish movement	EN-3 section 2.6.75
EMF during operation may be mitigated by use of armoured cable for interarray and export cables that should be buried at a sufficient depth. Some research has shown that where cables are buried at depths greater than 1.5m below the sea bed impacts are likely to be negligible. However, sufficient depth to mitigate impacts will depend on the geology of the sea bed.	EN-3 section 2.6.76
During construction, 24 hour working practices may be employed so that the overall construction programme and the potential for impacts to fish communities is reduced in overall time.	EN-3 section 2.6.77
The construction and operation of offshore wind farms can have both positive and negative effects on fish and shellfish stocks.	EN-3 section 2.6.122
Effects of offshore wind farms can include temporary disturbance during the construction phase (including underwater noise) and ongoing disturbance during the operational phase and direct loss of habitat. Adverse effects can be on spawning, overwintering, nursery and feeding grounds and migratory pathways in the marine area. However, the presence of wind turbines can also have positive benefits to ecology and biodiversity.	EN-3 section 2.6.63
Assessment of offshore ecology and biodiversity should be undertaken by the applicant for all stages of the lifespan of the proposed offshore wind farm and in accordance with the appropriate	EN-3 section 2.6.64

NPS Requirement	NPS Reference
policy for offshore wind farm EIAs (EN-3; Paragraph 2.6.64).	
Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate	EN-3 section 2.6.65
Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farm should be referred to where appropriate	EN-3 section 2.6.66
The assessment should include the potential for the scheme to have both positive and negative impacts on marine ecology and biodiversity	EN-3 section 2.6.67
Ecological monitoring is likely to be appropriate during the construction and operational phases to identify the actual impact so that, where appropriate, adverse effects can then be mitigated and to enable further useful information to be published relevant to future projects	EN-3 section 2.6.71

4. In addition to the above Scoping Responses were received from the Planning Inspectorate and the Marine Management Organisation (MMO), Joint Nature Conservation Committee (JNCC) as well as advice during consultation with the Centre for the Environment, Fisheries and Aquaculture (Cefas).

5. With regards to species specific assessments, the Scoping Responses of the Planning Inspectorate and the MMO, and advice provided by Cefas during consultation consider the species of primary concern, with particular reference to spawning grounds, to be:

- Species of conservation concern;
- Demersal spawning species, namely herring and sandeel;
- Commercially important species, namely sole, plaice and cod; and
- Non-commercially important species, namely herring and sprat due to their importance in supporting ecosystems in the North Sea and supporting commercial species.

11.2.3 Data and Information Sources

6. The principal data and information sources to compile the following baseline description were:

- Results of adult and juvenile fish site specific characterisation surveys see *Appendix 11.2*;

- Results of the Epibenthic beam trawl survey undertaken in the East Anglia ONE site (MESL 2011) see *Appendix 10.3*;
- Results of the site specific benthic characterisation survey (Fugro/ EMU 2013) (*Appendix 10.4: East Anglia THREE and FOUR Cable Route Benthic Characterisation Report*);
- MMO landings data (weight and value) by species for the period 2008-2012 (MMO 2011);
- International Beam Trawl Survey (IBTS) and ICES Beam Trawl Survey (BTS) data;
- ICES International Herring Larvae Survey (IHLS) data;
- ICES North Sea Cod and Plaice Egg Surveys in the North Sea (WGEGGS);
- Cefas Southern North Sea and English Channel Sole Egg Survey;
- Channel Habitat Atlas for Marine Resource Management (CHARM) (Carpentier et al 2009);
- Distribution of Spawning and Nursery Grounds as defined in Coull et al 1998 (Fisheries Sensitivity Maps in British Waters) and in Ellis et al 2010 (Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones);
- North Sea Ichthyoplankton survey data (van Damme et al 2011);
- Centre for Environment, Fisheries and Aquaculture (Cefas) publications;
- Institute for Marine Resources and Ecosystem Studies (IMARES) publications;
- Collaborative Offshore Wind Research into the Environment (COWRIE) reports;
- International Council for the Exploration of the Sea (ICES) publications;
- Results of monitoring programmes undertaken in operational wind farms in the UK and other European countries; and
- Other relevant peer-review publications and stock assessments.

11.2.4 Data Limitations, Sensitivities and Gaps

11.2.4.1 Spatial Extent of Spawning and Nursery Grounds

7. Coull et al (1998) and Ellis et al (2010; 2012) are frequently considered the standard references to be used to provide broad scale overviews of the potential spatial extent of spawning grounds and the relative intensity and duration of spawning. Both Coull et al (1998) and Ellis et al (2010; 2012) are based on a compilation of a variety of data sources. In the case of Coull et al (1998), many of the conclusions are based on historic research and therefore may not take account in recent changes in fish distributions and spawning behaviour. Ellis et al (2010; 2012) is also constrained by the wide scale distribution of the sampling sites used for the annual international larval survey data, resulting in broad scale grids of spawning and nursery grounds.

8. The spatial extent of the spawning grounds and the duration of spawning periods given in these publications are therefore likely to represent the maximum theoretical extent of the areas and periods within which spawning by the species is considered. It should therefore be possible that spawning grounds are likely to be smaller with shorter spawning periods or in certain cases no longer be active spawning grounds.

11.2.4.2 Landings Data

9. Landings data derived from UK registered vessels by species and ICES rectangle have been derived from catch statistics provided by the MMO.

10. It should be recognised that East Anglia Offshore Limited supports fishing by both UK and non UK registered vessels, principally Dutch and Belgian vessels. Activity by these categories of vessels is described in Chapter 14 Commercial Fisheries, and has been cross-referenced where appropriate.

11. Whilst landings statistics provide a good indication of the principal species targeted within a given area, assessments of the relative abundance and distribution of the species based on commercial landings should be made with caution due to factors such as; fisheries legislation and controls such as quotas and closed areas; and other factors such as gear selectivity and market forces.

11.2.4.3 ICES (International Council for the Exploration of the Sea) Survey Data

11.2.4.3.1 International Bottom Trawl Survey (IBTS)

12. IBTS data has been accessed via the ICES Data Portal (DATRAS, the Database of Trawl Surveys: http://datras.ices.dk). The DATRAS on-line database contains trawl information and biological data on all surveys conducted by the ICES IBTS sampling programme. Since 1997 surveys have employed a standardised method with a GOV[1] trawl used to sample a series of fixed stations, twice per year in the 1st and 3rd quarters of the year (IBTS 2004). The species abundance data presented refers to the average number of fish caught per hour (in those ICES rectangles corresponding to the defined study area) by IBTS North Sea surveys conducted between 2004 and 2013.

11.2.4.3.2 International Herring Larval Survey (IHLS)

13. IHLS data has been accessed via the ICES Data Portal (http://eggsandlarvae.ices.dk). The IHLS surveys routinely collect information on the size, abundance and distribution of herring eggs and larvae (and other species) in the North Sea. The values for larval abundance presented refer to the number of herring larvae in the smallest reported size category (<11mm total

[1] GOV - "Grande Ouverture Verticale": Standard otter trawl gear used in the IBTS

length) caught per square metre at each site sampled per fortnight in the 3rd quarter in each year between 2004 and 2013 (ICES 2013).

11.2.4.3.3 The Channel Habitat Atlas for Marine Resource Management (CHARM)

14. CHARM is a collaborative Franco-British project (Interreg IIIA) initiated to support decision-making for the management of essential fish habitats (http://www.charm-project.org/en/). The Atlas relates fish geographic distribution and environmental factors in order to delineate the optimum habitat for a number of species. The Atlas is based on data obtained from IFREMER's Channel Ground Fish Surveys (CGFS), including species abundance and environmental data, and fish eggs data collected using Continuous Underway Fish Egg Sampler (CUFES) during the French part of the IBTS (2006-2010). Habitat suitability models (HIS) are used to produce GIS outputs of optimum habitats, spawning grounds, nursery areas and presence probability. Unless otherwise specified, estimates of species abundance equates to the number of eggs per 20 m^3 following log-transformation (log10(x+1).

11.2.4.4 Site Specific Surveys

15. Fish and shellfish characterisation surveys using otter and beam trawls were undertaken within the East Anglia THREE site and offshore cable corridor to provide information on fish and shellfish assemblages. The methodologies of these surveys were designed and agreed in consultation with Cefas. A summary of the site specific survey results is provided in Section 11.2.5.1 and the full survey reports are given in *Annex 11.2.1* and *Annex 11.2.2.*

11.2.4.5 Knowledge Gaps

16. It should be recognised that there are gaps in the understanding of the distribution, behaviour and ecology of certain fish and shellfish species. This is particularly evident for a number of migratory species some of which are of conservation importance (e.g. lampreys and salmonids). At present little is known in relation to their migration routes and the use that they may make of discrete sea areas such as those of the East Anglia THREE site and offshore cable corridor.

11.2.5 Study Area

17. The project specific study areas are shown in Volume 2 *Figure 11.1*, with reference to the relevant ICES (International Council for the Exploration of the Sea) statistical rectangles.

18. ICES rectangles are the smallest spatial unit used to collate commercial fisheries data and the data from certain national and international fish surveys. The boundaries of each ICES rectangle aligns to 0.5° latitude by 1.0° longitude, giving

whole rectangle dimensions of approximately 30 by 30 nautical miles, at UK latitudes.

19. The East Anglia THREE site is located off the Norfolk/Suffolk coast, in ICES Division IVc (Southern North Sea). The windfarm analysis area is located primarily in ICES rectangles 34F2 with a small area of the north east of the site located in 34F3. The majority of the offshore cable corridor passes through ICES rectangles 33F1 and 33F2 (inshore and offshore cable analysis areas) with a short section of the offshore cable corridor located in rectangle 34F2.

20. Where warranted, broader geographic areas have been used to provide information in wider contexts in the southern North Sea with particular relevance to life history aspects for fish and shellfish such as the distribution of spawning grounds and migration routesOverview

21. The Southern North Sea (ICES Division IVc) is generally shallow (<50m depth) compared to the Central and Northern North Seas, with a greater species-richness and diversity (Calloway et al 2002). The principal commercial species in terms of landings weights and values are plaice *Pleuronectes platessa* and sole *Solea solea,* with cod *Gadus morhua* with thornback ray *Raja clavata* also being of importance to the local inshore fleets.

22. The fish community also includes the smaller demersal species typically associated with the sea bed including sandeels Ammodytidae spp., dab *Limanda limanda*, solenette *Buglossidium luteum*, grey gurnard *Eutrigla gurnardus* and common dragonet *Callionymus lyra*, (Calloway et al 2002). Dab and gurnard are generally the most abundant species recorded in the southern North Sea feeding on numerous different prey taxa ability and able to exploit wider habitats (Sell and Kroncke 2013). Sandeels and gobies Gobiidae spp. are also present with an important role as prey species (Teale 2011).

23. Other species often found in the southern North Sea include pogge *Agonus cataphractus*, flounder *Platichthys flesus* and sand gobies *Pomatoschistus minutus* in addition to more "southern" species including poor cod *Trisopterus minutus*, bib *Trisopterus luscus*, red mullet *Mullus surmuletus*, sardine *Sardina pilchardus*, lesser weever *Echiichthys vipera*, anchovy *Engraulis encrasicolus*, tub gurnard *Chelidonichthys lucerna*, John Dory *Zeus faber*, bass *Dicentrarchus labrax*, black sea bream *Spondyliosoma cantharus*, horse mackerel *Trachurus trachurus* and mackerel *Scomber scrombus* (Cefas 2007; Corten et al 1996).

24. Over 23 different elasmobranch species (sharks, skates and rays) have been recorded in the North Sea with the most common shark species, spurdog *Squalus*

acanthias, lesser spotted dogfish *Scyliorhinus canicula* and smoothhounds *Mustelus asterias* concentrated in the western part of the North Sea (Daan 2005). Among the rays, starry rays *Amblyraja radiata* are found offshore in the central North Sea within 50-100m depth, while thornback ray, spotted ray *Raja montagui* and blonde ray *Raja brachyura* are widespread in inshore waters around much of the British Isles (Cefas 2009; Daan, 2005). Juvenile undulate rays *Raja undulata* have been recorded off the Norfolk coast with egg cases recorded along the north Norfolk coast and at Felixstowe (Shark Trust 2012). Sightings or landings of other elasmobranch species, such as the common skate *Dipturus batis* complex, basking shark *Cetorhinus maximus,* tope *Galeorhinus galeus,* thresher shark *Alopias vulpinus* and porbeagle *Lamna nasus* are infrequent or rare given their population status or their spatial distribution (Ellis 2004; NBN Gateway 2013).

25. Diadromous species have the potential to transit through the East Anglia THREE site and offshore cable corridor during seasonal migrations between the sea and riverine environments, potentially for spawning and nursery life-history stages. Species with recorded presence in the southern North Sea, rivers and coastal regions off East Anglia are listed below.

- Sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis* are rarely observed in UK coastal waters, estuaries and accessible rivers (JNCC, 2007).
- The East Anglian coastal waters are thought to be feeding areas for sea trout spawned in rivers in the north east of England and in East Anglian rivers including; the Glaven, Wensum and Yare (Tingley et al 2007).
- European eel *Anguilla Anguilla* are reported to migrate to local rivers including the Waveney, Yare, Bure and Deben (DEFRA 2010);
- Smelt have been observed to shoal in estuaries including the lower tidal reaches of the Waveney and Yare (Colclough and Coates 2013).

26. Allis shad *Alosa alosa* and twaite shad *Alosa fallax* are considered to have a presence elsewhere in rivers and estuaries in Eire, Wales and in the Solway Firth, (Roche 2008; Aprahamian 1989; Maitland and Lyle 2005). Although formerly known to spawn in several English river systems, the only recently-confirmed spawning site in England is the Tamar Estuary, Devon (Jolly et al 2012).

27. The southern North Sea (ICES Division IVc) supports commercially important shellfish species including brown crab *Cancer pagurus* lobster *Hommarus gammarus*, velvet swimming crab *Necora puber*, brown shrimp *Crangon crangon*, pink shrimp *Pandalus montagui* and the edible common whelk *Buccinum undatum* (Walmsey and Pawson 2007).

28. Shellfish species of lower commercial importance relevant to the East Anglia THREE site and offshore cable route include common prawn *Palaemon serratus*, green crab *Carcinus maenas,* spider crab Majidae spp., cuttlefish Sepiidae spp., octopus Octopoda spp. and squid Teuthida spp.

29. A limited number of shellfish species including blue mussel *Mytilus edulis*, native oyster *Ostrea edulis*, Pacific oyster *Crassostrea gigas*, razor clams Ensis spp. and cockle *Cerastoderma edule* are harvested at localised inshore locations including areas classified as shellfish harvesting areas (FSA 2013). These fisheries are however outside of the East Anglia THREE site and offshore cable corridor areas.

11.2.5.1 Site Specific Fish and Shellfish Surveys

30. Project specific fish characterisation surveys were conducted in February and May 2013 using standard commercial demersal fishing gear, as presented in *Annex 11.2.1 and 11.2.2.*

11.2.5.1.1 Otter Trawl Sampling

31. A total of 18 species were caught by the demersal otter trawl sampling; eight at the control stations and eighteen within the EA THREE site. Dab was the most abundant species caught, followed by plaice and whiting *Merlangius merlangus*. Lesser spotted dogfish was the only elasmobranch species caught at control and windfarm stations.

32. A summary of the results of the demersal otter trawl sampling is given in *Table 0.2*.

Table 0.2 Summary results of the demersal otter trawl sampling (February and May 2013) (*Annex 11.2.1 and Annex 11.2.2*)

Common name	Scientific name	CPUE (number of individuals per hour)			
		Control		Windfarm	
		Feb 2013	May 2013	Feb 2013	May 2013
Dab	*Limanda limanda*	72.8	9.0	60.5	12.8
Plaice	*Pleuronectes platessa*	33.9	7.5	31.3	16.6
Whiting	*Merlangius merlangus*	3.0	32.8	34.8	11.0
Lesser spotted dogfish	*Scyliorhinus canicula*	-	13.5	-	3.8
Grey gurnard	*Eutrigla gurnardus*	4.0	-	3.0	2.1
Herring	*Clupea harengus*	-	-	6.9	-
Flounder	*Platichthys flesus*	3.0	-	2.0	-
Lesser weever fish	*Echiichthys vipera*	2.0	1.2	-	0.9
Cod	*Gadus morhua*	1.0	-	2.0	-
Bullrout	*Myoxocephalus scorpius*	-	-	-	1.8
Sprat	*Sprattus sprattus*	-	-	1.5	0.4
Bib	*Trisopterus luscus*	-	-	1.0	-
Cuttlefish	*Sepia officinalis*	-	-	0.5	-

Common name	Scientific name	CPUE (number of individuals per hour)			
		Control		Windfarm	
		Feb 2013	May 2013	Feb 2013	May 2013
Common dragonet	*Callionymus lyra*	-	-	-	0.5
Squid	Alloteuthis sp.	-	-	-	0.5
Horse mackerel	*Trachurus trachurus*	-	-	-	0.5
Lemon sole	*Microstomus kitt*	-	-	-	0.4

11.2.5.1.2 4m Beam Trawl Surveys

33. A total of 23 species of fish and shellfish were caught with the 4m beam trawl sampling; seventeen species at control stations and nineteen within the East Anglia THREE site (*Table 0.3*). Plaice was the most abundant species caught, followed by dab. Whelk were not caught in the windfarm area but were caught at control stations during the May 2013 survey. Solenette, velvet crab and lesser spotted dogfish were found in moderate numbers whilst catch rates of all other species were low.

Table 0.3 summary results of 4m beam trawl sampling in the study area (February and May 2013) (*Annex 11.2.*1 and *Annex 11.2.2*)

Common name	Scientific name	CPUE (number of individuals per hour)			
		Control		Windfarm	
		Feb	May	Feb	May
Plaice	*Pleuronectes platessa*	37.6	29.2	86.2	36.0
Dab	*Limanda limanda*	29.0	15.0	68.1	16.5
Whelk	*Buccinum undatum*	0.7	27.0	-	-
Solenette	*Buglossidium luteum*	0.7	3.0	5.2	6.8
Velvet crab	*Necora puber*	0.7	3.0	5.1	-
Lesser spotted dogfish	*Scyliorhinus canicula*	-	5.2	1.5	0.7
Cuttlefish	*Sepia officinalis*	1.5	-	5.2	-
Bullrout	*Myoxocephalus scorpius*	-	-	5.2	1.5
Scaldfish	*Arnoglossus laterna*	1.5	1.5	3.0	-
Common dragonet	*Callionymus lyra*	-	2.2	0.7	1.5
Grey gurnard	*Eutrigla gurnardus*	0.7	1.5	1.5	-
Lesser weever	*Echiichthys vipera*	-	0.7	-	1.5
Sole	*Solea solea*	-	0.7	-	0.8
Pogge	*Agonus cataphractus*	-	0.7	-	0.7
Whiting	*Merlangius merlangus*	-	0.7	0.7	-
Turbot	*Scophthalmus maximus*	-	-	-	0.8
John Dory	*Zeus faber*	-	-	-	0.7
Sea scorpion	*Taurulus bubalis*	-	-	-	0.7
Mackerel	*Scomber scombrus*	-	-	-	0.7
Goby indet	Gobiidae spp	0.7	-	-	-
Sprat	*Sprattus sprattus*	0.7	-	-	-
Brill	*Scophthalmus rhombus*	-	-	0.7	-
Thornback ray	*Raja clavata*	0.7	-	-	-

11.2.5.1.3 Epibenthic Survey

34. Site specific surveys were conducted during May 2013, in the East Anglia THREE site and offshore cable corridor to characterise the epifauna (i.e. animals that live on the surface of the sea bed). These surveys involved a range of industry standard sampling techniques such as grab sampling, deployment of 2m scientific beam trawl gears and drop down video (East Anglia THREE, Volume 3, Appendix 10.4).

35. A summary of the fish species caught by the 2m scientific beam trawl sampling is presented in *Table 0.4*. As shown, the most prevalent species caught were solenette and sand goby.

Table 0.4 Summary of the results of the 2m scientific beam trawl survey in the study area (May 2013) (*Appendix 10.4*).

Common name	Scientific name	Cable	Windfarm
		May 2013	May 2013
Solenette	*Buglossidium luteum*	6.51	5.49
Sand goby	*Pomatoschistus minutus*	2.08	5.83
Crangon allmanni	*Crangon allmanni*	4.65	1.10
Lesser weever	*Echiichthys vipera*	1.28	0.94
Scaldfish	*Arnoglossus laterna*	0.51	0.79
Brown shrimp	*Crangon crangon*	0.55	0.35
Common hermit crab	*Pagurus bernhardus*	0.45	0.22
Dab	*Limanda limanda*	0.31	0.24
Common dragonet	*Callionymus lyra*	0.22	0.17
Swimming crab	*Liocarcinus holsatus*	0.24	0.13
Dragonet indet	Callionymus spp	0.01	0.33
Little cuttlefish	*Sepiola atlantica*	0.27	0.06
Pogge	*Agonus cataphractus*	0.19	0.13
Pink shrimp	*Pandalus montagui*	0.22	0.06
Greater sandeel	*Hyperoplus lanceolatus*	0.11	0.06
Plaice	*Pleuronectes platessa*	0.04	0.15
Sandy swimming crab	*Liocarcinus depurator*	0.04	0.14
Sandeel	Ammodytes spp	0.08	0.06
Reticulated dragonet	*Callionymus reticulatus*	0.06	0.07
Smooth sandeel	*Gymnammodytes semisquamatus*	0.01	0.11
Sprat	*Sprattus sprattus*	0.11	0.00
Spider crab indet.	*Macropodia parva/rostrata*	0.11	0.00
Whiting	*Merlangius merlangus*	0.05	0.06
Marbled swimming crab	*Liocarcinus marmoreus*	0.08	0.03
Sole	*Solea solea*	0.06	0.04
Four bearded rockling	*Enchelyopus cimbrius*	0.04	0.04
Grey gurnard	*Eutrigla gurnardus*	0.02	0.06
Velvet crab	*Necora puber*	0.00	0.06
Masked Crab	*Corystes cassivelaunus*	0.04	0.02
Small sandeel	*Ammodytes tobianus*	0.03	0.02

Common name	Scientific name	Cable	Windfarm
		May 2013	May 2013
Greater pipefish	*Syngnathus acus*	0.05	0.00
Goby indet	*Pomatoschistus* spp.	0.01	0.02
Five bearded rockling	*Ciliata mustela*	0.01	0.02
Lesser spotted dogfish	*Scyliorhinus canicula*	0.03	-
Shrimp indet	Pandalus spp	0.03	-
Shrimp indet	Crangon spp	0.03	-
Whelk	*Buccinum undatum*	0.02	-
Goby indet	Gobiidae spp	0.02	-
Herring / Sprat	Clupidae spp	0.1	-
Spotted ray	*Raja montagui*	0.01	-
Slender spider crab	*Macropodia tenuirostris*	0.01	-
Squat lobster	*Galathea intermedia*	0.01	-

11.2.5.2 International Beam Trawl Surveys

36. The 50 most common species present in the East Anglia THREE site specific study areas (Volume 2***, Figure 11.2***), expressed as their average elative abundance (CPUE) in IBT surveys (spring, summer, autumn, winter) for the years 2004-2013 is given in *Table 0.5.* Sprat CPUE was highest in the windfarm analysis area (34F2), whereas sand goby CPUE was highest in the offshore cable analysis area (33F2). Herring CPUE was highest within the windfarm analysis area (34F2), but low in the offshore cable analysis area (33F2).

37. Of note is the CPUE for greater sandeel *Hyperoplus lanceolatus*. The CPUE for greater sandeel in the windfarm analysis area (34F2) is considered low (CPUE 4.27), whilst moderate CPUE's occurred in adjacent ICES rectangles 34F3 (to the east of the windfarm analysis areas) and 33F2 (offshore cable analysis area).

Table 0.5 Average catch per unit effort CPUE (number/hour) for principal species recorded in the IBTS in the local study area (2004-2013) (DATRAS 2013)

Common name	Scientific name	CPUE (number of individuals per hour)		
		Inshore cable analysis area 33F1	Offshore cable analysis area 33F2	Windfarm analysis area 34F2
Sprat	*Sprattus sprattus*	301.20	69.52	843.42
Sand goby	Pomatoschistus spp	0.00	1234.80	177.10
Whiting	*Merlangius merlangus*	132.60	145.20	406.40
Greater sandeel	*Hyperoplus lanceolatus*	0.00	239.45	4.27
Lesser weever fish	*Echiichthys vipera*	3.30	120.34	90.43
Poor cod	*Trisopterus esmarkii*	7.30	330.76	7.72
Herring	*Clupea harengus*	8.40	31.51	270.86
Dab	*Limanda limanda*	54.40	17.88	98.70
Mackerel	*Scomber scombrus*	1.40	7.85	64.50

Common name	Scientific name	CPUE (number of individuals per hour)		
		Inshore cable analysis area 33F1	Offshore cable analysis area 33F2	Windfarm analysis area 34F2
Small sandeel	*Ammodytes tobianus*	0.00	0.00	5.80
Horse mackerel	*Trachurus trachurus*	2.20	10.36	31.38
Bib	*Trisopterus luscus*	1.00	18.64	6.70
Pogge	*Agonus cataphractus*	1.40	21.85	2.94
Red mullet	*Mullus barbatus*	0.00	0.70	1.40
Squid indet	Loliginidae spp	0.00	0.00	17.80
Lesser sandeel	*Ammodytes marinus*	0.00	3.56	2.79
Plaice	*Pleuronectes platessa*	0.50	5.86	3.38
Lesser spotted dogfish	*Scyliorhinus canicula*	9.00	3.28	3.33
Striped red mullet	*Mullus surmuletus*	1.80	0.81	2.90
European common squid	*Alloteuthis subulata*	0.00	1.86	3.50
Solenette	*Buglossidium luteum*	0.00	0.85	6.00
Long-finned squid	*Loligo forbesii*	0.00	0.60	0.10
Common squid	*Alloteuthis subulata*	0.00	0.00	4.47
Grey gurnard	*Eutrigla gurnardus*	0.00	2.31	2.52
Cuttlefish indet	Sepiidae spp.	0.00	0.00	0.20
Scaldfish	*Arnoglossus laterna*	0.00	0.30	4.94
Goby indet	Gobiidae spp	0.00	0.00	1.20
Sole	*Solea solea*	0.30	1.10	0.20
Red gurnard	*Chelidonichthys cuculus*	0.00	0.80	0.73
Sandeel	Ammodytidae spp	0.00	0.60	0.00
Smooth sandeel	*Gymnammodytes semisquamatus*	0.00	4.80	0.20
Lemon sole	*Microstomus kitt*	2.00	0.66	2.11
Common dragonet	*Callionymus lyra*	0.20	0.52	0.93
Cod	*Gadus morhua*	0.40	2.04	0.88
Starry smoothhound	*Mustelus asterias*	1.30	0.26	0.34
Blonde ray	*Raja brachyura*	0.00	3.10	0.40
Common smoothhound	*Mustelus mustelus*	0.00	1.73	0.29
Flounder	*Platichthys flesus*	0.00	0.00	0.00
European anchovy	*Engraulis encrasicolus*	0.00	0.2	0.86
Little cuttlefish	*Sepiola atlantica*	0.00	0.00	0.20
Sea lamprey	*Petromyzon marinus*	0.00	0.80	0.00
Thornback ray	*Raja clavata*	0.20	0.20	0.23
European eel	*Anguilla anguilla*	0.00	0.00	0.00
Pilchard	*Sardina pilchardus*	0.00	0.00	0.00

11.2.5.3 Commercial Species

38. An indication of the spatial distribution of the main commercially targeted species relevant to the East Anglia THREE site is given below with landings data for each species presented by weight (tonne) from the study areas in ICES rectangles 33F1, 33F2 and 34F4.

39. *Table 0.6* presents the main species landed by weight in the study areas. *Table 0.6* shows that plaice contributes 45.47% and 34.46% of landings (tonnes) in the offshore cable analysis area (33F2) and the windfarm analysis area (34F2), whereas the contribution of plaice in the inshore cable analysis area (33F1) is low at 0.47%. In both the inshore cable analysis area (33F1) and the windfarm analysis area (34F2) sprat contributes 30.95% and 34.2% of the total landings, compared to 15.0% in the offshore cable analysis area (33F2). The highest landings of cod and sole by weight are reported to occur in the inshore cable analysis area (33F1) at 18.31% and 16.03%.

40. *Diagram 0.1* and *Diagram 0.2* shows the UK annual landings weights (tonnes) for the windfarm analysis area and the inshore and offshore cable analysis areas. *Diagram 0.3* shows that he landings of plaice have generally declined over the 10 year period (2003-2012), with the exceptions of peaks in 2005 (123.67 tonnes) and 2013 (139.09 tonnes). Landings of sprat were only recorded in 2011 within the windfarm analysis area (34F2) at a weight of 342.25 tonnes. Sole landings by weight in the windfarm analysis area (34F2) have been relatively consistent throughout the ten year period for which data is shown. *Diagram 0.4* shows landing records for sprat in the offshore cable corridor are more consistent than in the windfarm analysis area, with records every year from 2004 to 2010, peaking in 2005. Landings of plaice and cod were higher between 2003 and 2006. The landings weight of skates and rays are higher in the offshore cable analysis area than in the windfarm analysis area.

41. *Diagram 0.5* shows seasonal variation (average 2008-2012) in landings weights for the windfarm analysis area (34F2). Landings of sprat are only recorded in the windfarm analysis area (34F2) in December, in 2011. Landings of plaice are generally higher from July to September. The highest cod landings within the windfarm analysis area corresponds to the spawning period defined by Coull et al 1998 and Ellis et al 2010 (December to April). Seasonal variation in landings weights within the offshore cable corridor are shown in *Diagram 0.6*. Cod landings are highest between January and April (i.e. the spawning period). Landings of sole are generally consistent throughout the year, with a peak in July. Landings for sprat are recorded in December only.

42. *Diagram 0.7* and *Diagram 0.8* show annual Dutch landings weights (tonnes) for the windfarm analysis area and the inshore and offshore cable analysis areas respectively. Dutch fishing activity is high within the windfarm analysis area and both the inshore and offshore cable analysis areas. The main species targeted by Dutch vessels are plaice and sole. *Diagram 0.7* shows that plaice landings within

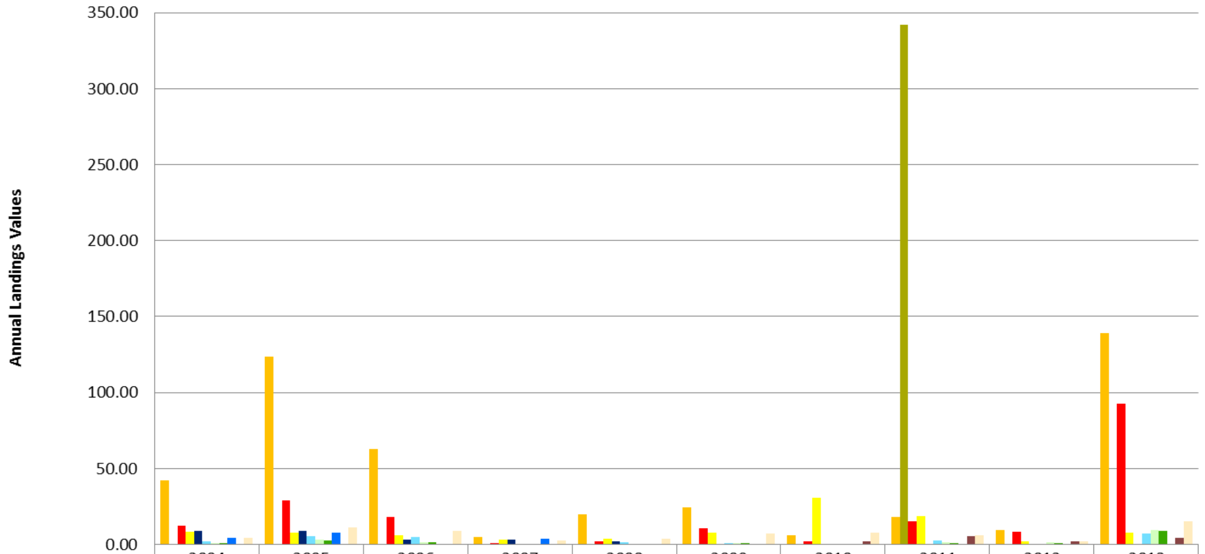
the windfarm analysis area peaked in 2013 at 1,447 tonnes. Sole landings also peaked in 2013, reaching 947 tonnes. *Diagram 0.8* shows that the landings of plaice were highest in 2011 (1,390 tonnes), declining in 2012 and 2013. Landings weights for sole in the cable analysis areas have been generally consistent throughout the five year period (2008-2013).

43. *Diagram 0.7*and *Diagram 0.8* show annual Belgian landings weights (tonnes) for the windfarm analysis area (34F2) and the inshore and offshore analysis areas (33F1 and 33F2) over a 5 year period (2011-2015) respectively. Belgian fishing activity relatively low within the windfarm analysis area (34F2) compared to that by the Dutch fleet. The highest recorded landings are of plaice and sole. Landings of both these species increased markedly during 2013 and 2014. Plaice and sole also represent the highest landed weights in the inshore and offshore cable analysis areas (33F1, 33F2). On average, weights are considerably higher in the cable analysis areas than the windfarm analysis areas. For example, the highest recorded weight for Dover sole and plaice in 34F2 were 94.5 and 77.6 tonnes, respectively, whilst the corresponding weights in the combined cable analysis areas were 283.5 and 335.2 tonnes.

Table 0.6 Average weight (tonnes) and percentage contribution of the principal commercial species (MMO landings data 2004-2013) within each ICES rectangle relevant to the East Anglia THREE site and the offshore cable corridor

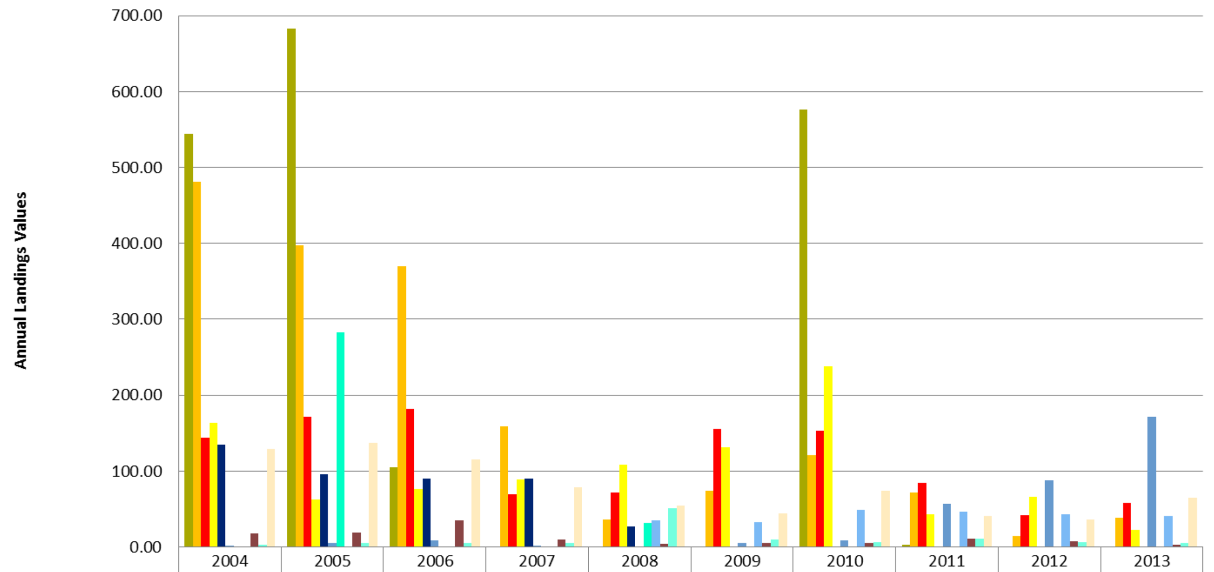
Species	33F1 (Inshore cable)		33F2 (Offhore cable)		34F2 (Windfarm)	
	Average Landings (tonnes)	Average contribution to total landings in 33F1 (%)	Average Landings (tonnes)	Average contribution to total landings in 33F2 (%)	Average Landings (tonnes)	Average contribution to total landings in 34F2 (%)
Sprats	133.9039	30.95%	57.526	15.00%	34.225	26.94%
Plaice	2.01389	0.47%	174.3154	45.47%	45.04076	35.46%
Sole	69.35468	16.03%	43.67373	11.39%	19.05274	15.00%
Cod	79.23073	18.31%	20.84125	5.44%	9.66258	7.61%
Skates and Rays	37.74711	8.72%	6.11023	1.59%	2.62124	2.06%
Whelks	32.52077	7.52%	2.29862	0.60%	0.70437	0.55%
Horse Mackerel	0.09573	0.02%	31.47378	8.21%	0.01029	0.01%
Thornback Ray	22.0964	5.11%	2.50123	0.65%	1.45031	1.14%
Flounder or Flukes	6.8168	1.58%	4.82326	1.26%	1.21828	0.96%
Dabs	1.3921	0.32%	7.67828	2.00%	2.60041	2.05%
Herring	6.31707	1.46%	4.76439	1.24%	0	0.00%
Brill	1.44719	0.33%	5.90903	1.54%	1.89307	1.49%
Bass	5.94981	1.38%	0.62031	0.16%	0.11845	0.09%
Edible Crabs	6.35022	1.47%	0.07605	0.02%	0.09446	0.07%

Species	33F1 (Inshore cable)		33F2 (Offhore cable)		34F2 (Windfarm)	
	Average Landings (tonnes)	Average contribution to total landings in 33F1 (%)	Average Landings (tonnes)	Average contribution to total landings in 33F2 (%)	Average Landings (tonnes)	Average contribution to total landings in 34F2 (%)
Turbot	0.20484	0.05%	4.34837	1.13%	1.7965	1.41%
Whiting	0.86587	0.20%	4.51059	1.18%	0.55835	0.44%
Spurdog	3.86022	0.89%	0.20621	0.05%	1.7005	1.34%
Lobsters	4.93737	1.14%	0.07527	0.02%	0.02214	0.02%
Smoothhound	4.7051	1.09%	0.12876	0.03%	0.02859	0.02%
Brown Shrimps	4.364	1.01%	0	0.00%	0.004	0.00%
Blonde Ray	1.4645	0.34%	1.08149	0.28%	1.50934	1.19%
Lesser Spotted Dog	3.0316	0.70%	0.353	0.09%	0.248	0.20%
Black Seabream	0.0004	0.00%	2.74421	0.72%	0	0.00%
Pouting	0.26769	0.06%	1.69384	0.44%	0.15209	0.12%
Other Species	3.70933	0.86%	5.64899	1.47%	2.32466	1.83%



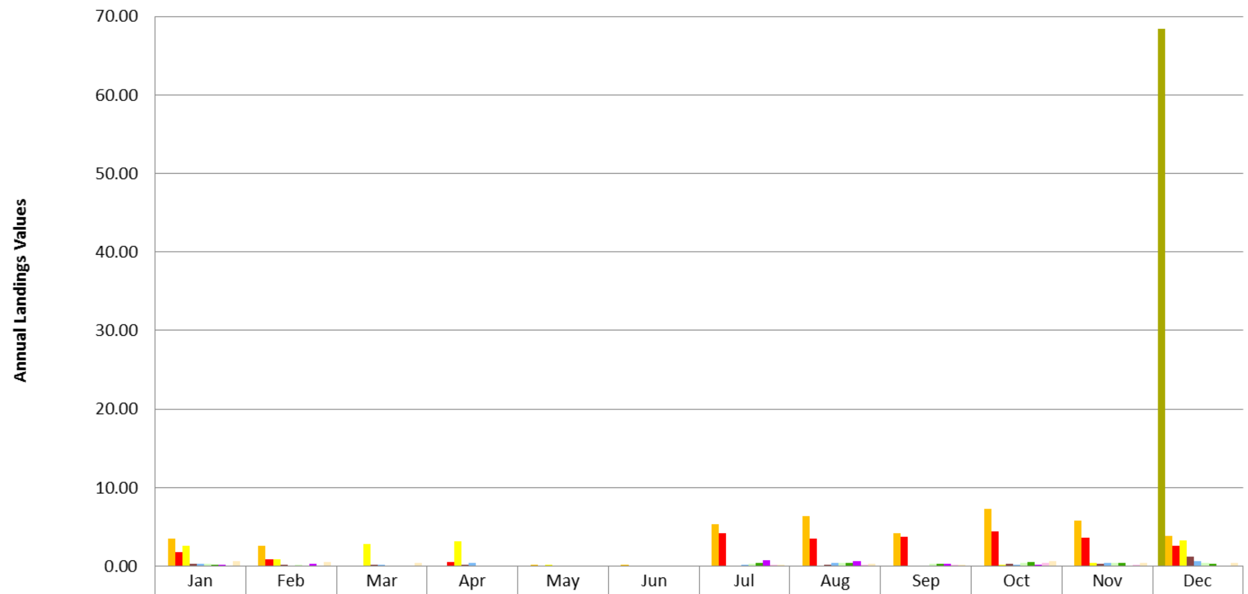
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Plaice	41.97	123.67	62.89	5.08	20.10	24.21	6.05	18.04	9.31	139.09
Sprats	0.00	0.00	0.00	0.00	0.00	0.00	0.00	342.25	0.00	0.00
Sole	12.09	29.20	17.83	0.95	2.25	10.47	1.90	15.22	8.14	92.46
Cod	8.58	7.59	6.07	3.45	3.88	7.89	30.61	18.55	2.05	7.96
Skates and Rays	8.72	8.74	3.23	3.47	2.06	0.00	0.00	0.00	0.00	0.00
Dabs	2.20	5.44	4.78	0.55	1.55	1.12	0.27	2.35	0.44	7.31
Brill	0.65	2.93	1.57	0.19	0.37	0.91	0.37	1.40	1.19	9.35
Turbot	0.72	2.78	1.69	0.23	0.37	1.04	0.30	1.01	0.71	9.11
Spurdog	4.45	7.77	0.51	4.01	0.07	0.18	0.02	0.00	0.00	0.00
Blonde Ray	0.00	0.00	0.00	0.00	0.55	0.27	2.12	5.57	2.06	4.51
Other Species	4.35	11.03	8.95	2.61	3.81	7.12	7.49	6.30	2.24	15.44

Diagram 0.1 Annual UK landings weight (tonnes) by species in the ICES rectangle relevant to the windfarm analysis area (34F2) (2004-2013) (Source: MMO 2014)



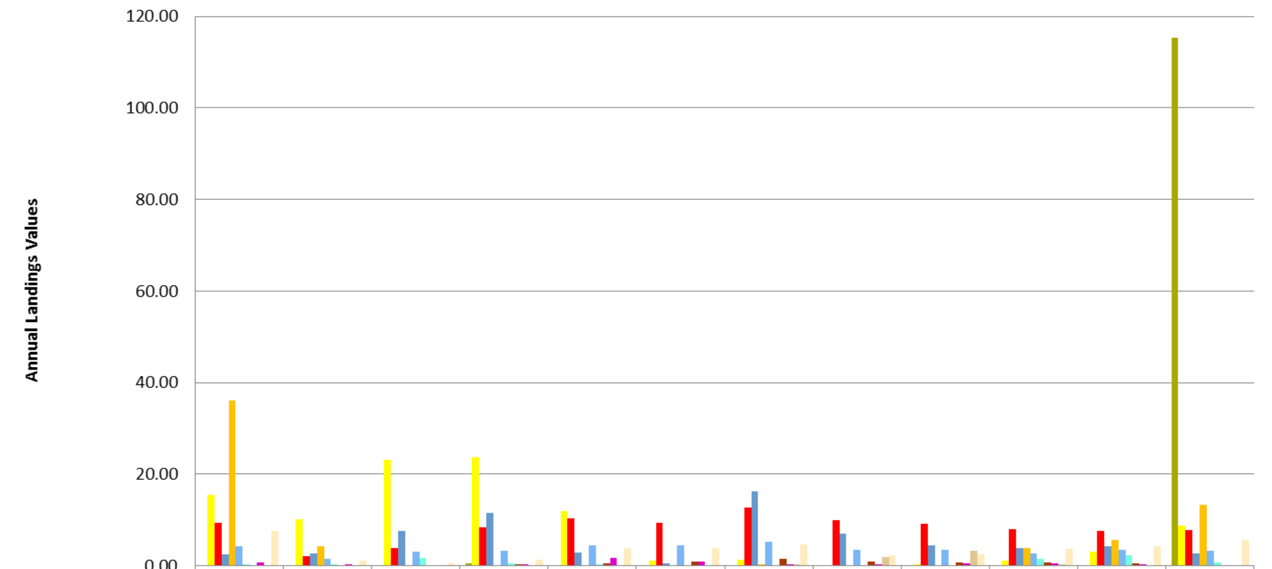
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sprats	544.57	683.00	105.28	0.40	1.11	0.76	576.13	2.94	0.11	0.00
Plaice	480.94	397.62	370.46	158.42	35.63	74.01	120.74	72.16	14.36	38.95
Sole	143.43	171.31	181.44	69.10	72.30	155.42	152.69	84.40	41.97	58.22
Cod	163.55	62.77	76.77	88.48	108.85	130.80	238.10	42.84	65.89	22.68
Skates and Rays	134.34	95.55	90.05	90.43	26.66	0.47	0.00	0.00	0.03	1.04
Whelks	1.41	5.14	8.60	1.62	0.16	5.81	8.62	57.20	87.76	171.88
Horse Mackerel	0.01	282.80	0.06	0.05	31.89	0.00	0.64	0.10	0.14	0.00
Thornback Ray	0.00	0.00	0.00	0.00	34.70	33.03	48.44	46.46	42.92	40.43
Flounder or Flukes	17.85	18.51	35.14	9.83	3.70	4.96	5.62	10.46	7.68	2.66
Herring	3.48	5.06	5.19	5.48	51.38	10.16	6.90	11.05	6.81	5.31
Other Species	128.75	137.49	115.82	78.76	55.09	44.51	73.74	41.01	36.56	64.51

Diagram 0.2 Annual UK landings weight (tonnes) by species in the ICES rectangles relevant to the Inshore and offshore cable analysis areas (33F1 and 33F2) (2004-2013) (Source: MMO 2014)



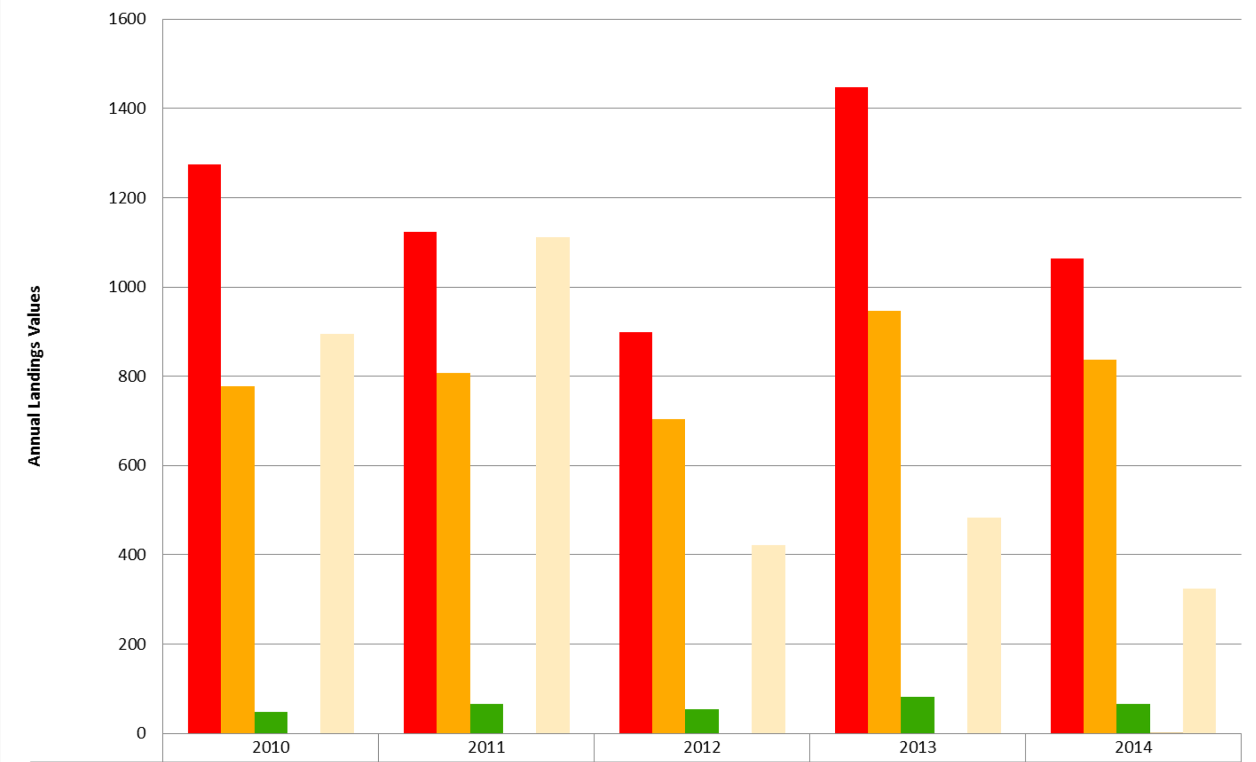
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sprats	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.45
Plaice	3.55	2.59	0.03	0.06	0.16	0.16	5.39	6.33	4.15	7.23	5.81	3.89
Sole	1.80	0.90	0.05	0.58	0.09	0.05	4.18	3.56	3.68	4.46	3.67	2.61
Cod	2.54	0.84	2.79	3.14	0.15	0.08	0.02	0.03	0.03	0.16	0.38	3.26
Blonde Ray	0.31	0.12	0.14	0.23	0.03	0.02	0.07	0.13	0.06	0.26	0.32	1.24
Thornback Ray	0.33	0.06	0.18	0.36	0.02	0.00	0.13	0.43	0.05	0.14	0.43	0.62
Brill	0.24	0.12	0.00	0.04	0.04	0.00	0.33	0.36	0.26	0.45	0.37	0.41
Turbot	0.16	0.08	0.00	0.04	0.00	0.00	0.36	0.42	0.27	0.48	0.36	0.27
Dabs	0.14	0.26	0.00	0.01	0.00	0.00	0.71	0.68	0.24	0.17	0.05	0.04
Tub Gurnard	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.23	0.19	0.36	0.15	0.00
Other Species	0.69	0.55	0.39	0.03	0.04	0.01	0.21	0.25	0.21	0.67	0.46	0.37

Diagram 0.3 Average seasonal UK landings weight (tonnes) by species in the ICES rectangle relevant to the windfarm analysis area (34F2) (average 2008-2012) (Source: MMO 2014)



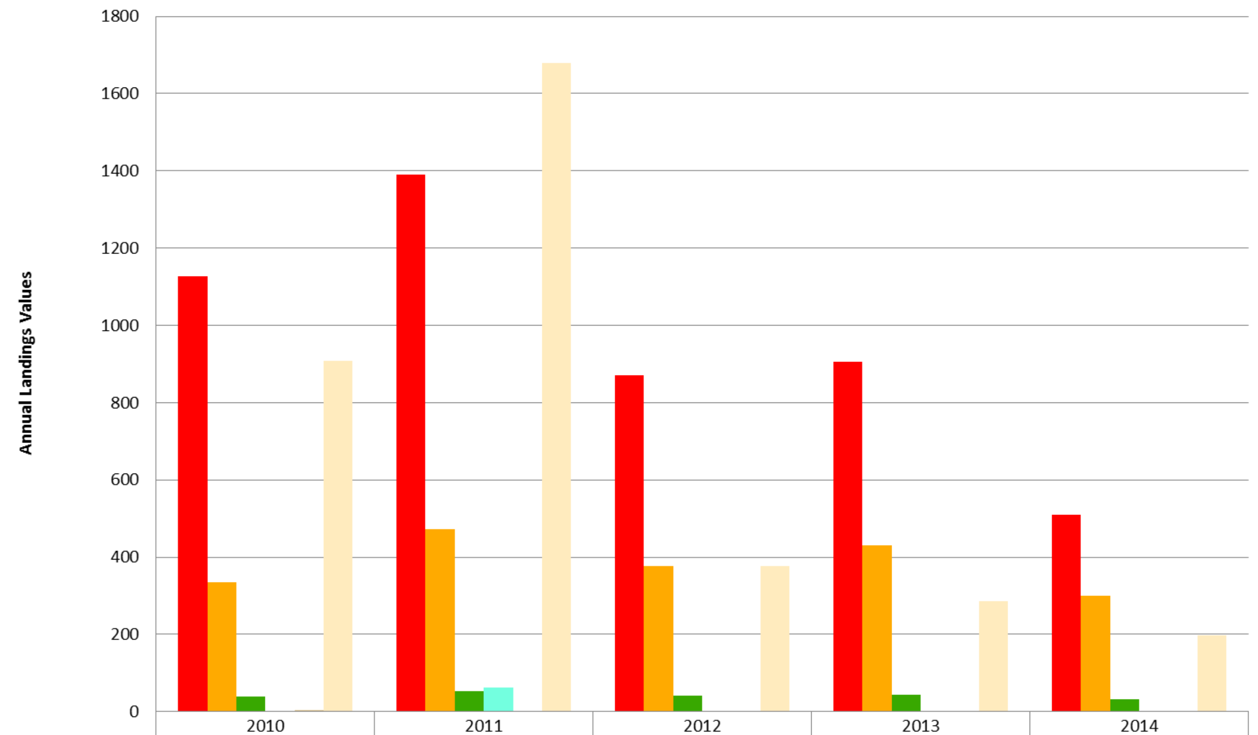
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sprats	0.02	0.03	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.05	115.35
Cod	15.54	10.07	23.21	23.73	11.88	1.17	1.23	0.21	0.24	1.09	3.00	8.70
Sole	9.37	2.11	3.91	8.41	10.25	9.34	12.75	9.90	9.23	7.94	7.61	7.71
Whelks	2.42	2.73	7.66	11.51	2.93	0.58	16.31	6.96	4.44	3.84	4.25	2.62
Plaice	36.11	4.26	0.10	0.05	0.12	0.08	0.29	0.21	0.15	3.89	5.57	13.22
Thornback Ray	4.21	1.53	3.00	3.16	4.48	4.50	5.20	3.47	3.37	2.57	3.52	3.23
Herring	0.23	0.36	1.67	0.58	0.39	0.19	0.00	0.00	0.08	1.44	2.33	0.78
Flounder or Flukes	0.14	0.11	0.03	0.24	0.54	0.81	1.48	0.96	0.68	0.71	0.45	0.14
Bass	0.62	0.24	0.07	0.29	1.77	0.87	0.32	0.29	0.50	0.52	0.25	0.10
Brown Shrimps	0.00	0.00	0.00	0.00	0.00	0.01	0.21	1.81	3.30	0.40	0.03	0.01
Other Species	7.56	1.07	0.58	1.28	3.85	3.92	4.67	2.30	2.40	3.55	4.20	5.55

Diagram 0.4 Average seasonal UK landings weight (tonnes) by species in the ICES rectangles relevant to the Inshore and offshore cable analysis areas (33F1 and 33F2) (average 2009-2013) (Source: MMO 2014)



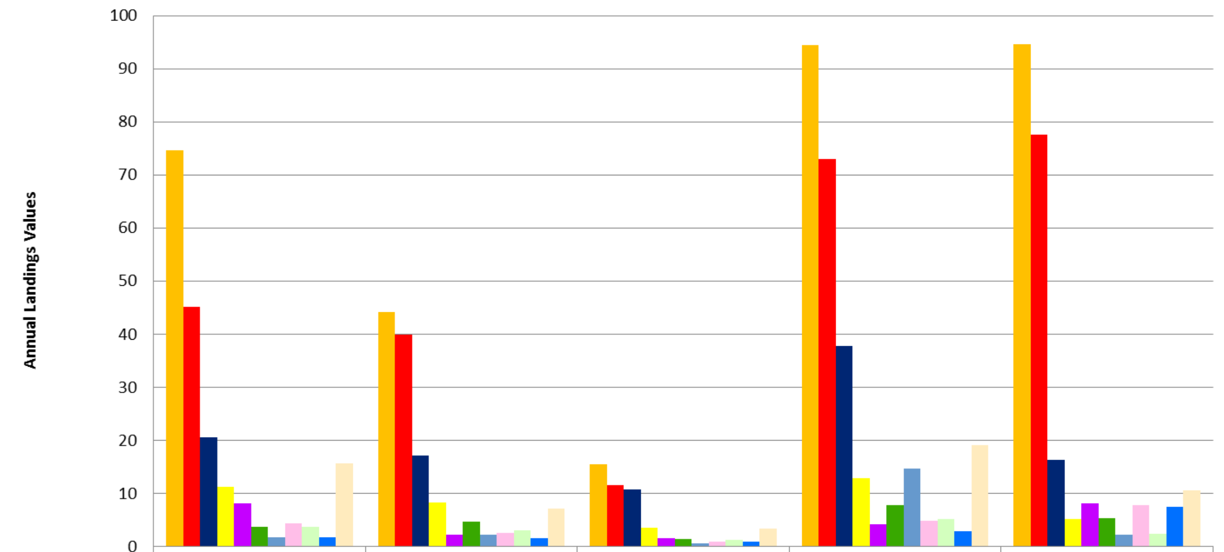
	2010	2011	2012	2013	2014
Plaice	1275.19	1122.45	898.3	1447.71	1063.91
Sole	778.5	807.62	703.28	947.42	836.36
Turbot	47.51	65.3	54.78	81.26	65.16
Brown Shrimp	0	0	0	0	1.6
Other	894.03	1112.03	421.56	483.9	324.87

Diagram 0.5 Annual Dutch landings weight (tonnes) by species in the ICES relevant to the windfarm analysis area (34F2) (average 2010-2014) (Source: IMARES 2015)



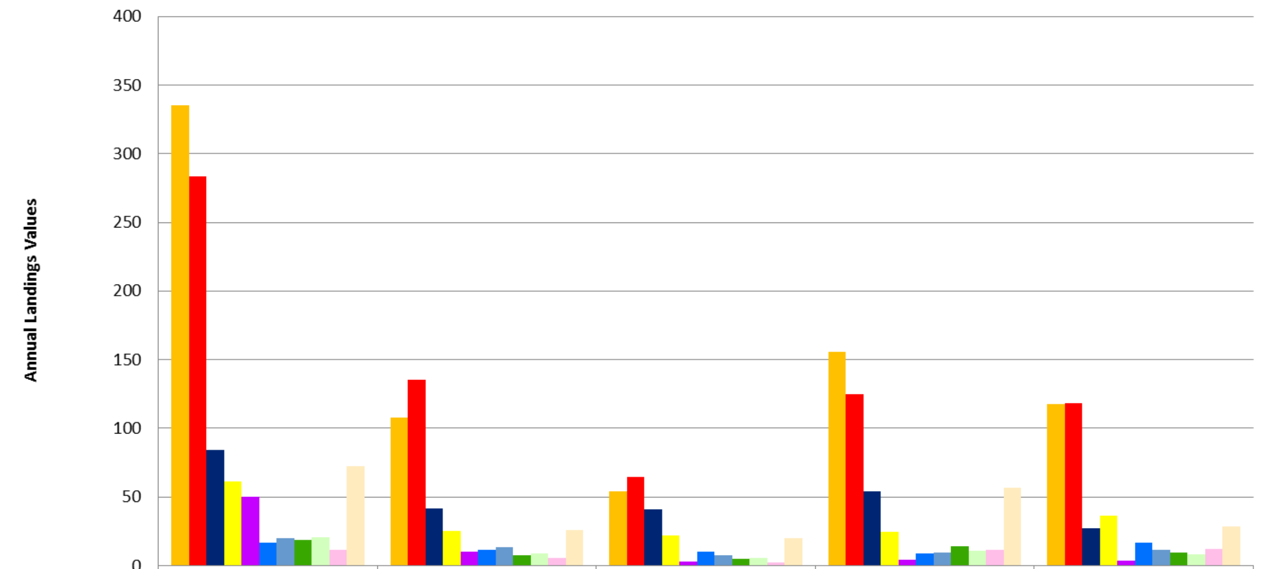
	2010	2011	2012	2013	2014
Plaice	1126.99	1390.31	871	905.64	510.14
Sole	333.87	473.49	377.11	429.54	300.78
Turbot	40.06	54.21	40.58	43.47	32.72
Herring	0	63.39	0	0	0
Brown Shrimp	4.35	0	0	0	1.75
Other	907.11	1680.32	376.45	285.98	197.5

Diagram 0.6 Annual Dutch landings weight (tonnes) by species in the ICES relevant to the Inshore and offshore cable analysis areas (33F2, 33F1) (average 2010-2014) (Source: IMARES 2015)



	2010	2011	2012	2013	2014
Plaice	74.65	44.169	15.488	94.456	94.538
Dover Sole	45.068	39.834	11.594	72.977	77.64
Skates & Rays	20.538	17.195	10.738	37.758	16.312
Cod	11.16	8.337	3.495	12.873	5.1
Dab	8.143	2.262	1.484	4.237	8.162
Turbot	3.707	4.593	1.401	7.733	5.249
Whelk	1.759	2.226	0.53	14.589	2.15
Tub Gurnard	4.35	2.526	0.974	4.912	7.727
Brill	3.643	3.068	1.195	5.078	2.419
Catsharks	1.679	1.601	0.913	2.926	7.384
Other Species	15.709	7.1	3.285	19.035	10.541

Diagram 0.7 Annual Belgian landings weight (tonnes) by species in the ICES relevant to the windfarm analysis area (34F2) (average 2011 - 2015) (Source: ILVO)



	2010	2011	2012	2013	2014
Plaice	335.183	107.536	53.997	155.53	117.355
Dover Sole	283.521	135.512	64.866	125.023	118.059
Skates & Rays	84.484	41.557	40.73	53.807	27.26
Cod	61.086	25.285	22.04	24.691	36.427
Dab	49.919	10.036	2.626	3.988	3.868
Catsharks	16.954	11.533	10.424	8.866	16.578
Whelk	20.227	13.493	7.37	9.538	11.566
Turbot	18.7	7.443	5.037	14.079	9.319
Brill	20.785	8.634	5.743	10.801	8.512
Tub Gurnard	11.662	5.294	2.446	11.482	11.862
Other Species	72.327	26.2	19.795	56.951	28.8

Diagram 0.8 Annual Belgian landings weight (tonnes) by species in the ICES relevant to the Inshore and offshore cable analysis areas (33F2, 33F1) (2011- 2015) (Source: ILVO)

11.2.5.4 Spawning and Nursery Grounds

44. The East Anglia THREE site and offshore cable corridor are in the proximity of the spawning grounds of a number of species (Coull et al 1998; Ellis et al 2010; 2012). The spawning periods and their relative intensities are given in *Table 0.7*. The majority of the species with spawning grounds in the proximity of the East Anglia THREE site and offshore cable corridor are pelagic spawners, releasing their eggs in the water column over wide areas. The exceptions are herring and sandeels which deposit eggs on the seabed.

Table 0.7 Spawning seasonality and intensity in the East Anglia THREE site and the offshore cable corridor for species with defined spawning periods (based on Coull et al 1998 and Ellis et al 2010

Species	Spawning seasonality and intensity in East Anglia THREE site and the offshore cable corridor												Nursery Grounds	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	East Anglia THREE	Offshore Cable Corridor
Sole				●									n/a	
Plaice	●	●											n/a	n/a
Cod		●	●											
Whiting														
Lemon Sole													n/a	n/a
Herring														
Mackerel					●	●	●							
Sprat					●	●								
Sandeel														
Thornback Ray	n/a													
Tope	Gravid females present year round													
Spurdog	Gravid females present year round												n/a	n/a

(Spawning times and intensity colour key: red= high intensity spawning/nursery ground, yellow= low intensity spawning/ nursery grounds, grey= unknown spawning/ nursery grounds, ● = peak spawning, n/a = no overlap with spawning/nursery grounds)

45. Coull et al (1998), and latterly Ellis et al (2010; 2012) have, to-date, been the main start point references for the consideration of windfarm consent conditions regarding fish spawning. Coull et al (1998) and Ellis et al (2010; 2012) are reviews of a variety of published research data and as such give broad scale definitions of spawning areas and periods. Furthermore, since the publication of Coull et al (1998) there is evidence to suggest, that the spawning grounds of certain species may have changed. For example, since the mid-1970s, herring have not been found to have spawned on the Dogger Bank spawning grounds, which were previously considered important spawning grounds for the species (Nichols 1999; Schmidt et al 2009).

11.2.5.5 Species of Conservation Interest

46. A summary of fish and shellfish species with recognised conservation status requiring consideration in the East Anglia THREE site impact assessment is presented below in *Table 0.8, Table 0.9* and *Table 0.10*.

11.2.5.5.1 Demersal Species

47. A limited number of demersal fish species have conservation status under internationally recognised criteria including cod and haddock are listed as 'Vulnerable' on the IUCN Red List (www.iucnredlist.org).

48. Other demersal species including whiting, plaice, sandeel and sole are listed as UK Biodiversity Action Plan (BAP) priority marine species.

11.2.5.5.2 Diadromous Species

49. A number of diadromous species may transit parts of the East Anglia THREE site and the offshore cable corridor during certain periods of their life cycle. These species are listed in *Table 0.8* together with their conservation status. Whilst these species were not caught during the site specific fish and shellfish surveys, certain diadromous species including sea trout, European eel, smelt and river lamprey, have been documented in the vicinity of the East Anglia THREE site (Potter and Dare 2003, Colclough and Coates, 2013). They have also been recorded in IBTS samples and recorded occasionally in MMO commercial landings statistics.

11.2.5.5.3 Elasmobranchs

50. A summary of the principal elasmobranch species with designated conservation status are given in *Table 0.9*. Sharks, skates and rays are of conservation interest as a consequence of their slow growth rates and low reproductive output compared to other species groups (Camhi et al 1998). This results in slow rates of stock increase (Smith et al 1998) and a low resilience to fishing mortality (Holden 1974). Stocks of most elasmobranch species are currently considered low and international advice and spatial management measures have been introduced to conserve the remaining stocks (ICES 2013).

11.2.5.5.4 Other Species of Conservation Interest

51. In addition to the above, a number of species using the local study area are of conservation interest, being listed as UK BAP priority species. These are presented in Table 0.10. Other conservation designations and status e.g. OSPAR and IUCN listings are also presented. It should be noted that many of these species are commercially exploited in the area either directly or indirectly as by-catch.

52. Non-commercial shellfish species with listed conservation status recorded in the southern North Sea include several bivalve species. Records of these species are rare and occurred outside of the study areas (NBN 2014).

11.2.5.5.5 Prey Species and Food Web Linkages

53. A number of species which occur in the general area of the East Anglia THREE site have a role in the North Sea's food web being prey to predators such as birds, marine mammals and piscivorous fish.

54. Sandeels are preyed upon whilst in the sediment by a number of predators, although they are more commonly taken when in transit to, or feeding in, the water column (Van der Kooij et al 2008; Furness 2002; Hobson 1986). They are a component of the diet of birds, such as kittiwakes, razorbills, puffins and terns, (Wright and Bailey 1993; Furness, 1999; Wanless, et al 1998; Wanless et al 1999; Wanless et al 2005). Sandeels are also prey to other fish species such as herring, sea trout, cod, whiting, grey gurnard and saithe. In addition, marine mammals such as seals and harbour porpoises *Phocoena phocoena* are known to feed on sandeels (ICES 2006; Santos and Pierce 2003).

55. Herring is a prey item for a variety of bird species and fish species such as whiting, cod, mackerel and horse mackerel (ICES 2008; ICES 2005a; ICES 2005b). Predation mortality of one year old herring in the North Sea is considered to be mainly a result of consumption by cod, whiting, saithe *Pollachius virens* and seabirds, whilst younger herring (0-group herring) are largely preyed upon by horse mackerel (ICES 2008). Herring egg mats are also known to attract a number of predators such as spurdog, mackerel, lemon sole and other herring (Richardson et al 2011).

56. Spat is also prey for other fish species including cod, grey gurnard, herring, sandeels, spurdog, horse mackerel, mackerel, sea trout and whiting (ICES 2005; ICES 2009) and seabirds (Wanless et al 2005). Both herring and sprat are considered to form part of the diet of marine mammals such as seals and harbour porpoise (Santos and Pierce 2003; Wood 2001; Santos et al 2004).

Table 0.8 Conservation status of diadromous migratory species

Common name	Latin name	Conservation Status							
		[2]IUCN Red List	[3]UK BAP	[4]NERC Act 2006	[3]OSPAR	[5]Bern Convention	[6]CITES	[7]W&C 1981	[8]Habitats Directive
European eel	*Anguilla anguilla*	Critically Endangered	✓	✓	✓	-	✓	-	-
Allis shad	*Alosa alosa*	Least concern	✓	✓	✓	✓	-	✓	-
Twaite shad	*Alosa fallax*	Least concern	✓	✓	-	✓	-	✓	-
Sea lamprey	*Petromyzon marinus*	Least concern	✓	✓	✓	✓	-	-	-
River lamprey	*Lampetra fluviatilis*	Least concern	✓	✓	-	✓	-	-	✓
Atlantic salmon	*Salmo salar*	Least concern	✓	✓	✓	✓	-	-	✓
Sea trout	*Salmo trutta*	Least concern	✓	✓	-	-	-	-	-
Smelt (sparling)	*Osmerus esperlanus*	Least concern	✓	✓	-	-	-	-	-

[2] IUCN - International Union for the Conservation of Nature – Red-listed species
[3] OSPAR - Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic – Threatened or declining species
[4] NERC Act 2006
[5] Bern Convention
[6] CITES
[7] Wildlife and Conservation Act 1981
[8] Habitats Directive

Table 0.9 Conservation status of elasmobranch species

Common name	Scientific name	Conservation Status							
		IUCN Red List	UK BAP	NERC Act 2006	OSPAR	Bern Convention	CITES	W&C 1981	Habitats Directive
Sharks									
Basking shark	*Cetorhinus maximus*	Vulnerable	✓	✓	✓	✓	✓	✓	-
Starry smoothhound	*Mustelus asterias*	Vulnerable	-	-	-	-	-	-	-
Smoothhound	*M. mustelus*	Least concern	-	-	-	-	-	-	-
Spurdog	*Squalus acanthias*	Vulnerable	-	-	✓	-	-	-	-
Thresher shark	*Alopias vulpinus*	Vulnerable	-	-	-	-	-	-	-
Tope	*Galeorhinus galeus*	Vulnerable	-	✓	-	-	-	-	-
Skates and rays									
Blonde ray	*Raja brachyura*	Near Threatened	-	-	-	-	-	-	-
Cuckoo ray	*Leucoraja naevus*	Least concern	-	-	-	-	-	-	-
Common Skate Complex[9]	*Dipturus intermedia/Dipturus flossada*	Critically endangered	✓	✓	✓	-	-	-	-
Spotted ray	*Raja montagui*	Least concern	-	-	✓	-	-	-	-
Thornback ray	*Raja clavata*	Near Threatened	-	-	✓	-	-	-	-
Undulate ray[10]	*Raja undulata*	Endangered	✓	✓	-	-	-	-	-
White skate	*Rostroraja alba*	Endangered	✓	✓	✓	-	-	-	-

[9] A recent study by Iglésias *et. al* (2010) has revealed that common skate actually comprises two species: *Dipturus intermedia* and *Dipturus flossada*. Common names already in use for these species are the flapper skate and blue skate respectively, although it remains to be seen if these become widely accepted (Iglésias et. al 2010, Shark Trust, 2009).

[10] *Raja undulata* is considered to be occasionally present off the East Anglian coast (Shark Trust 2009) and occurs locally in the Eastern English Channel (Coelho et al 2009).

Table 0.10 Conservation status of Fish and Shellfish species relevant to the East Anglia THREE site and the offshore cable corridor (excluding diadromous and elasmobranch species).

Common name	Latin name	Recorded present in Site specific surveys Y/N	Conservation Status IUCN Red List	UK BAP	NERC Act 2006	OSPAR	Bern Convention	CITES	W&C 1981	Habitats Directive
Demersal species										
Cod	*Gadus morhua*	Y	Vulnerable	✓	✓	✓	-	-	-	-
Plaice	*Pleuronectes platessa*	Y	Least concern	✓	✓	-	-	-	-	-
Gobiidae - sand goby/ common goby	*Pomatoschistus minutus/P. microps/*	Y	Least concern	-	-	-	✓ Sand goby/ common goby	-	✓	-
Haddock	*Melanogrammus aeglefinus*	N	Vulnerable	-	-	-	-	-	-	-
Lesser sandeel	*Ammodytes marinus*	Y	-	✓	✓	-	-	-	-	-
Sole	*Solea solea*	Y	-	✓	✓	-	-	-	-	-
Whiting	*Merlangius merlangus*	Y	-	✓	✓	-	-	-	-	-
Ling	*Molva molva*	N	-	✓	✓	-	-	-	-	-
European Hake	*Merluccius merluccius*	N	-	✓	✓	-	-	-	-	-
Pelagic species										
Herring	*Clupea harengus*	Y	Least concern	✓	✓	-	-	-	-	-
Horse mackerel	*Trachurus trachurus*	Y	-	✓	✓	-	-	-	-	-

Common name	Latin name	Recorded present in Site specific surveys Y/N	Conservation Status IUCN Red List	UK BAP	NERC Act 2006	OSPAR	Bern Convention	CITES	W&C 1981	Habitats Directive
Mackerel	*Scomber scombrus*	Y	Least concern	✓	✓	-	-	-	-	-
Shellfish										
Horse mussel	*Modiolus modiolus*	N	-	-	-	✓	-	-	-	-
Blue mussel	*Mytilus edulis*	N	-	✓	-	✓	-	-	-	✓
Dog whelk	*Nucella lapillus*	N	-	-	-	✓	-	-	-	-
Crawfish	*Palinurus elephas*	N	-	✓	✓	-	-	-	-	-
Fan mussel	*Atrina fragilis*	N	-	✓	✓	-	-	-	✓	-
Ocean quahog	*Arctica islandica*	N	-	-	-	✓	-	-	-	-
Native oyster	*Ostrea edulis*	N	-	✓	✓	✓	-	-	-	-

11.2.5.6 Relevant Species

57. *Table 0.11* summarises the rationales for the identification of relevant species, based on consultation with statutory stakeholders and fishermen, guidance documents, information on conservation status and relevant scientific advice and research.

Table 0.11 Fish and shellfish species relevant to the East Anglia THREE site and the offshore cable corridor with basis for consideration

Relevant Fish and Shellfish Species	Rationale
Commercial demersal fish species	
Sole	• Abundant throughout the study area • UK BAP species. • Commercially important species in the study area • Low/high intensity nursery areas in vicinity of the inshore and offshore cable analysis area
Plaice	• Abundant throughout the study area. • UK BAP listed species. • Low/High intensity spawning areas in vicinity of the study area • Commercially important species in vicinity of the study area • Low intensity nursery areas in vicinity of the study area
Cod	• UK BAP and OSPAR listed species and 'vulnerable' on the IUCN Red List. • Commercially important species to local vessels in the study area • Low intensity spawning areas in vicinity of the study area • Low/high intensity nursery areas in vicinity of study area
Whiting	• Abundant throughout the study area. • UK BAP listed species. • Extensive spawning grounds around the UK including in the vicinity of the study area
Lemon sole	• Present throughout the study area • Extensive North Sea spawning grounds including in vicinity of the study area • Low intensity nursery areas in vicinity of offshore cable corridor
Commercial pelagic fish species	
Herring	• Present in the vicinity of the study area. • UK BAP listed species

Relevant Fish and Shellfish Species	Rationale
	• Low/high intensity nursery habitats within the cable analysis study areas. • Key prey species for fish, birds and marine mammals. • Demersal spawner • Hearing specialist (potentially sensitive to underwater noise)
Sprat	• Abundant in the vicinity of the East Anglia THREE site and offshore cable corridor • Important prey species for fish, birds and marine mammal species. • Spawning areas (undefined intensity) present within vicinity of the study area • Nursery areas (undefined intensity) within the vicinity of the study area
Ammodytidae (Sandeels)	
Greater sandeel Lesser sandeel Smooth sandeel Small sandeel	• UK BAP listed species • Spawning areas within the East Anglia THREE site and offshore cable corridor • Low intensity nursery areas occurs within the East Anglia THREE site and offshore cable corridor • Prey species for fish, birds and marine mammals. • Demersal spawner
Elasmobranchs	
Rays, Skates and Sharks	• Present in the vicinity of the study area • Some species are UK BAP or OSPAR listed and several are classified on the IUCN Red-List with landings restricted or prohibited • Some species have important local commercial value • The study area is situated within low intensity nursery area for tope and undefined/low for thornback ray
Diadromous fish species	
Sea trout	• Present in some East Anglian rivers • UK BAP listed species • Feeding grounds located in vicinity of the East Anglia THREE site • May transit/feed in vicinity of the study area during marine migration
Atlantic salmon	• UK BAP listed species • May transit/feed in the vicinity of the study area during marine migration
European eel	• Present in almost all East Anglian rivers

Relevant Fish and Shellfish Species	Rationale
	• UK BAP listed species and listed as 'critically endangered' on the IUCN Red List • May transit/feed in the East Anglia THREE site during marine migration
European smelt	• Considered to be of national importance • UK BAP listed species • Spawning populations present in some East Anglian rivers • May transit/feed in vicinity of offshore cable corridor
River lamprey Sea lamprey	• Present in some East Anglian Rivers • UK BAP listed species and sea lamprey listed by OSPAR as declining and/or threatened. • May transit/feed in vicinity of the study during marine migration
Twaite shad Allis shad	• UK BAP listed species • Potential (rarely) transit/feed in vicinity of the study area during marine migration
Non commercial fish species	
Includes grey gurnard, lesser weever fish and solenette (characterising species of the fish assemblage), and small demersal species Gobiidae spp.	• Present/ abundant throughout the study area • Possible prey items for fish, bird and marine mammal species
Shellfish species	
Brown (edible) crab	• Present in the vicinity of the offshore cable corridor • Commercially important species • May overwinter within the regional area
Lobster	• Present in the vicinity of the export cable corridor • Commercially important species in the vicinity of the East Anglia THREE site
Brown and pink shrimp	• Present in vicinity of the study area • Important prey species for fish • Commercially important species in the vicinity of the study area
Whelk	• Becoming a commercially important species in the regional area

11.2.5.7 Commercial Demersal Species

11.2.5.7.1 Sole

58. The main populations of sole in the North Sea are located south of latitude 56°N with a wide distribution in the southern North Sea (Limpenny et al 2011; Cefas, 2007), with sea temperature considered as a major factor in determining the northern limit (Burt and Miller 2008). Sole exhibit a preference for sandy and muddy sediments at depths up to 70m where their favoured food source (e.g. polychaetes) are most abundant (Eastwood et al 2000; Limpenny et al 2011). In the winter, sole tend to move further offshore and have been found at depths up to 150m (Kay and Dipper 2009; Reeve 2007).

59. Mature fish return to shallow inshore waters in the spring to spawn and spawning areas include those with relatively higher water temperatures such as the mouths of estuaries e.g. the Wash and Thames Estuary, and shallow waters such as sand banks which also act as nursery areas for juveniles (Limpenny et al 2011; Cefas 2007). Juveniles occupy shallow inshore waters whereas 0-groups (fish in their first year of life) are relatively abundant at all depths (Rogers et al 1998).

60. As shown by Coull et al (1998) and the Ichthyoplankton survey results given in Ellis et al (2010, 2012) and inferred by van Damme et al (2011)(*Diagram 0.10 Diagram 0.11*), the East Anglia THREE site is some distance from defined sole spawning grounds, although the western section of the inshore cable analysis area falls within low intensity nursery grounds. This is supported by the charts produced by CHARM Consortium (Carpentier et al 2009).

61. Sole spawning is considered to start in March in the English Channel and southern North Sea once sea temperatures reach around 7°C (Burt and Millner 2008; Limpenny et al 2011; Eastwood et al 2001; Fonds 1979). Spawning continues until May with a peak in April and sporadic spawning until June. Recent ichthyoplankton surveys (van Damme et al 2011) found the highest concentrations of stage one eggs between April and June (*Diagram 0.10*).

62. Sole is one of the main species targeted in the vicinity of the East Anglia THREE site, predominantly by Dutch beam trawlers as a consequence of quota allocations. As shown by *Diagram 0.3* and *Diagram 0.4*, anding of sole by UK vessels are relatively consistent throughout the year. Unfortunately, monthly landings data was not available for Dutch registered vessels.

63. As shown in *Table 0.10,* sole is listed as a UK BAP priority species. ICES have advised that landings of sole in 2014 should not exceed 11,900 tonnes in the North Sea (subarea IV) (ICES Advice, 2013).

64. Sole prey upon small crustaceans, small molluscs and fish (Wheeler 1978). In Dutch coastal waters polychaete worms are reported to be a key part of their diet with small echinoderms e.g. brittle stars, also representing important prey for adults in some areas (ICES 2012b).

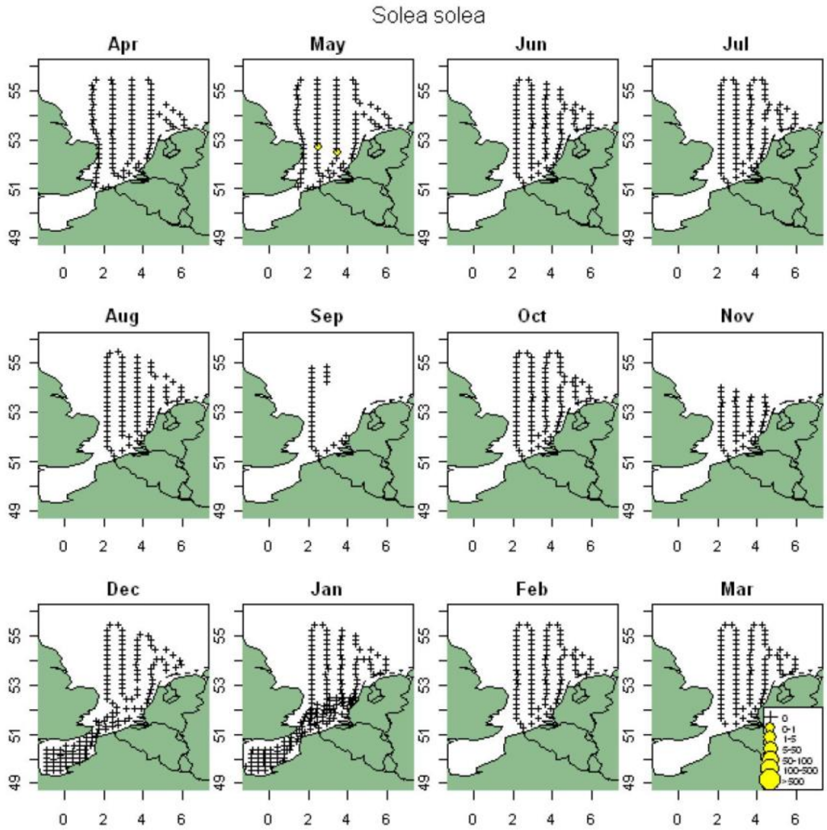


Diagram 0.9 and temporal distribution of Sole yolk sac larvae (van Damme et al 2011)

11.2.5.7.2 Plaice

65. Plaice are widely distributed in the North Sea (Volume 2, *Figure 11.13*), generally between depths 10 and 50m (Kay and Dipper 2009), with a preference for sand and gravel substrates and they are also found on muds (Ruiz 2007a).

66. Tagging of plaice in the North Sea (by Cefas and collaborators) suggests plaice divide into sub-populations during summer for feeding in the Southern and German Bights, along the east coast of the UK and in the Skagerrak and Kattegat (Hunter et al 2004). The spawning distribution of North Sea plaice described by Christophe et al (2010), indicates high abundances in the southern part of North Sea and along

the east coast of the United Kingdom with very low abundances found in the central North Sea. Shallow coastal and inshore waters of the North Sea provide juvenile plaice with nursery habitats, with the Wadden Sea off the Dutch and German coast considered the most important (Wegner et al 2003; Teal 2011). One year old plaice show a mainly coastal distribution whilst the older age classes gradually disperse offshore, from nursery areas (ICES 2012a). As shown in Volume 2 *Figure 11.14,* the western section of the offshore cable orridor overlaps with an area defined as a low intensity nursery ground for plaice (Ellis et al 2010).

67. In the southern North Sea and English Channel where tides are stronger, the migratory behaviour of plaice is influenced by the speed and direction of tidal flows (Creutzberg et al 1978; Rijnsdorp et al 1985, cited in Hufnag et al 2012). Mature fish are thought to select the tidal streams flowing towards spawning grounds whilst spent fish use the reciprocal tidal stream to return to feeding grounds (Cefas 2012).

68. Spawning in the North Sea occurs over a wide area, across most of the offshore and deeper areas of the southern North Sea and off the UK coast from Flamborough Head to the Moray Firth with spawning areas connected to known nursery areas (Hufnag et al 2013; ICES 2012a).

69. As shown by Volume 2 *Figure 11.14* (Ellis et al 2010), areas of egg production are extensive, ranging from the English Channel to as far north as approximately latitude 58°N off the coast of Norway. The main centres of egg concentrations are considered to be located in the English Channel, Southern Bight and German Bight (Hufnag et al 2013). The charts produced by CHARM (Volume 2 *Figure 11.15*) illustrate considerable variation in the annual bundance and distribution of plaice stage one eggs.

70. Ichthyoplankton surveys (*Diagram 0.10*) have generally found plaice stage one eggs in the southern North Sea between December and March with the highest concentrations in the eastern southern North Sea occurring in January (van Damme et al 2011). This coincides with the finding of Rijnsdorp (1989), Simpson (1959) and Harding et al (1978) which suggest spawning as peaking during the last two weeks of January. Tagging by Hunter et al (2003) found strong spawning area fidelity with individual fish returning to the same spawning areas.

71. Juvenile nursery areas are generally in shallow (< 10m deep), sandy or muddy areas (Zijlstra 1972; van der Veer 1986; Able et al 2005 cited in Hufnag et al 2013).

72. As discussed in Chapter 14 (Commercial Fisheries), plaice are one of the main species targeted by vessels fishing in the vicinity of the windfarm analysis area, particularly Dutch beam trawlers. According to Beare et al (2010) undersized plaice constitute a significant proportion of by-catch due to the mesh sizes of the nets used. Plaice were also one of the principal species caught during the otter and beam trawl surveys undertaken in the East Anglia THREE site (*Table 0.2 and Table 0.3*).

73. Plaice is listed as a UK BAP species and its conservation status is defined as of Least Concern in the IUCN Red List of Threatened Species (*Table 0.10*). ICES have advised that the TAC for plaice in Area lV (North Sea) for 2014 should not exceed 111,631 tonnes.

74. Plaice feed on a wide range of benthic and epibenthic species including polychaetes, crustaceans and molluscs and occasionally on brittle stars and sandeels.

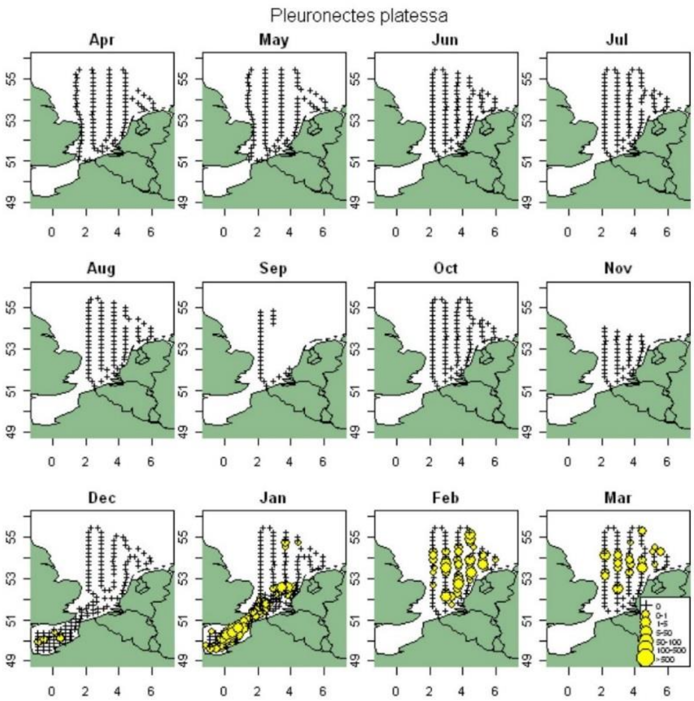


Diagram 0.10 Spatial and temporal distribution of Plaice yolk sac larvae (van Damme et al 2011)

11.2.5.7.3 Cod

75. Both juvenile and adult cod occur throughout most of the North Sea (Volume 2 *Figure 11.16*). Cod are a demersal species and are generally ound within 30-80m of the seabed at depths up to 500m (ICES, 2012c; Hedger et al 2004). Demersal juveniles inhabit a wide variety of habitats but are often found in shallower waters than adults (Teal et al 2009). The results of quarterly IBTS surveys

show that adults are widely distributed during the colder, winter months but their range contracts during spring and summer as they retreat northwards in response to increasing temperatures in the English Channel and Southern Bight. Cod undergo an extensive spawning migration, returning to the southern North Sea during autumn (ICES 2012c).

76. The North Sea cod stock is thought not to comprise a single distinct population but a number of sub-populations with differential rates of mixing between components (Blanchard et al 2005; STECF 2005). There is a limited influx of young cod from the eastern English Channel into the southern North Sea and cod in the German Bight show some limited mixing with those in the Southern Bight (Horwood et al 2006).

77. Hutchinson et al (2001) have identified several genetically distinct populations within the southern and northern North Sea at Bergen Bank, Moray Firth, Flamborough Head and the Southern Bight. These populations appear to form units that are reproductively isolated from each other and which may be spatially distinct at least during the spawning season (ICES 2005).

78. Information on currently active cod spawning areas in the North Sea is limited (Fox et al 2008). Being pelagic spawners, cod spawning grounds are not substrate specific. Previous studies have recorded the presence of spawning areas in the Southern Bight (Daan 1978), in the vicinity of Flamborough (Harding and Nichols 1987) and around the southern and eastern edges of the Dogger Bank (Heessen and Rijnsdorp 1989). Van Damme et al (2011) found yolk sac larvae at a limited number of sampling stations in the eastern sector of the southern North Sea in February (*Diagram 0.11*). Ichthyoplankton surveys have generally confirmed the results of these spawning studies showing hot spots of egg production around the southern and eastern edges of the Dogger Bank, in the German Bight, the Moray Firth and to the east of the Shetlands (Fox et al 2008). The low numbers of cod eggs at sites off Flamborough Head however suggests that this area can now be considered as a historical spawning ground (Fox et al 2008).

79. Both the windfarm analysis area and the cable analysis areas fall within a wider zone defined as a low intensity spawning area by Ellis et al (2010) (Volume 2 *Figure 11.17*). In the Southern Bight, peak spawning occurs in February but in the southern North Sea it varies from the last week of January to mid-February (Daan et al 1980; Heessen and Rijnsdorp 1989) with peak spawning occurring in the eastern English Channel in mid-February (Brander 1994; Pawson 1995).

80. ICES also collects data on the abundance of cod eggs and larvae as part of the MIK (Isaacs-Kidd midwater trawl) herring larval sampling program during the annual IBTS survey. The data from MIK samples for the years 2007-2009 has been mapped by the CHARM III Project (http://www.charm-project.org/) and the distribution of early stage cod eggs is presented in Volume 2 *Figure 11.18* **a**nd *Figure 11.19*. Comparatively low densities of cod stage 1 and 2 eggs were present in the inshore and offshore cable analysis areas and windfarm analysis areas in January for the years 2006, 2007 and 2008. As is apparent from Volume 2 *Figure 11.18* and *Figure 11.19,* more extensive distributions of stage 1 and stage 2 cod eggs were observed to the east and north-east of the East Anglia THREE site.

81. First-feeding cod larvae consume small organisms in the plankton including diatoms and dinoflagellates before moving onto the nauplii of small crustaceans such as isopods and small crabs. As juvenile cod move from inshore areas into deeper waters further offshore they target larger, benthic prey (Demain et al 2011).

82. Adult cod in the central North Sea feed on crustaceans, molluscs, and fish including sandeels, haddock, herring and several flatfish species (Wilding and Heard 2004; Arnett and Whelan 2001) and there is evidence of cannibalism (ICES 2005). Cod are considered to be responsible for significant mortality on commercial stocks of clupeid, gadoid and flatfish species (Daan 1973).

83. For management purposes, ICES currently defines three separate assessment areas for the North Sea cod: Divisions IIIa (Skagerrak), VIId (English Channel) and Sub-Area IV (southern and northern North Sea). ICES have advised, on the basis of the EU-Norway management plan, that landings of cod in the North Sea should not exceed 28,809 tonnes in 2014. ICES reports that there has been a gradual improvement in North Sea cod stock status over the last few years and spawning stock biomass has increased since 2007. The North Sea cod stock remains below target MSY and recruitment is poor (ICES 2013).

84. Cod is one of the target species of local East Anglian long lining vessels (Chapter 14 Commercial Fisheries) particularly in the inshore cable analysis area (33F1), where the western section of the offshore cable corridor is located (*Table 0.6*). Low numbers of cod were recorded in otter trawl samples at both control and windfarm stations in February 2013 and were not present during repeat sampling in May (*Table 0.2*). It is also likely that cod, including undersized cod may form a proportion of the Dutch beam trawl catches which comprise the majority of fishing activity within the vicinity of the windfarm site.

85. Cod are listed as a UK BAP priority species and are included in the OSPAR list of threatened and/or declining species and the IUCN defines their species' status as vulnerable (*Table 0.10*).

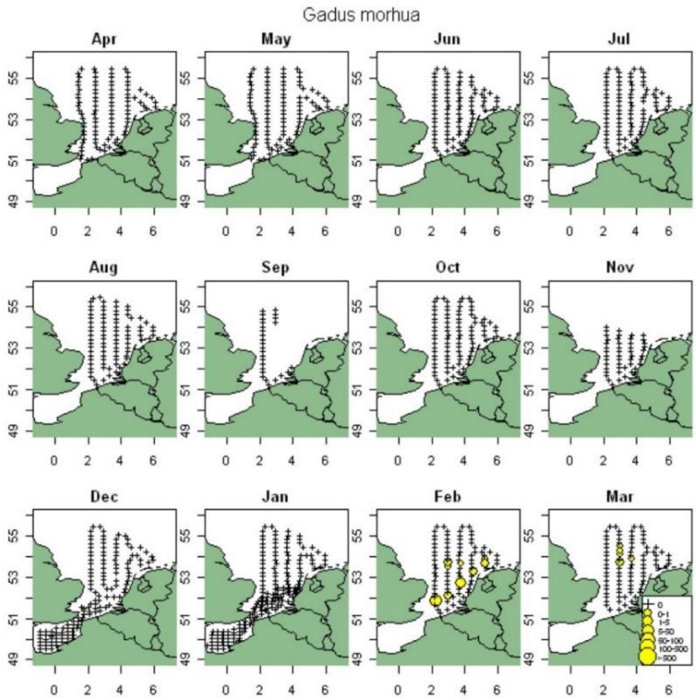


Diagram 0.11 Spatial and temporal distribution of Cod yolk sac larvae (van Damme et al 2011)

11.2.5.7.4 Whiting

86. Whiting is a fast growing demersal species, widespread across the North Sea and common to inshore waters (Loots et al 2011). Whiting is considered to be most abundant between 30m and 100m on a variety of substrates including mud, gravel, sand and rock (Barnes 2008a). As illustrated by Volume 2 *Figure 11.20* whiting are distributed throughout the North Sea, Skagerrak and Kattegat (ICES 2012d) with high densities of both juvenile and adult whiting being found almost anywhere with older individuals (>2yr) showing a preference for deeper waters (Daan et al 1990).

87. Juvenile whiting are particularly abundant inshore off the German Bight and the Dutch coast during the summer (ICES, 2012d). As shown in Volume 2 *Figure 11.21*, the East Anglia THREE site and the offshore cable corridor are located within broad areas defined as low intensity spawning and nursery grounds for this species (Ellis et al 2010). It is of note that the distributions of eggs and larvae given in Volume 2 *Figure 11.21*, reproduced from Ellis et al (2010) do not correlate with the whiting spawning grounds depicted in by Coull et al (1998).

88. The factors that determine spawning ground selection are considered limited, with no clear sediment preference being apparent (Daan et al 1990; de Oliveria and Elliot 2010). The species is however, reported to spawn at depths between 50 and 100m (Limpenny et al 2010).

89. Whiting have one of the longest spawning periods among North Sea species, from February to June, with a peak in April (Loot et al 2011; Coull et al 1998).

90. Recent surveys (van Damme et al 2011) found stage one whiting eggs in the vicinity of the East Anglia THREE site in June (*Diagram 0.5*) which coincides with the latter part of the spawning period given in Ellis et al (2012). Whiting yolk sac larvae were found between January to March during the recent IMARES surveys (van Damme et al 2011) (*Diagram 0.12*).

91. Whiting are caught throughout the North Sea, although substantial quantities are also discarded from commercial catches (ICES 2012d). Landings by weight for whiting are comparatively low in the vicinity of the windfarm analysis area (34F2). Whiting was however one of the top three species caught during the otter trawl fish sampling undertaken in the proposed East Anglia THREE site (*Table 0.2*).

92. The charts produced by the CHARM Consortium (Volume 2 *Figure 11.22 and Figure 11.23*) illustrate considerable variation in the annual abundance and distribution of whiting eggs in the vicinity of the East Anglia THREE site. These suggest an increase in the January egg abundance in the English Channel and southern North Sea in 2009 compared to previous years. This may however be a consequence of the IBTS surveys only conducted during January and their limited spatial coverage.

93. As shown in *Table 0.10,* whiting is listed as a UK BAP priority species and ICES have advised on the basis of precautionary considerations, that total catches should be no more than 31,553 tonnes in the North Sea and Eastern Channel for whiting for 2014 (ICES 2013).

94. Whiting have a mixed diet consisting of decapods e.g. Crangon spp., amphipods, copepods and fish, including small species such as sprat, sandeel, herring, cod, and haddock (Derweduwen et al 2012). Immature whiting feed primarily on small crustaceans such as crangonid shrimp (ICES 2012d; Hislop et al 1991).

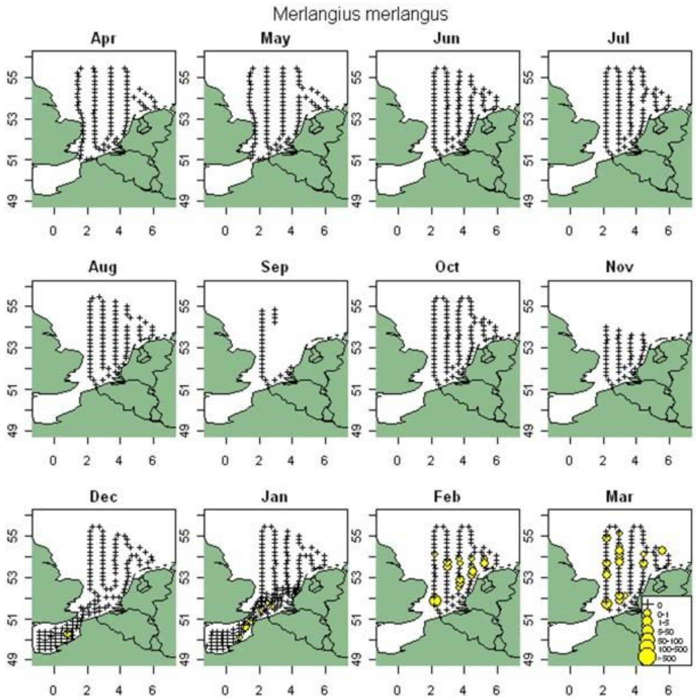


Diagram 0.12 Spatial and temporal distribution of whiting yolk sac larvae (van Damme et al 2011)

11.2.5.8 Commercial Pelagic Species

11.2.5.8.1 Herring

95. Herring are common throughout the North Sea (Volume 2 *Figure 11.24*), occupying depths from the sea surface to 200m. They have a wide distribution in North Atlantic waters and migrate considerable distances in large shoals to feeding and spawning grounds (Munro et al 1998). Juvenile fish generally remain for up to two years in nursery areas before joining adult fish migrations (ICES, 2010b). The migration of herring is divided into three phases, the over-wintering phase, the feeding phase and the spawning phase (Maurcops, 1969).

96. The North Sea autumn-spawning herring stock is understood to be a complex of multiple spawning components (sub-populations) (*Diagram 0.13* Payne et al 2010). There are considered to be four major components, each defined by distinct spawning times and sites (Payne et al 2010). The sub-population relevant to the proposed East Anglia THREE site is the Downs component. The Downs herring spawn during December and January in the eastern English Channel and overwinters in the southern North Sea (ICES 2013). The other three components spawn in the North Sea in August/September (the Orkney–Shetland, the Buchan and the Banks components) (*Diagram 0.13* and Volume 2 *Figure 11.25.* The

Downs herring move to the central and northern North Sea to feed in the spring (Corten 2001).

97. The Downs herring generally spawn in high energy environments on coarse substrates including gravel, sandy gravel, and small stones or rocks (Keltz and Bailey 2010; Munro et al 1998; Hodgson 1957) at depths between 20-40m (Cushing and Burd 1957; Parrish et al 1959). Herring spawn benthic eggs in single batches, often several eggs deep (Maitland and Herdson 2009) forming large mats and clumps that tend to hatch synchronously (Harden Jones 1968; Burd 1978; Blaxter and Hunter 1982).

98. The Downs herring are less fecund than the other three spawning components (i.e. produce fewer eggs). However, the eggs produced by the Downs herring are larger (Baxter 1959; 1963; Cushing 1958; Almatar and Bailey 1989) and as a result, the hatched larvae are larger than their northern counterparts (Heath et al 1997). Herring larvae hatch after approximately three weeks, depending on sea temperature and become planktonic (Craik and Harvey 1984; 1987; Ying and Craik 1993). The Downs larvae hatch between 7.5 and 9.5 mm in length (Dickey-Collas, 2005) and have faster escape responses than the smaller northern larvae (Batty et al 1993).

99. It is considered that almost all stocks in Western Europe drift in an easterly direction (Dickey-Collas 2005). The transport of larvae in the southern North Sea is towards the juvenile nursery grounds from the Wadden Sea to the Skagerrak and Kattegat (Wallace 1924; Burd 1978). Dickey-Collas et al (2009) propose that herring larvae can travel up to 100km in the first 15 days after hatching. Drifting larvae from the Downs component are dispersed in high numbers along the Dutch coastline as they are transported towards the German Bight and Skagerrak.

100. The East Anglia THREE site is located a considerable distance from the spawning grounds of the Downs component as given by Coull et al (1998) and Ellis et al (2010) (Volume 2 *Figure 11.25*).

101. The results of the IHLS in the area in recent years (Volume 2 *Figure 11.26, Figure 11.27* and *Figure 11.28*) herring larvae densities in the immediate vicinity of the proposed East Anglia THREE site are low. The proposed East Anglia THREE site partially overlaps the southern North Sea IHLS survey area which includes three separate sampling periods for Downs component larvae between November and January each year. The Banks component in the Central North Sea is sampled by the IHLS survey program once per year during September to October. It should be noted that not

all sites are sampled in all years and sampling coverage is not uniform between the southern and central North Sea surveys.

102. The southern limit of the central North Sea survey occurs at ICES rectangles 36F0 and 36F1; some distance to the north of East Anglia THREE site. The low abundance of Banks larvae at sites in ICES rectangles 36F0 and 36F1 indicates that Banks herring are not venturing further south beyond the spawning areas mapped by Coull et al (1998) and Banks herring are not spawning in the vicinity of the proposed East Anglia THREE site.

103. Recent monthly ichthyoplankton surveys which cover the windfarm analysis area did not find yolk sac herring larvae in the proximity of the proposed East Anglia THREE site; larvae were found in the Straights of Dover and the English Channel in November, December and January (van Damme et al 2011) (*Diagram 11.6*). The IHLS southern North Sea surveys between 2004 to 2012 however recorded some small larvae (<11mm) at stations in the vicinity of the East Anglia THREE site (Volume 2 *Figure 11.26*, *Figure 11.27* and *Figure 11.28*). It is therefore possible that on occasions, some planktonic larvae pass through the East Anglia THREE site being carried by currents from the spawning grounds in the eastern English Channel to the nursery areas along the Dutch coast and into the German Bight (Maurcops, 1969; Munro et al 1998; Hodgson 1957, ICES, 2010b).

104. Herring is of low commercial importance in the study area (*Table 0.5* and *Table 0.6*). Landings in the regional area are principally from ICES rectangle 32F2, to the south of the East Anglia THREE site. Clupeids (herring and sprat) occurred in very low numbers at sites sampled by the 2m scientific beam trawl survey along the offshore cable corridor in May 2013 (*Table 0.4*).

105. Herring is of conservation interest, being listed as a UK BAP priority species (*Table 0.10*). The Downs herring was the first North Sea component to collapse due to fishing over-exploitation in the 1960s and took the longest time to recover. Since 2001, however, the Downs component has increased consistently to a point where it is the largest component of the North Sea stock. The relative contribution of the Downs component to the total stock has increased since the start of the IHLS survey in the early 1970s (Schmidt et al 2009). The Downs component has varied from almost negligible in the 1970s to 40% of the total stock in recent times (Payne 2010).

106. Overall, herring recruitment has been low in the North Sea in recent years. This is thought to be related to a decrease in survival rates during the larval

overwintering phase associated with increases in water temperatures in the North Sea and changes in the plankton community (Payne et al 2009). ICES currently classifies the North Sea stock as being at full reproductive capacity and harvested sustainably (ICES Advice 2011g).

107. As previously mentioned, herring are prey to piscivorous fish and marine mammals and seabirds. Herring feed on zooplankton particularly Calanoid copepods during their early juvenile life, although they also feed on euphausids, hyperiid amphipods, juvenile sandeels, sea-squirts (*Oikopleura* spp.) and fish eggs. Other dietary items include small fish, arrow worms and ctenophores (ICES 2012f).

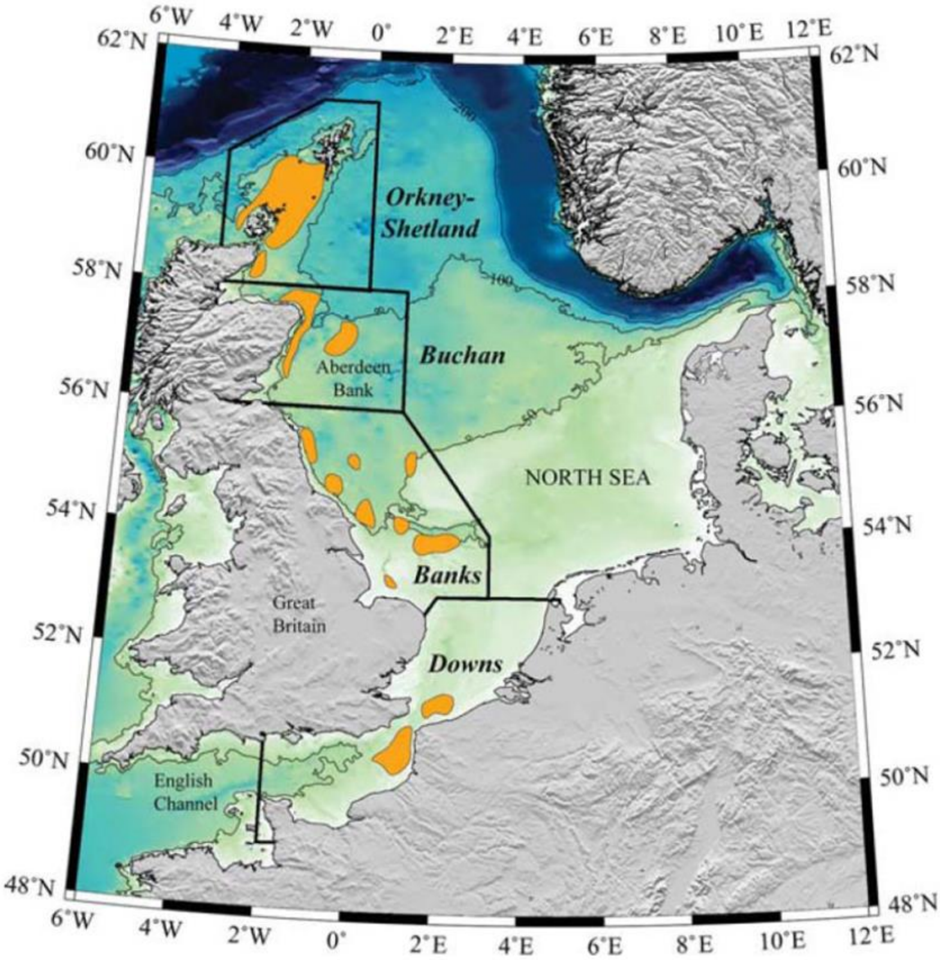


Diagram 0.13 Atlantic herring spawning sub-populations in the North Sea (From: Payne 2010).

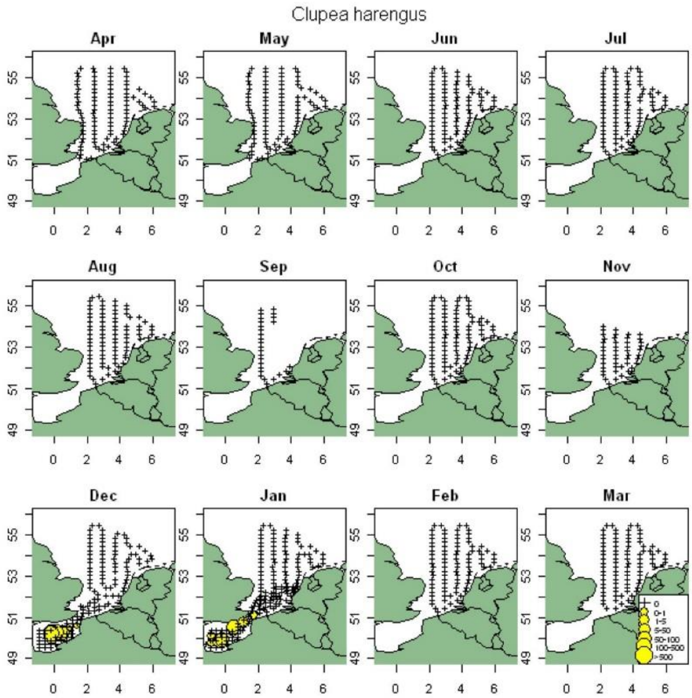


Diagram 0.14 Spatial and temporal distribution of herring yolk sac larvae (van Damme et al 2011)

11.2.5.8.2 Mackerel

108. Mackerel are distributed throughout the North Sea with seasonal inshore and northward migrations in summer (Maitland and Ryland 2005) (Volume 2 *Figure 11.29*). There is thought to be a relationship between the timing of spawning and sea surface temperature. Mackerel spawning in the North Sea migrate north in June and July and disperse to feed in the central North Sea and Skagerrat in late summer. In October, some of these fish migrate to western Shetland and some to the Norwegian Trench, where they overwinter. The following spring they return south to the spawning grounds (Pawson 1995).

109. The windfarm analysis area (34F2) and the eastern section of the offshore cable analysis area (33F2) fall within defined mackerel spawning grounds. Both the windfarm analysis area and offshore cable analysis area are located within an area defined as of low intensity as a nursery ground for this species (Volume 2 *Figure 11.30*). In the North Sea mackerel spawning occurs from May to August, peaking from May to July (Coull et al 1998).

110. Recent ichthyplankton surveys (van Damme et al 2011) did not find yolk sac mackerel larvae in the windfarm analysis area (*Diagram 0.15 and Diagram 0.16*). Further developed larval stages were found in the vicinity of the windfarm analysis area in July, although at comparatively low levels.

111. Mackerel are of limited commercial importance in the vicinity of the windfarm analysis area (ICES rectangle 34F2), and both the inshore and offshore cable analysis areas (33F2 and 33F1). The species were relatively common in IBTS surveys and were most abundant in the windfarm analysis area (34F2) (*Table 0.5*).

112. Mackerel is listed as a UK BAP priority species and classified as of 'Least Concern' in the IUCN Red List of Threatened Species (*Table 0.10*). ICES advice for 2014 suggests that the existing measures to protect North Sea spawning mackerel should remain in place, including no fishing in ICES Division IVc, where the East Anglia THREE site is located (ICES Advice, 2011i).

113. Mackerel have a varied diet with adults consuming large quantities of pelagic crustaceans. They also prey on schools of smaller fish, particularly sprat, herring and sandeels (Wheeler 1978). Juveniles consume fish larvae, crustacean larvae and their own larvae (Maitland and Ryland 2005). Mackerel are also of importance as a food resource for sharks, marine mammals and a variety of seabirds (ICES 2012h).

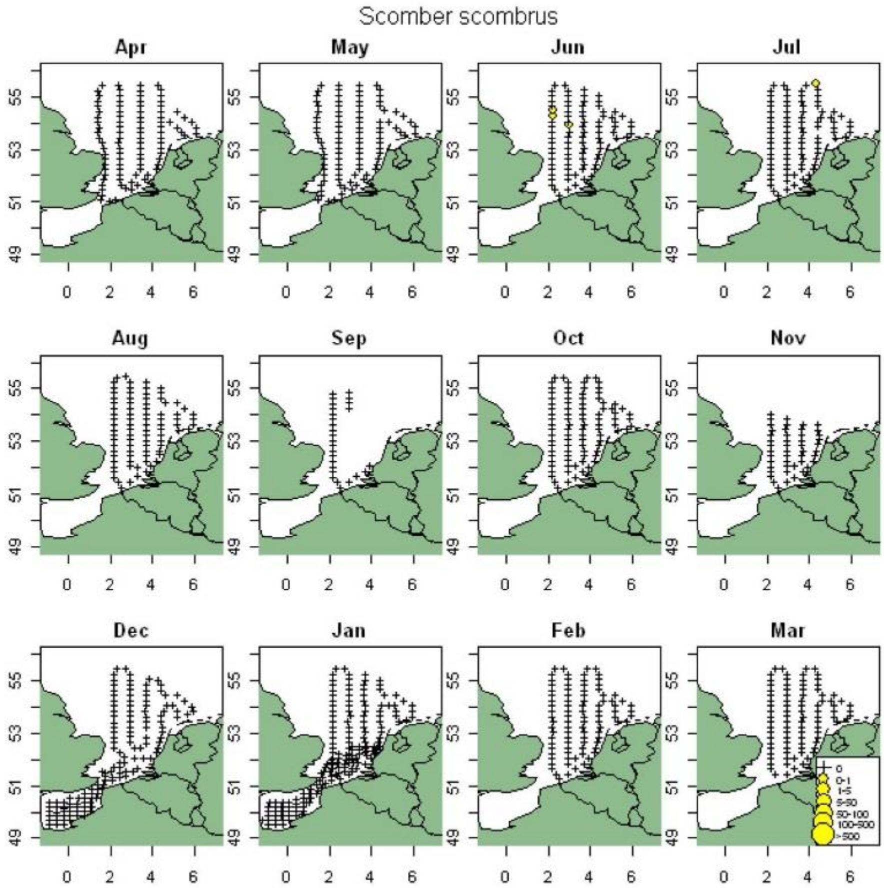


Diagram 0.15 Spatial and temporal distribution of yolk sac mackerel larvae (van Damme et al 2011)

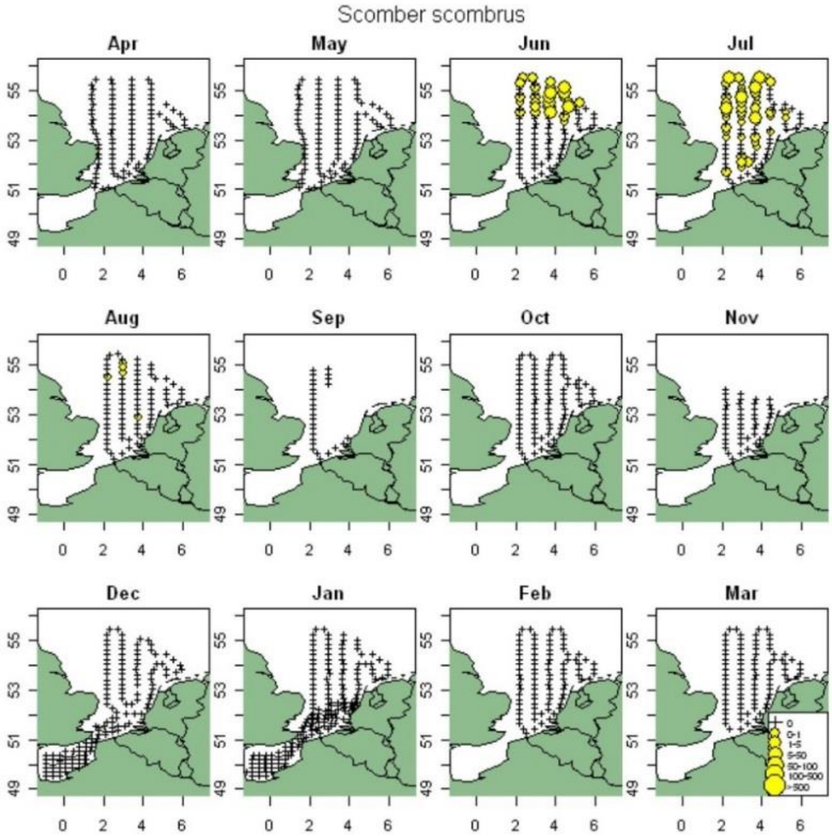


Diagram 0.16 Spatial and temporal distribution of Mackerel bent notochord stage (van Damme et al 2011)

11.2.5.8.3 Sprat

114. Sprat are distributed throughout the North Sea (Volume 2 *Figure 11.31.* They generally remain within the 50m depth contour and are common in inshore waters during summer for spawning, with migrations to winter feeding grounds (Maitland and Ryland 2005; ICES, 2012g).

115. As shown by *Table 0.5* and *Table 0.6,* landings of sprat are predominantly from the windfarm analysis area (34F2) and the inshore cable analysis area (33F1) (*Table 0.6*). It is also in these rectangles that the highest abundances of sprat have been recorded by the IBTS (*Table 0.5).*

116. Spawning is considered to occur between May and August, peaking between May and June (Coull et al 1998; Voss et al 2009) (Volume 2 *Figure 11.32*), in both coastal waters and up to 100km offshore in deep basins (Whitehead 1986; FAO, 2011; Nissling et al 2003). Females spawn repeatedly in batches throughout the spawning season (Milligan, 1986). Sprat are pelagic spawners with eggs and larvae are subject to larval drift, moving to inshore nursery areas (Hinrichsen et al 2005; Nissling et al 2003). Juvenile sprat are often found close inshore in schools with juvenile herring.

117. The East Anglia THREE site and the eastern section of the offshore cable corridor (in the offshore cable analysis area 33F2) fall within the broad spawning grounds defined for sprat, and similarly both offshore elements of the East Anglia THREE site and offshore cable corridor coincide with the species' nursery areas (Volume 2 *Figure 11.32*).

118. Recent ichtyoplankton surveys (van Damme et al 2011) found sprat stage one eggs in the windfarm analysis area and the wider North Sea from March to June. The ichthyplankton surveys did not find yolk sac sprat larvae in the East Anglia THREE site (*Diagram 0.17*), however, sprat stage one eggs have been recorded in the study area between March and June (*Diagram 0.16*).

119. Sprat are not listed as a species of conservation importance. The currently available information is considered inadequate to evaluate the state of the North Sea stock. ICES have advised, on the basis of precautionary considerations, that catches of sprat should be reduced in 2012 (ICES Advice 2014).

120. Sprat are important prey species for a number of species, including pisicivorous fish, marine mammals and seabirds. They primarily feed on small planktonic crustaceans including copepod nauplii and bivalve larvae (Maes and Ollevier 2002; ICES 2012g).

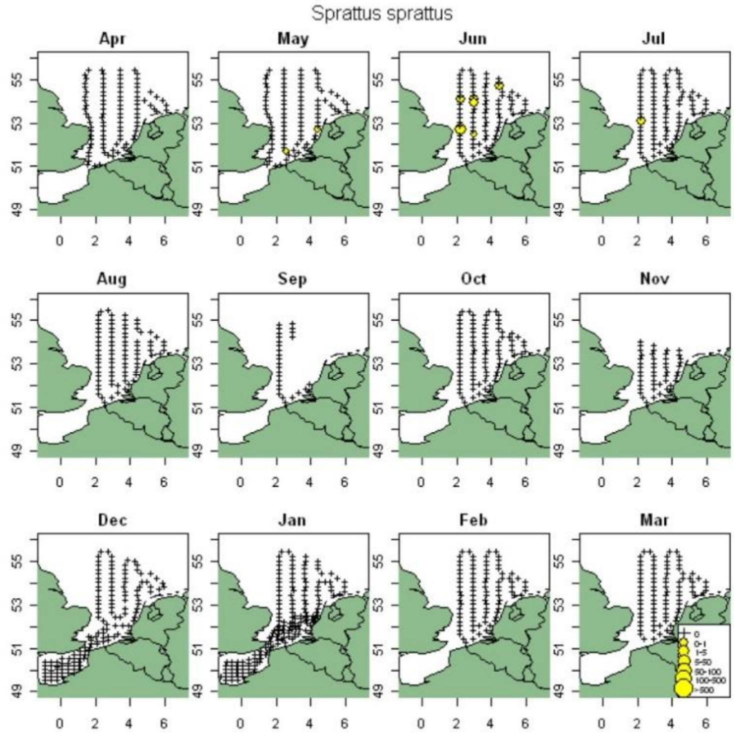


Diagram 0.17 Spatial and temporal distribution of Sprat yolk sac larvae (van Damme et al 2011)

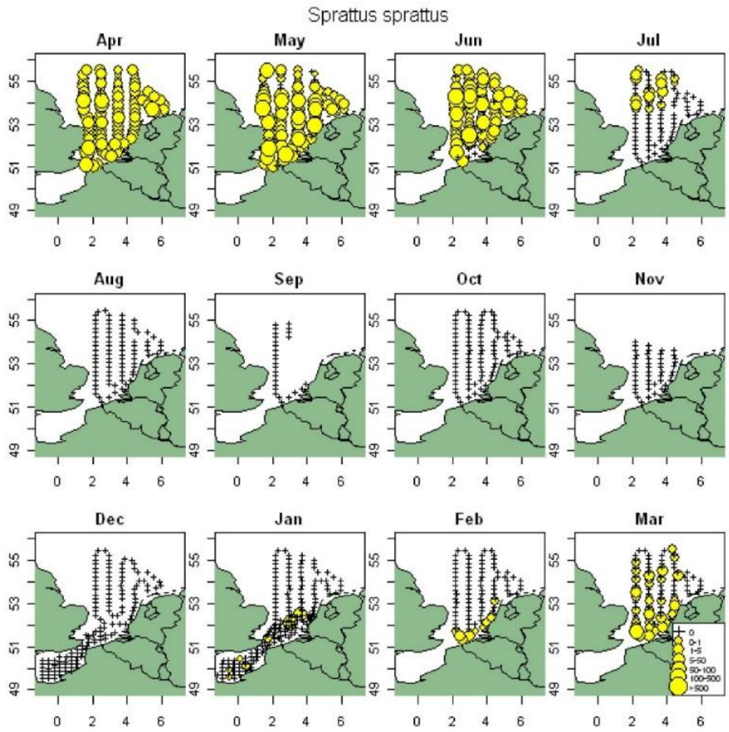


Diagram 0.18 Spatial and temporal distribution of Sprat stage one eggs (van Damme et al 2011)

11.2.5.8.4 Sandeels

121. The sandeel population of the North Sea is considered to consist of several discrete meta-populations rather than a single homogeneous stock. For the purposes of stock management ICES has divided the North Sea into seven sandeel areas (SAs). The East Anglia THREE site and offshore cable corridor fall within the boundaries of the Sandeel Assessment Area 1 and in close vicinity to Sandeel Assessment Area 2 (ICES 2010a) as shown in *Volume 2 Figure 11.34*.

122. Three species of sandeel were recorded in the site specific beam trawl surveys undertaken in the East Anglia THREE site: small sandeel *Ammodytes tobianus*, greater sandeel *Hyperoplus lanceolatus* and smooth sandeel *Gymnammodytes semisquamatus (Annex 11.2.1 and Annex 11.2.2*). Small sandeel, greater sandeel, smooth sandeel and lesser sandeel *Ammodytes marinus* have also been recorded in the study area by the IBTS, particularly in the offshore cable analysis area (rectangle 33F2), where the eastern section of the offshore cable corridor is located.

123. Sandeels spend a large part of the year buried in the sediment, emerging into the water column briefly in winter to spawn and for an extended feeding period in spring and summer (Van der Kooij et al 2008). Sandeel distribution is highly patchy being dependent sediment type (Volume 2 *Figure 11.33* to *Figure 11.37*) with a preference for shallow, turbulent sandy areas at depths of 20–70 m including the sloping edges of sandbanks (Greenstreet et al 2010; Jensen et al 2011).

124. Research undertaken on lesser sandeel suggests that sandeels require a very specific substratum, favouring sea bed habitats containing a high proportion of medium and coarse sand and low silt content (Holland et al 2005). Sandeels have been found to be rare in sediments where the silt content (particle size <0.63µm) is greater than around 4% and absent where it is greater than 10% (Holland et al 2005; Wright et al 2000). Sediment categories first proposed by Holland et al (2005) adapted by Greenstreet et al (2010) define sandeel suitable substrate in terms of “coarse sands” (with a particle size between 250µm to 2mm) and “silt and fine sands” (with particles between 0.1 µm and 250µm). The greater the percentage of “coarse sands” relative to the percentage of ‘‘silt and fine sands’’ the greater the potential for the substrate in a given area to constitute a preferred sandeel habitat.

125. Females lay demersal eggs on the sea bed and after several weeks planktonic larvae hatch usually in February or March (Macer 1965; Langham 1971; Wright and Bailey, 1996). Spawning is thought to occur between November and February (Coull et al 1998) and while recruitment to individual fishing banks is

largely related to the local (sub-) stock, some interchange can occur between these sub-stocks before larvae settle. After settlement sandeels form a complex of local (sub-) stocks in the North Sea and are largely sedentary (ICES Advice, 2013).

126. As shown in Volume 2 Figure 11.38*,* the East Anglia THREE site and offshore cable corridor fall within low intensity sandeel (Ammodytidae spp.) spawning and nursery grounds.

127. Fishing grounds are considered to provide reliable information on the distribution of sandeel habitat areas (Jensen 2001), and are used as an indicator of the distribution of sandeel habitat (van der Kooij et al 2008). Known fishing grounds are considered to represent the major areas of sandeel distribution in the North Sea in recognised peer-review publications (Jensen and Christensen 2008, Jensen et al 2011). The proposed East Anglia THREE site is located at a considerable distance from the majority of the sandeel habitat areas defined by Jensen et al (2011) (see Volume 2 *Figure 11.34*).

128. Recent ichtyoplankton surveys (van Damme et al 2011) found sandeel yolk sac larvae of lesser sandeel in the area of the East Anglia THREE site and the offshore cable corridor, particularly in February and March, whilst early larval stages of small sandeel, greater sandeel and smooth sandeel were not found in significant numbers (*Diagram 0.19* and *Diagram 0.20*).

129. As suggested by the landings data (*Table 0.5* and *Table 0.6*), there is little commercial targeting of sandeels in the study area. Traditionally important fishing grounds for this species are located some distance to the north of the East Anglia THREE site, in the Dogger Bank area as shown in Volume 2 *Figure 11.39*. The majority of the commercial catch of sandeels is for fish meal, predominantly by the non UK fleets including Denmark, Norway, Sweden and Germany. Volume 2 *Figure 11.39.* presents VMS fishing ntensity of the Danish sandeel fleet (2008-2012), the predominant sandeel fishery in the North Sea which shows the majority of the fishing activity occurring to the north of the East Anglia THREE site.

130. A single Total Allowable Catch (TAC) of 286,424 tonnes is set for the management of sandeel catches in EU waters of ICES divisions IIa, IIIa, and ICES subarea IV. This is divided between UK and non-UK fisheries, with Denmark holding the majority of the TAC (87%). ICES have advised that for the Dogger Bank stock (Sandeel Area 1. southern North Sea) the catch should be less than 224,544 tonnes (ICES Advice, 2013).

131. Sandeels are of conservation interest, being listed as a UK BAP priority species and are considered a nationally important marine feature due to being a component of the diets of fish, marine mammal and seabird species (Furness 1990; Hammond et al 1994; Tollit and Thompson 1996; Wright and Tasker 1996; Greenstreet et al 1998; Engelhard et al 2008).

132. Sandeels feed on zooplankton (particularly copepods) and some large diatoms as well as worms, small crustaceans, fish larvae and small fish (Rowley and Wilding 2008; Wheeler 1978). Changes in the North Sea availability of copepod prey species (especially *Calanus finmarchicus*) has been linked to the survival of sandeel larvae (ICES Advice, 2013). Sandeels are noted for their vulnerablity to declining Calanus abundance, changes in sea surface temperature and changes to the plankton community for example, warm winters (Frederiksen et al 2004).

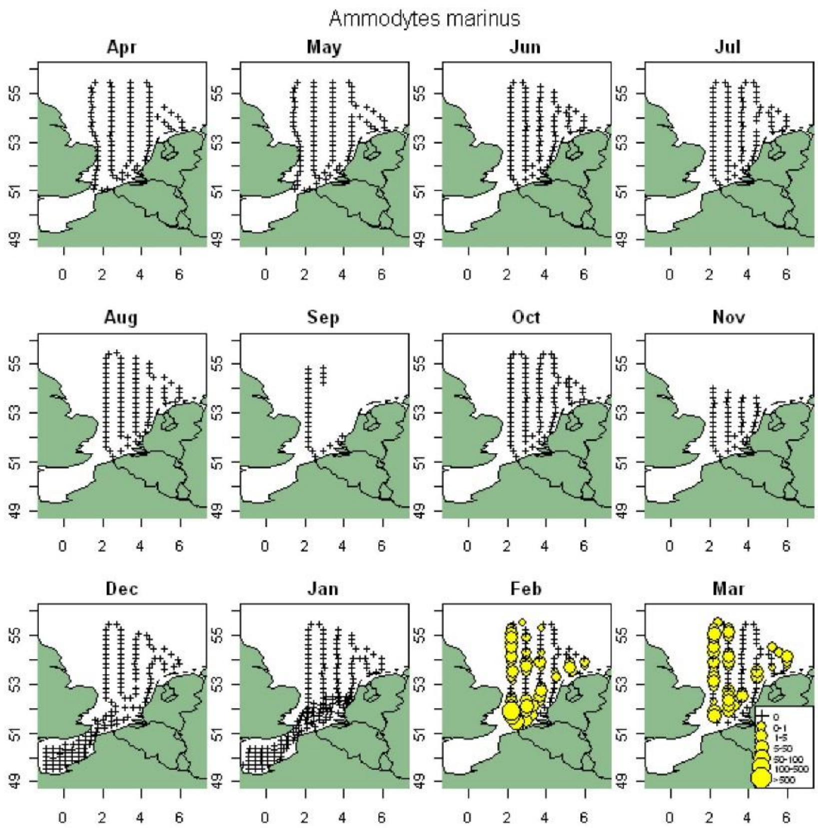


Diagram 0.19 Spatial and temporal distribution of lesser sandeel (*Ammodytes marinus*) yolk sac larvae (van Damme et al 2011)

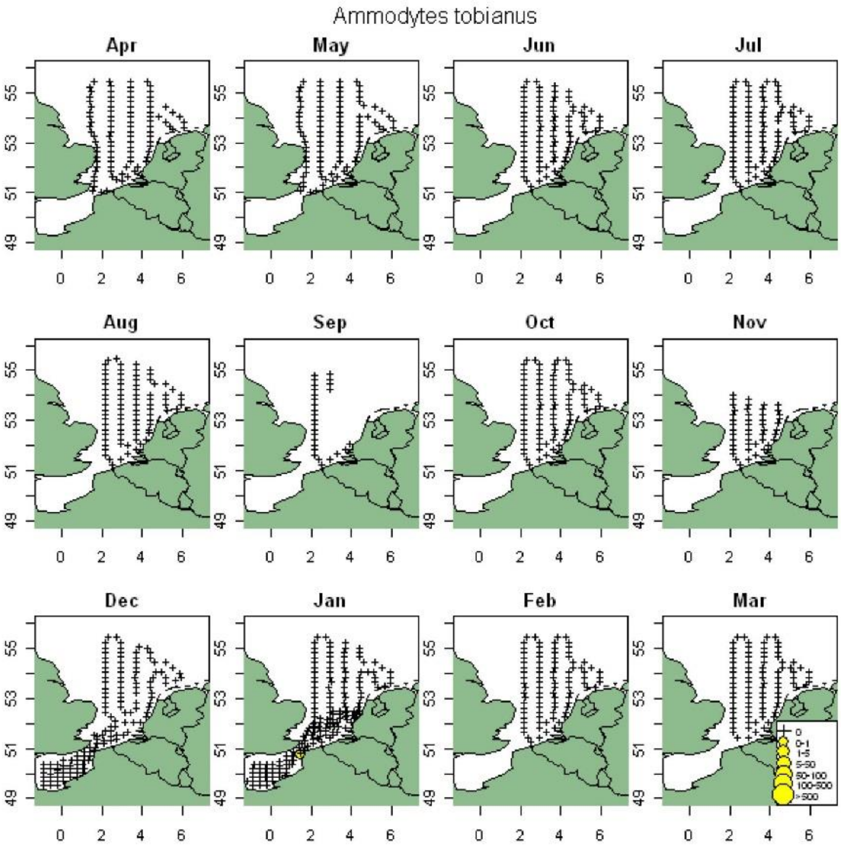


Diagram 0.20 Spatial and temporal distribution of small sandeel (*Ammodytes tobianus*) yolk sac larvae (van Damme et al 2011)

11.2.5.9 Elasmobranchs – Skates and Rays

11.2.5.9.1 Thornback Ray

133. An indication of the average distribution of this species in the North Sea from 2002 to 2011 is given in Volume 2 *Figure 11.40*. Prior to he 1950's, Thornback rays were widespread and abundant in the North Sea. Due to their slow growth rate, late maturity and low fecundity they were susceptible to over-exploitation by fishing and since then their abundance and range has decreased (Chevolot et al 2006). Thornback rays are found on a wide variety of softer sediment including mud, sand, shingle and gravel, though less frequently recorded on coarser sediment types (Wilding and Snowden 2008).

134. Tagging experiments carried out in the Thames Estuary (Hunter et al 2005) indicate that mature thornback ray remain in deeper waters of 20 to 35m depth with seasonal movements during the autumn and winter to shallower waters (less than 20m depth) in early spring to spawn. Fertilised egg cases are deposited no the seabed and juveniles emerge as fully formed rays after a 4-5 month incubation (Holden 1975 *cited in* Chevolot et al 2006). They appear to be more widely distributed in the southern North Sea during the autumn and winter.

135. As shown in Volume 2 *Figure 11.41,* the western section of he offshore cable corridor falls within defined low intensity nursery areas. Spawning grounds are considered to broadly overlap with nursery grounds although there is currently insufficient data on the occurrence of egg-bearing females in the spawning season (Ellis et al 2012). Spawning occurs over an extensive period from February to October peaking from April to August (Ellis et al 2012).

136. In the local study area thornback rays are amongst the main species of elasmobranch landed (*Table 0.5* and *Table 0.6)*. Landings of thornback ray and the MMO category "skates and rays" are primarily recorded in the inshore cable analysis areas (33F1), with comparatively lower landings in both the offshore cable analysis area (33F2) and the windfarm analysis area (34F2). During site specific beam trawl surveys, thornback ray were found in very low numbers in the vicinity of the East Anglia THREE site (*Table 0.3*).

137. Thornback ray is included in the OSPAR list of threatened and / or declining species. In addition, the species has been classified as 'Near Threatened' by the IUCN (*Table 0.9*).

138. Juveniles feed predominantly on small crustaceans (amphipods, mysids and crangonid shrimps), with larger individuals incorporating larger crustaceans (eg.

swimming crabs) and fish (eg. sandeels, small gadoids and dragonet) in their diet (ICES 2012j).

11.2.5.9.2 Spotted Ray

139. Spotted rays are most commonly found in moderately deep waters of between 8 and 283m depths on sandy and muddy sediment (Ellis et al 2004). The distribution around the British Isles is considered similar to that described for thornback ray (Ellis et al 2005). As shown by the results of IBTS surveys, (Volume 2 *Figure 11.42)* spotted rays occur off the East Anglian oast.

140. Nursery grounds are broadly similar to those of thornback rays, being typically in shallower waters (Ellis et al 2004). Spotted rays lay between 24 and 60 eggs cases on the sea bed during the spawning season which hatch after 4-5 months (Kay and Dipper 2009). Juveniles have, however, been found to be less abundant in the Greater Thames Estuary than thornback rays (Ellis et al 2012). The East Anglia THREE site and the offshore cable corridor do not fall within the defined nursery areas for this species (Ellis et al 2010). Spotted rays are considered of secondary importance in UK landings data in comparison to thornback rays.

141. Spotted rays are included in the OSPAR list of threatened and / or declining species and have been classified as of 'Least Concern' by the IUCN (*Table 0.9*).

142. Spotted rays primarily feed on crustaceans, amphipods, isopods and shrimps. Fish are also consumed but they are not an important element of their diet (Wheeler 1978).

11.2.5.9.3 Blonde Ray

143. Blonde rays are found on sandy substrates in coastal waters to depths of 100m but are more abundant at around 40m (Wheeler 1978). Blonde rays are less frequent in the North Sea and Celtic Sea, being more common to inshore waters (14 to 146m) off southern and western England (Volume 2 *Figure 11.23*). Blonde ray were found at IBTS sites in the vicinity of the East Anglia THREE site (*Table 0.5*).

144. Blonde rays lay approximately 30 eggs cases per year with a 7 month incubation period (Kay and Dipper 2009). They feed on a wide range of crustaceans, worms and fish, particularly herring, sprat, pouting, sandeels and sole (Wheeler 1978).

145. Blonde rays are of less commercial importance in UK landings in comparison to thornback rays. They are also landed with thornback ray and spotted ray by the Dutch beam trawl fleet (ICES 2007). The species is classified as 'Near Threatened' in the IUCN Red List of threatened species (*Table 0.9*).

11.2.5.9.4 Common Skate Complex

146. The common skate complex (*Dipturus intermedia* and *Dipturus flossada*) were historically amongst the most abundant ray species in the north-east Atlantic, with a wide distribution around the British Isles. They have now disappeared from the Irish Sea, English Channel and the southern and central North Sea. Individual specimens are reported occasionally from these areas, however they are now only regularly observed off northern and north-western Scotland, Celtic Sea and along the edge of the continental shelf (more than 150m deep) (Dulvy et al 2006).

147. Common skate complex is classified as 'Critically Endangered' by the IUCN Red List of Threatened Species. In addition, they are listed as a UK BAP priority species and in the OSPAR list of threatened and / or declining species (*Table 0.9*).

11.2.5.10 Elasmobranchs – Sharks

11.2.5.10.1 Small Spotted Catshark/ Lesser Spotted Dogfish

148. Small spotted catsharks, more commonly known as lesser spotted dogfish occupy a variety of mixed sediment and on rocky reefs. They are widespread around the British Isles, they are common at depths from 3 to 110m (Kay and Dipper 2009). The distribution of lesser spotted dogfish is considered to be patchy (Ellis et al 2005).

149. Lesser spotted dogfish was one of the more abundant species found in the area of the East Anglia THREE site during the site specific otter trawl surveys (*Table 0.2*) and beam trawl surveys (*Table 0.3*). Commercial landings in the local study area for this species are comparatively low, with lesser spotted dogfish being included under the category "other" in *Table 0.5* and Table 0.6*.*

150. Live egg cases are mostly laid between November and July, although can be found throughout the year. The species primarily feed on crustaceans, including a variety of crab and shrimp species, molluscs and polychaete worms. Benthic fish species also form part of their diet (Wheeler 1978).

11.2.5.10.2 Smoothhounds

151. Starry smoothhound *Mustelus asterias* and Smoothhound *Mustelus mustelus* are normally found in depths of up to approximately 50m (Kay and Dipper 2009). As shown by Volume 2 *Figure11.44,* starry smoothhounds ave a wide distribution across the North Sea whereas the distribution of smoothhounds is much smaller (Volume 2 *Figure 11.45*) nd they have rarely been recorded in the North Sea (Ellis et al 2005).

152. Cefas are currently of the opinion that smoothhounds and starry smoothhounds can be considered the same species and cannot be differentiated by external physiological features (pers comm. J. Ellis and M. Etherton, Cefas 2013).

153. Starry smoothhounds and smoothhounds are occasionally recorded in the local study area by the IBTS (*Table 0.5*), particularly in rectangle 33F2. Starry smoothound have been assessed as of 'Least Concern' on the IUCN Red List of Threatened Species, (*Table 0.9*).

154. Smoothhounds (Mustelus spp.) feed primarily on crustaceans, including hermit crabs, edible crabs, shore crabs, small lobsters and squat crabs (Wheeler, 1978).

11.2.5.10.3 Tope

155. Tope range from 70° N to 55° S and are regularly recorded around the British Isles (Morato et al 2003:, Ellis et al 2005). Larger individuals may be solitary, however they mostly aggregate to form schools of similar sized individuals, often segregated by sex (Kay and Dipper 2009).

156. Tope were not recorded in the area of the East Anglia THREE site during site specific fish surveys. The East Anglia THREE site falls within defined low intensity nursery grounds for this species.

157. Tope are of conservation interest, being listed as a UK BAP priority species. The species is assessed as vulnerable in the IUCN Red List of Threatened Species (*Table 0.9*).

158. The diet of tope consists of a variety of fish, including pilchards, herring, anchovies, smelt, hake, cod sole, mackerel and gobies. They also prey on a number of crustacean and cephalopod species such as squid, octopus, crabs and whelk (Morato et al 2003; Shark Trust 2010).

11.2.5.10.4 Spurdog

159. Spurdogs are wide ranging over the North Sea with the highest densities found well to the north of the East Anglia THREE site (Volume 2 *Figure 11.47*) between depths of 15 and 528m (Ellis et al 2004).

160. Tagging studies suggest a single North East Atlantic stock and have shown that mature males migrate to the north and east of the British Isles in spring and return to the south-west in autumn. Immature females seem to be evenly distributed in all sea areas at all times of the year, and tend to move year by year in a clockwise direction around the British Isles. Data from fisheries suggests that adult females gather in the eastern Celtic Sea in winter and spring to release their young and leave this area rapidly in late spring (Pawson 1995).

161. After thornback ray, spurdog is the main elasmobranch species landed from the offshore cable corridor study area. Spurdog were not recorded during site specific fish surveys undertaken in the area of the East Anglia THREE site.

162. The exploitation of this species has been reduced substantially in recent years as a result of decreasing quota allocations (Ellis et al 2009). In 2010, the TAC for spurdog was set to zero, landings were however still permitted under a by-catch TAC, provided certain conditions were met (ICES, 2010). In 2013 ICES advice states that;

> "*there should be no target fishery and that bycatch in a mixed fisheries should be reduced to the lowest possible level. A rebuilding plan should be developed for this area*".

163. In 2013, the TAC for spurdog was retained at zero and no landings (including by-catch) were permitted (ICES 2013).

164. CHARM consortium charts show sprudog abundance to be low within the vicinity of the East Anglia Three site and offshore cable corridor, with higher presence to the north, in the central North Sea (Volume 2 *Figure 11.46*).

165. Spurdog are of conservation interest, being listed as a UK BAP priority species and included in the OSPAR list of threatened and / or declining species. They are assessed to be 'Critically Endangered' in the IUCN Red List of Threatened Species (*Table 0.9*).

166. Spurdog are opportunistic feeders that take a wide range of predominantly pelagic prey. Important fish prey includes herring, sprat, small gadoids, sandeel, and mackerel, however crustaceans (swimming crabs, hermit crabs and euphausids), squid and ctenophores also represent an important part of diet (ICES 2012).

11.2.5.10.5 Basking Shark

167. Basking sharks *Cetorhinus maximus*, may occasionally transit the southern North Sea between May and October as seasonal visitors to British waters. Sightings in coastal waters off the East Anglian coast are however, extremely rare (Bloomfield and Solandt 2006), being more prevalent elsewhere such as off the south west of England, west Scotland and west of the Isle of Man.

168. Basking sharks are of conservation interest, protected under UK legislation (Wildlife and Countryside Act, 1981), they are also listed as a UK BAP priority species and feature on the OSPAR list of threatened and / or declining species. In

addition, they have been assessed as 'Vulnerable' on the IUCN Red List of Threatened Species (*Table 0.9*).

11.2.5.11 Diadromous Migratory Species

11.2.5.11.1 River and Sea Lamprey

169. River lamprey and sea lamprey are parasitic anadromous migratory species. Their distribution around the British Isles is shown in Volume 2 *Figure 11.48 and Diagram 0.21*. Sea lamprey were recorded in low numbers in IBTS surveys in the vicinity of the East Anglia THREE site (*Table 0.5*). Records of river and sea lamprey in East Anglian rivers are relatively scarce compared with other areas of the UK.

170. Both species spawn in fresh water in spring or early summer, followed by a larval phase (ammocoetes) spent in suitable silt beds in streams and rivers before migration to the sea, to feed (Laughton and Burns 2003).

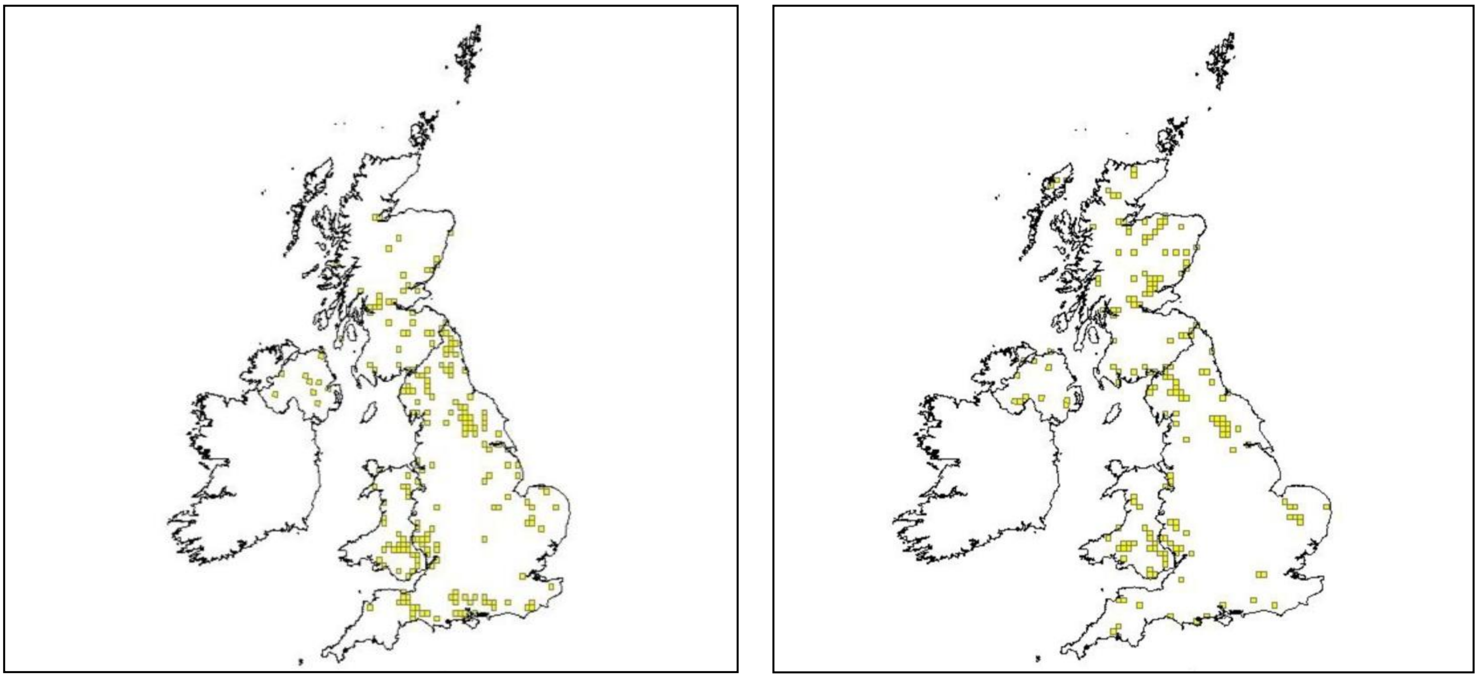
171. Ammocoetes can spend several years in freshwater on silt beds, feeding on organic detritus and eventually transforming into adults from late summer onwards (Laughton and Burns 2003). The transformation into the adult stage is characterised by the development of functional eyes and the mouth changes into a fully formed sucker (Maitland 2003a). After transformation, river and sea lampreys migrate to sea, where they use their suckers to attach to other fish (Maitland 2003a).

172. River lampreys generally inhabit coastal waters, estuaries and accessible rivers feeding on a variety of fish including young herring, sprat and flounder. After one to two years in an estuarine environment, river lampreys cease feeding in the autumn and move upstream between October and December (Maitland 2003a). After several years in the marine environment the adults return to fresh water to spawn (Laughton and Burns 2003).

173. Sea lamprey are recorded most in estuarine and inshore waters, with low abundance (Maitland and Herdson 2009) and in the open sea with attachment to host species including basking shark and occasionally sperm whale (Maitland and Herdson 2009). Their distribution is largely dictated by their hosts (Waldman et al 2008) and adults are parastitic on a variety of marine mammals and fish, including herring, salmon, cod, haddock and sea bass (Kelly and King 2001; ter Hofstede et al 2008). Homing behaviour is not apparent in this species (Waldman et al 2008) and unlike salmonids and shads, lampreys do not have specific river populations (ter Hofstede et al 2008). The rarity of capture in coastal and estuarine waters suggests that marine lampreys are solitary feeders and widely dispersed at sea. It

is possible that sea lamprey often feed in deeper offshore waters as they have been caught at considerable depths (4100m water depth) (Moore et al 2003).

174. River and Sea lamprey are of conservation interest, being listed as a UK BAP priority species.



a)River Lamprey b) Sea Lamprey

Diagram 0.21 The distribution of river lamprey and sea lamprey in the UK (records 1990 to 2011) (JNCC 2012)

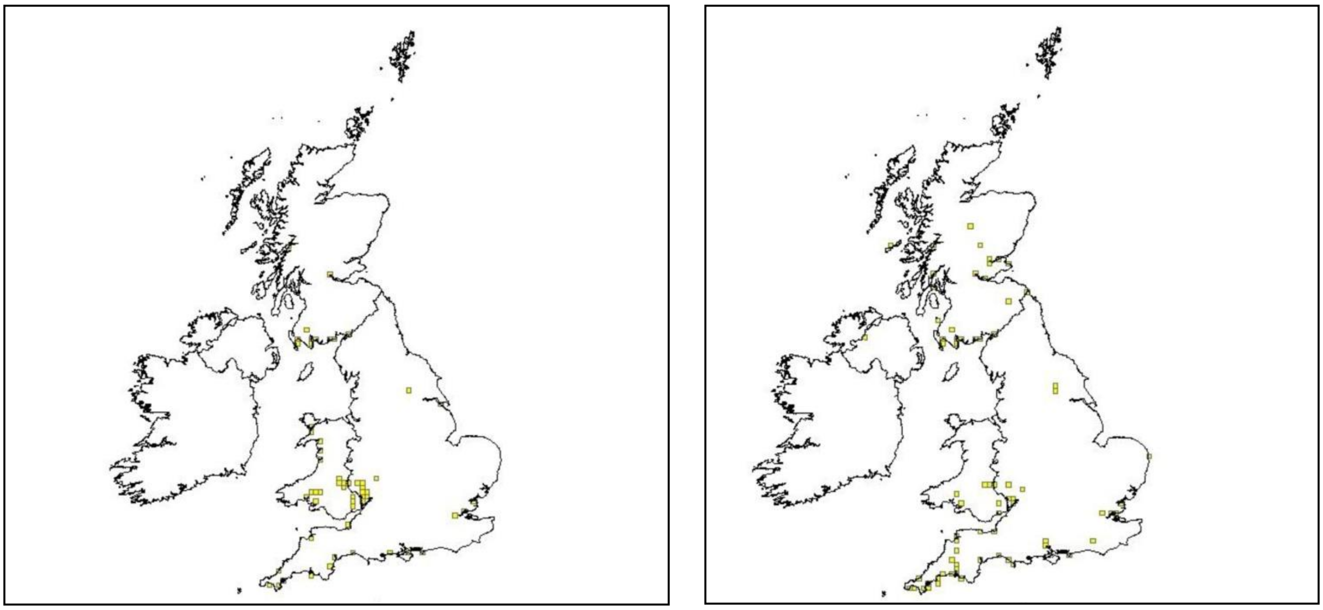
11.2.5.11.2 Allis and Twaite Shad

175. Allis shad and twaite shad are anadromous migratory species which school in shallow coastal waters and estuaries at depths between 10 and 20m before entering rivers to spawn. Adults migrate from the sea to fresh water in spring and early summer (April to June) and travel to higher, middle watercourses of rivers to spawn from mid-May to mid-July (Maitland and Hatton-Ellis 2003; Acolas et al 2004; Patberg et al 2005). Following spawning, adults return to the sea whereas juveniles remain in rivers over summer months prior to their migration downstream in the autumn.

176. The distribution of allis shad and twaite shad is presented in *Diagram 0.22.*

177. Spawning stocks of the twaite shad are only found in a few rivers in and around the southern Welsh border (JNCC 2007). In contrast to twaite shad, the majority of allis shad only spawn once and then die (ter Hofstede et al 2008). There are no known spawning sites for allis shad in the UK although both sub-adults and sexually mature adults are still regularly found around the UK coast (Maitland and

Lyle 1995). It can therefore be assumed that allis and twaite shad are unlikely to be present and do not spawn in the vicinity of the East Anglia THREE site.



a) Twaite Shad b) Allis Shad

Diagram 0.22 The distribution of Twaite shad and Allis shad in the UK (records 1990 to 2011) (JNCC 2012)

11.2.5.11.3 Atlantic Salmon

178. Atlantic salmon have a life cycle involving both fresh and sea water environments, spawning in rivers but spending most of their life at sea.

179. Salmon return to their natal rivers and after a period of up to five years at sea, although the majority spend one to three years at sea (JNCC 2011). Young salmon migrate downstream from spawning areas entering the sea as "smolts". They spend one to three years feeding at sea and then return to their home rivers to spawn (JNCC 2011). There is scarcity of information on salmon life history at sea although mark-recapture and salmon tagging programmes have provided some information on migration routes.

180. Salmon are widely distributed in EU waters and the UK's salmon population comprises a significant proportion of the total European stock with Scottish rivers being the most important in terms of spawning sites. There are 79 rivers in England and Wales that support salmon populations, the East Anglian region with rivers of low gradient do not support important salmon populations (NASCO, 2009). No rivers south of the Esk in Yorkshire or east of the Itchen in Hampshire are classified as salmon rivers (Salmon Atlas, 2011).

181. The distribution of Atlantic salmon recorded in the UK is summarised in *Diagram 11.23* which suggests that the East Anglian region does not support salmon populations.

182. Salmon have not been recorded in the regional study area during the IBTS (2001-2010), although there have been rare occurrences recorded in the MMO landings data from rectangle 33F2 (East Anglia Offshore Wind ZEA, 2011). Salmon may therefore very occasionally transit the area of the East Anglia THREE site and the offshore cable corridor but they are not considered to be located in important migratory pathways for salmon.

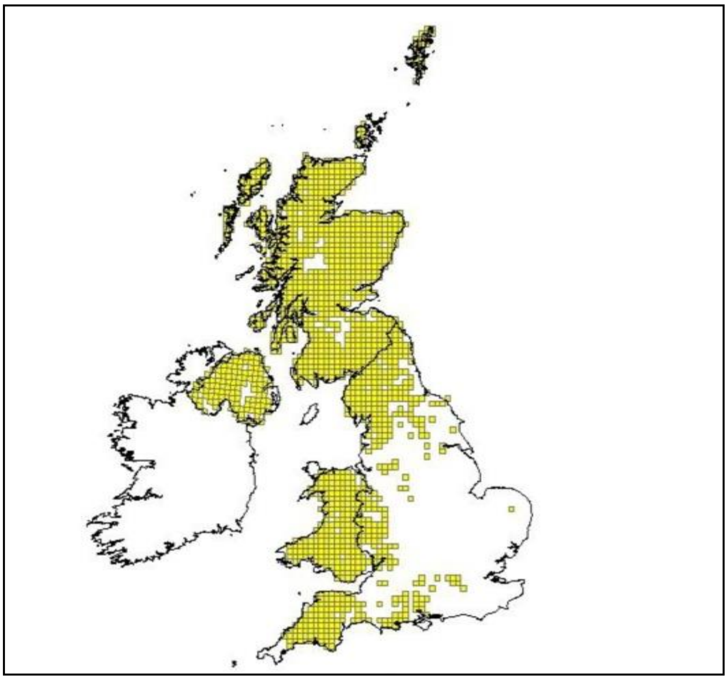


Diagram 0.23 The distribution of Atlantic salmon in the UK (records 1990-2011)

11.2.5.11.4 Sea Trout

183. Sea trout are the migratory form of the common and widely distributed brown trout. Their life cycle, similar to that of Atlantic salmon, includes juvenile stages in freshwater, migration to the sea (as smolts), maturation at sea and a return migration to freshwater for spawning (Pawson 2013).

184. The East Anglian coast is thought to be a feeding area for sea trout post-smolts from rivers in the north east coast of England. Populations are also present in East Anglian rivers including; the Glaven, Wensum and Yare (Tingley et al 2007).

185. Sea trout were once part of local fisheries off Norfolk with decline from the 1950's (MMO 2013), and there are projects currently underway to restore and improve access for migratory trout across a number of Anglian rivers encompassing the rivers Stiffkey, Glaven, Burn, Nar, Great Ouse and Welland. (Everard 2010). Despite sea trout records in each of these rivers, sea trout off East Anglian coast are thought to originate from the rivers in north-east England

and south-east Scotland such as the Esk, Wear, Coquet, Tyne and Tweed (Pawson 2014).

186. Sea trout spend at least one year in the southern North Sea to mature before returning to their natal rivers to spawn. Sea trout fisheries are being phased out given brown/sea trout are listed as a UK BAP Species (*Table 0.10*).

187. Sea trout have not been recorded in the vicinity of the East Anglia THREE site (windfarm analysis area) in IBTS data (2001 to 2010), but are recorded present in the MMO landings data in the inshore cable analysis area (33F1) (East Anglia Offshore Wind ZEA 2011).

11.2.5.11.5 Smelt

188. Smelt are widespread throughout the North Atlantic and European waters but populations are localised in the UK waters being more common in estuaries. As with salmon and trout, smelt move from the sea into rivers to spawn. Adult smelt shoal in estuaries during the winter and enter rivers in early spring to spawn (February to April). After spawning the adults return to sea whilst the juveniles remain in the estuary for the remainder of the summer. Eggs are laid in estuaries on gravel, sand and on weed and the young remain in estuaries for several years.

189. Records for the species have been made from a number of English rivers with small populations noted in the Broads, Great Yarmouth, Lowestoft, Alde, Deben, Orwell and Stour, and larger populations recorded in the Blackwater, Crouch, and Thames and catchment rivers (Maitland 2003b).

11.2.5.11.6 European Eel

190. European eel is a catadromous migratory species found all around the British Isles. Eels carry out long-distance migrations (over 5,000 km) from the coasts of Europe and are thought to spawn in the Sargasso Sea although evidence for this is limited (Schmidt *cited in* van Ginneken et al 2005; Aarestrup et al 2009). The newly hatched larvae are transported back towards the European coast by prevailing currents and metamorphose into glass eels as they arrive on the continental shelf, and subsequently become pigmented ‘elvers’ (Aarestrup et al 2009; Potter and Dare 2003).

191. Adults are thought to migrate to sea from August to December. Glass eels arrive at coastal waters from February to March and migrate upstream as elvers from May until September (Environment Agency 2011).

192. European eel are widely distributed throughout the Anglian region. The adult eel fishery was relatively strong in the past, although few records were kept. A commercial glass eel fishery has never been in operation. Currently, due to

reduced numbers of eels, fishing is patchy and at best a subsistence activity for many of the fishermen involved (DEFRA 2010).

193. Due to the absence of any commercial glass eel or elver catch data for the region, monitoring traps have been installed on the lower freshwater to saltwater limit on the River Stour and on the Chelmer and Blackwater Canal at Beeleigh in Essex (DEFRA 2010).

194. This species has been occasionally recorded within the ICES rectangle 32F1 by the IBTS (2004 to 2013) (*Table 0.5*).

11.2.5.12 Other Non-Commercial Fish Species

11.2.5.12.1 Solenette

195. Solenette is the smallest species of the Soleidae family with a distribution from the Mediterranean, along the west coast of Europe and around the British Isles (Baltus et al 1995). They are common on sandy sediments offshore at depths 9 to 37m, and found across the North Sea in association with their prey species (Sell et al 2013; Callaway et al 2002). They are rarely found inshore, do not make pronounced migrations and abundance is not seasonal (Amara et al 2004). In addition, there is no separation between juveniles and adults (Baltus et al 1995).

196. Amara et al (2004) suggests the species may be intolerant of the physical conditions encountered in shallow, warmer waters, inshore and at large riverine outflows. Solenette distribution therefore differs from that of sole and plaice which have a euryhaline tendency and inhabit shallow coastal and estuarine areas as nursery grounds (Amara et al 2004).

197. The species has increased in abundance in the North Sea and has moved northwards since the late 1980s, often attributed to the effects of increasing temperatures from milder winters on adult habitat conditions (van Hal et al 2010).

198. During the East Anglia fish surveys, solenette was one of the more abundant non-commercial species in the catch samples (*Table 0.3*).

199. Spawning occurs in early summer although key spawning areas are unknown (Kay and Dipper 2009). Once hatched, solenette larvae are present in the plankton until settlement at the seabed at around 12mm (Kay and Dipper 2009).

200. Solenette have a varied diet including small benthic crustaceans, polychaetes, molluscs and fish (Derweduwen et al 2012; Amara et al 2004).

11.2.5.12.2 Sand Goby

201. Sand goby are a common short-lived species of the Gobiidae family, living on inshore sandy grounds from the mid-tide level to 20m (Maitland and Herdson 2009). As repeat spawners, males guard the eggs that females deposit under rocks or bivalve shells (Riley 2007). Males guard approximately 2 egg batches at the same time, belonging to different females, and females respawn with an interval of about 1 to 2 weeks. Sand goby were the second most abundant species caught in the East Anglia THREE site beam trawl surveys (*Table 0.4*)

202. Life history information for the species is limited, although Maitland and Herdson (2009) suggest it may move to deeper water to commence breeding between March and July. Sand gobies are important prey for a number of demersal fish species (ICES 2012e) and are protected under the Bern Convention, Appendix III.

203. Of the 19 species of Gobiidae found in UK waters (Wheeler 1992), the other Gobiidae species represented in the site specific otter and beam trawl survey catches included common goby *Pomatoschistus microps,* two-spotted goby *Gobiusculus flavescens*; Crouch's goby *Gobius couchii*; Giant goby *Gobius cobitis* and transparent goby *Aphia minuta.*

204. Common goby prefer low salinities and are abundant on sandy and muddy shores in pools to MHW, low salinity pools, coastal ditches and estuaries (Kay and Dipper 2009).

205. Painted gobies are often found in lower shore pools in stony areas or near rocks on sandy shores (Kay and Dipper 2009).

206. The giant goby and Couch's goby (listed under Schedule 5 of the Wildlife and Countryside Act) are rare in British coastal waters and have not been recorded from the offshore waters of the North Sea (Rogers and Stocks 2001).

11.2.5.12.3 Lesser Weever fish

207. Lesser weever fish are common to inshore areas off the east of England and abundant on sandy substrates in shallower, warmer waters from less of than 5 m depth, down to 50 m (Rogers et al 1998; Pizzola 2002).

208. Weever fish spawn in summer and both eggs and larvae float in the plankton (Maitland and Herdson 2009). Early life history stages have been associated with sandbank crests in the North Sea, suggesting that sandbanks provide suitable conditions as nursery grounds (Ellis et al 2011). There have also been marked temporal extensions for the species attributed to the effects of increasing North Sea temperatures (Tulp 2006).

209. Lesser weaver fish normally feed on small bottom-living organisms including decapods, mysid shrimps and fish species such as sandeels and gobies (Derweduwen et al 2012).

11.2.5.12.4 Grey Gurnard

210. Grey gurnard is one of the more abundant demersal species in the North Sea with a wide distribution to depths of 140m on a variety of sediment and in rocky areas, both inshore and offshore (Barnes 2008a; Floeter et al 2005; Kay and Dipper, 2009). The species shows a seasonal shift in distribution forming local aggregations in the western part of the central North Sea and north-west of the Dogger Bank in winter months, before widespread summer dispersal (Mackinson et al, 2007; Floeter et al 2005).

211. Gurnards are generalist feeders with a diet including bottom-dwelling fish, crustaceans and invertebrates including shrimp Crangon spp. and sandeels (Weinert et al 2010). As a key predator of juvenile fish, gurnard have a significant top-down effect on other species including the gadoids whiting and cod (Floeter et al 2005). Regional differences in diet are reported (Sell and Krocke 2013).

212. Current market demand for grey gurnard is low and as a by-catch species in demersal fisheries they are widely discarded (Mackinson et al 2007).

213. Other species of gurnard recorded in the otter trawl surveys carried out at the East Anglia THREE site include red gurnard *Aspitrigla cuculus* and tub gurnard *Trigla lucerna*.

11.2.5.13 Commercial Shellfish

11.2.5.13.1 Edible Crab

214. Edible crab *Cancer pagarus* are found on a range of intertidal and subtidal habitats, on bedrock, under boulders, mixed coarse grounds and offshore in muddy sand (Neal and Wilson 2008). They are commercially important in the inshore cable analysis area (33F1), where they support local commercial fisheries (see Volume 2 *Figure 11.51* and Chapter 14 Commercial isheries).

215. Edible crabs undertake wide-ranging migrations over considerable distances to offshore overwintering grounds where eggs are hatched (Edwards, 1979; Bennett, 1995). The findings of tagging studies suggest that mature females undertake long-distance migrations whilst the movements of males and immature females is more random, in local areas (Edwards 1979; Bennett 1995). The results of suture tagging experiments carried out off the Norfolk coast (Edwards 1979) suggest a northerly long-distance movement of mature females.

216. The movement of female crabs is related to spawning activity (Cefas 2011). After pairing and mating (July to September) and subsequent spawning (October to December), egg bearing ("berried") females move to offshore over-wintering grounds and are largely inactive over the brooding period until their eggs hatch in the spring and summer. Adult females then return their migration inshore during spring and summer for pairing and mating to commence again. The hatched larvae remains in the plankton offshore prior to settlement on the sea bed, following which young crabs are then considered to migrate inshore (Proctor 2005). Studies carried out in the English Channel by Thompson et al (1995) suggest that although berried female crabs may prefer to incubate their eggs whilst overwintering in hollows of sand and gravel, they are not necessarily confined to such areas, and eggs may be hatched over a wide variety of sediment types from fine sands to pebbles. Mating activity peaks in summer following female moulting, with spawning occurring late autumn or winter in offshore areas (Cefas 2011).

217. Volume 2 *Figure 11.51* indicates a moderate to high ercentage probability of the presence of edible crab in the vicinity of the offshore cable corridor and a low percentage probability within the East Anglia THREE site.

218. The commercial landings of edible crab in the vicinity of the East Anglia THREE site and offshore cable corridor are shown in *Table 0.6.*

11.2.5.13.2 European Lobster

219. European lobster *Homarus gammarus* have a wide distribution along the UK and Europe coasts (Bennett et al 2006). Lobsters occupy a range of habitats from rocky grounds and soft sediments and shelf areas from below MLW to depths of 150m (Buchholz et al 2012, Bennet et al 2006).

220. Unlike edible crabs, lobsters of both sexes are considered sedentary and have not been found to undertake extensive migrations. Localised random inshore/offshore movements and longshore migration may occur, driven by local competition for food or requirements to move to a different habitat throughout their different life-stages (Cefas 2011, Pawson et al 1995). Tagging experiments carried out in the south coast of England found that 95% of recaptured lobsters moved less than 3.8km from their original position over periods of 862 days (Smith et al 2001). Some individuals however moved distances up to 45km with little difference between female and male movements. Similarly, tagging experiments using hatchery reared lobsters released into the wild suggest strong site fidelity, with most recaptures being recorded within six kilometres of release sites (Bannister et al 1994).

221. Berried females tend to appear from September to December in areas where lobsters are normally present with eggs carried externally on females until April/May. As they do not carry out extensive migrations, hatching normally takes place in the same grounds (in spring and early summer) (Pawson et al.1995).

222. Larval distribution and abundance is subject to local hydrographical conditions and is therefore very variable (Cefas, 2011). It is however, thought to be released close inshore in July to October being dependant on water temperature (Bennett et al 2006).

223. Commercial landings for lobster in the vicinity of the East Anglia THREE site and the offshore cable corridor can be found in *Table 0.6.*

224. The main lobster nursery grounds are thought to occur on rocky grounds in coastal waters (Pawson 1995) and juveniles are thought to inhabit crevices and be capable of burrowing into soft sediment (Bennett et al 2006).

225. As opportunistic scavengers, their diet consists of small crustaceans, molluscs and polychaetes (Cefas 2011).

11.2.5.13.3 Whelk

226. The common whelk is commonly found off all British coasts on a range of hard and soft subtidal substrates and occasionally in intertidal fringes (Ager et al 2008; Vause 2009). There are no known specific whelk migrations for spawning although they show aggregating behaviour and the distribution of juvenile whelks tends to be limited to areas close to the adult stock (Lockwood 2005). Breeding occurs by copulation in late autumn following which demersal egg-cases are laid in masses from November until April (Vause 2009). Egg development is intracapsular whereby they do not have pelagic eggs but instead lay clumps of demersal egg-cases from which juveniles hatch as a fully formed whelk during February and March (Smith and Thatje 2013; Hancock 1967).

227. As shown in *Table 0.6* there is evidence of an emerging whelk fishery in the inshore cable analysis area (33F1).

228. Volume 2 *Figure 11.52* indicates a moderate to high percentage probability for the presence of whelk in the vicinity of the East Anglia THREE site and a high percentage probability within the vicinity of the offshore cable corridor (data 2006 to 2012).

11.2.5.13.4 Shrimp

229. Brown shrimp has high productivity and is an important food source for many birds, fish and crustaceans. In addition, it is commercially exploited for human

consumption (Neal 2008). As suggested by landings data, shrimp do not support important fisheries in the East Anglia THREE site and offshore cable corridor (*Table 0.6*).

230. Pink shrimp *Pandulus montagui* are common at depths between 20 to100m (Ruiz 2008d). The species is typically associated hard substrates including *Sabellaria spinulosa* reef (Warren and Sheldon, 1967) but may also occur over sand, mud and gravel substrates. In the North Sea, pink shrimp migrate to deeper offshore waters for spawning occurs during October and November (Ruitz 2008). Eggs are laid from November to February and hatching occurs April/May (Ruiz 2008d).

231. Brown and pink shrimp have a diet consisting principally of small polycheates, hydroids, copepods and other small invertebrates (Ruiz 2008d).

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ANNEX 1

East Anglia Offshore Windfarm

East Anglia THREE

Fish and Shellfish Survey

16th to 26th February 2013

Undertaken by
Brown and May Marine Ltd

Ref	Issue Date	Issue Type	Author	Checked	Approved
EA3OB01	10/09/2013	Final	LS/AWG	LS/AWG/PO	SJA

Contents

Figures

Tables

1.0 Summary

1.1 Otter Trawl

1. A total of 11 species were caught in the otter trawl survey; seven at the control stations and 10 within the East Anglia THREE site. Overall, dab *Limanda limanda* was the most abundant species caught, followed by plaice *Pleuronectes platessa* and then whiting *Merlangius merlangus*. All other species were caught in relatively low numbers. The total overall catch rate was highest within the East Anglia THREE site. The highest catch rate for all species combined was recorded at station OT09 within the East Anglia THREE site. Plaice and dab represented the highest proportion of the catch at all stations, with the exception of OT09, where whiting was most prevalent.

2. Four species of fish were caught with a set minimum landing size (MLS). Most of the plaice and whiting caught in both sampling areas were below the MLS. All of the cod *Gadus morhua* found at the control stations and within East Anglia THREE were above the MLS, and all of the herring *Clupea harengus* caught within East Anglia THREE site were below the set MLS.

3. The sex ratio of the plaice caught at the control stations and within the East Anglia THREE site was approximately even, with most individuals classed as maturing. The majority of plaice caught in both sampling areas were male; the highest proportion of which were maturing. Three whiting were caught at the control stations; two of which were immature males, and one was a maturing female. Within the East Anglia THREE site, the sex ratio of the whiting found was approximately even, with most individuals identified as maturing.

1.2 Beam Trawl

4. A total of 16 species of fish and shellfish were caught, 11 of which were found at the control stations and 12 within the East Anglia THREE site. Overall, plaice was the most abundant species caught, followed by dab. All other species were caught in relatively low numbers. The total overall catch rate was highest within the East Anglia THREE site. The station with the greatest total catch rate was BT02 within the East Anglia THREE site, with dab and plaice representing 80.9% of the catch. These species represented the highest proportion of the catch at most sampling stations.

5. Two fish and one shellfish species were caught with a set MLS. Most of the plaice caught at the control stations and within the East Anglia THREE site were below the set MLS. One whelk *Buccinum undatum* was caught at the control stations and was above the MLS, and one whiting was found within the East Anglia THREE site and was below the set MLS.

6. The majority of the plaice caught at the control stations and within the East Anglia THREE site were male, most of which were spent. A higher proportion of the plaice caught within the East Anglia THREE site were female, whereas at the control

stations the sex ratio was approximately even; the majority of all individuals were spent.

2.0 Introduction

7. The following report details the findings of the February 2013 fish and shellfish survey, undertaken within and adjacent to the East Anglia THREE site, located within the East Anglia Zone, between the 16th and 26th February.

8. The East Anglia THREE site is located in the North Sea, approximately 79 km off the coast of Suffolk.

9. The survey methodology, vessel and sampling gear detailed were agreed in consultation with Cefas and the Marine Management Organisation (MMO). A dispensation from the MMO for the Provisions of Council Regulation 850/98 to catch and retain undersize fish for scientific research and 43/2009 specifically related to days at sea was obtained prior to commencement of this survey. A summary of the health and safety performance of the survey is provided in Appendix 1.

10. The aim of the survey was to establish the abundance and composition of fish and shellfish species within the East Anglia THREE site.

3.0 Scope of Works

11. The proposed scope of works for the February 2013 fish and shellfish survey is detailed below, and the proposed sampling stations are illustrated in Figure 3.1 overleaf.

- **Otter Trawl**
  - Six tows of approximately 20 minutes duration within the East Anglia THREE site and three control tows in adjacent areas.
- **Beam Trawl**
  - Four tows of approximately 20 minutes duration within the East Anglia THREE site and four control site tows in adjacent areas.

- **Otter and Beam Trawl Sample Analysis**
  - Number of individuals and catch rate by species;
  - Length distribution by species;
    - Finfish and sharks (except Herring *C. harengus* & sprat; *Sprattus sprattus*): individual lengths (nearest cm below);
    - Herring and sprat: individual lengths (nearest ½ cm below); and
    - Rays: individual length and wing-width (nearest cm below).
  - Sex ratio by species;
  - Spawning condition;
    - Finfish species (except herring): Cefas Standard Maturity Key - Five Stage;
    - Herring: Cefas Maturity Key – Nine Stage; and

- Ray and shark species: Cefas Standard Elasmobranch Maturity Key - Four Stage.

12. For the purposes of data analysis, catch rates have been calculated to allow for quantitative comparisons to be made between the numbers of individuals caught per hour at each station.

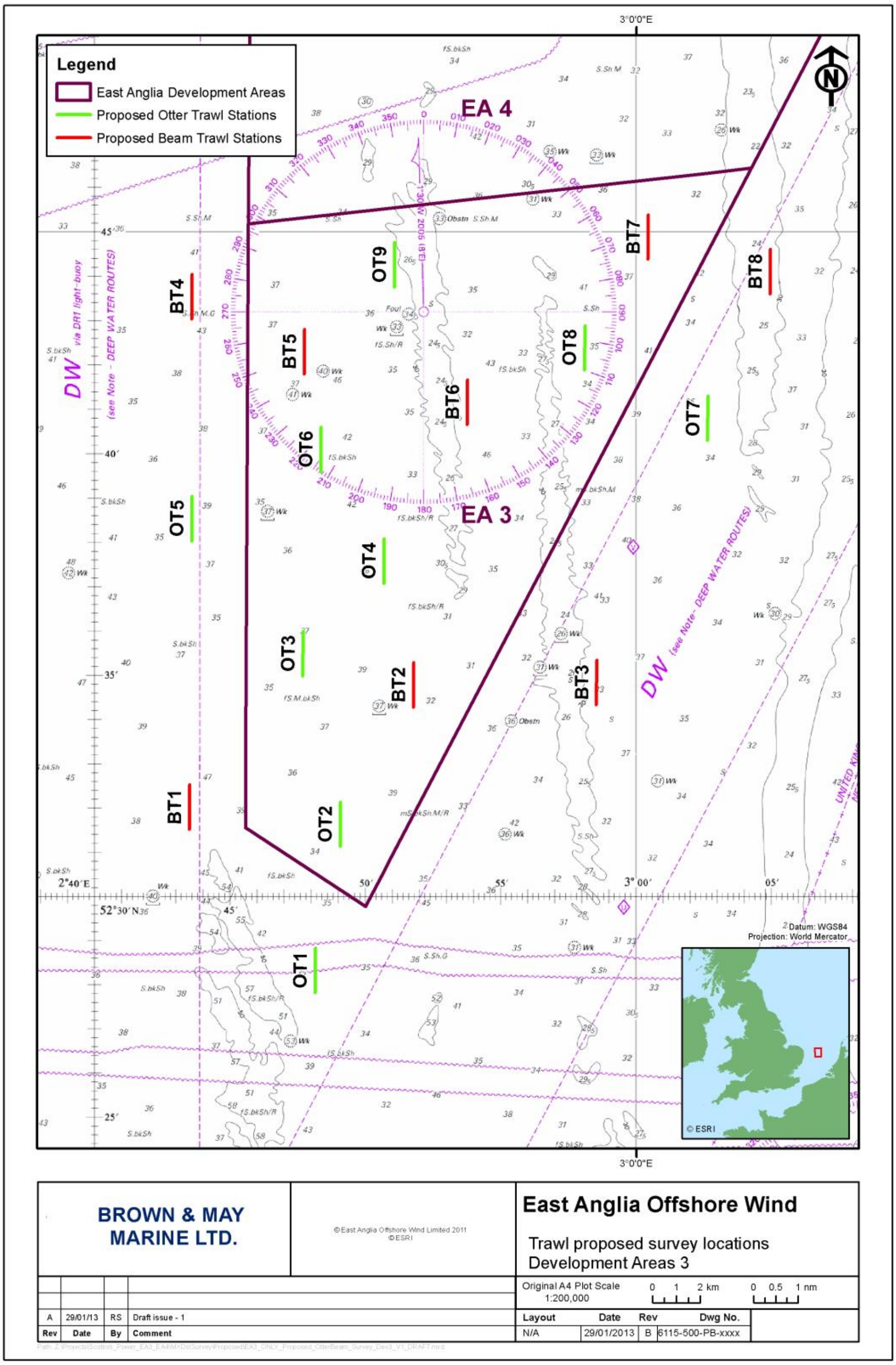


Figure 3.1 Proposed Trawl Locations

4.0 Methodology

4.1 Survey Vessel

13. The vessel chartered for the survey (Figure 4.1), the "Jubilee Spirit", is a Grimsby-based commercial trawler that was contracted for previous fish and shellfish surveys at East Anglia One. The specifications of the vessel are given below in Table 4.1.

Figure 4.1 Survey Vessel "Jubilee Spirit"

Table 4.1 Survey Vessel Specifications

Survey Vessel Specifications	
Length	21.2m
Beam	6.9m
Draft	2.3m
Main engine	Caterpillar Type 340TA 475 BHP
Gearbox	Hydraulic 6: reduction
Propeller	4 Blade Manganese Bronze Fixed Pitch 1.7m diameter
GPS	2-Furuno GP80
Plotters	Sodena Plotter with Electronic Charts
Sounder	Furuno Daylight Viewing

4.2 Sampling Gear

4.2.1 Commercial Otter Trawl

14. A commercial otter trawl (Figure 4.2) with a 100mm mesh cod-end was used for fish and shellfish sampling; the specifications of which are given in Table 4.2 below.

Figure 4.2 Otter Trawl Used

Table 4.2 Otter Trawl Specifications

Otter Trawl Specifications	
Towing Warp	18mm, 6x19+1
Depth: Payout Ratio	3:1
Trawl Doors	Perfect B 84
Net	100mm mesh cod-end
Ground line length	24.4m
Footrope	Rock-hopper with 18 inch bobbins
Est. Headline height	7.3m
Distance between doors (est.)	51m

4.2.2 Commercial 4m Beam Trawl

15. A commercial beam trawl (Figure 4.3) with an 80mm mesh cod end was used for fish and shellfish sampling; the specifications of which are given in Table 4.3 below.

Figure 4.3 Beam Trawl Used

Table 4.3 Beam Trawl Specifications

Beam Trawl Specifications	
Beam width	4m
Headline height	60cm
Cod-end liner	80mm (double twinned on belly and cod end)
Ground gear	5cm rubber bobbins and chain mat

4.3 Positioning and Navigation

16. The position of the vessel was tracked at all times using a Garmin GPSMap 60 with an EGNOS differential connected to an external Garmin GA30 antenna. Trawl start times and positions were taken when the winch stopped paying out the gear. Similarly, trawl end times and positions were taken when hauling of the gear commenced.

4.4 Sampling Operations

17. The survey was undertaken from the 16th to the 26th February 2013. A summarised log of events is given in Table 4.4 below.

Table 4.4 Summarised Log of Events

Thursday 14th February 2013
Vessel audited in Grimsby
Friday 15th February 2013
Vessel on standby awaiting confirmation
Saturday 16th February 2013
Vessel departs Grimsby at 0800 and steams to Lowestoft
Surveyors meet vessel at Lowestoft 2330, load and stow gear
Pre-departure H&S meeting conducted. Safety drill carried out at 2345
Vessel departs Lowestoft at 2355 and steams overnight to survey area
Overnight at sea
Sunday 17th February 2013
Beam trawls: BT01 (3 repeats), BT02 (2 repeats), BT03, BT06
Archaeological samples: BT02 (peat and wood), BT03 (peat)
Weather: BF 1/2
Overnight at sea
Tuesday 19th February 2013
Beam trawls: BT08, BT07, BT05, BT04
Weather: BF 1/2
Archaeological samples: BT07 (peat), BT05 (peat)
Steam overnight to Lowestoft for sample drop and gear changeover
Overnight at sea
Wednesday 20th February 2013
Arrive at Lowestoft at 0430
Beam trawl removed from vessel
Beam trawl and archaeological samples landed and transported to BMM
Depart Lowestoft at 1715 and steam to survey area
Weather: BF4-5, moderate
Overnight at sea
Friday 22nd February 2013
Otter trawls: OT09
Weather: BF 4
Overnight at sea
Saturday 23rd February 2013
Otter trawls: OT05, OT06, OT04, OT08, OT07

Weather: BF 5
Overnight at sea
Sunday 24th February 2013
Otter trawls: OT03, OT02, OT01
Steam to Lowestoft
Weather: BF 6
Overnight at sea
Monday 25th February 2013
Arrive into Lowestoft at 0930
Demobilise survey
Otter trawl samples landed and transported to BMM
Vessel steams to Grimsby overnight
Tuesday 26th February 2013
Vessel arrives at Grimsby at 1200

4.5 Otter Trawl Sampling

18. The whole catch from each otter trawl was retained. The samples were then boxed, labelled, photographed, iced and stored at +2°C before transportation to Cefas (Lowestoft) for analysis at the end of the survey, in line with the agreed scope of works.

19. The start and end times, co-ordinates and the duration of each otter trawl are given in Table 4.5 (control and East Anglia THREE tows highlighted green and red respectively). The vessel tracks whilst towing the otter trawl are illustrated in Figure 4.4 overleaf.

Table 4.5 Start and End Times, Co-ordinates and Duration of each Otter Trawl

Station	Date	Start				End				Duration (hh:mm:ss)
		Time (GMT)	UTM31N Easting	UTM31N Northing	Depth (m)	Time (GMT)	UTM31N Easting	UTM31N Northing	Depth (m)	
OT01	24/02/2013	11:29:01	486,217.90	5,813,209.15	41.6	11:49:02	486,145.75	5,814,461.27	43.8	00:20:01
OT02		09:58:50	487,422.74	5,819,196.80	42.9	10:18:52	487,230.58	5,820,000.08	43.4	00:20:02
OT03		08:20:46	485,945.24	5,826,006.23	41.4	08:40:50	485,897.42	5,826,647.08	40.3	00:20:04
OT04	23/02/2013	11:29:18	489,607.57	5,831,842.24	45.8	11:49:37	489,485.59	5,830,410.79	45.8	00:20:19
OT05		08:06:19	481,455.17	5,831,077.08	41.8	08:26:30	481,258.74	5,832,147.59	41.6	00:20:11
OT06		10:07:53	486,599.86	5,836,939.84	42.7	10:27:57	486,881.86	5,835,369.09	43.8	00:20:04
OT07		15:36:34	503,037.74	5,837,504.56	36.5	15:56:36	502,926.78	5,836,108.93	36.3	00:20:02
OT08		14:04:07	497,831.06	5,840,576.67	36.7	14:24:11	497,870.74	5,839,399.55	38.0	00:20:04
OT09	22/02/2013	08:41:06	489,412.99	5,841,534.77	37.0	09:01:12	489,761.39	5,842,740.84	36.3	00:20:06

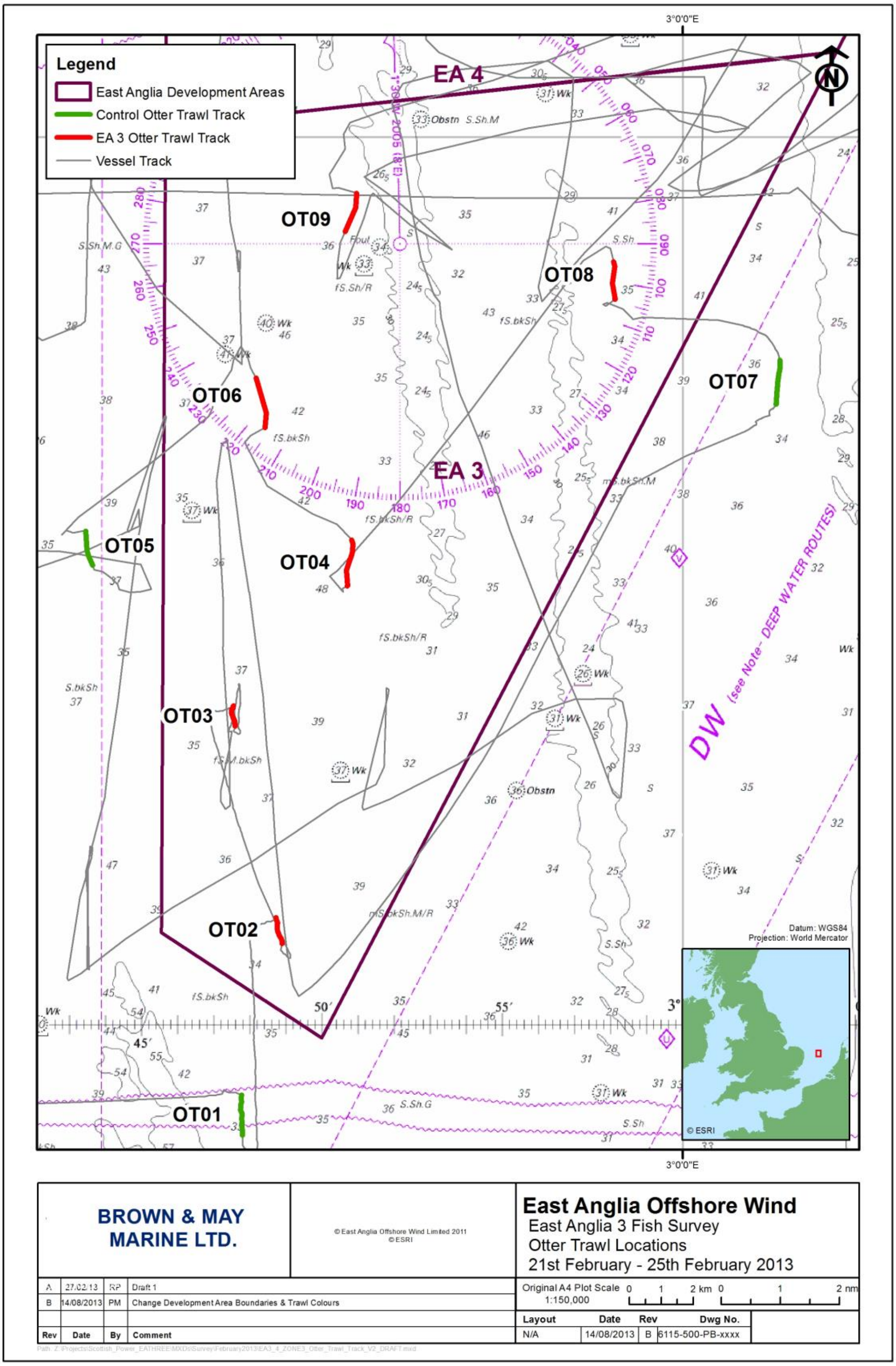


Figure 4.4 Vessel Tracks whilst Towing the Otter Trawl

4.6 Beam Trawl Sampling

20. The whole catch from each beam trawl was retained. The samples were then boxed, labelled, photographed, iced and stored at +2°C before transportation to Cefas (Lowestoft) for analysis at the end of the survey, in line with the agreed scope of works.

21. The start and end times, co-ordinates and the duration of each beam trawl are given in Table 4.6 (control and East Anglia THREE tows highlighted green and red respectively). The vessel tracks whilst towing the beam trawl are illustrated in Figure 4.5.

Table 4.6 Start and End Times, Co-ordinates and Duration of each Beam Trawl

Station	Date	Start				End				Duration (hh:mm:ss)
		Time (GMT)	UTM31N		Depth (m)	Time (GMT)	UTM31N		Depth (m)	
			Easting	Northing			Easting	Northing		
BT01	17/02/2013	10:00:44	481,268.97	5,821,478.75	47.8	10:20:51	481,356.48	5,819,026.48	47.1	00:20:07
BT02		13:28:25	490,692.00	5,826,745.83	39.6	13:48:50	490,111.69	5,824,259.11	41.4	00:20:25
BT03		15:03:16	498,178.15	5,826,496.81	37.6	15:24:22	498,102.18	5,824,307.54	33.2	00:21:06
BT04	19/02/2013	15:42:56	481,428.57	5,842,901.57	42.9	16:03:05	481,296.69	5,840,193.78	45.3	00:20:09
BT05		14:11:07	486,124.87	5,840,493.40	44.2	14:31:25	486,148.92	5,837,974.61	43.3	00:20:18
BT06	17/02/2013	16:50:20	493,048.35	5,836,314.47	35.4	17:10:21	492,545.37	5,838,282.74	34.3	00:20:01
BT07	19/02/2013	09:24:00	500,506.15	5,843,289.83	40.3	09:44:01	500,628.20	5,845,484.99	37.4	00:20:01
BT08		08:04:51	505,641.48	5,841,748.10	32.3	08:24:57	505,602.89	5,844,106.84	31.6	00:20:06

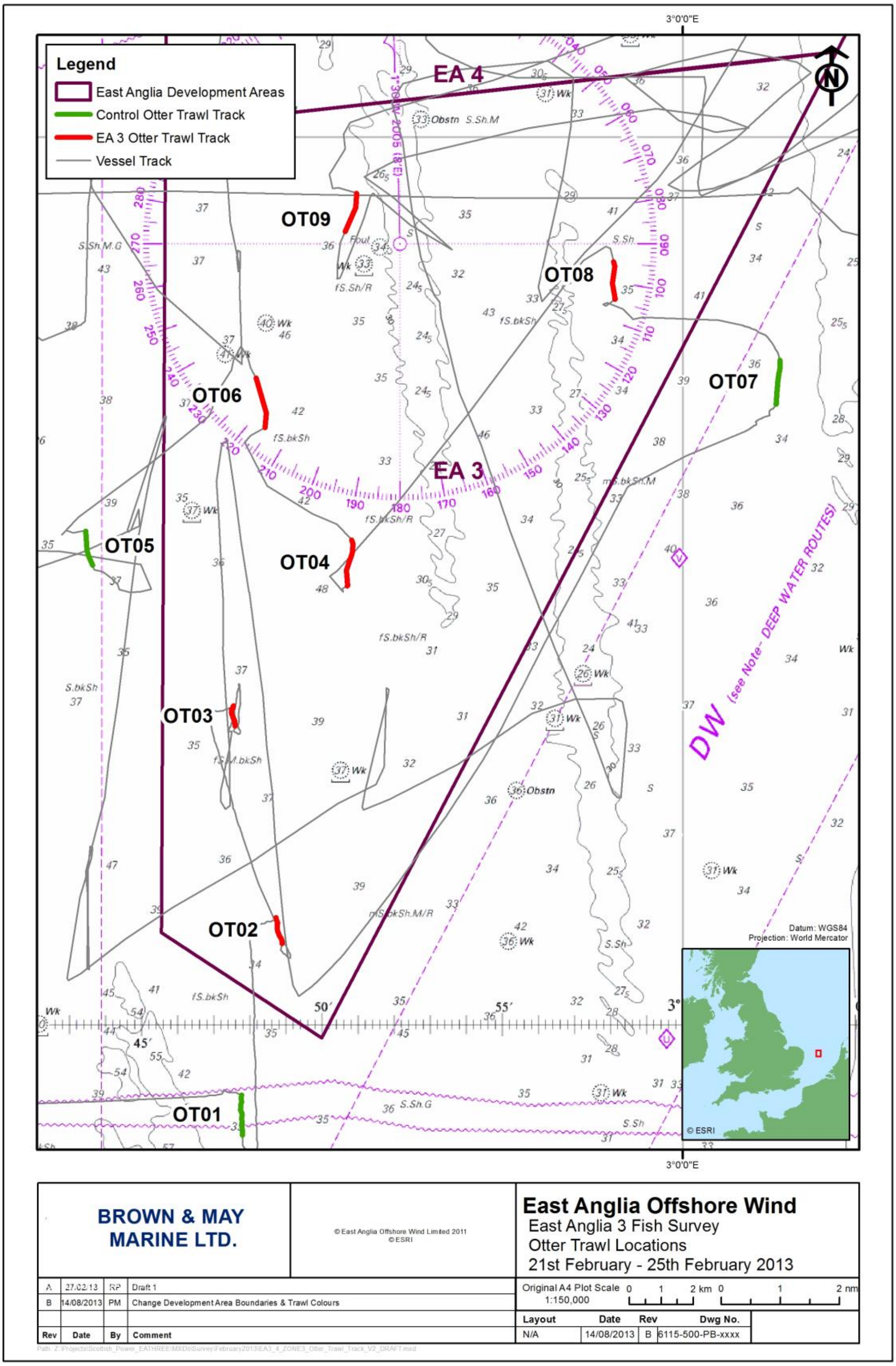


Figure 4.5 Vessel Tracks whilst Towing the Beam Trawl

5.0 Otter Trawl Results

5.1 Catch Rates and Species Distribution

22. The total number of individuals caught and the catch rate (number of individuals caught per hour) for fish and shellfish species by sampling area (control and East Anglia THREE) are given in Table 5.1 and are illustrated in Figure 5.1. The catch rates by sampling station are illustrated in Figure 5.2 (red boxes denote stations within East Anglia THREE).

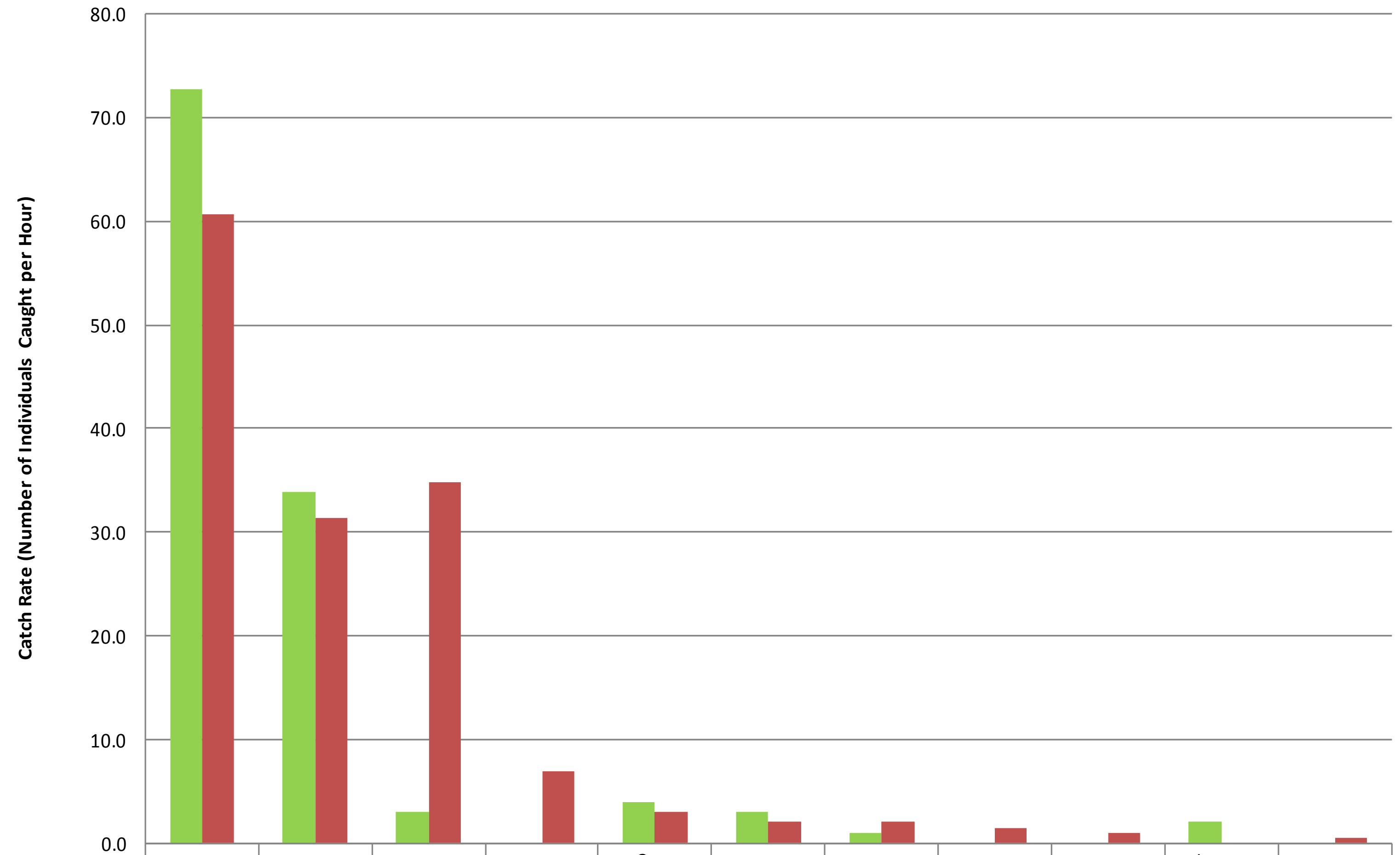
23. Spatial distribution plots for the most abundant species are given in Figure 5.3 to Figure 5.5, showing the percentage distribution by catch rate of *L. limanda*, *P. platessa* and *M. merlangus*. The circle size corresponds to the catch rate i.e. larger circles indicate greater catch rates. A total of 11 species were caught; seven at the control stations and 10 within East Anglia THREE. Overall, *L. limanda* was the most abundant species caught, followed by *P. platessa* and then *M. merlangus*. All other species were caught in relatively low numbers.

24. The highest catch rate for all species combined was recorded at station OT09 (289.6/hr) within East Anglia THREE, with *M. merlangus* accounting for 62.9% of the catch. *P. platessa* and *L. limanda* represented the highest proportion of the catch at all stations, with the exception of OT09, where *M. merlangus* was most prevalent.

25. Overall, the total catch rate was higher within East Anglia THREE (143.7/hr) than at the control stations (119.5/hr).

Table 5.1 Total Numbers of Individuals Caught and Catch Rate for Fish Species by Sampling Area

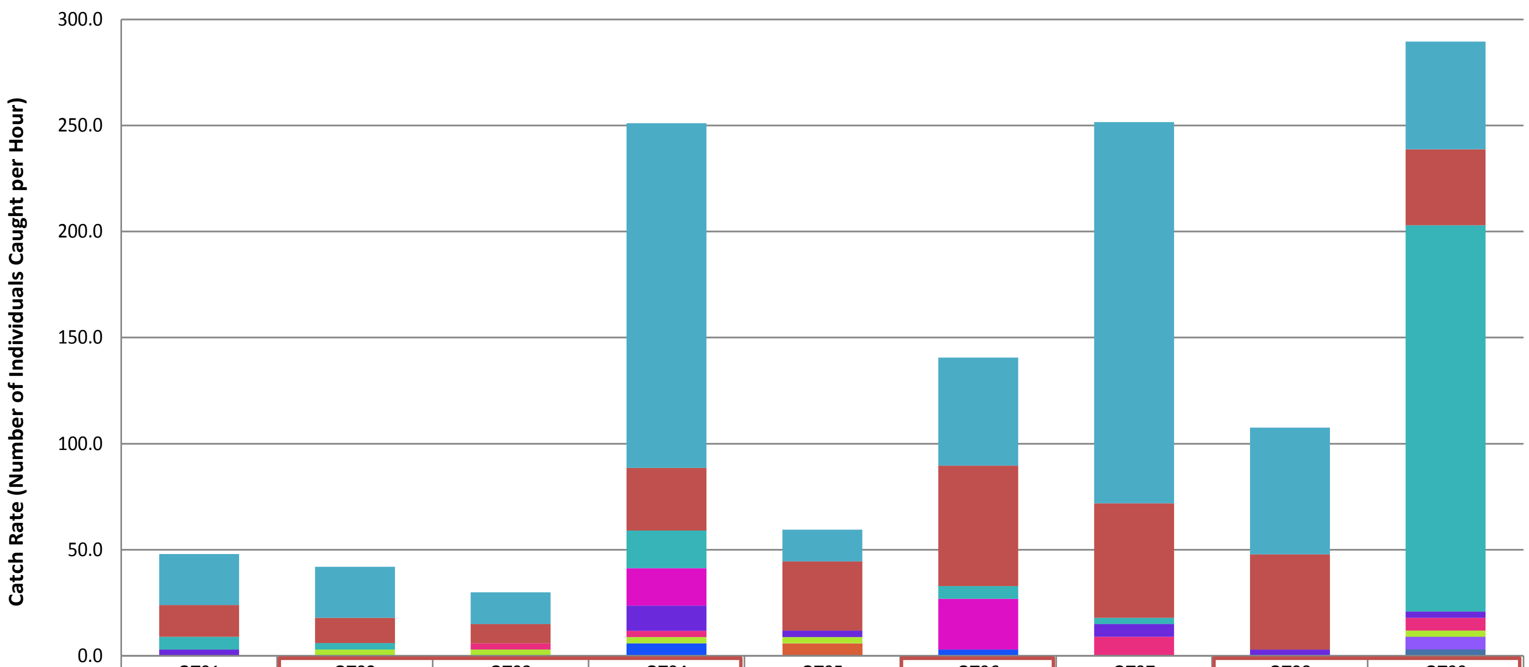
Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	**Scientific Name**	**Control**	**East Anglia THREE**	**Total**	**Control**	**East Anglia THREE**
Dab	*Limanda limanda*	73	122	195	72.7	60.7
Plaice	*Pleuronectes platessa*	34	63	97	33.9	31.3
Whiting	*Merlangius merlangus*	3	70	73	3.0	34.8
Herring	*Clupea harengus*	0	14	14	0.0	7.0
Grey Gurnard	*Eutrigla gurnardus*	4	6	10	4.0	3.0
Flounder	*Platichthys flesus*	3	4	7	3.0	2.0
Cod	*Gadus morhua*	1	4	5	1.0	2.0
Sprat	*Sprattus sprattus*	0	3	3	0.0	1.5
Bib	*Trisopterus luscus*	0	2	2	0.0	1.0
Lesser Weever	*Echiichthys vipera*	2	0	2	2.0	0.0
Cuttlefish	*Sepia officinalis*	0	1	1	0.0	0.5
Total No. of Individuals		120	289			
Total No. of Species		7	10			
Catch Rate (No. of Individuals Caught per Hour)		119.5	143.7			



	Dab	Plaice	Whiting	Herring	Grey Gurnard	Flounder	Cod	Sprat	Bib	Lesser Weever	Cuttlefish
Control	72.7	33.9	3.0	0.0	4.0	3.0	1.0	0.0	0.0	2.0	0.0
East Anglia THREE	60.7	31.3	34.8	7.0	3.0	2.0	2.0	1.5	1.0	0.0	0.5

Species

Figure 5.1 Catch Rate by Species and Sampling Area



	OT01	OT02	OT03	OT04	OT05	OT06	OT07	OT08	OT09
Dab	24.0	24.0	15.0	162.4	14.9	50.8	179.7	59.8	50.7
Plaice	15.0	12.0	9.0	29.5	32.7	56.8	53.9	44.9	35.8
Whiting	6.0	3.0	0.0	17.7	0.0	6.0	3.0	0.0	182.1
Herring	0.0	0.0	0.0	17.7	0.0	23.9	0.0	0.0	0.0
Grey Gurnard	3.0	0.0	0.0	11.8	3.0	0.0	6.0	3.0	3.0
Flounder	0.0	0.0	3.0	3.0	0.0	0.0	9.0	0.0	6.0
Cod	0.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	3.0
Sprat	0.0	0.0	0.0	5.9	0.0	3.0	0.0	0.0	0.0
Lesser Weever	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0
Bib	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
Cuttlefish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0

Station

Figure 5.2 Catch Rate by Species and Station (red boxes denote stations within East Anglia THREE)

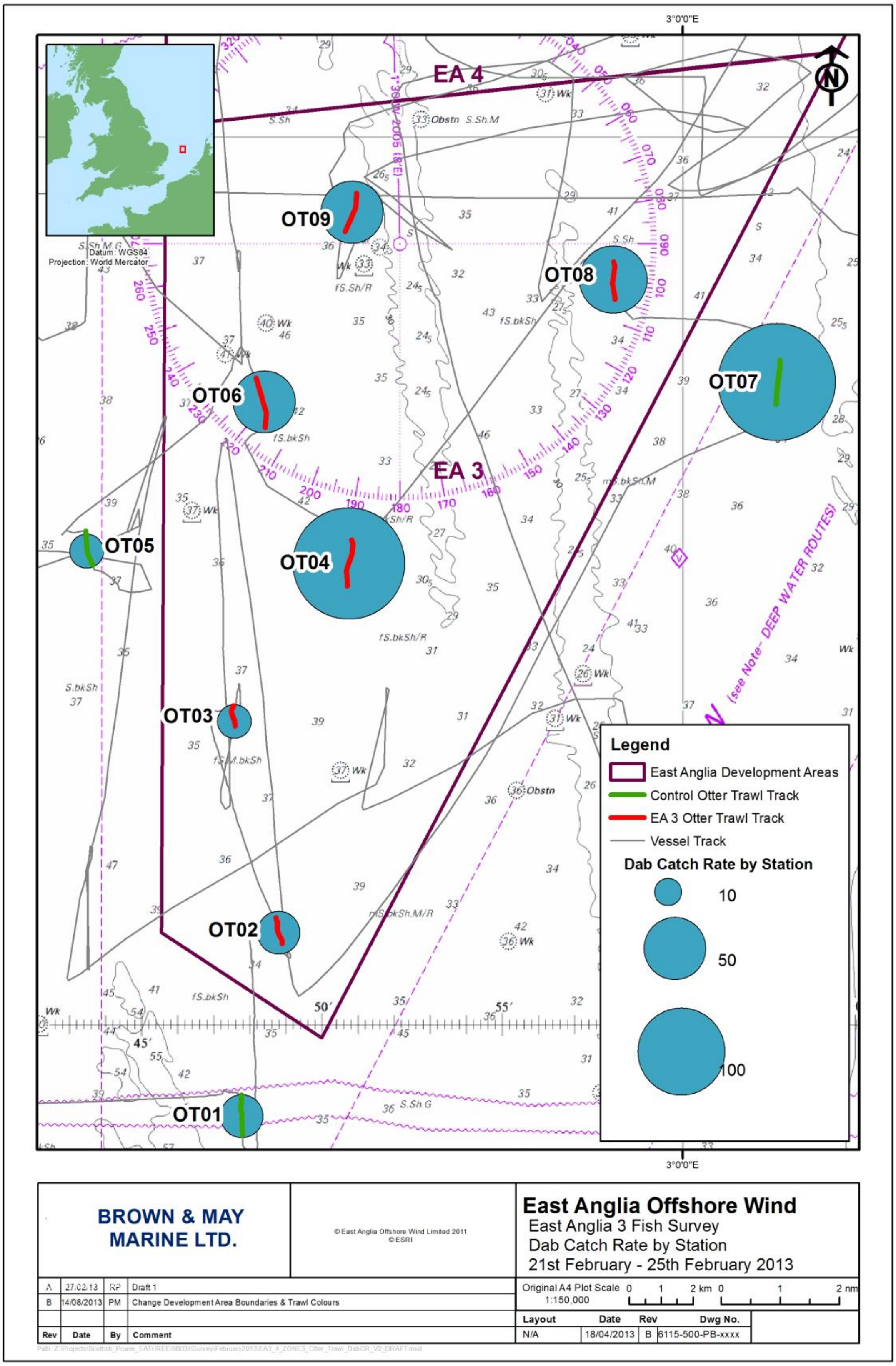


Figure 5.3 Spatial Distribution of Dab (*L. limanda*) in the Area of East Anglia THREE

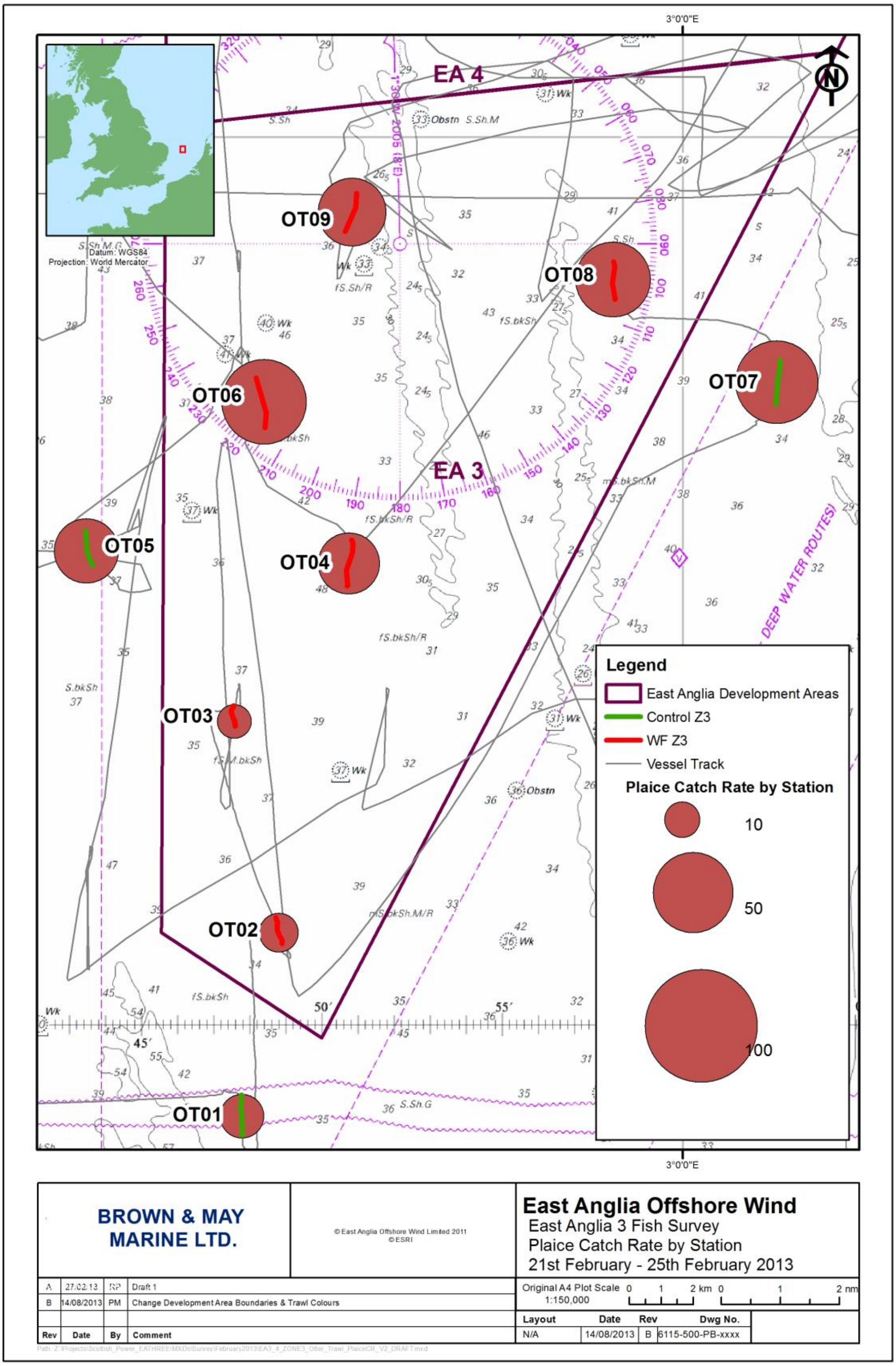


Figure 5.4 Spatial Distribution of Plaice (*P. platessa*) in the Area of East Anglia THREE

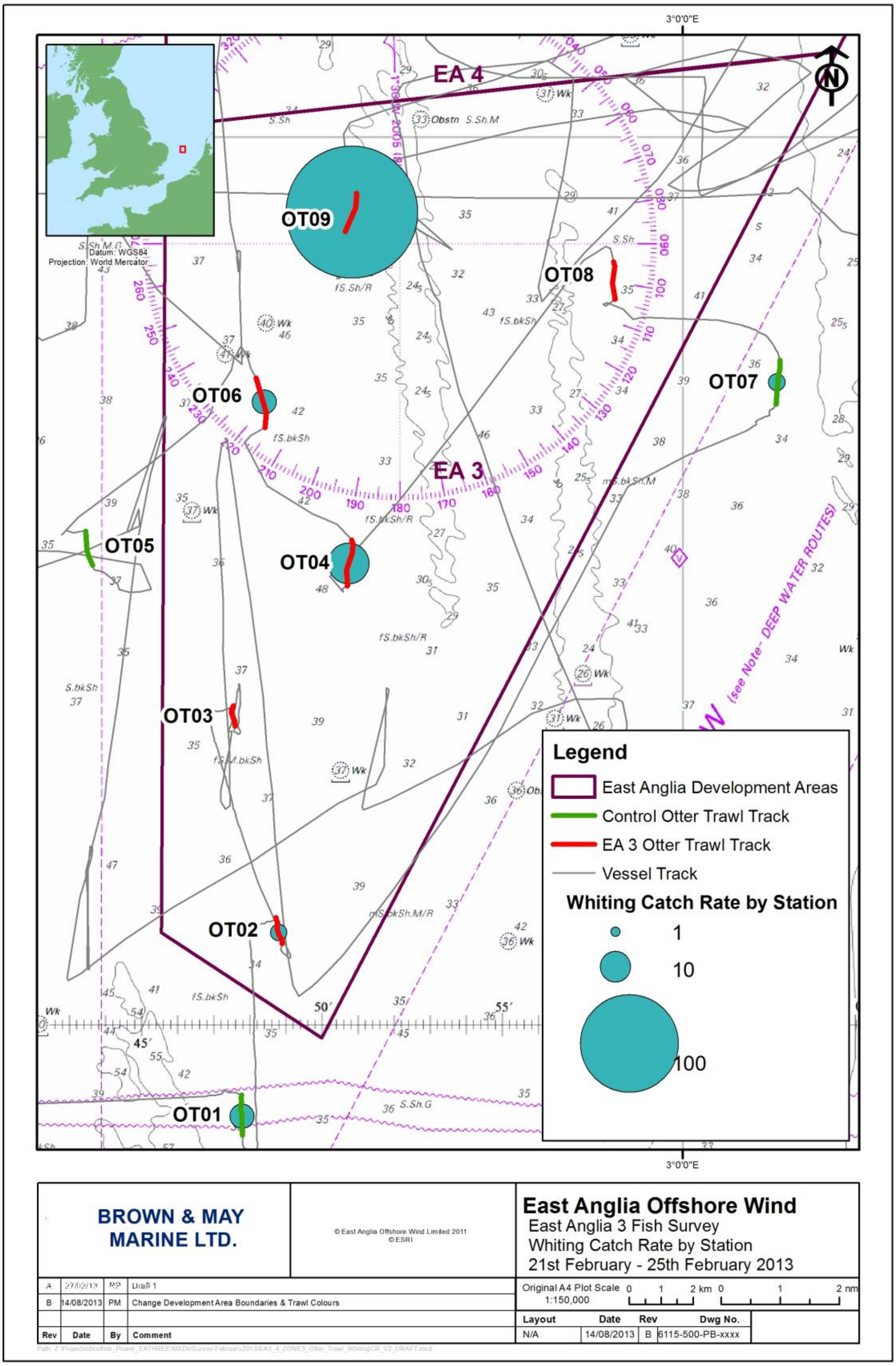
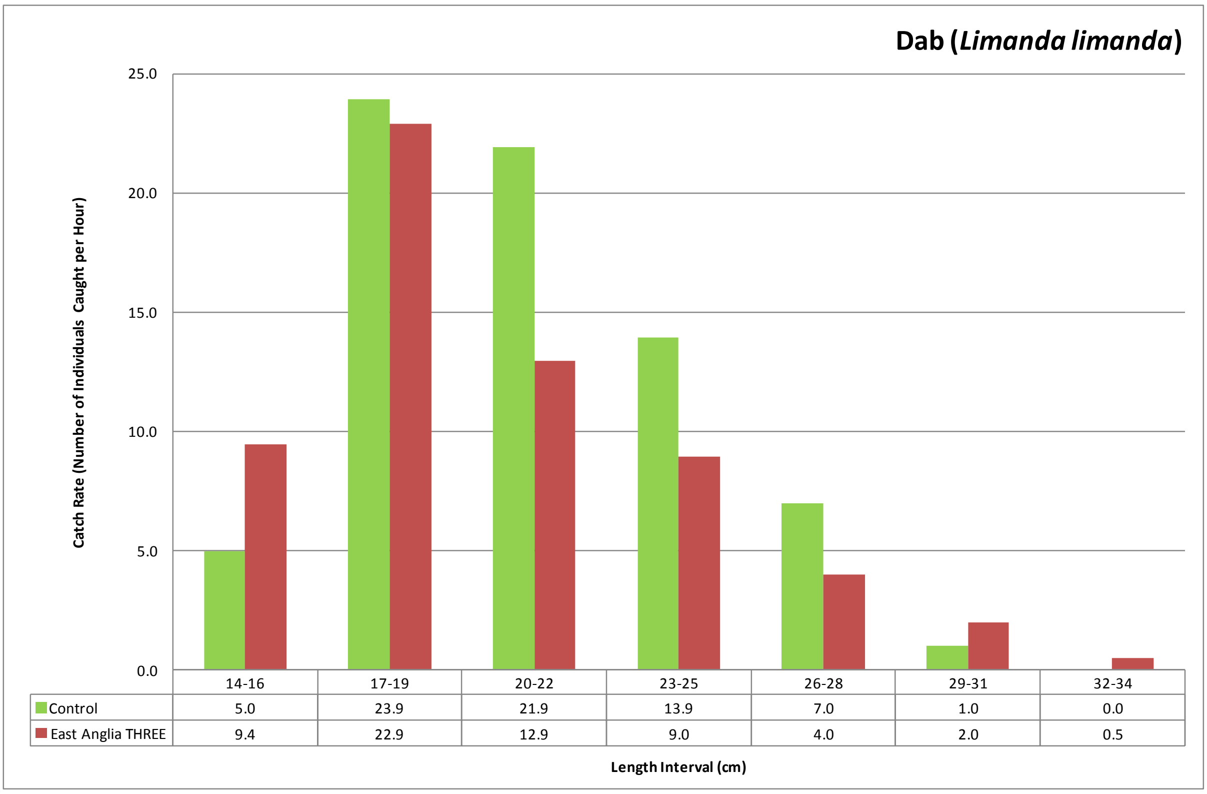


Figure 5.5 Spatial Distribution of Whiting (*M. merlangus*) in the Area of East Anglia THREE

5.2 Length Distributions

26. The length distributions of the three most abundant species caught during the survey, expressed as the catch rate (number of individuals caught per hour) by length (cm) and by sampling area (control and East Anglia THREE), are shown in Figure 5.6 to Figure 5.8.



	14-16	17-19	20-22	23-25	26-28	29-31	32-34
Control	5.0	23.9	21.9	13.9	7.0	1.0	0.0
East Anglia THREE	9.4	22.9	12.9	9.0	4.0	2.0	0.5

Figure 5.6 Dab (*L. limanda*) Length Distribution by Sampling Area

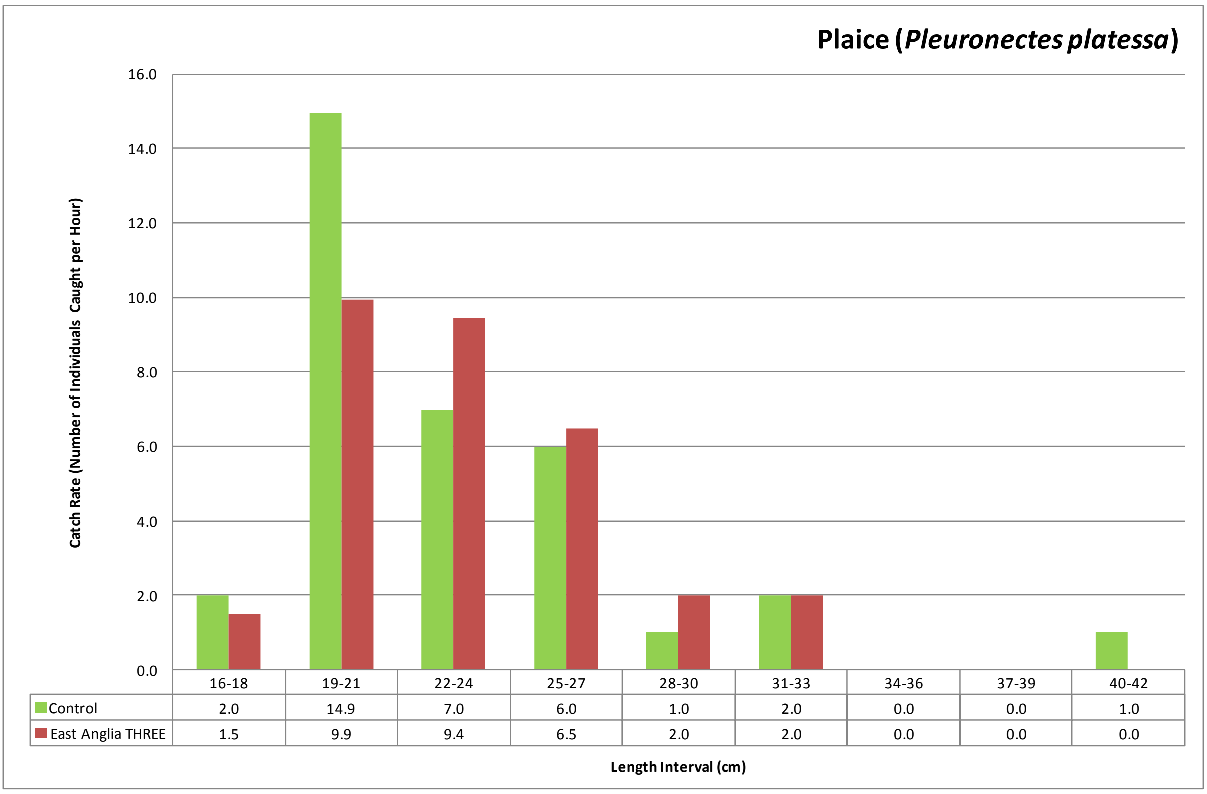


Figure 5.7 Plaice (*P. platessa*) Length Distribution by Sampling Area

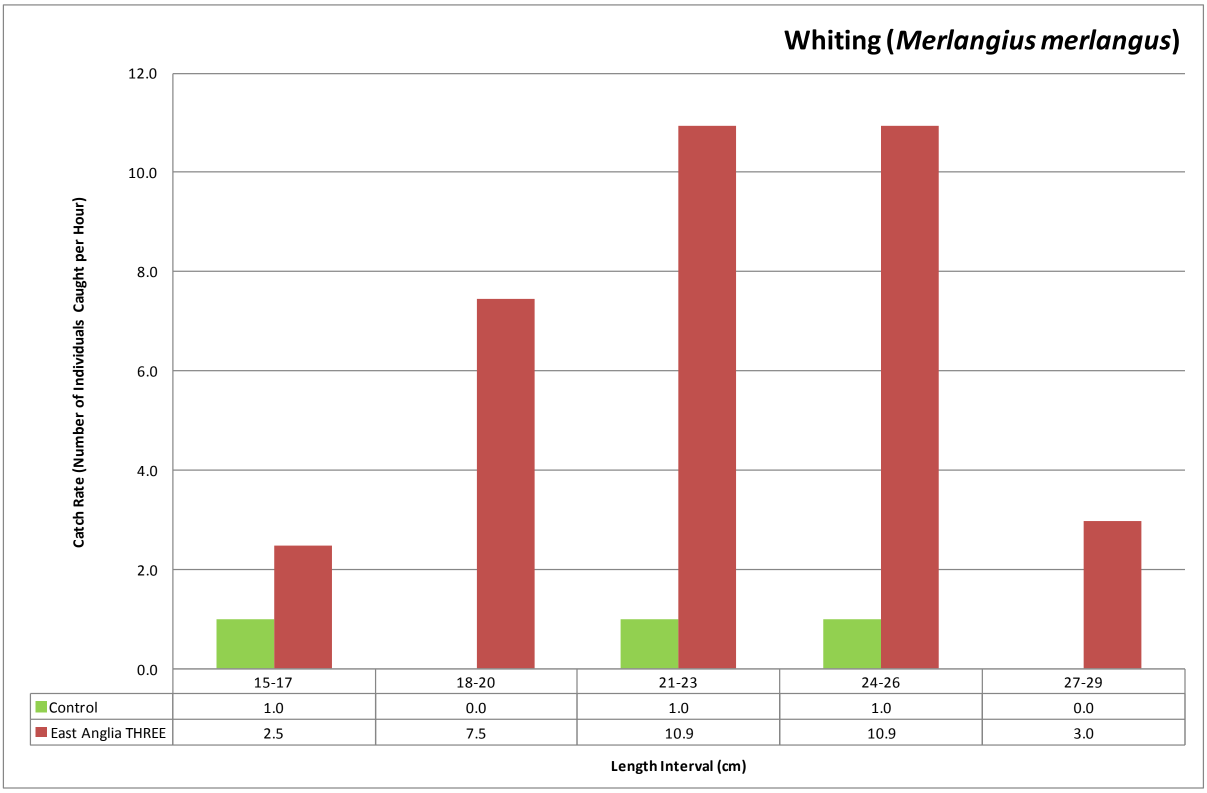


Figure 5.8 Whiting (*M. merlangus*) Length Distribution by Sampling Area

5.3 Minimum Landing Sizes

27. Minimum landing sizes (MLS) for fish and shellfish species are set by the EC under Regulation No. 850/98 (Annex XII).

28. Table 5.2 shows the four species of fish caught for which a MLS has been set, and denotes their presence or absence by sampling area (control and East Anglia THREE).

Table 5.2 MLS Set by EC

Species		EC MLS (cm)	Presence	
Common Name	Scientific Name		Control	East Anglia THREE
Cod	*Gadus morhua*	35	✓	✓
Herring	*Clupea harengus*	20	-	✓
Plaice	*Pleuronectes platessa*	27	✓	✓
Whiting	*Merlangius merlangus*	27	✓	✓

29. The percentage of individuals caught above and below their set MLS by species is shown in Figure 5.9 and Figure 5.10 for control and East Anglia THREE stations respectively.

30. Most of the *P. platessa* (control, 82.4%; East Anglia THREE, 77.8%) and *M. merlangus* (100.0% and 91.4%) caught in both sampling areas were below the MLS. All of the *G. morhua* found at the control stations and within East Anglia THREE were above the MLS, and all of the *C. harengus* caught within East Anglia THREE were below the set MLS.

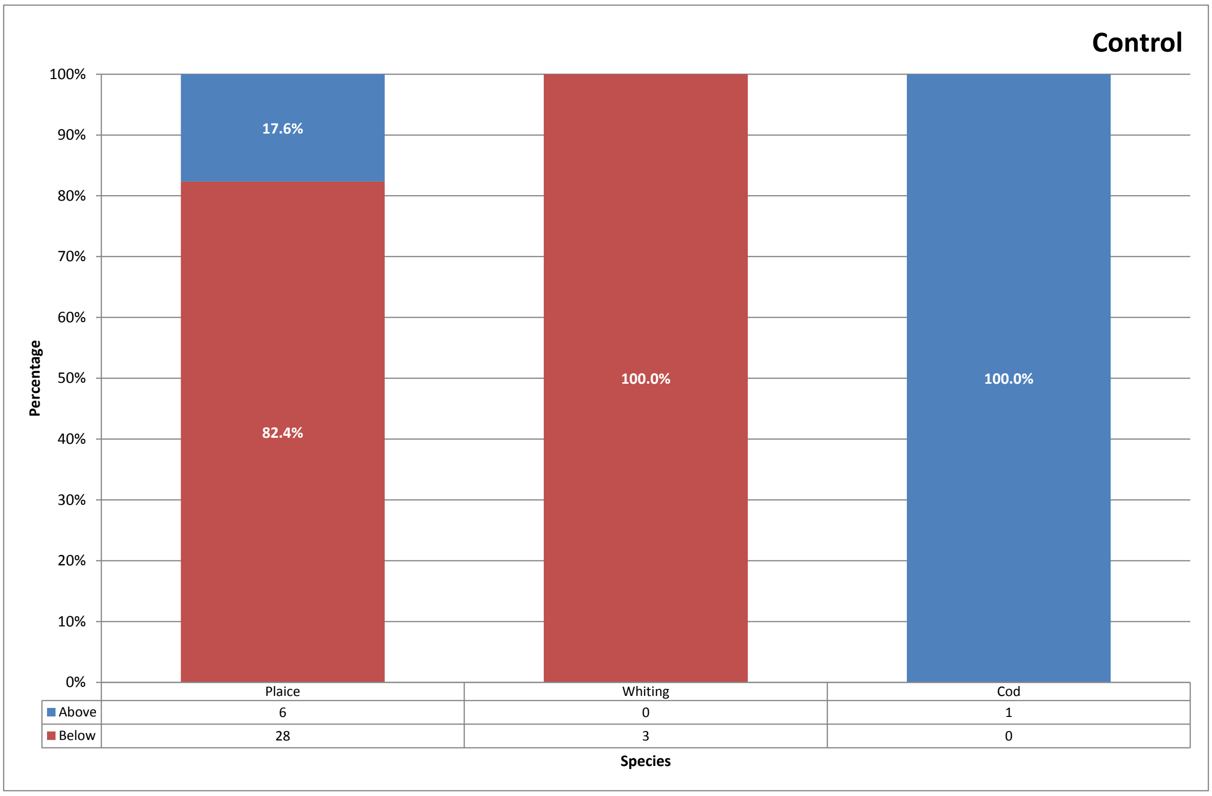


Figure 5.9 Percentage of the Catch Above and Below the MLS by Species at the Control Stations

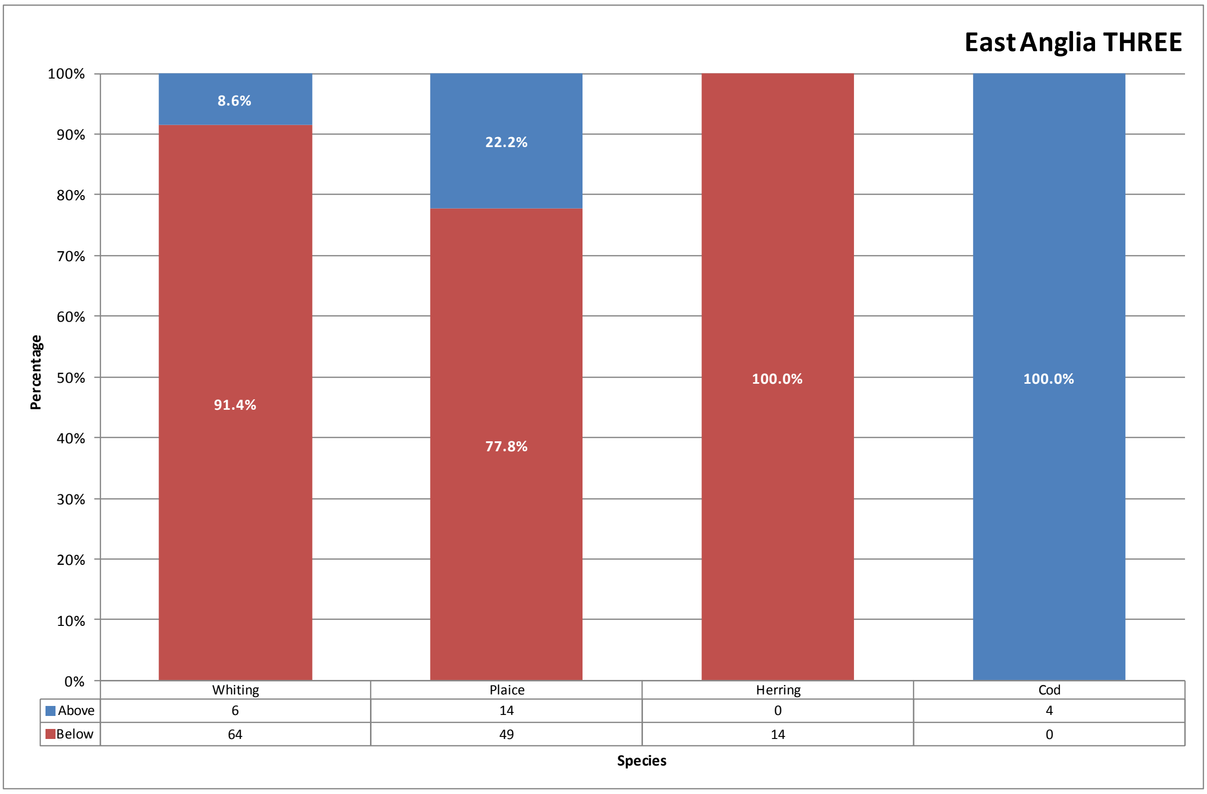


Figure 5.10 Percentage of the Catch Above and Below the MLS by Species within East Anglia THREE

5.4 Sex Ratios

31. The sex ratios of the three most abundant species caught during the survey are shown in Figure 5.11 and Figure 5.12 for control and East Anglia THREE stations respectively.

32. The sex ratio of the *L. limanda* caught at the control stations and within East Anglia THREE was approximately even. The majority of *P. platessa* caught in both sampling areas were male (control, 82.4%; East Anglia THREE, 87.3%). Low numbers of *M. merlangus* were caught at the control stations, most of which were male (66.7%), whereas within East Anglia THREE the sex ratio was approximately even.

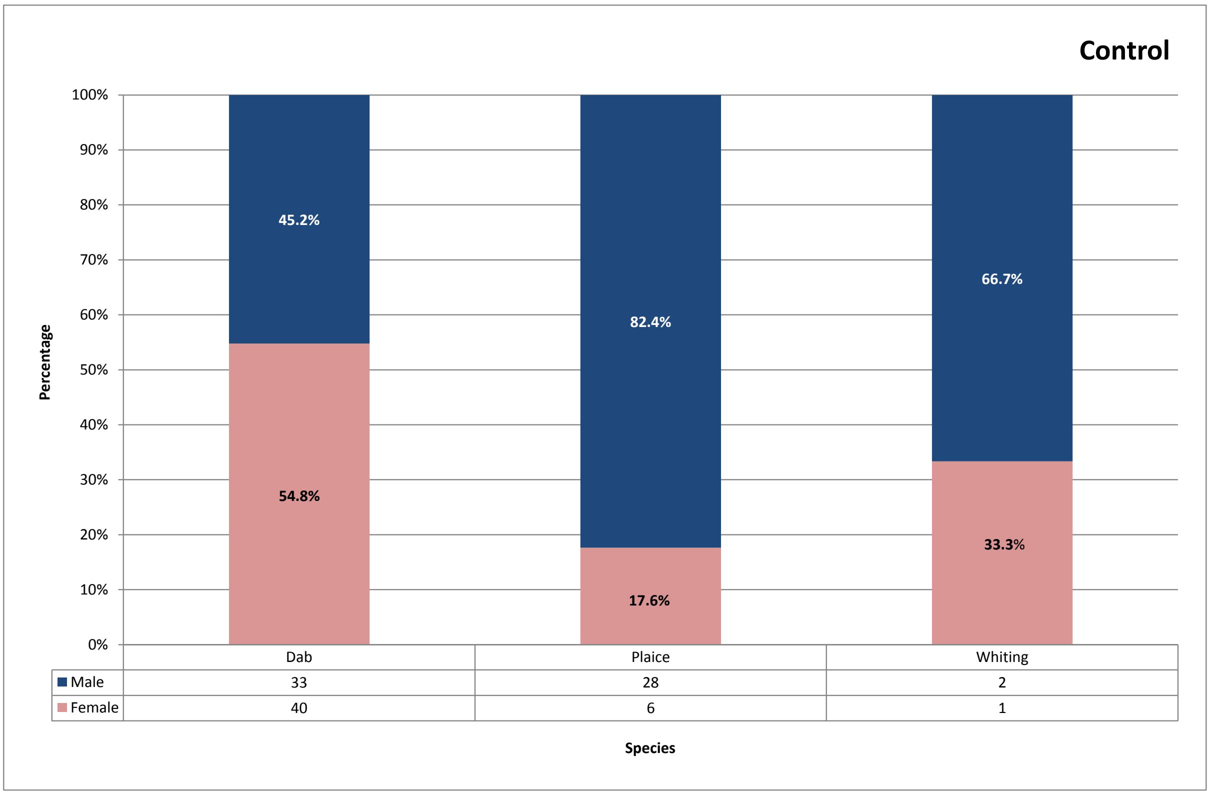


Figure 5.11 Sex Ratio by Species at the Control Stations

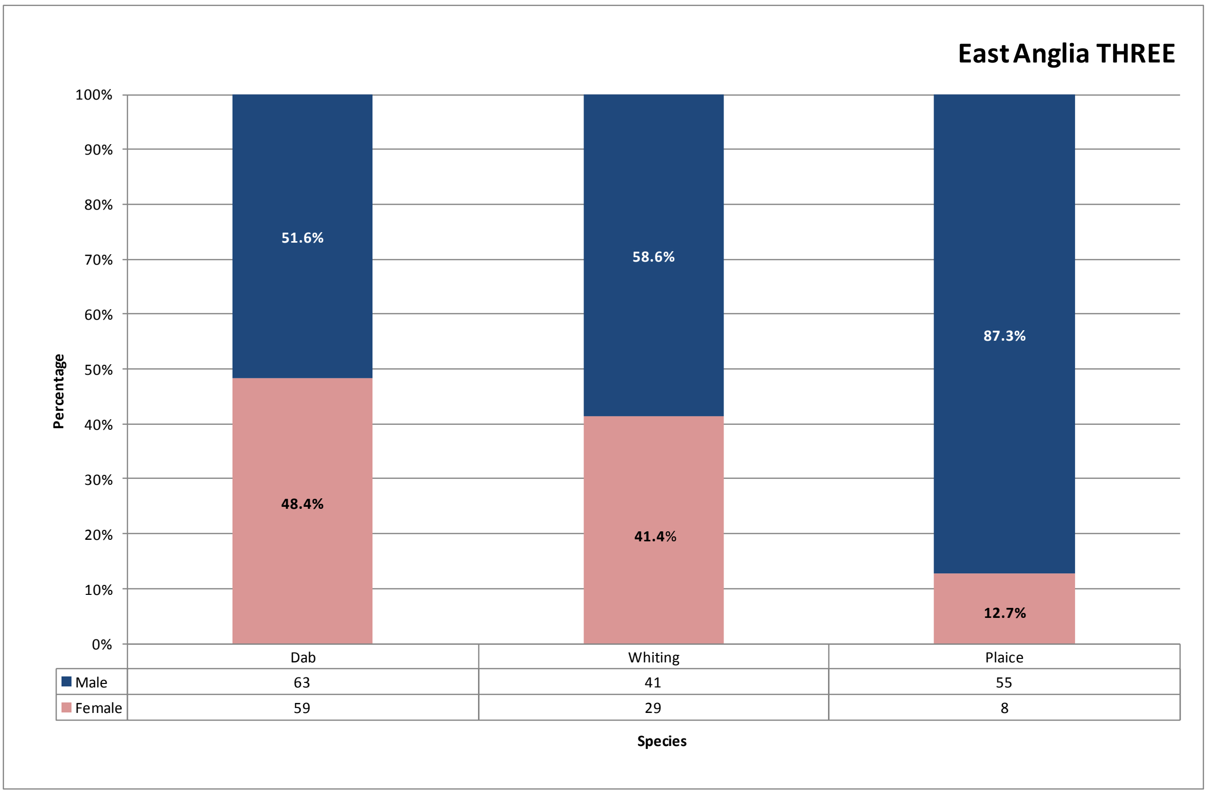


Figure 5.12 Sex Ratio by Species within East Anglia THREE

5.5 Spawning Condition

33. The spawning condition, sex and length range (nearest cm below) for the three most abundant species caught during the survey are given below in Table 5.3 to Table 5.5.

34. Most of the *L. limanda* caught at the control stations (95.9%) and within East Anglia THREE (89.3%) were maturing individuals. Approximately half of the *P. platessa* caught in both sampling areas were maturing males. The majority of the *M. merlangus* caught within East Anglia THREE were maturing individuals (74.3%). Three *M. merlangus* were caught at the control stations; two of which were immature males, and one was a maturing female.

Table 5.3 Dab (*L. limanda*) Spawning Condition

Dab							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Maturing	37	54	91	46.7%	15	34
	Spent	3	5	8	4.1%	19	31
Male	Immature	0	6	6	3.1%	14	16
	Maturing	33	55	88	45.1%	14	22
	Spent	0	2	2	1.0%	18	20

Table 5.4 Plaice (*P. platessa*) Spawning Condition

Plaice							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	3	6	9	9.3%	19	26
	Hyaline	0	1	1	1.0%	28	28
	Spent	3	1	4	4.1%	27	42
Male	Immature	8	18	26	26.8%	16	25
	Maturing	16	35	51	52.6%	18	33
	Spent	4	2	6	6.2%	23	31

Table 5.5 Whiting (*M. merlangus*) Spawning Condition

Whiting							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	0	2	2	2.7%	19	21
	Maturing	1	27	28	38.4%	21	29
Male	Immature	2	16	18	24.7%	15	22
	Maturing	0	25	25	34.2%	16	28

6.0 Beam Trawl Results

6.1 Catch Rates and Species Distribution

35. The total number of individuals caught and the catch rate (number of individuals caught per hour) for fish and shellfish species by sampling area (control and East Anglia THREE) are given in Table 6.1 below and are illustrated in Figure 6.1. The catch rates by sampling station are shown in Figure 6.2 (red boxes denote stations within East Anglia THREE).

36. Spatial distribution plots for *P. platessa* and *L. limanda* are given in Figure 6.3 and Figure 6.4. Spatial plots show the percentage distribution by catch rate of *P. platessa* and *L. limanda*. The circle size corresponds to the catch rate i.e. larger circles indicate greater catch rates.

37. A total of 16 species of fish and shellfish were caught, 11 of which were found at the control stations and 12 within East Anglia THREE. Overall, *P. platessa* was the most abundant species caught, followed by *L. limanda*. All other species were caught in relatively low numbers.

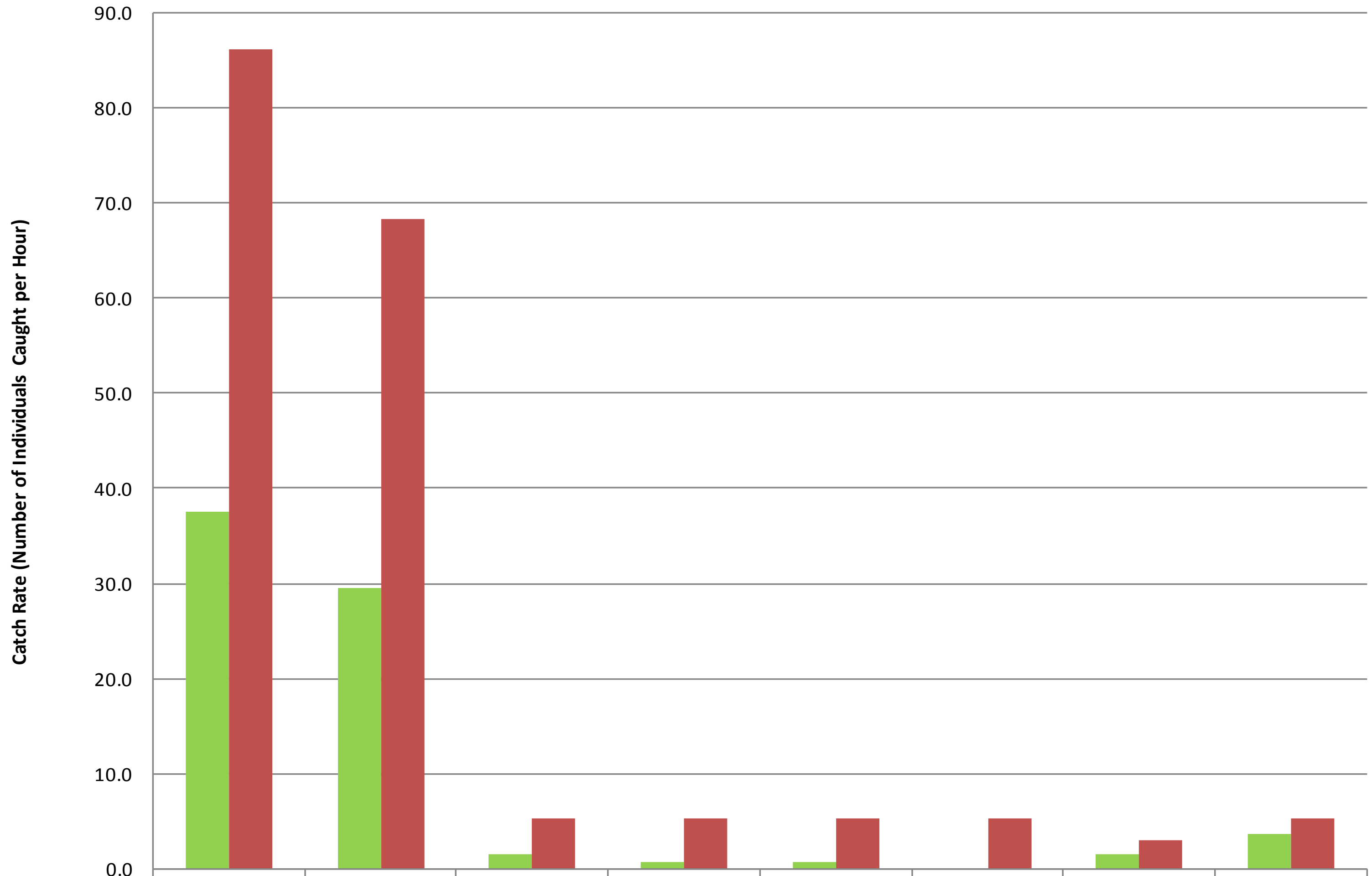
38. The station with the greatest total catch rate was BT02 within East Anglia THREE (261.6/hr), with *L. limanda* and *P. platessa* representing 80.9% of the catch. *L. limanda* and *P. platessa* represented the highest proportion of the catch at most sampling stations.

39. Overall, catch rates were greater within East Anglia THREE (183.5/hr) than at the control stations (75.1/hr).

Table 6.1 Number of Individuals Caught and the Catch Rate for Fish and Shellfish Species by Sampling Area

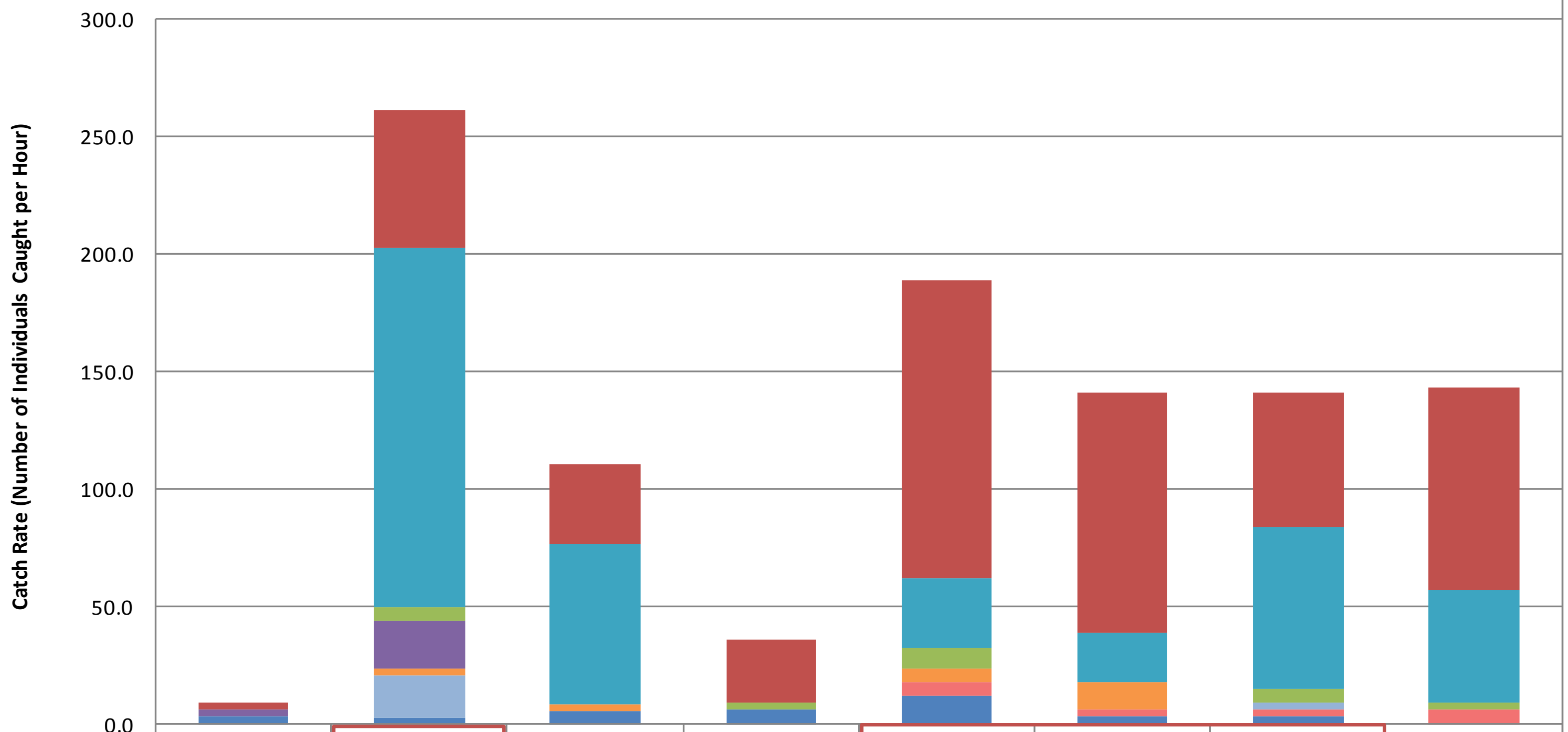
Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	Scientific Name	Control	East Anglia THREE	Total	Control	East Anglia THREE
Plaice	*Pleuronectes platessa*	51	116	167	37.6	86.2
Dab	*Limanda limanda*	40	92	132	29.5	68.4
Cuttlefish	*Sepia officinalis*	2	7	9	1.5	5.2
Solenette	*Buglossidium luteum*	1	7	8	0.7	5.2
Velvet Crab	*Necora puber*	1	7	8	0.7	5.2
Bullrout	*Myoxocephalus scorpius*	0	7	7	0.0	5.2
Scaldfish	*Arnoglossus laterna*	2	4	6	1.5	3.0
Grey Gurnard	*Eutrigla gurnardus*	1	2	3	0.7	1.5
Lesser Spotted Dogfish	*Scyliorhinus canicula*	0	2	2	0.0	1.5
Brill	*Scophthalmus rhombus*	0	1	1	0.0	0.7
Common Dragonet	*Callionymus lyra*	0	1	1	0.0	0.7
Goby (indet.)	*Pomatoschistus sp.*	1	0	1	0.7	0.0
Sprat	*Sprattus sprattus*	1	0	1	0.7	0.0
Thornback Ray	*Raja clavata*	1	0	1	0.7	0.0

Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	**Scientific Name**	**Control**	**East Anglia THREE**	**Total**	**Control**	**East Anglia THREE**
Whelk	*Buccinum undatum*	1	0	1	0.7	0.0
Whiting	*Merlangius merlangus*	0	1	1	0.0	0.7
Total No. of Individuals		102	247			
Total No. of Species		11	12			
Catch Rate (No. of Individuals Caught per Hour)		75.1	183.5			



	Plaice	Dab	Cuttlefish	Solenette	Velvet Crab	Bullrout	Scaldfish	Other Species
Control	37.6	29.5	1.5	0.7	0.7	0.0	1.5	3.7
East Anglia THREE	86.2	68.4	5.2	5.2	5.2	5.2	3.0	5.2

Figure 6.1 Catch Rates for Fish and Shellfish Species by Sampling Area



	BT01	BT02	BT03	BT04	BT05	BT06	BT07	BT08
Plaice	3.0	58.8	34.1	26.8	127.1	101.9	57.0	86.6
Dab	0.0	152.8	68.2	0.0	29.6	21.0	68.9	47.8
Cuttlefish	0.0	5.9	0.0	3.0	8.9	0.0	6.0	3.0
Velvet Crab	3.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0
Solenette	0.0	2.9	2.8	0.0	5.9	12.0	0.0	0.0
Bullrout	0.0	17.6	0.0	0.0	0.0	0.0	3.0	0.0
Scaldfish	0.0	0.0	0.0	0.0	5.9	3.0	3.0	6.0
Other Species	3.0	2.9	5.7	6.0	11.8	3.0	3.0	0.0

Station

Figure 6.2 Catch Rates for Fish and Shellfish Species by Station (red box denotes East Anglia THREE stations)

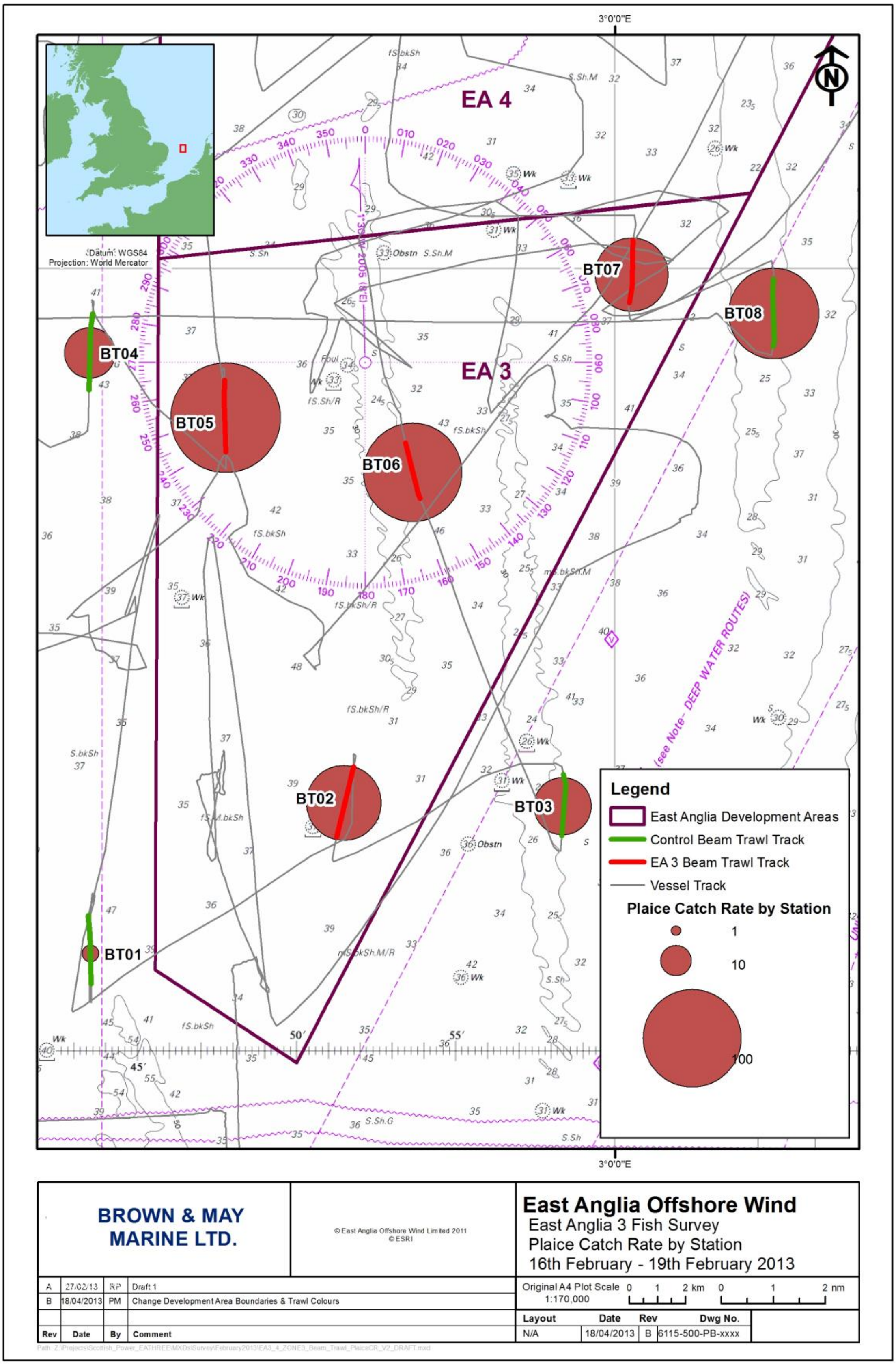


Figure 6.3 Spatial Distribution of Plaice (*P. platessa*) in the Area of East Anglia THREE

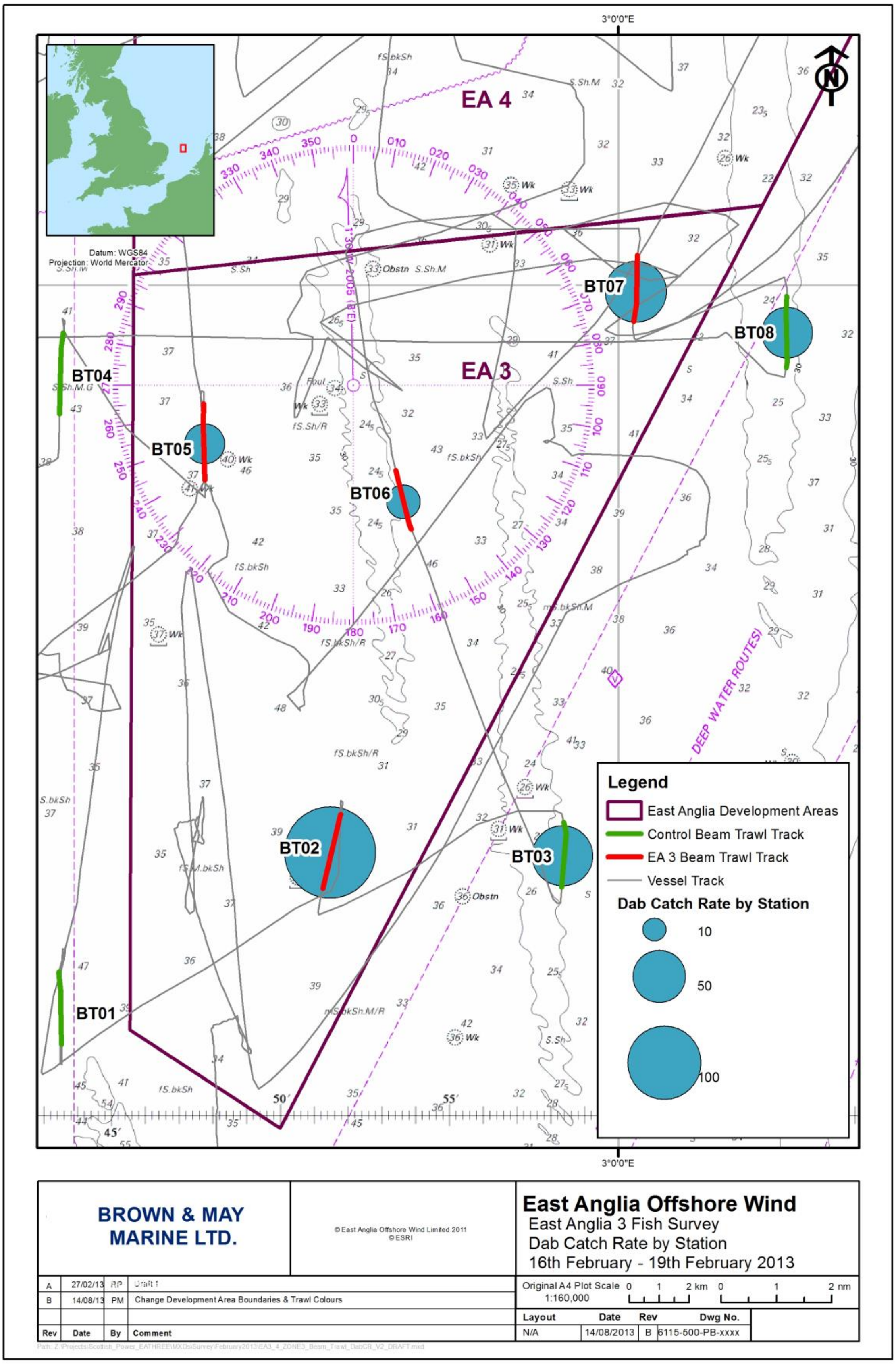


Figure 6.4 Spatial Distribution of Dab (*L. limanda*) in the Area of East Anglia THREE

6.2 Length Distributions

40. The length distributions of the two most abundant species caught during the survey, expressed as the catch rate (number of individuals caught per hour) by length (cm) and by sampling area (control and East Anglia THREE), are shown in Figure 6.5 and Figure 6.6 below.

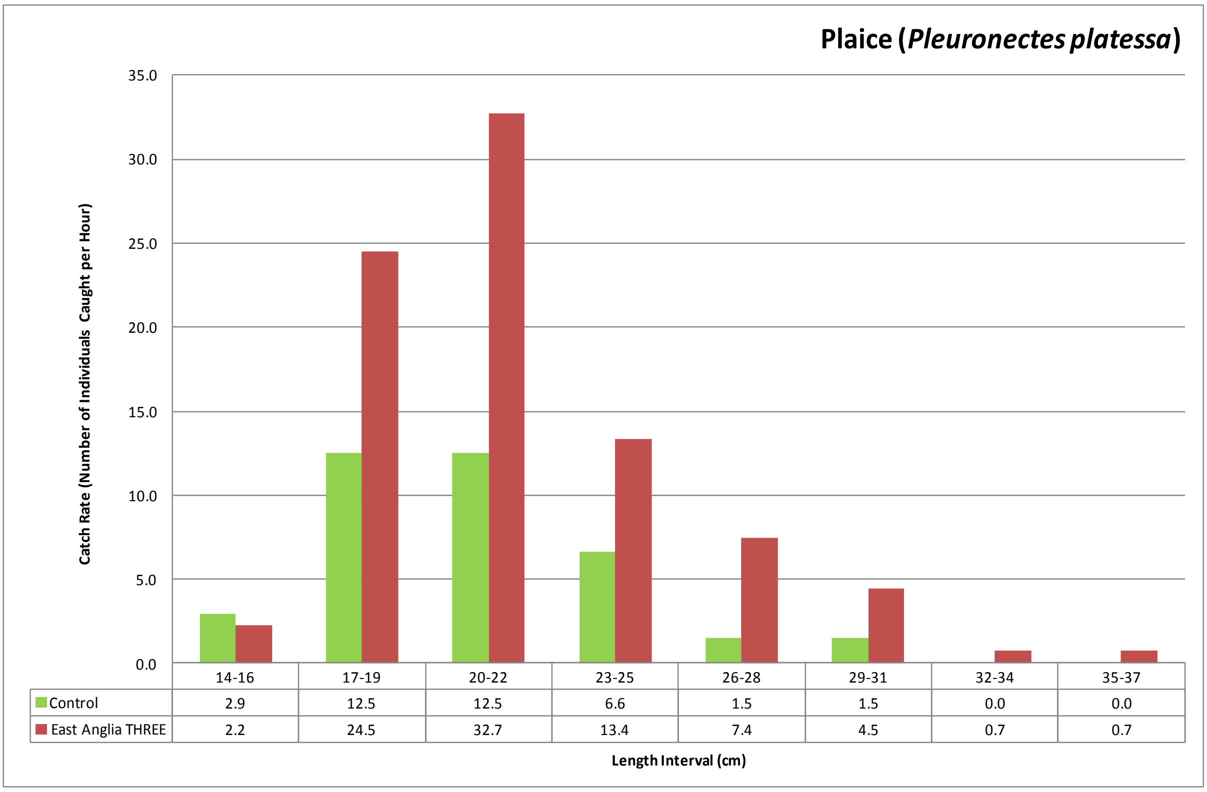
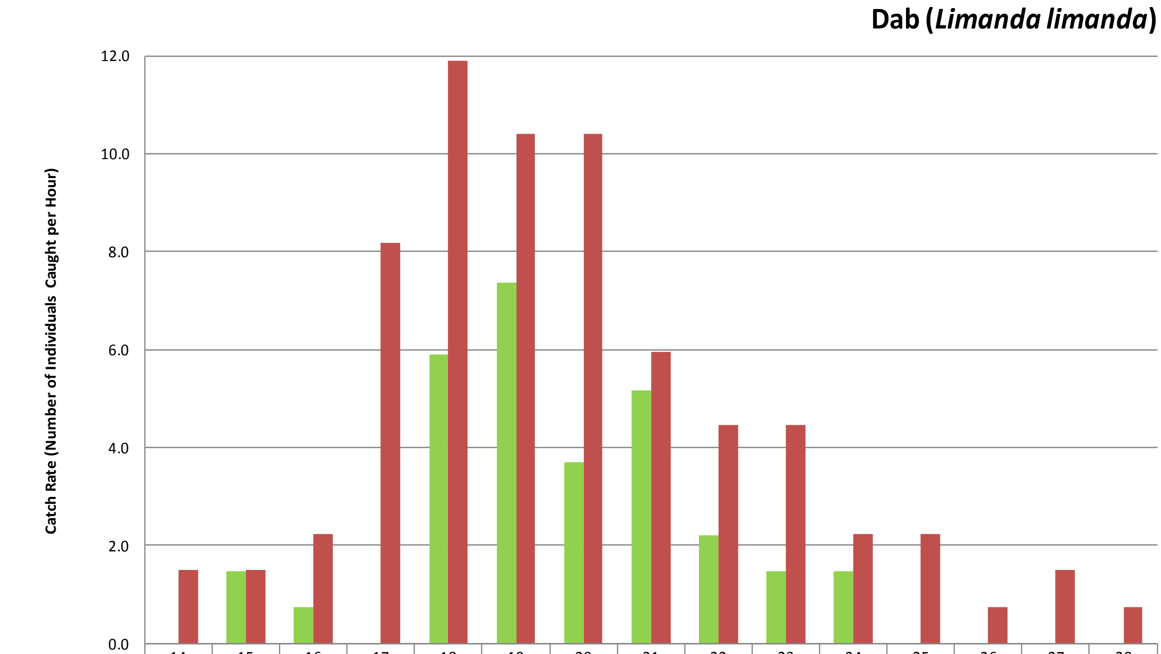


Figure 6.5 Plaice (*P. platessa*) Length Distribution by Sampling Area



	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Control	0.0	1.5	0.7	0.0	5.9	7.4	3.7	5.2	2.2	1.5	1.5	0.0	0.0	0.0	0.0
East Anglia THREE	1.5	1.5	2.2	8.2	11.9	10.4	10.4	5.9	4.5	4.5	2.2	2.2	0.7	1.5	0.7

Figure 6.6 Dab (*L. limanda*) Length Distribution by Sampling Area

6.3 Minimum Landing Sizes

41. Minimum landing sizes (MLS) for fish and shellfish species are set by the EC under Regulation No. 850/98 (Annex XII).

42. Table 6.2 shows the three species of fish and shellfish caught for which a MLS has been set, and denotes their presence or absence by sampling area (control and East Anglia THREE).

Table 6.2 MLS Set by EC

Species		EC MLS (cm)	Presence	
Common Name	Scientific Name		Control	East Anglia THREE
Plaice	*Pleuronectes platessa*	27	✓	✓
Whiting	*Merlangius merlangus*	27		✓
Whelk	*Buccinum undatum*	4.5	✓	

43. The percentage of individuals caught above and below their set MLS by species is shown in Figure 6.7 and Figure 6.8 for control and East Anglia THREE stations respectively.

44. Most of the *P. platessa* caught at the control stations (92.2%) and within East Anglia THREE (87.9%) were below the set MLS. One *B. undatum* was caught at the control

stations and was above the MLS, and one *M. merlangus* was found within East Anglia THREE and was below the set MLS.

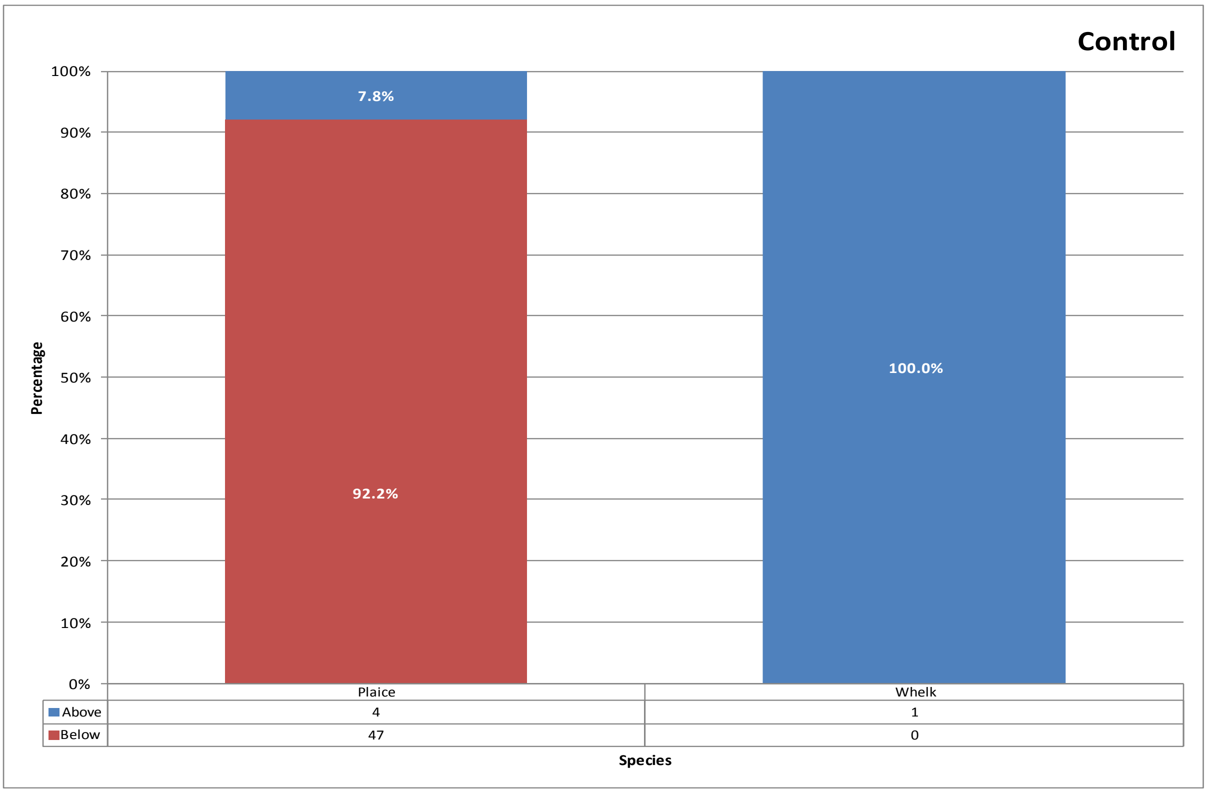
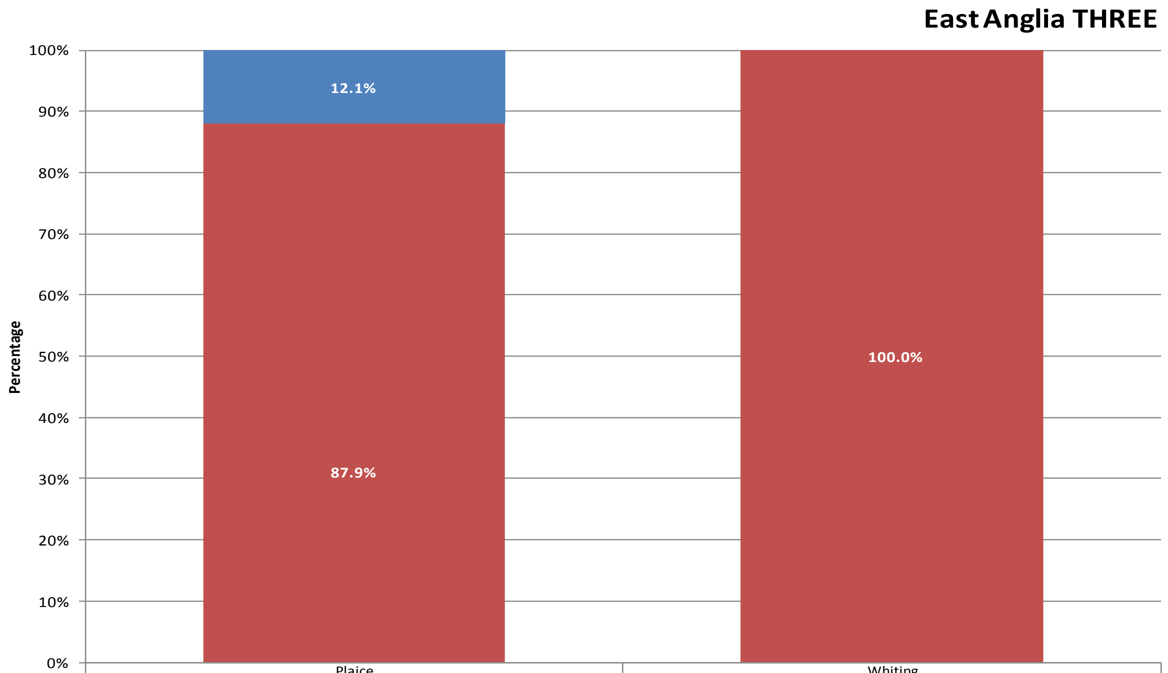


Figure 6.7 Percentage of the Catch Above and Below the MLS by Species at the Control Stations



	Plaice	Whiting
Above	14	0
Below	102	1

Figure 6.8 Percentage of the Catch Above and Below the MLS by Species within East Anglia THREE

6.4 Sex Ratios

45. The sex ratios of the two most abundant species caught during the beam trawl survey are shown in Figure 6.9 and Figure 6.10 for control and East Anglia THREE stations respectively.

46. The majority of the *P. platessa* caught at the control stations (78.4%) and within East Anglia THREE (81.0%) were male. A higher proportion of the *L. limanda* caught within East Anglia THREE were female (64.1%), whereas at the control stations the sex ratio was approximately even.

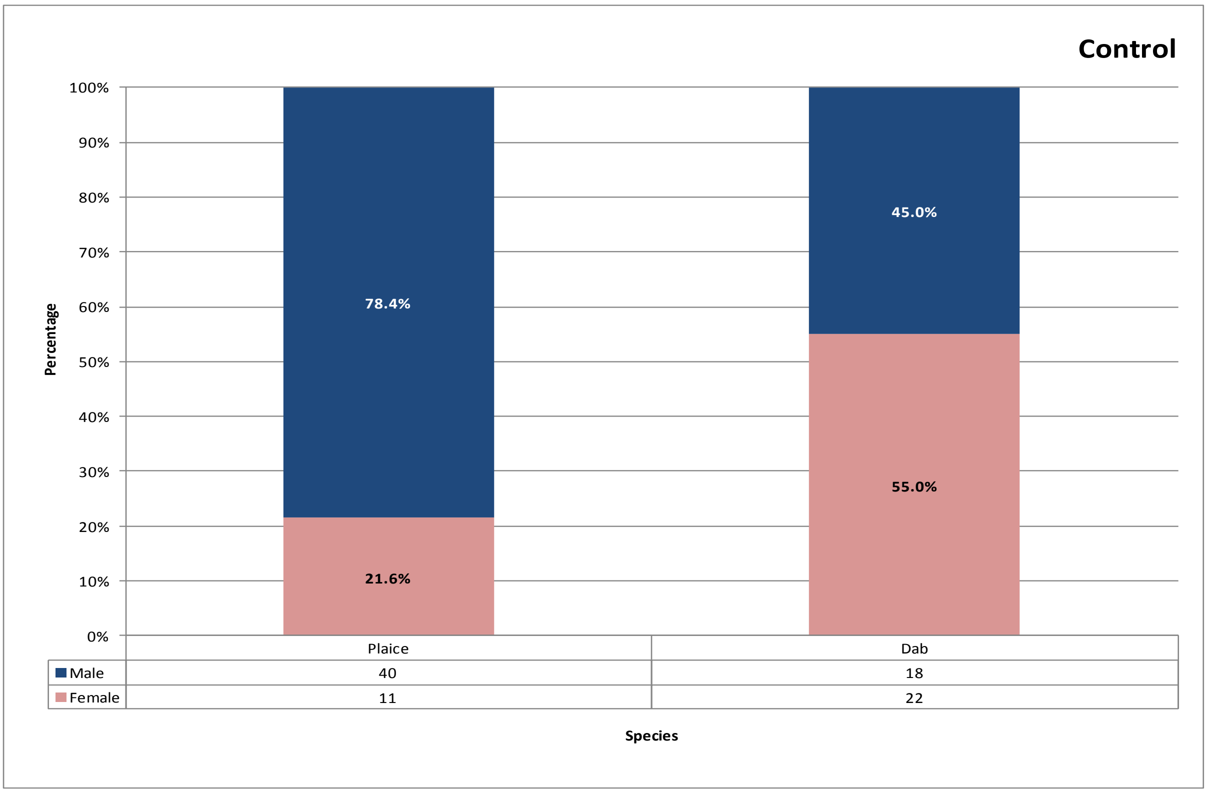


Figure 6.9 Sex Ratio by Species at the Control Stations

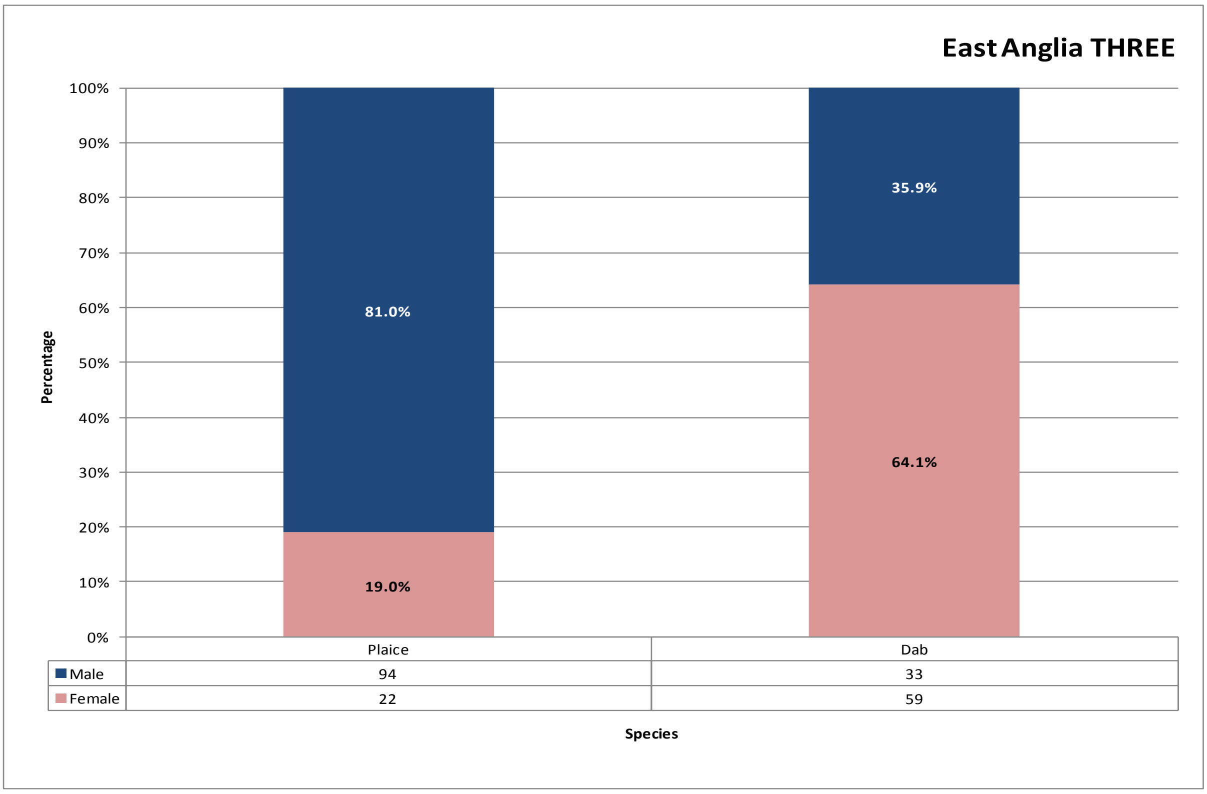


Figure 6.10 Sex Ratio by Species within East Anglia THREE

6.5 Spawning Condition

47. The spawning condition, sex and length range (nearest cm below) for the two most abundant species caught during the beam trawl survey are given below in Table 6.3 and Table 6.4.

48. The highest proportion of the *P. platessa* (control, 56.9%; East Anglia THREE, 62.9%) and *L. limanda* (85.0% and 93.5%) caught in both sampling areas were spent.

Table 6.3 Plaice (*P. platessa*) Spawning Condition

Plaice							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	9	15	24	14.4%	14	24
	Spent	2	7	9	5.4%	22	36
Male	Immature	13	29	42	25.1%	16	23
	Spent	27	65	92	55.1%	16	31

Table 6.4 Dab (*L. limanda*) Spawning Condition

Dab							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	5	4	9	6.8%	15	22
	Spent	17	55	72	54.5%	17	28
Male	Immature	1	2	3	2.3%	14	16
	Spent	17	31	48	36.4%	14	21

7.0 Appendix

7.1 Appendix 1 – Health and Safety

7.1.1 Personnel

49. Brown and May Marine (BMM) staff protocol followed the standard health and safety protocol outlined in the BMM "Offshore Operational Procedures for Surveys using Commercial Fishing Vessels".

50. All BMM staff have completed a Sea Survival course approved by the Maritime and Coastguard Agency, meeting the requirements laid down in: **STCW 95 Regulation VI/1 para 2.1.1 and STCW Code section A- VI/1** before boarding any vessel conducting works for the company. Employees are also required to have valid medical certificates (ENG1 or ML5), Seafish Safety Awareness, Seafish Basic First Aid and Seafish Basic Fire Fighting and Fire Prevention certificates before participating in offshore works.

7.1.2 Vessel Induction

51. Before boarding the survey team were shown how to safely board and disembark the vessel. Prior to departure the skipper briefed the BMM staff on the whereabouts of the safety equipment, including the life raft, emergency flares and fire extinguishers, and also the location of the emergency muster point. The safe deck areas, man-overboard procedures and emergency alarms were also discussed. The survey team were warned about the possible hazards, such as slippery decks and obstructions whilst aboard. The BMM staff were briefed about trawling operations and the need to keep clear of all winch's when operational and a safety drill was conducted. All hazards were assessed prior to the survey in the BMM health and safety risk assessment.

7.1.3 Daily Safety Checks

52. The condition of the life jackets, EPIRB's, and life raft were inspected daily. Also checked were the survey team working areas, including the fish room and the wheelhouse to ensure these areas were clear of hazards such as clutter and obstructions.

7.1.4 Post Trip Survey review

53. Upon completion of the survey a "Post Trip Survey Review" was filed, see Table 7.1 overleaf.

Table 7.1 Post Trip Survey Review

Project: East Anglia THREE	**Vessel:** Jubilee Spirit
Surveyors: Alex Winrow-Giffin, Richard Preston	**Skipper:** Ross Crookes
Survey Area: East Anglia THREE, southern North Sea	**Total Time at Sea:** 11 Days
Dates at Sea: 16/02/2013 – 26/02/2013	

	Comments	Actions
Did vessel comply with pre trip safety audits?	Yes Passed audit by LOC on 14/02/2013	N/A
Skipper and crew attitude to safety?	Good	N/A
Vessel machinery failures?	None	N/A
Safety equipment failures?	None	N/A
Accidents?	None	N/A
Injuries?	None	N/A

ANNEX 2

East Anglia Offshore Wind Farm

East Anglia THREE

Fish and Shellfish Survey

15^{th} to 27^{th} May 2013

Undertaken by
Brown and May Marine Ltd

Ref	Issue Date	Issue Type	Author	Checked	Approved
EA3OB02	10/09/2013	Final	LS/AWG	AWG/JP	SJA

Contents

Figures

Tables

1.0 Summary

1.1 Otter Trawl

1. A total of 12 species of fish and shellfish were caught in the otter trawl survey; six at the control stations and 12 within East Anglia THREE. Overall, whiting (*Merlangius merlangus*) was the most abundant species caught, followed by plaice *(Pleuronectes platessa*), dab (*Limanda limanda*) and then lesser spotted dogfish (*Scyliorhinus canicula*). All other species were caught in relatively low numbers. The highest catch rate for all species combined was recorded at station OT08 within East Anglia THREE, with *P.* platessa and *L. limanda* accounting for 75.0% of the catch.

2. Three species of fish were caught for which there is a set minimum landing size (MLS). Most of the *P. platessa* and *M. merlangus* caught in both sampling areas were below the MLS. One horse mackerel (*Trachurus trachurus*) was caught within East Anglia THREE and was above the MLS.

3. At the control stations the sex ratio of the *M. merlangus* caught was approximately even, whereas within East Anglia THREE a large proportion of individuals were female; high numbers of which were running females in both sampling areas. The sex ratio of the *L. limanda* caught at the control stations was approximately equal with the highest proportion of individuals identified as immature males, whereas most of those caught with East Anglia THREE were maturing males. At the control stations the highest proportion of the *P. platessa* caught were immature and running males, whereas within East Anglia THREE most of which were maturing males.

1.2 Beam Trawl

4. Of the 18 species caught in the commercial beam trawl survey, 13 were found at the control stations and 13 within East Anglia THREE. Overall, *P. platessa* was the most abundant species caught, followed by *L. limanda*. The total catch rate was highest at the control stations. Control station BT01 had the highest catch rate overall; this is attributed to the high numbers of whelk (*Buccinum undatum*) recorded.

5. Most of the *P. platessa* caught in both sampling areas were below the set MLS. All of the *B. undatum*, caught within East Anglia THREE were below the MLS. All other species were caught in low numbers.

6. The highest proportion of the *P. platessa* caught in both sampling areas were maturing males. Most of the *L. limanda* caught at the control stations were immature males, whereas within East Anglia THREE the majority were maturing females.

1.3 Scientific 2-metre Beam Trawl

7. A total of 28 species of fish were caught in the s East Anglia THREE scientific beam trawl survey; 20 within East Anglia THREE, and 27 along the export cable. Solenette (*Buglossidum luteum*) was the most abundant species along the export cable whereas sand goby (*Pomatoschistus minutus*) was more abundant within East Anglia THREE, followed by lesser weever (*Echiichthys vipera*) and scaldfish (*Arnoglossus laterna*). All other species were caught in relatively low numbers. Station T12 within East Anglia THREE yielded the highest catch rate (1,222.6/hr), with *B. luteum* and *P. minutus* representing the majority of the catch (43.7% and 42.9% respectively).

2.0 Introduction

8. The following report details the findings of the May 2013 fish and shellfish survey, undertaken within and adjacent to the East Anglia THREE offshore windfarm between the 15th and 27th May.

9. The East Anglia THREE offshore windfarm is located in the North Sea, approximately 79 km off the coast of Suffolk.

10. The survey methodology, vessel and sampling gear detailed were agreed in consultation with Cefas and the Marine Management Organisation (MMO). A dispensation from the MMO for the Provisions of Council Regulation 850/98 to catch and retain undersize fish for scientific research and 43/2009 specifically related to days at sea was obtained prior to commencement of this survey. A summary of the health and safety performance of the survey is provided in Appendix 1.

11. The aim of the survey was to establish the abundance and composition of fish and shellfish species within the area of the East Anglia THREE offshore windfarm.

12. The results of the epi-benthic survey undertaken by Fugro Emu Limited are also detailed in Section 7.0. Please refer to the epi-benthic survey report for information regarding the vessel and sampling gear specifications.

3.0 Scope of Works

13. The proposed scope of works for the May 2013 fish and shellfish survey replicates that of the February 2013 survey, and is detailed below. The methodology is in line with the Terms of Reference, as agreed with Cefas prior to the commencement of sampling. The proposed sampling stations are illustrated in Figure 3.1 overleaf.

- **Otter Trawl**
    - Six tows of approximately 20 minutes duration within East Anglia THREE and three control tows in adjacent areas

- **Beam Trawl**
    - Four tows of approximately 20 minutes duration within East Anglia THREE, four control tows in adjacent areas

- **Otter and Beam Trawl Sample Analysis**
    - Number of individuals and catch rate by species
    - Length distribution by species
        - Finfish and sharks (except herring and sprat): individual lengths (nearest cm below)
        - Herring and sprat: individual lengths (nearest ½ cm below)
        - Rays: individual length and wing-width (nearest cm below)
    - Sex ratio by species
    - Spawning condition
        - Finfish species (except herring and sprat): Cefas Standard Maturity Key - Five Stage
        - Herring and sprat: Cefas Maturity Key – Nine Stage
        - Ray and shark species: Cefas Standard Elasmobranch Maturity Key - Four Stage

- **2-metre Scientific Beam Trawl**
    - Six tows of approximately 400 to 700 metres distance along the export cable route and three tows within East Anglia THREE (undertaken by Fugro Emu Limited between 1st and 8th May 2013)

- **2-metre Scientific Beam Trawl Sample Analysis**
    - Number of individuals and catch rate by species
    - Length distribution by species
        - Finfish and sharks (except herring and sprat): individual lengths (nearest cm below)
        - Herring and sprat: individual lengths (nearest ½ cm below)
        - Rays: individual length and wing-width (nearest cm below)

14. For the purposes of data analysis, catch rates have been calculated to allow for quantitative comparisons to be made between the numbers of individuals caught per hour at each station.

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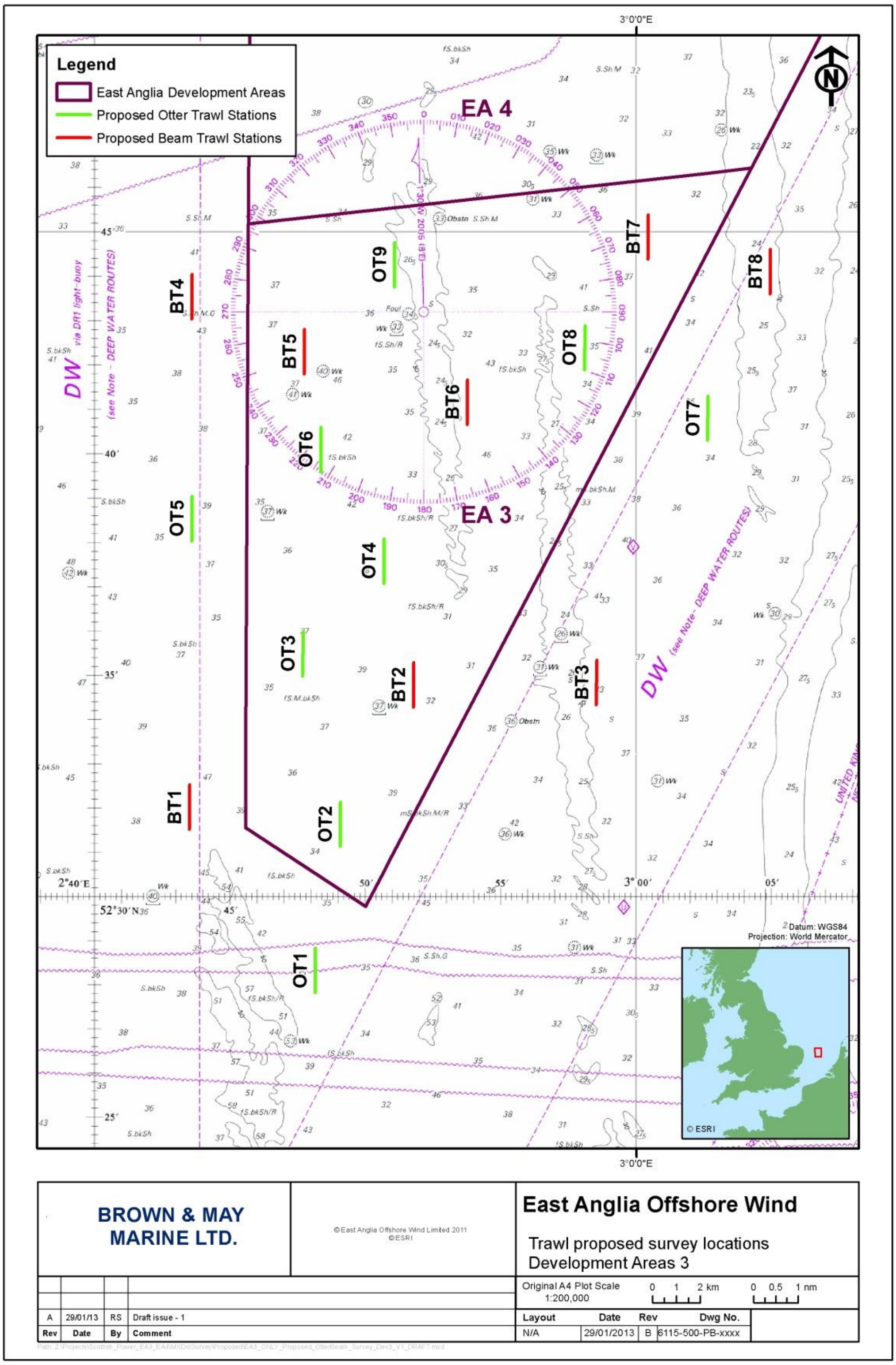


Figure 3.1 Proposed Trawl Locations

4.0 Methodology

4.1 Survey Vessel

15. The vessel chartered for the survey (Figure 4.1), the "Jubilee Spirit", is a Grimsby-based commercial trawler that was contracted for previous fish and shellfish surveys at East Anglia One. The specifications of the vessel are given below in Table 4.1.

Figure 4.1 Survey Vessel "Jubilee Spirit"

Table 4.1 Survey Vessel Specifications

Survey Vessel Specifications	
Length	21.2m
Beam	6.9m
Draft	2.3m
Main engine	Caterpillar Type 340TA 475 BHP
Gearbox	Hydraulic 6: reduction
Propeller	4 Blade Manganese Bronze Fixed Pitch 1.7m diameter
GPS	2-Furuno GP80
Plotters	Sodena Plotter with Electronic Charts
Sounder	Furuno Daylight Viewing

4.2 Sampling Gear

4.2.1 Commercial Otter Trawl

16. A commercial otter trawl (Figure 4.2) with a 100mm mesh cod end was used for fish and shellfish sampling; the specifications of which are given in Table 4.2 below.

Figure 4.2 Otter Trawl Used

Table 4.2 Otter Trawl Specifications

Otter Trawl Specifications	
Towing Warp	18mm, 6x19+1
Depth: Payout Ratio	3:1
Trawl Doors	Perfect B 84
Net	100mm mesh cod-end
Ground line length	24.4m
Footrope	Rock-hopper with 18 inch bobbins
Est. Headline height	7.3m
Distance between doors (est.)	51m

4.2.2 Commercial 4m Beam Trawl

17. A commercial beam trawl (Figure 4.3) with an 80mm mesh cod end was used for fish and shellfish sampling; the specifications of which are given in Table 4.3 below.

Figure 4.3 Beam Trawl Used

Table 4.3 Beam Trawl Specifications

Beam Trawl Specifications	
Beam width	4m
Headline height	60cm
Cod-end liner	80mm (double twinned on belly and cod end)
Ground gear	5cm rubber bobbins and chain mat

4.3 Positioning and Navigation

18. The position of the vessel was tracked at all times using a Garmin GPSMap 278 with an EGNOS differential connected to an external Garmin GA30 antenna. Trawl start times and positions were taken when the winch stopped paying out the gear. Similarly, trawl end times and positions were taken when hauling of the gear commenced.

4.4 Sampling Operations

19. The survey was undertaken from the 15th to the 27th May 2013. A summarised log of events is given in Table 4.4 below.

Table 4.4 Summarised Log of Events

Wednesday 15th May 2013
Depart Scarborough at 0600 hrs (BST)
Vessel in transit from Scarborough to Lowestoft
Thursday 16th May 2013
Arrive into Lowestoft at 0230 hrs (BST)
Load beam trawl and survey gear aboard
Friday 17th May 2013
Depart Lowestoft at 0200 hrs (BST)
Beam Trawls: BT04
Overnight at sea
Saturday 18th May 2013
Beam Trawls: BT01, BT02, BT03, BT06, BT05
Overnight at sea
Monday 20th May 2013
Beam Trawls: BT08, BT07
Overnight at sea
Tuesday 21st May 2013
Arrive into Lowestoft at 0720 hrs (BST)
Land beam trawl samples, unload beam trawl
Depart Lowestoft at 2020 hrs (BST) to commence otter trawl survey
Wednesday 22nd May 2013
Otter Trawls: OT01, OT02, OT03, OT04, OT05, OT06, OT09
Overnight at sea
Thursday 23rd May 2013
Otter Trawls: OT07, OT08
Overnight at sea
Sunday 26th May 2013
Arrive into Lowestoft at 1030 hrs (BST)
Land otter trawl samples
Vessel departs Lowestoft at 1130 hrs (BST)
Monday 27th May 2013

Vessel in transit from Lowestoft to Grimsby
Vessel arrives into Grimsby at 0930 hrs (BST)
Survey vessel demobilised

4.5 Otter Trawl Sampling

20. The whole catch from each otter trawl was retained. The samples were then boxed, labelled, photographed, iced and stored at +2°C before transportation to Cefas (Lowestoft) for analysis at the end of the survey, in line with the agreed scope of works.

21. The start and end times, co-ordinates and the duration of each otter trawl are given in Table 4.5 (control and East Anglia THREE tows highlighted green and red respectively). The vessel tracks whilst towing the otter trawl are illustrated in Figure 4.4 overleaf.

Table 4.5 Start and End Times, Co-ordinates and Duration of each Otter Trawl

Station	Date	Start				End				Duration (mm:ss)
		Time (GMT)	UTM31N		Depth (m)	Time (GMT)	UTM31N		Depth (m)	
			Easting	Northing			Easting	Northing		
OT01	22/05/2013	07:14:07	486,263.4	5,813,235.2	39.6	07:34:13	486,120.9	5,814,384.1	40.7	20:06
OT02		09:36:01	487,703.2	5,819,326.4	44.2	09:56:03	487,609.9	5,820,714.7	42.2	20:02
OT03		10:57:26	486,135.0	5,827,048.2	44.0	11:17:30	486,146.4	5,828,806.0	45.3	20:04
OT04		12:05:35	489,508.5	5,830,236.2	46.9	12:26:02	489,865.0	5,832,156.9	44.9	20:27
OT05		13:47:39	481,411.1	5,832,537.2	43.6	14:07:40	481,788.0	5,834,270.4	37.6	20:01
OT06		15:01:27	486,790.3	5,834,321.7	42.7	15:21:31	486,888.5	5,835,717.1	44.5	20:04
OT07	23/05/2013	07:27:12	502,533.6	5,836,319.9	36.5	07:47:18	502,830.3	5,837,096.6	36.5	20:06
OT08		09:24:06	497,742.2	5,838,635.2	39.4	09:44:08	497,667.5	5,839,694.3	37.8	20:02
OT09	22/05/2013	16:26:58	489,761.8	5,842,044.5	37.2	16:47:05	489,980.3	5,843,104.4	33.4	20:07

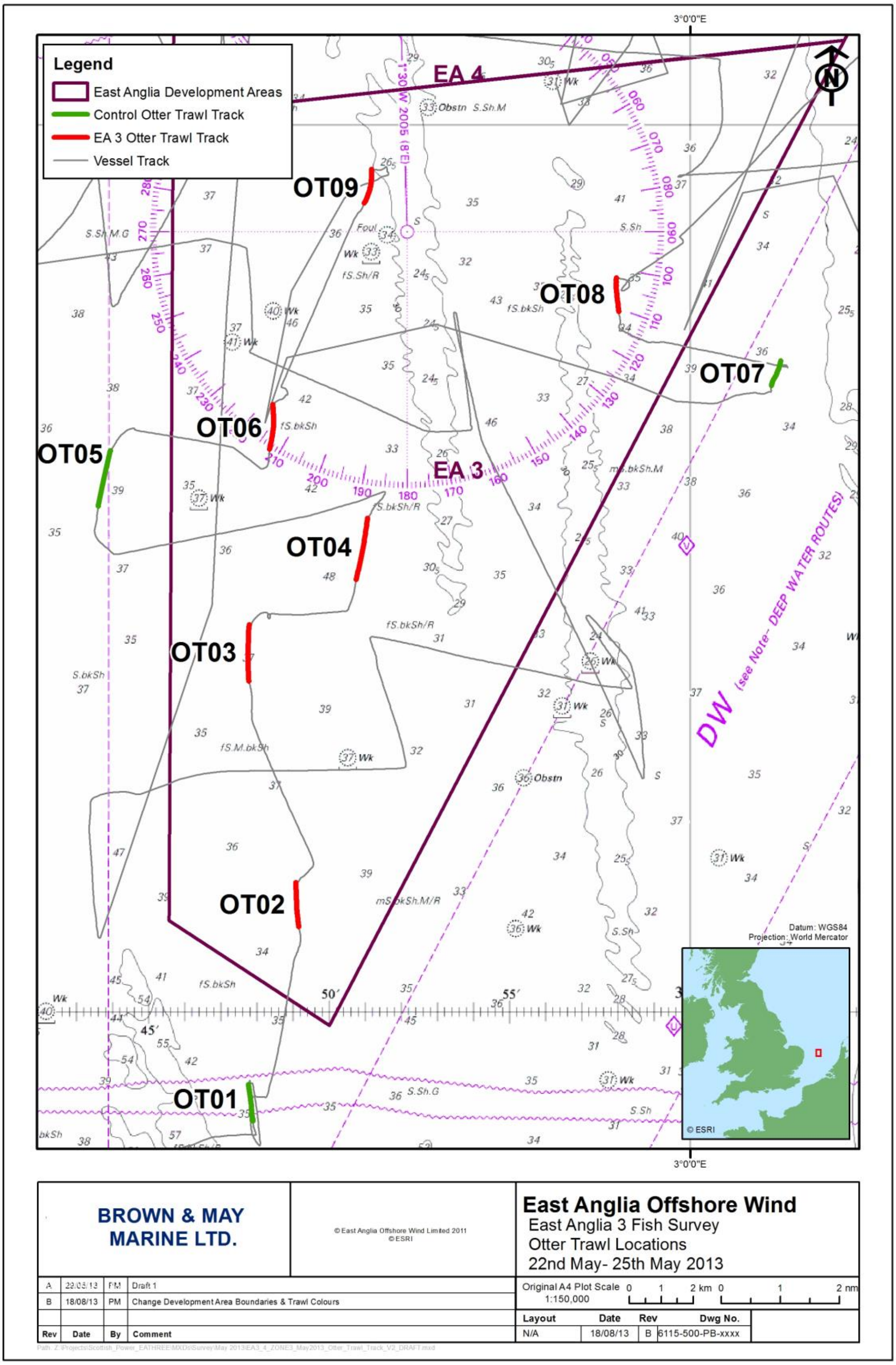


Figure 4.4 Vessel Tracks whilst Towing the Otter Trawl

4.6 Beam Trawl Sampling

22. The whole catch from each beam trawl was retained. The samples were then boxed, labelled, photographed, iced and stored at +2°C before transportation to Cefas (Lowestoft) for analysis at the end of the survey, in line with the agreed scope of works.

23. The start and end times, co-ordinates and the duration of each beam trawl are given in Table 4.6 (control and East Anglia THREE tows highlighted green and red respectively). The vessel tracks whilst towing the beam trawl are illustrated in Figure 4.5.

Table 4.6 Start and End Times, Co-ordinates and Duration of each Beam Trawl

Station	Date	Start				End				Duration (mm:ss)
		Time (GMT)	UTM31N		Depth (m)	Time (GMT)	UTM31N		Depth (m)	
			Easting	Northing			Easting	Northing		
BT01	18/05/2013	07:54:42	481,349.0	5,819,551.7	48.6	08:14:43	481,129.0	5,822,428.9	48.0	20:01
BT02		09:27:35	490,971.4	5,824,880.6	37.2	09:47:34	490,191.4	5,827,394.3	44.7	19:59
BT03		11:38:36	498,297.9	5,826,798.9	37.6	11:58:36	498,499.9	5,824,755.6	38.3	20:00
BT04	17/05/2013	11:24:27	481,406.4	5,842,896.5	43.8	11:44:27	481,735.1	5,839,951.8	44.2	20:00
BT05	18/05/2013	15:42:45	486,242.4	5,838,087.9	42.5	16:02:45	486,152.6	5,839,934.7	43.8	20:00
BT06		14:00:16	492,727.3	5,838,118.9	34.5	14:20:17	493,013.5	5,835,932.0	38.0	20:01
BT07	20/05/2013	08:55:20	500,298.7	5,843,254.3	39.8	09:15:20	500,976.3	5,845,485.2	38.1	20:00
BT08		07:42:20	505,798.6	5,840,595.2	34.3	08:02:20	505,689.5	5,842,827.3	31.9	20:00

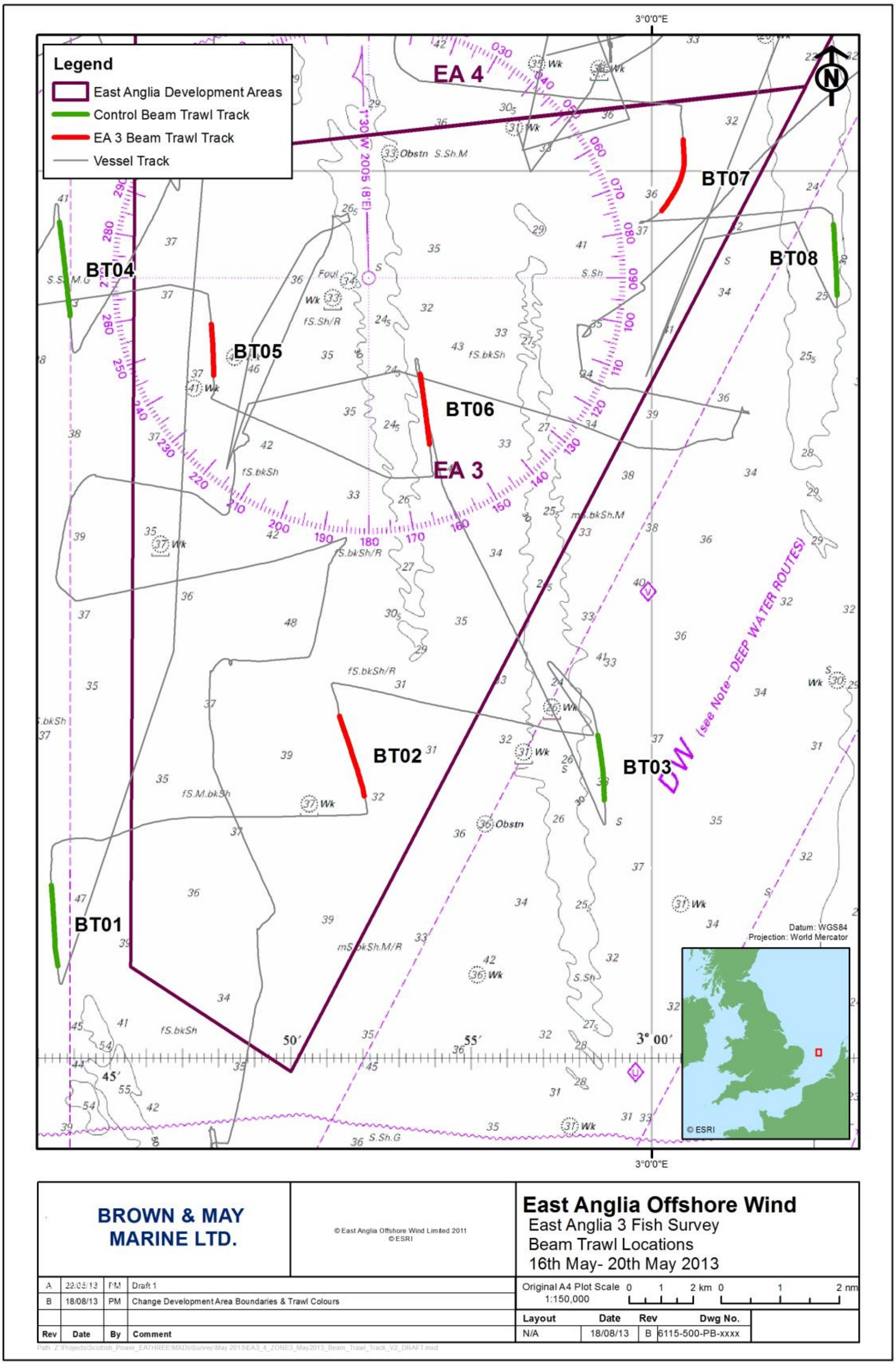


Figure 4.5 Vessel Tracks whilst Towing the Beam Trawl

4.7 Scientific 2-metre Beam Trawl Sampling

24. The start and end times, co-ordinates and the duration of each 2-metre scientific beam trawl are given in Table 4.7 (export cable and East Anglia THREE tows highlighted blue and red respectively). The start and end points of each 2-metre scientific beam trawl tow are illustrated in Figure 4.6 and Figure 4.7 for the export cable and East Anglia THREE respectively.

Table 4.7 Start and End Times, Co-ordinates and Duration of each 2-metre Scientific Beam Trawl

Station	Date	Start				End				Duration (hh:mm)
		Time (GMT)	UTM31N		Depth (m)	Time (GMT)	UTM31N		Depth (m)	
			Easting	Northing			Easting	Northing		
T1	06/05/2013	19:14	447327	5794118	45.3	19:28	447636	5794499	49.9	00:14
T2	03/05/2013	11:31	466510	5803073	44.5	11:49	466403	5802553	42.7	00:18
T4	06/05/2013	11:08	482069	5801344	45.7	11:24	481969	5800803	44.9	00:16
T5	05/05/2013	21:51	482930	5828944	41.5	22:02	482858	5828502	42.5	00:11
T6	06/05/2013	09:07	486956	5812571	40.2	09:15	487020	5813084	38.5	00:08
T7	08/05/2013	00:13	421359	5778923	29.3	00:24	420957	5778623	31.8	00:11
T11	01/05/2013	22:48	494424	5833705	37.4	23:04	494649	5834151	37.3	00:16
T12		08:08	497024	5840979	33.4	08:14	497140	5841459	38.3	00:06
T13	06/05/2013	07:41	488145	5822430	43.3	07:53	488234	5822880	44.3	00:12

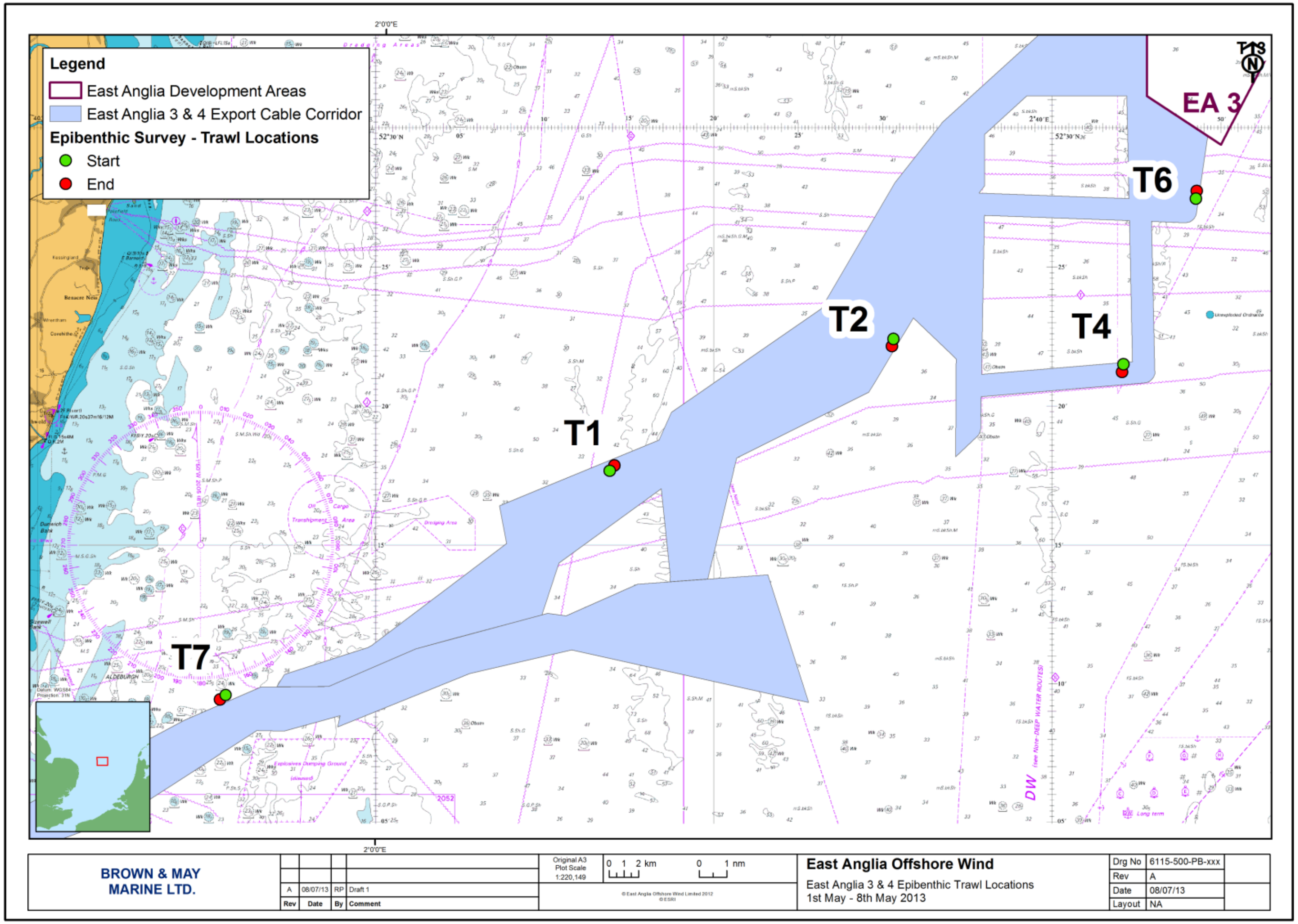


Figure 4.6 Start and End Points of each 2-metre Scientific Beam Trawl Tow along the Export Cable

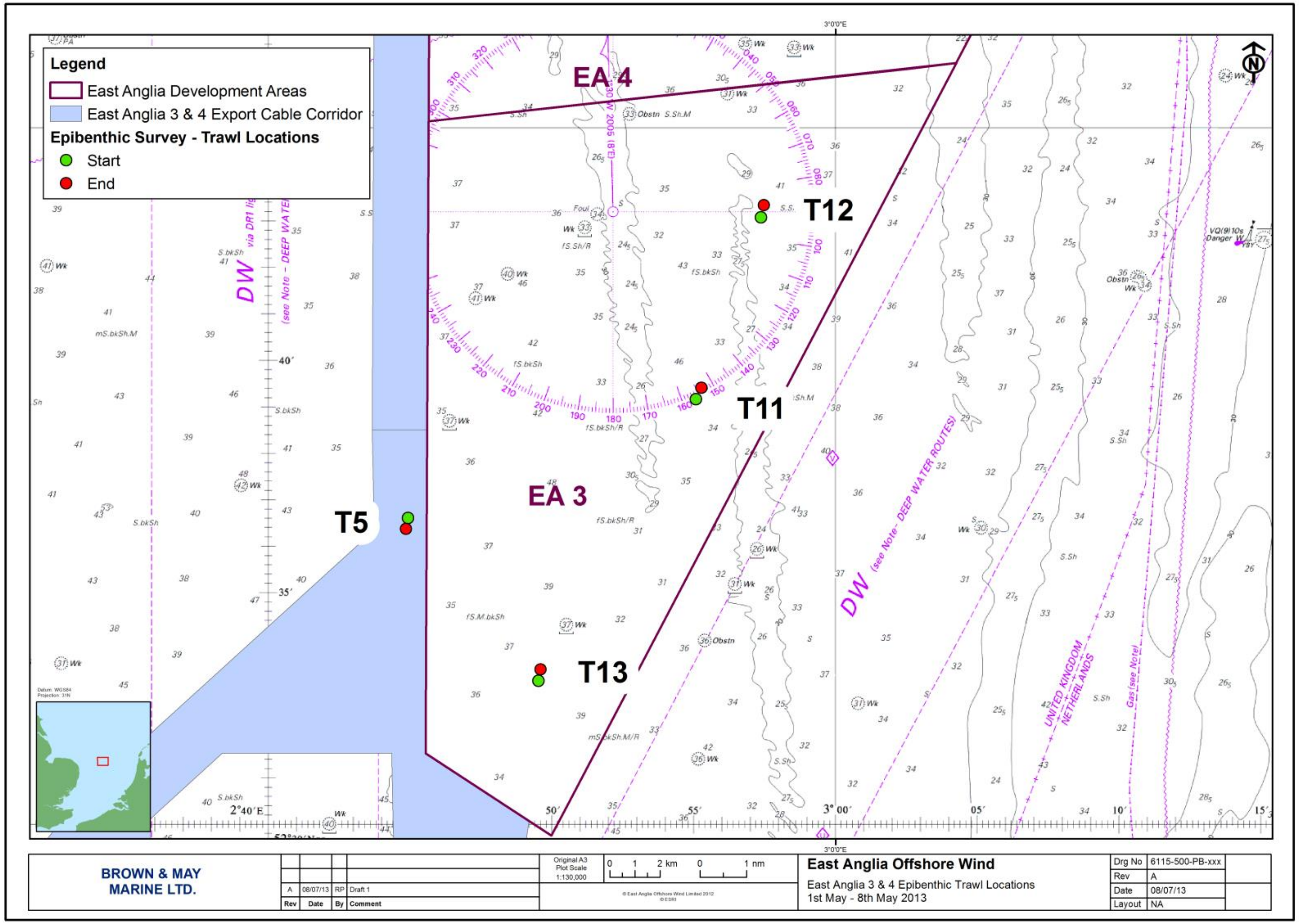


Figure 4.7 Start and End Points of each 2-metre Scientific Beam Trawl Tow within East Anglia THREE

5.0 Otter Trawl Results

5.1 Catch Rates and Species Distribution

25. The total number of individuals caught and the catch rate (number of individuals caught per hour) for fish and shellfish species by sampling area (control and East Anglia THREE) are given in Table 5.1 and are illustrated in Figure 5.1. The catch rates by sampling station are illustrated in Figure 5.2.

26. Spatial distribution plots for the most abundant species are given in Figure 5.3 to Figure 5.5, showing the percentage distribution by catch rate of *M. merlangus*, *P. platessa* and *L. limanda*. The circle size corresponds to the catch rate i.e. larger circles indicate greater catch rates.

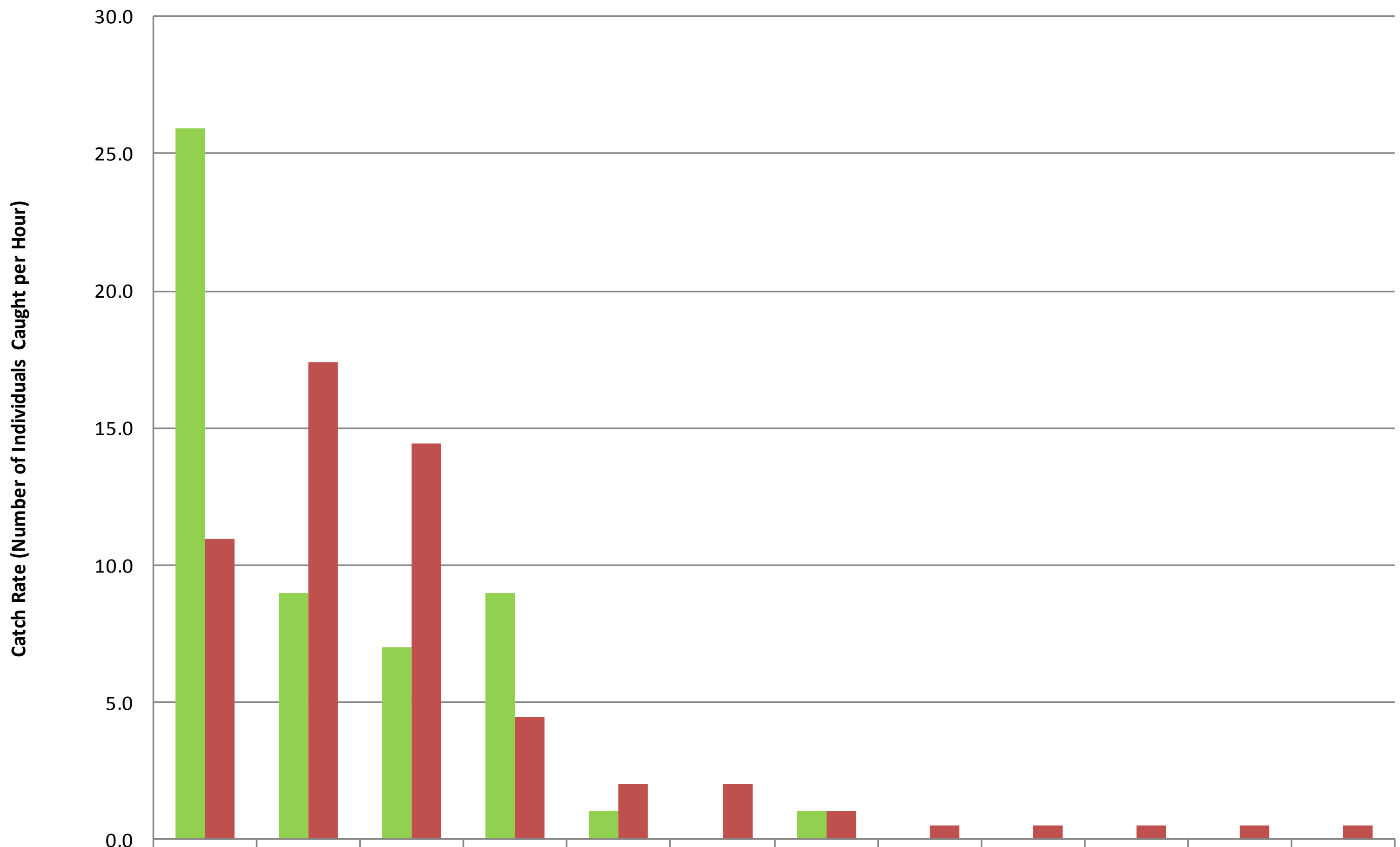
27. A total of 12 species were caught; six at the control stations and 12 within East Anglia THREE. Overall, *M. merlangus* was the most abundant species caught, followed by *P. platessa, L. limanda* and then *S. canicula*. All other species were caught in relatively low numbers.

28. The highest catch rate for all species combined was recorded at station OT08 (95.8/hr) within East Anglia THREE, with *P.* platessa and *L. limanda* accounting for 75.0% of the catch.

29. The total catch rate was approximately equal in both sampling areas.

Table 5.1 Total Numbers of Individuals Caught and Catch Rate for Fish Species by Sampling Area

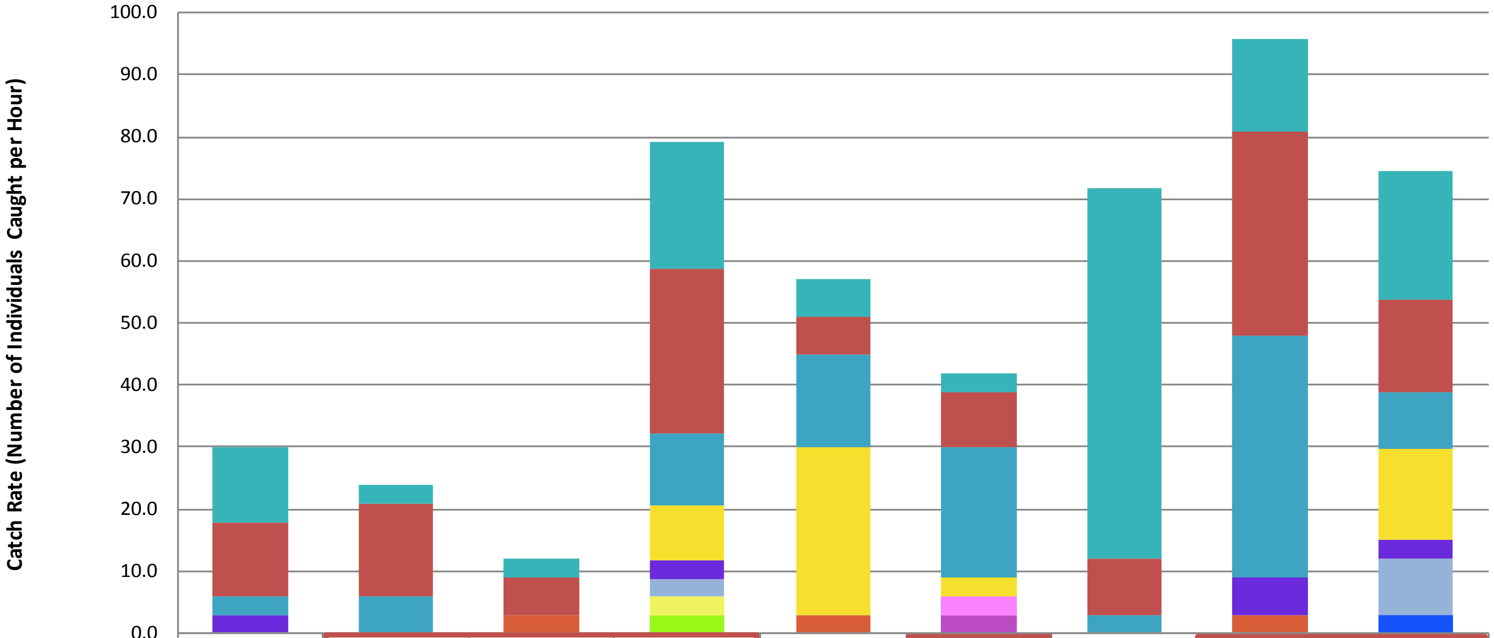
Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	**Scientific Name**	**Control**	**East Anglia THREE**	**Total**	**Control**	**East Anglia THREE**
Whiting	*Merlangius merlangus*	26	22	48	25.9	10.9
Plaice	*Pleuronectes platessa*	9	35	44	9.0	17.4
Dab	*Limanda limanda*	7	29	36	7.0	14.4
Lesser Spotted Dogfish	*Scyliorhinus canicula*	9	9	18	9.0	4.5
Grey Gurnard	*Eutrigla gurnardus*	1	4	5	1.0	2.0
Bullrout	*Myoxocephalus scorpius*	0	4	4	0.0	2.0
Lesser Weever	*Echiichthys vipera*	1	2	3	1.0	1.0
Common Dragonet	*Callionymus lyra*	0	1	1	0.0	0.5
Horse Mackerel	*Trachurus trachurus*	0	1	1	0.0	0.5
Lemon Sole	*Microstomus kitt*	0	1	1	0.0	0.5
Sprat	*Sprattus sprattus*	0	1	1	0.0	0.5
Squid	*Alloteuthis sp.*	0	1	1	0.0	0.5
Total No. of Individuals		53	110			
Total No. of Species		6	12			
Catch Rate (No. of Individuals Caught per Hour)		52.8	54.7			



	Whiting	Plaice	Dab	Lesser Spotted Dogfish	Grey Gurnard	Bull Rout	Lesser Weever	Common Dragonet	Horse Mackerel	Lemon Sole	Sprat	Squid
Control	25.9	9.0	7.0	9.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
East Anglia THREE	10.9	17.4	14.4	4.5	2.0	2.0	1.0	0.5	0.5	0.5	0.5	0.5

Species

Figure 5.1 Catch Rate by Species and Sampling Area



	OT01	OT02	OT03	OT04	OT05	OT06	OT07	OT08	OT09
Whiting	11.9	3.0	3.0	20.5	6.0	3.0	59.7	15.0	20.9
Plaice	11.9	15.0	6.0	26.4	6.0	9.0	9.0	32.9	14.9
Dab	3.0	6.0	0.0	11.7	15.0	20.9	3.0	38.9	8.9
Lesser Spotted Dogfish	0.0	0.0	0.0	8.8	27.0	3.0	0.0	0.0	14.9
Grey Gurnard	3.0	0.0	0.0	2.9	0.0	0.0	0.0	6.0	3.0
Bull Rout	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	8.9
Lesser Weever	0.0	0.0	3.0	0.0	3.0	0.0	0.0	3.0	0.0
Common Dragonet	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
Horse Mackerel	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
Lemon Sole	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
Sprat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
Squid	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0

Station

Figure 5.2 Catch Rate by Species and Station (red boxes denote stations within East Anglia THREE)

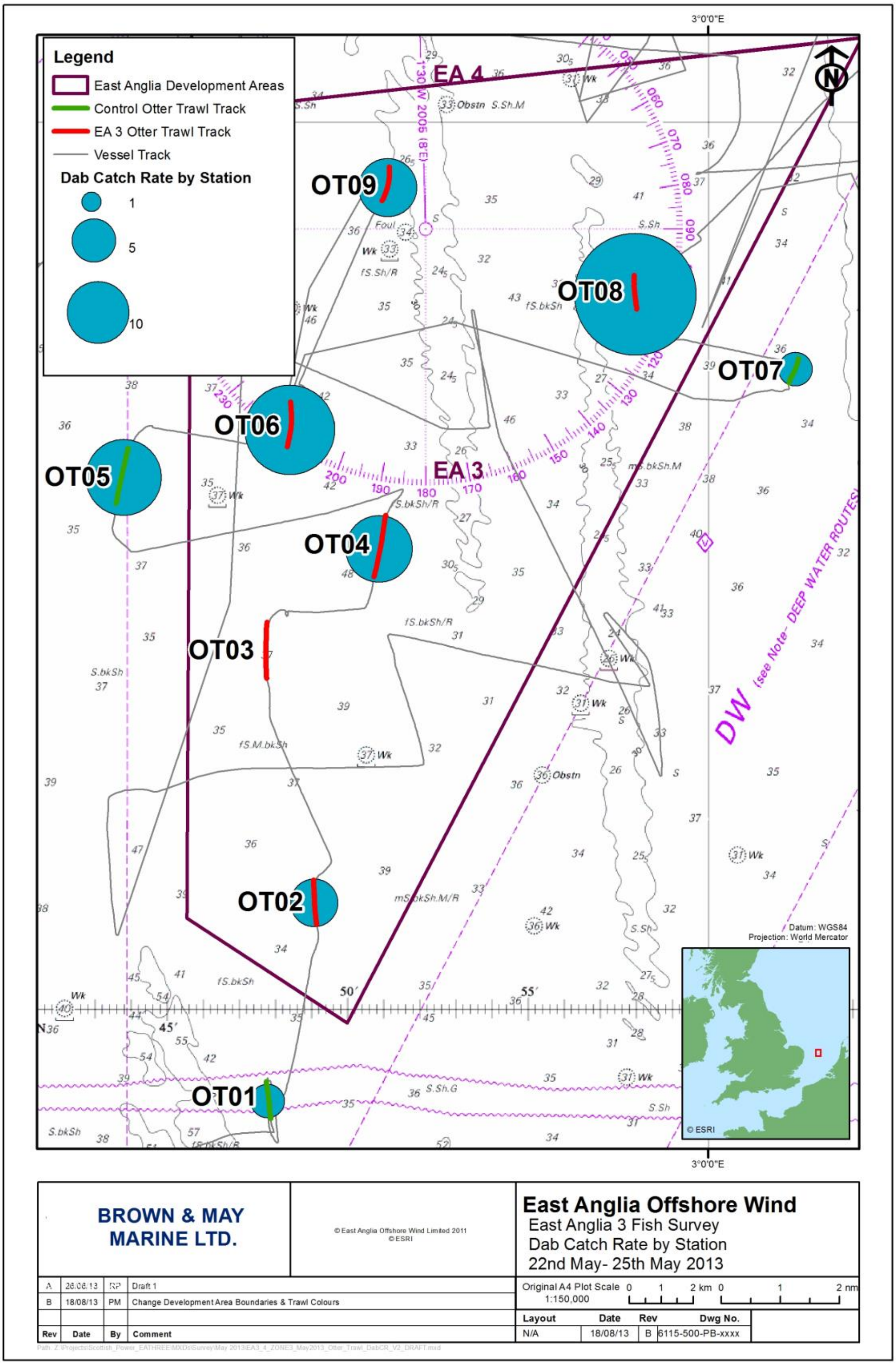


Figure 5.3 Spatial Distribution of Dab (*L. limanda*) in the Area of East Anglia THREE

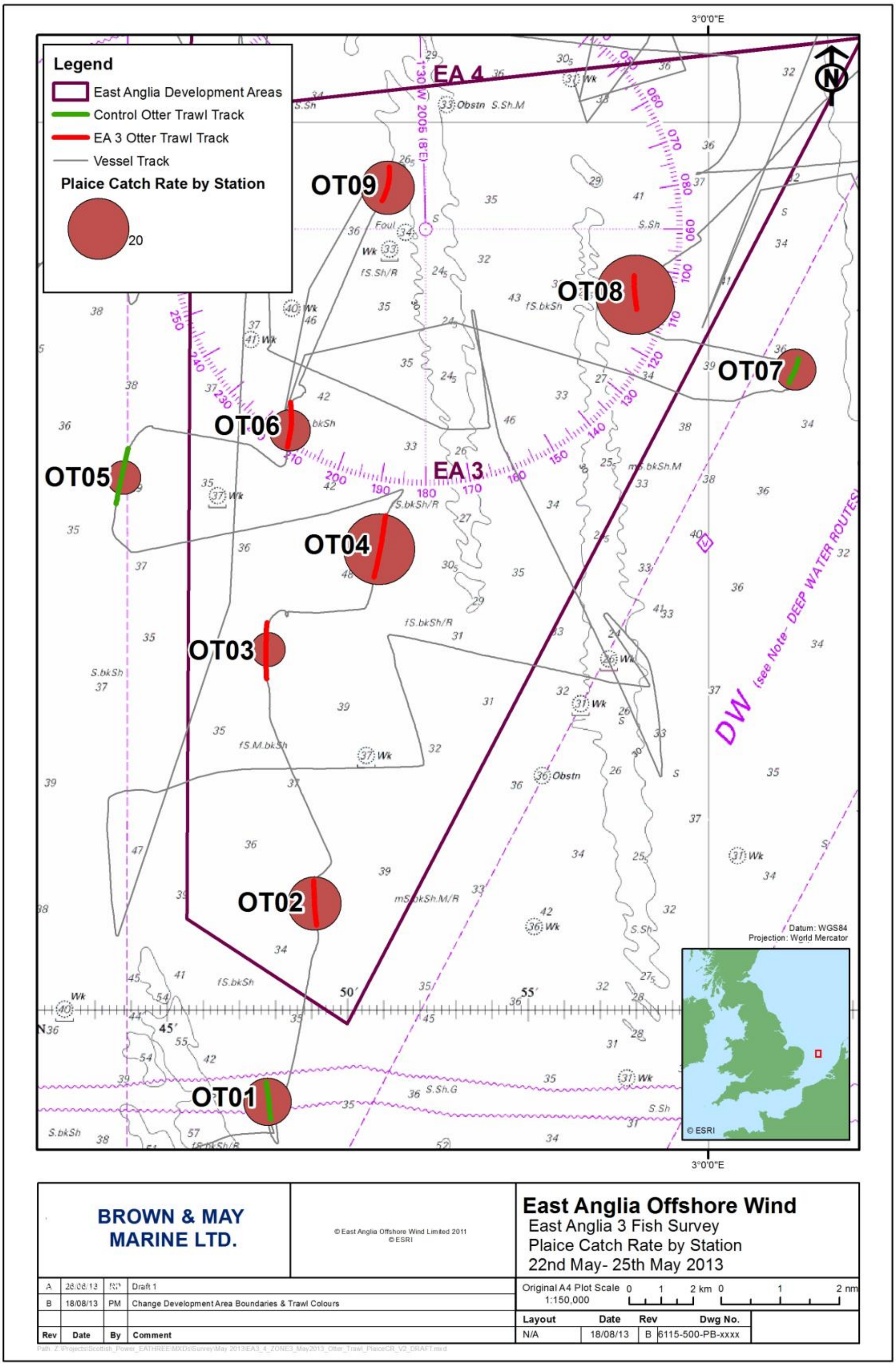


Figure 5.4 Spatial Distribution of Plaice (*P. platessa*) in the Area of East Anglia THREE

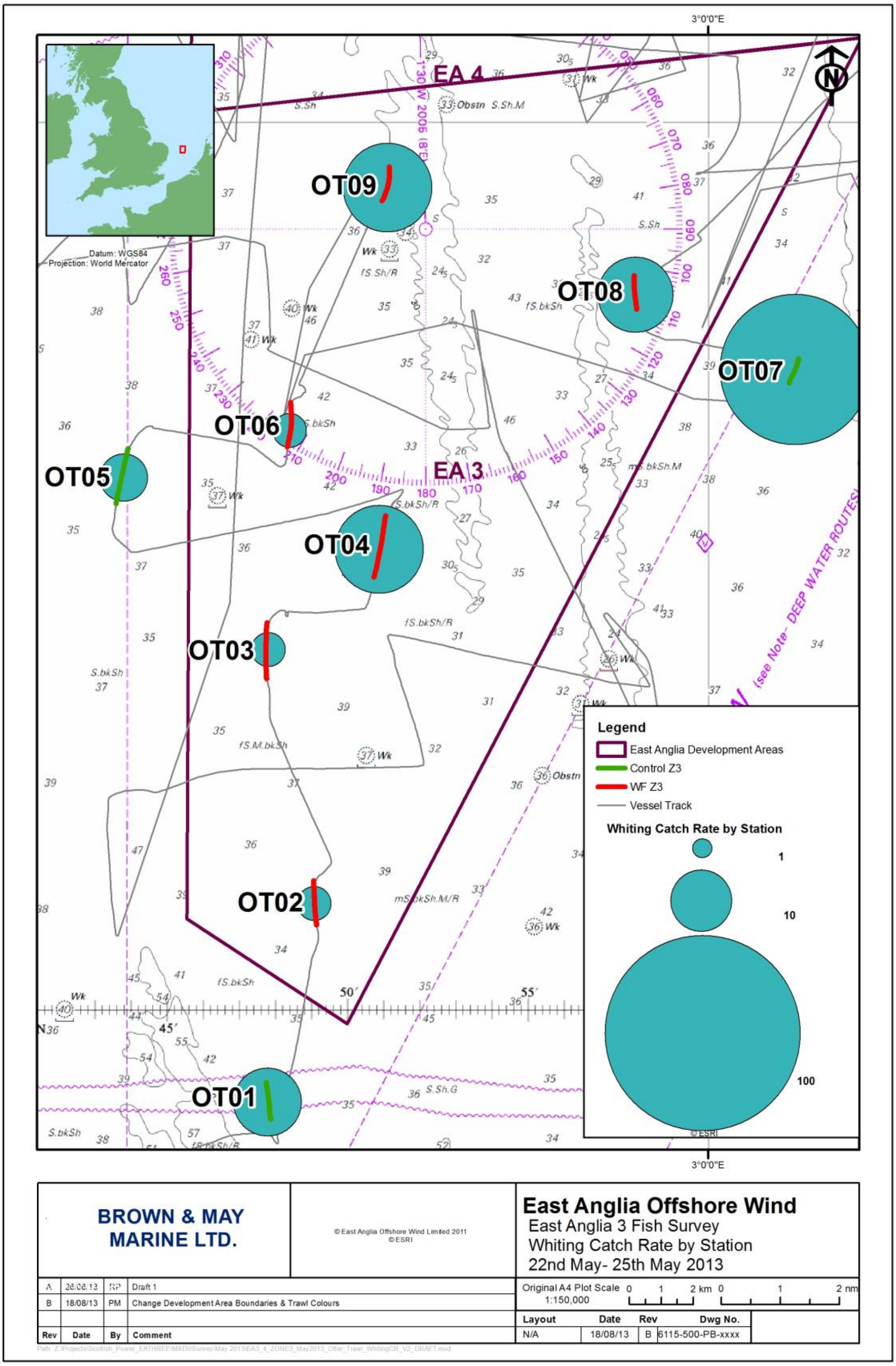


Figure 5.5 Spatial Distribution of Whiting (*M. merlangus*) in the Area of East Anglia THREE

5.2 Length Distributions

30. The length distributions of the three most abundant species caught during the survey, expressed as the catch rate (number of individuals caught per hour) by length (cm) and by sampling area (control and East Anglia THREE), are shown in Figure 5.6 to Figure 5.8.

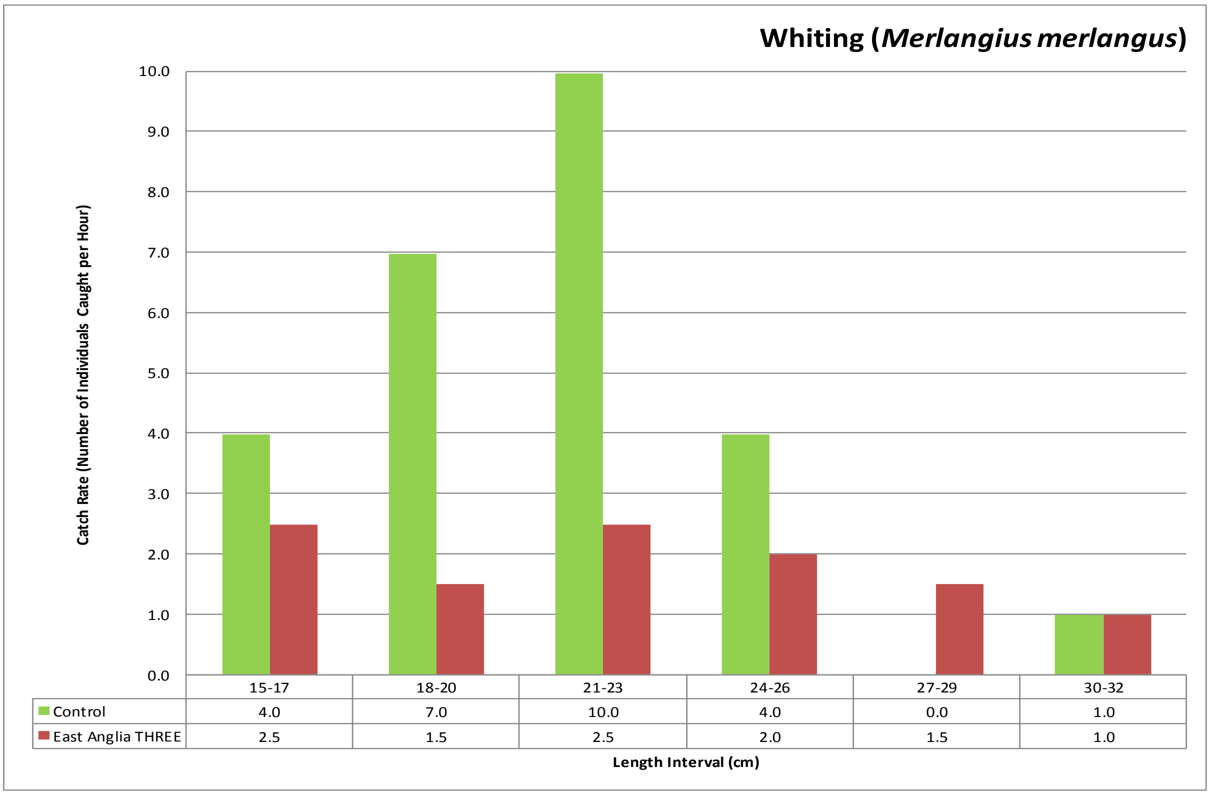
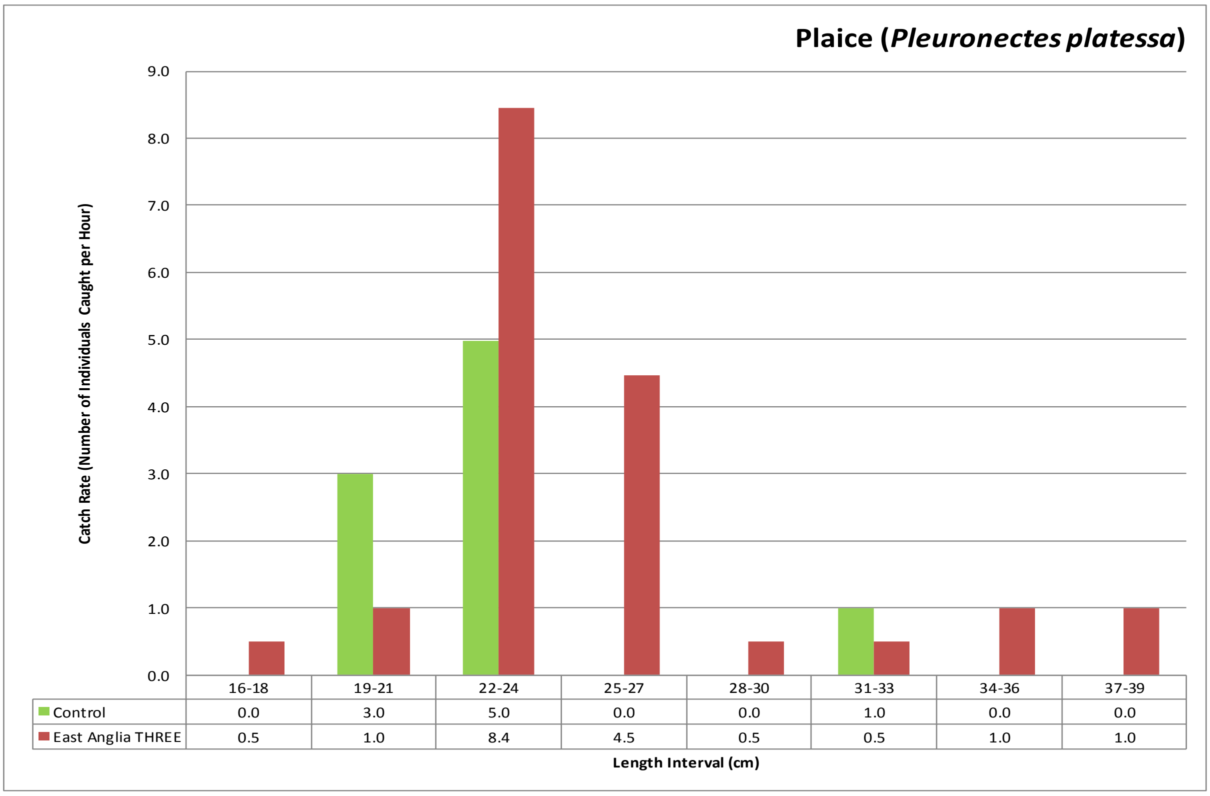
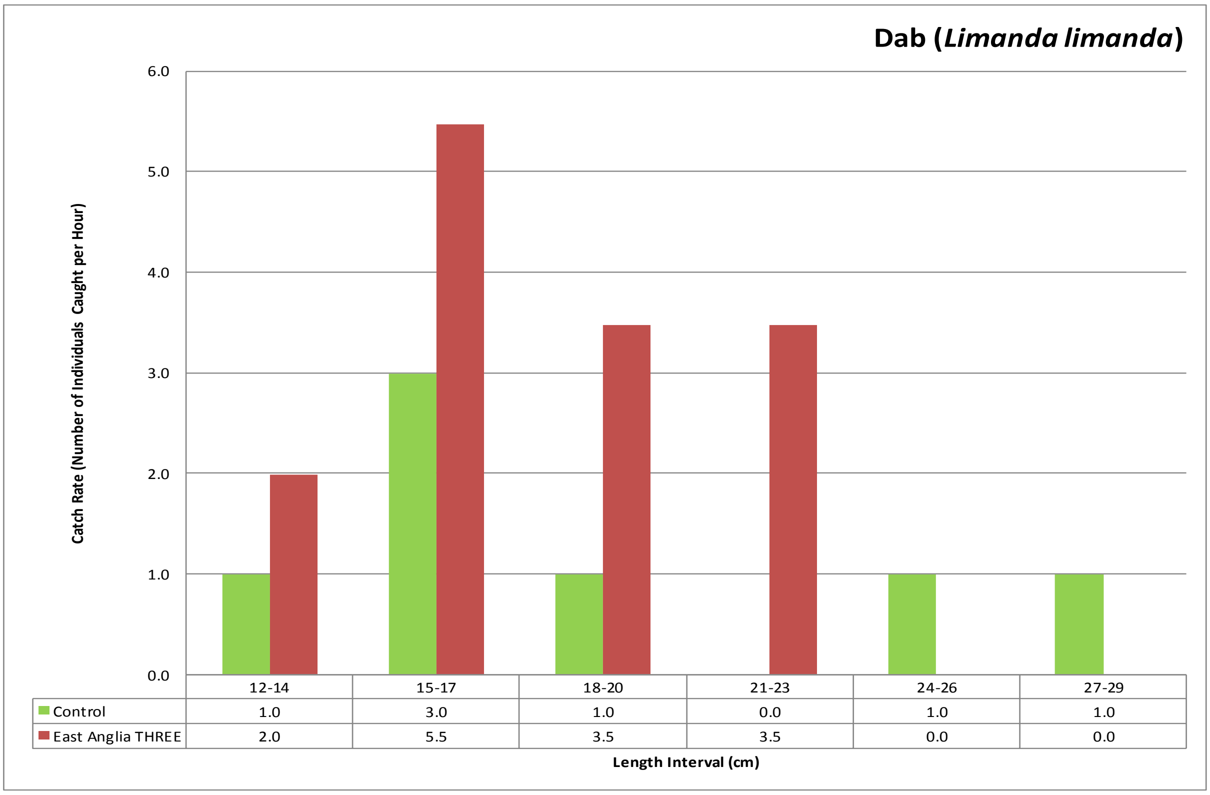


Figure 5.6 Whiting (*M. merlangus*) Length Distribution by Sampling Area



	16-18	19-21	22-24	25-27	28-30	31-33	34-36	37-39
Control	0.0	3.0	5.0	0.0	0.0	1.0	0.0	0.0
East Anglia THREE	0.5	1.0	8.4	4.5	0.5	0.5	1.0	1.0

Figure 5.7 Plaice (*P. platessa*) Length Distribution by Sampling Area



	12-14	15-17	18-20	21-23	24-26	27-29
Control	1.0	3.0	1.0	0.0	1.0	1.0
East Anglia THREE	2.0	5.5	3.5	3.5	0.0	0.0

Figure 5.8 Dab (*L. limanda*) Length Distribution by Sampling Area

5.3 Minimum Landing Sizes

31. Minimum landing sizes (MLS) for fish and shellfish species are set by the EC under Regulation No. 850/98 (Annex XII).

32. Table 5.2 shows the three species of fish caught for which a MLS has been set, and denotes their presence or absence by sampling area (control and East Anglia THREE).

Table 5.2 MLS Set by EC

Species		EC MLS (cm)	Presence	
Common Name	Scientific Name		Control	East Anglia THREE
Horse Mackerel	*Trachurus trachurus*	15	–	✓
Plaice	*Pleuronectes platessa*	27	✓	✓
Whiting	*Merlangius merlangus*	27	✓	✓

33. The percentage of individuals caught above and below their set MLS by species is shown in Figure 5.9 and Figure 5.10 for control and East Anglia THREE stations respectively.

34. Most of the *P. platessa* (control, 88.9%, East Anglia THREE, 77.1%) and *M. merlangus* (96.2% and 77.3%) caught in both sampling areas were below the MLS. One *T. trachurus* was caught within East Anglia THREE and was above the MLS.

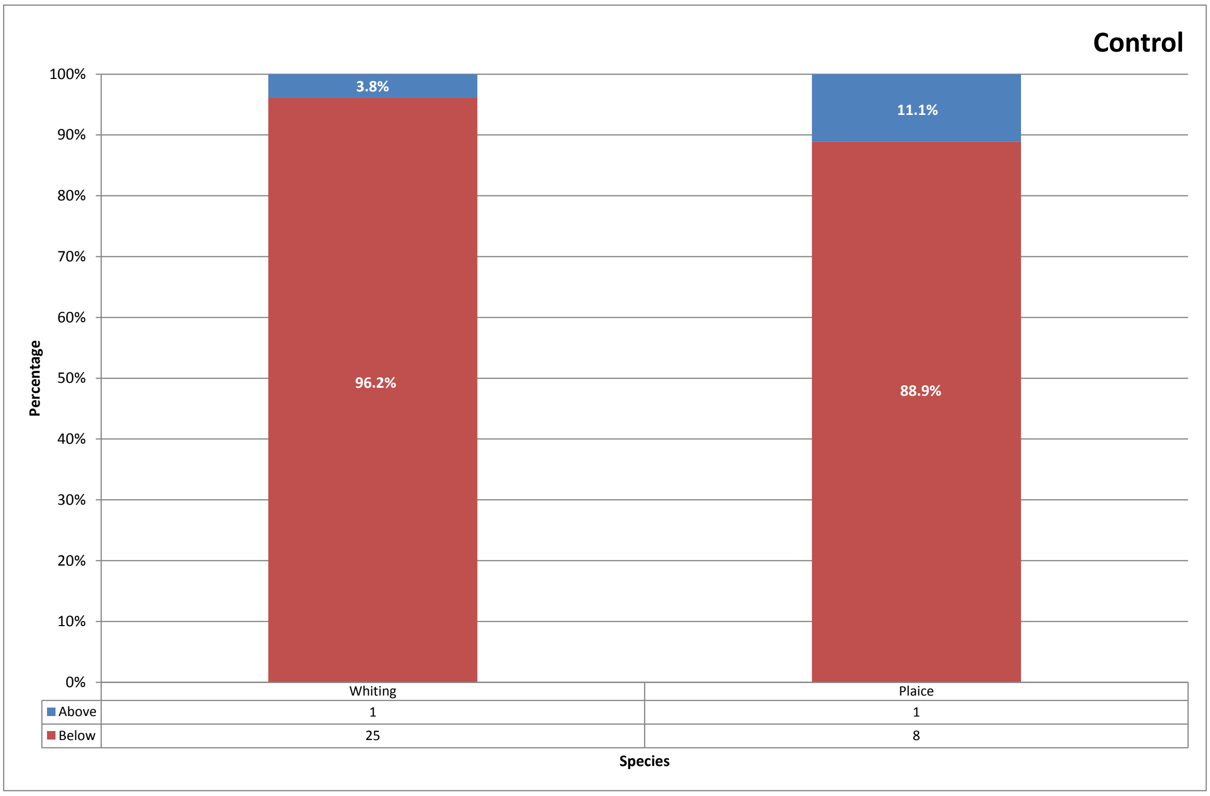


Figure 5.9 Percentage of the Catch Above and Below the MLS by Species at the Control Stations

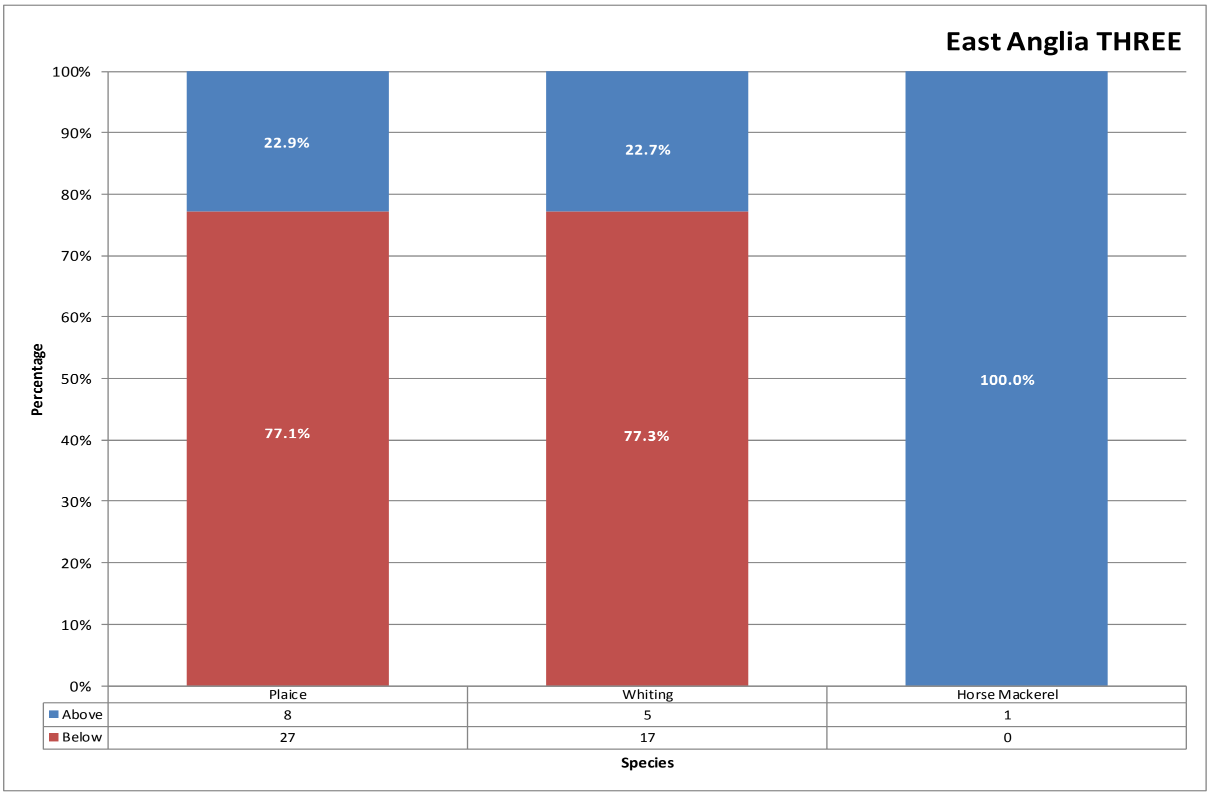


Figure 5.10 Percentage of the Catch Above and Below the MLS by Species within East Anglia THREE

5.4 Sex Ratios

35. The sex ratios of the three most abundant species caught during the survey are shown in Figure 5.11 and Figure 5.12 for control and East Anglia THREE stations respectively.

36. At the control stations the sex ratio of the *M. merlangus* and *L. limanda* caught was approximately equal, whereas most of the *P. platessa* found in this sampling area were male (88.9%). The majority of the *P. platessa* (80.0%) and *L. limanda* (93.1%) caught within East Anglia THREE were male, whereas the highest proportion of the *M. merlangus* caught were female (63.6%).

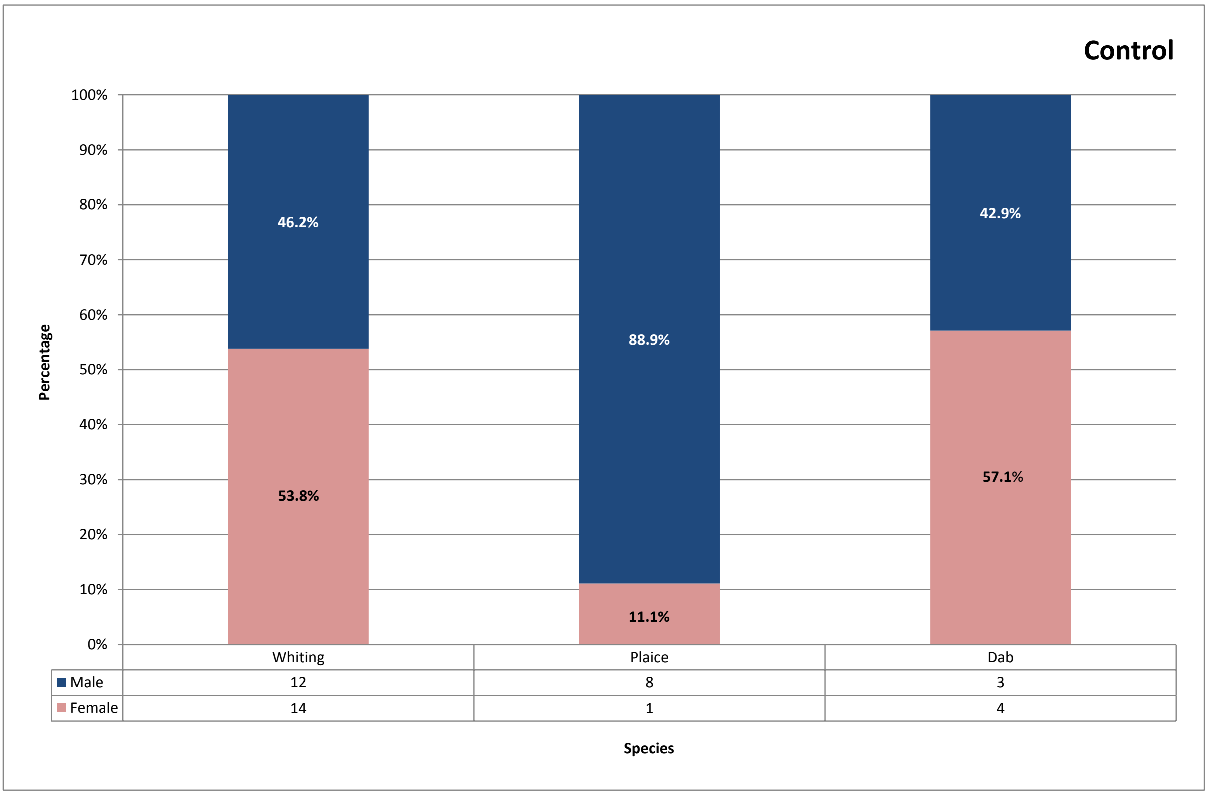


Figure 5.11 Sex Ratio by Species at the Control Stations

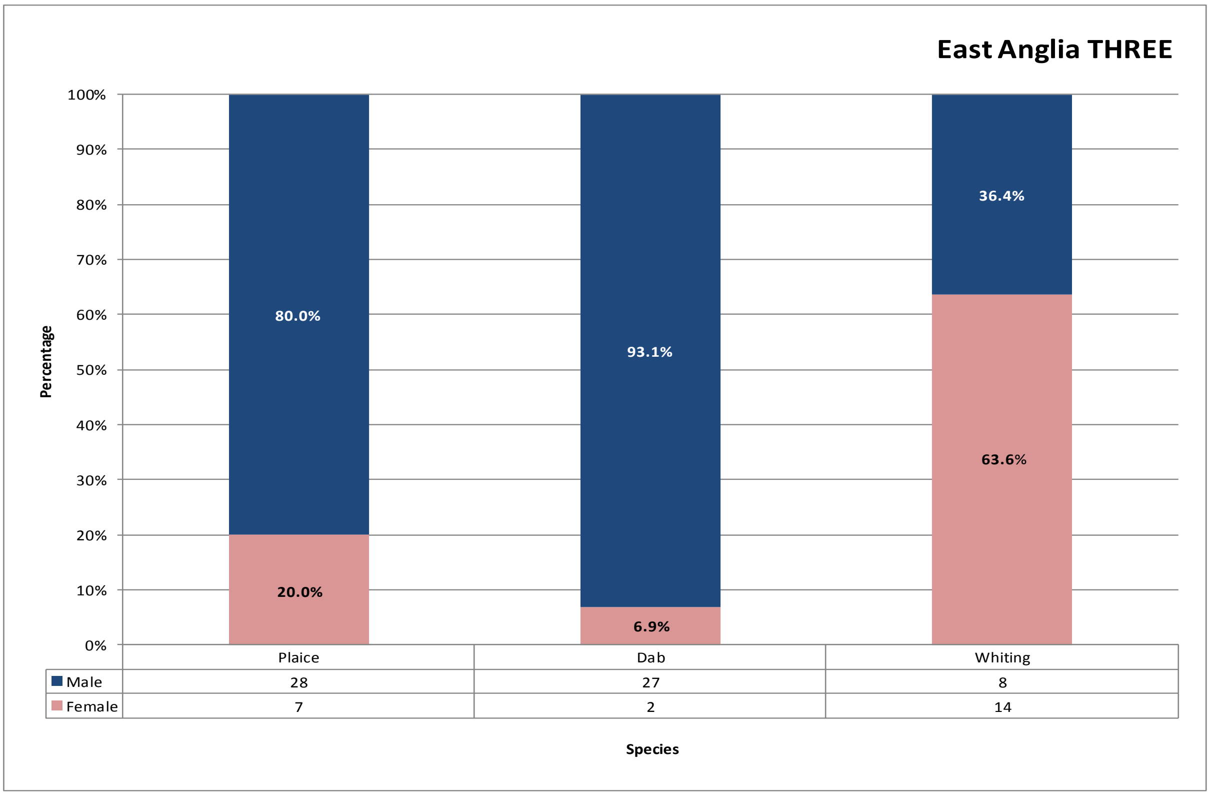


Figure 5.12 Sex Ratio by Species within East Anglia THREE

5.5 Spawning Condition

37. The spawning condition, sex and length range (nearest cm below) for the three most abundant species caught during the survey are given below in Table 5.3 to Table 5.5.

38. The highest proportion of the *M. merlangus* caught at the control stations and within East Anglia THREE were running females (control 30.8% and East Anglia THREE 54.5%) and maturing males (23.1% and 36.4%). At the control stations the highest proportion of the *P. platessa* caught were immature (44.4%) and running (33.3%) males, whereas within East Anglia THREE most of which were maturing males (65.7%). The highest proportion of the *L. limanda* caught at the control stations were immature males (42.9%) whereas within East Anglia THREE most individuals were identified as maturing males (65.5%).

Table 5.3 Whiting (*M. merlangus*) Spawning Condition

Whiting							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	3	1	4	8.3%	15	24
	Maturing	3	1	4	8.3%	20	23

	Running	8	12	20	41.7%	18	31
Male	Immature	3	0	3	6.3%	17	18
	Maturing	6	8	14	29.2%	16	26
	Spent	3	0	3	6.3%	19	25

Table 5.4 Plaice (*P. platessa*) Spawning Condition

Plaice							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	0	1	1	2.3%	24	24
	Maturing	0	1	1	2.3%	25	25
	Running	1	2	3	6.8%	22	33
	Spent	0	3	3	6.8%	34	38
Male	Immature	4	0	4	9.1%	20	22
	Maturing	0	23	23	52.3%	16	28
	Running	3	1	4	9.1%	21	24
	Spent	1	4	5	11.4%	23	39

Table 5.5 Dab (*L. limanda*) Spawning Condition

Dab							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min.	Max.
Female	Immature	1	0	1	2.8%	18	18
	Maturing	1	1	2	5.6%	16	21
	Running	1	0	1	2.8%	26	26
	Spent	1	1	2	5.6%	19	27
Male	Immature	3	7	10	27.8%	12	16
	Maturing	0	19	19	52.8%	15	23
	Running	0	1	1	2.8%	20	20

6.0 Beam Trawl Results

6.1 Catch Rates and Species Distribution

39. The total number of individuals caught and the catch rate (number of individuals caught per hour) for fish and shellfish species by sampling area (control and East Anglia THREE) are given in Table 6.1 below and are illustrated in Figure 6.1. The catch rates by sampling station are shown in Figure 6.2.

40. Spatial distribution plots for *P. platessa* and *L. limanda* are given in Figure 6.3 and Figure 6.4. Spatial plots show the percentage distribution by catch rate of *P. platessa* and *L. limanda*. The circle size corresponds to the catch rate i.e. larger circles indicate greater catch rates.

41. A total of 18 species of fish and shellfish were caught, 13 of which were found at the control stations and 13 within East Anglia THREE. Overall, *P. platessa* was the most abundant species caught, followed by *L. limanda*.

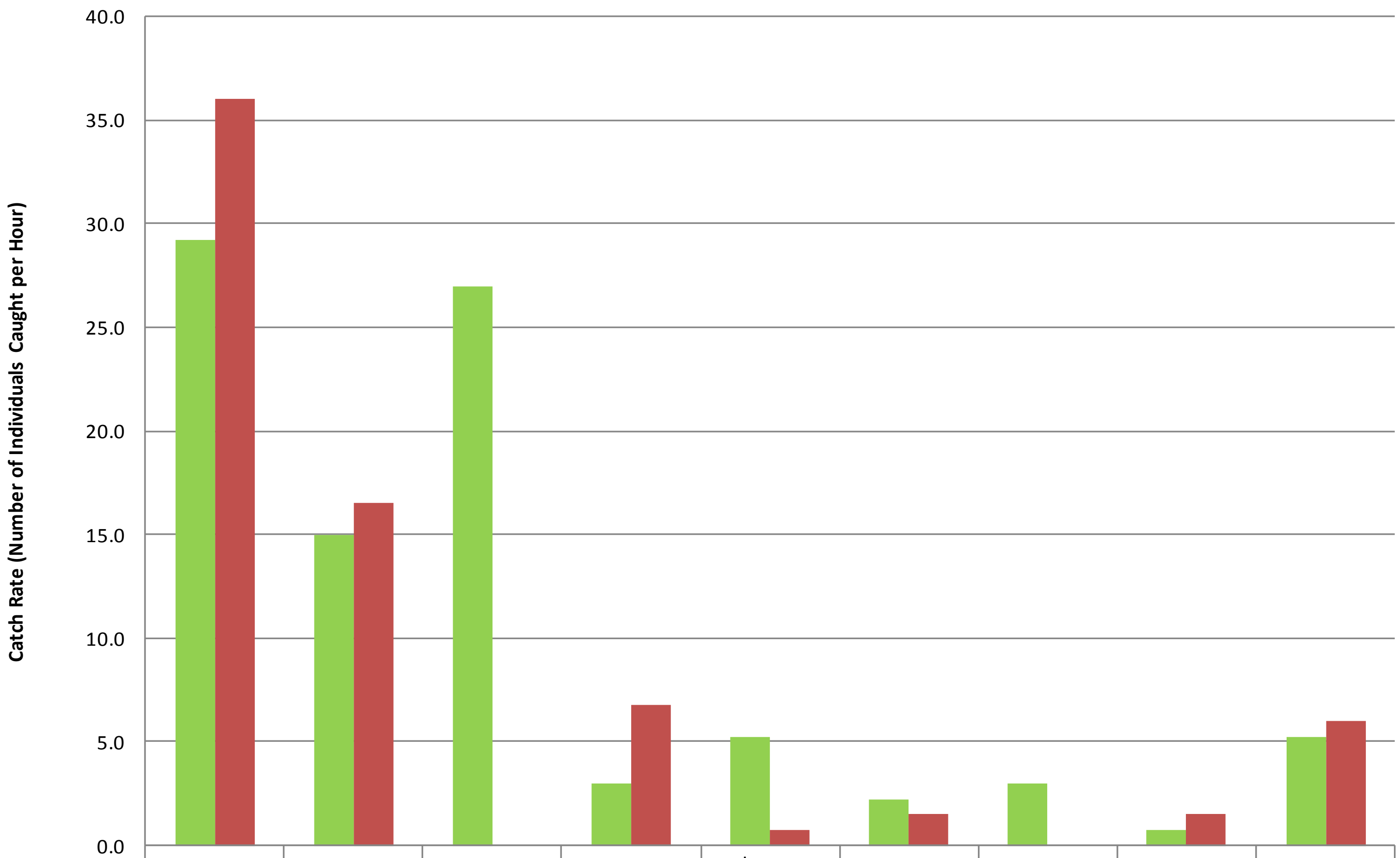
42. The station with the greatest total catch rate was control station BT01 (188.8/hr); this can be attributed to the high numbers of *B. undatum* caught, representing 57.1% of the catch. *P. platessa* represented the highest proportion of the catch at half of the sampling stations.

43. Overall, the total catch rate was higher at the control stations (90.7/hr) than within East Anglia THREE (69.0/hr).

Table 6.1 Number of Individuals Caught and the Catch Rate for Fish and Shellfish Species by Sampling Area

Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	Scientific Name	Control	East Anglia THREE	Total	Control	East Anglia THREE
Plaice	*Pleuronectes platessa*	39	48	87	29.2	36.0
Dab	*Limanda limanda*	20	22	42	15.0	16.5
Whelk	*Buccinum undatum*	36	0	36	27.0	0.0
Solenette	*Buglossidium luteum*	4	9	13	3.0	6.8
Lesser Spotted Dogfish	*Scyliorhinus canicula*	7	1	8	5.2	0.8
Common Dragonet	*Callionymus lyra*	3	2	5	2.2	1.5
Velvet Crab	*Necora puber*	4	0	4	3.0	0.0
Lesser Weever	*Echiichthys vipera*	1	2	3	0.7	1.5
Bullrout	*Myoxocephalus scorpius*	0	2	2	0.0	1.5
Dover Sole	*Solea solea*	1	1	2	0.7	0.8
Grey Gurnard	*Eutrigla gurnardus*	2	0	2	1.5	0.0
Pogge	*Agonus cataphractus*	1	1	2	0.7	0.8
Scaldfish	*Arnoglossus laterna*	2	0	2	1.5	0.0
John Dory	*Zeus faber*	0	1	1	0.0	0.8
Mackerel	*Scomber scombrus*	0	1	1	0.0	0.8
Sea Scorpion	*Taurulus bubalis*	0	1	1	0.0	0.8

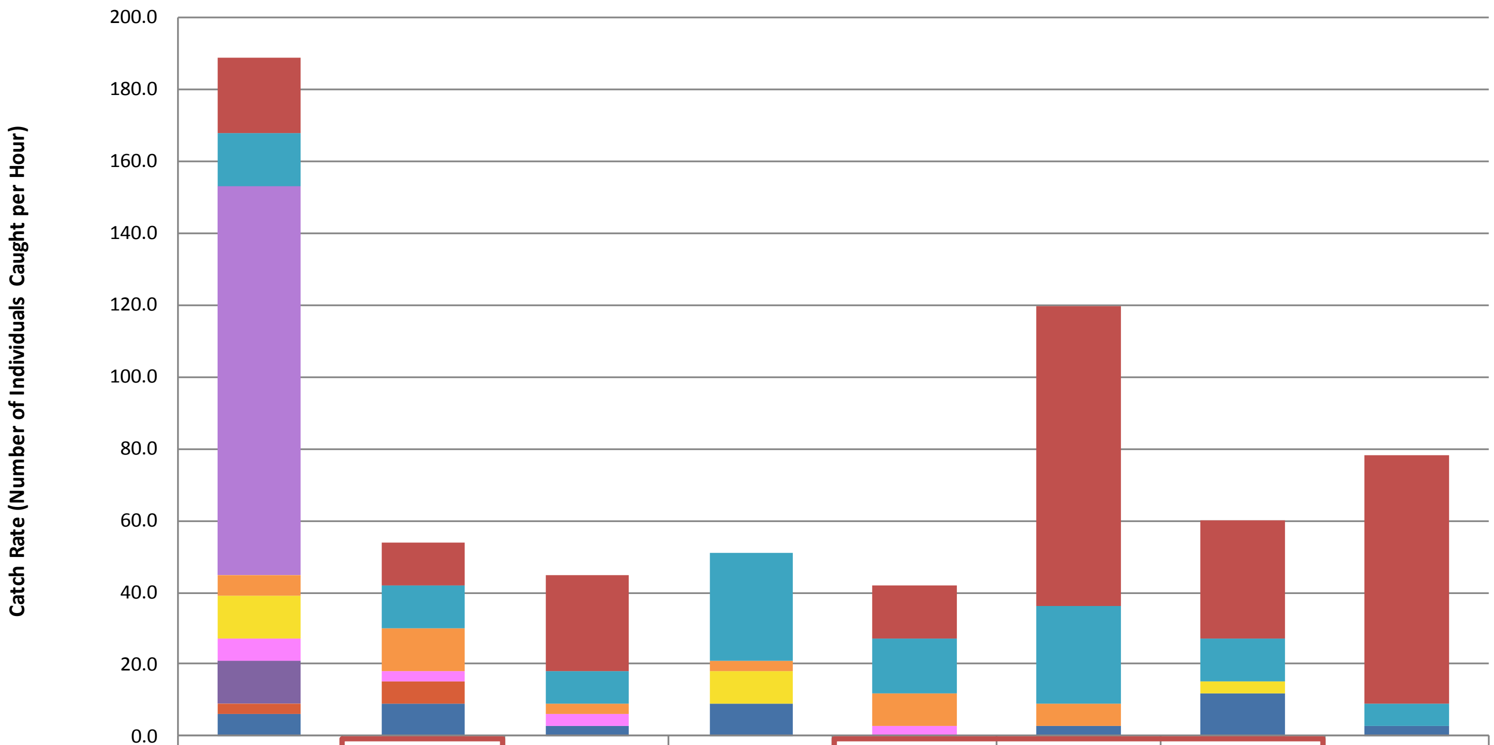
Turbot	*Psetta maxima*	0	1	1	0.0	0.8
Whiting	*Merlangius merlangus*	1	0	1	0.7	0.0
Total No. of Individuals		121	92			
Total No. of Species		13	13			
Catch Rate (No. of Individuals Caught per Hour)		90.7	69.0			



	Plaice	Dab	Whelk	Solenette	Lesser Spotted Dogfish	Common Dragonet	Velvet Crab	Lesser Weever	Other Species
Control	29.2	15.0	27.0	3.0	5.2	2.2	3.0	0.7	5.2
East Anglia THREE	36.0	16.5	0.0	6.8	0.8	1.5	0.0	1.5	6.0

Species

Figure 6.1 Catch Rates for Fish and Shellfish Species by Sampling Area



	BT01	BT02	BT03	BT04	BT05	BT06	BT07	BT08
Plaice	21.0	12.0	27.0	0.0	15.0	83.9	33.0	69.0
Dab	15.0	12.0	9.0	30.0	15.0	27.0	12.0	6.0
Whelk	107.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solenette	6.0	12.0	3.0	3.0	9.0	6.0	0.0	0.0
Lesser Spotted Dogfish	12.0	0.0	0.0	9.0	0.0	0.0	3.0	0.0
Common Dragonet	6.0	3.0	3.0	0.0	3.0	0.0	0.0	0.0
Velvet Crab	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lesser Weever	3.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Species	6.0	9.0	3.0	9.0	0.0	3.0	12.0	3.0

Station

Figure 6.2 Catch Rates for Fish and Shellfish Species by Station (red box denotes East Anglia THREE stations)

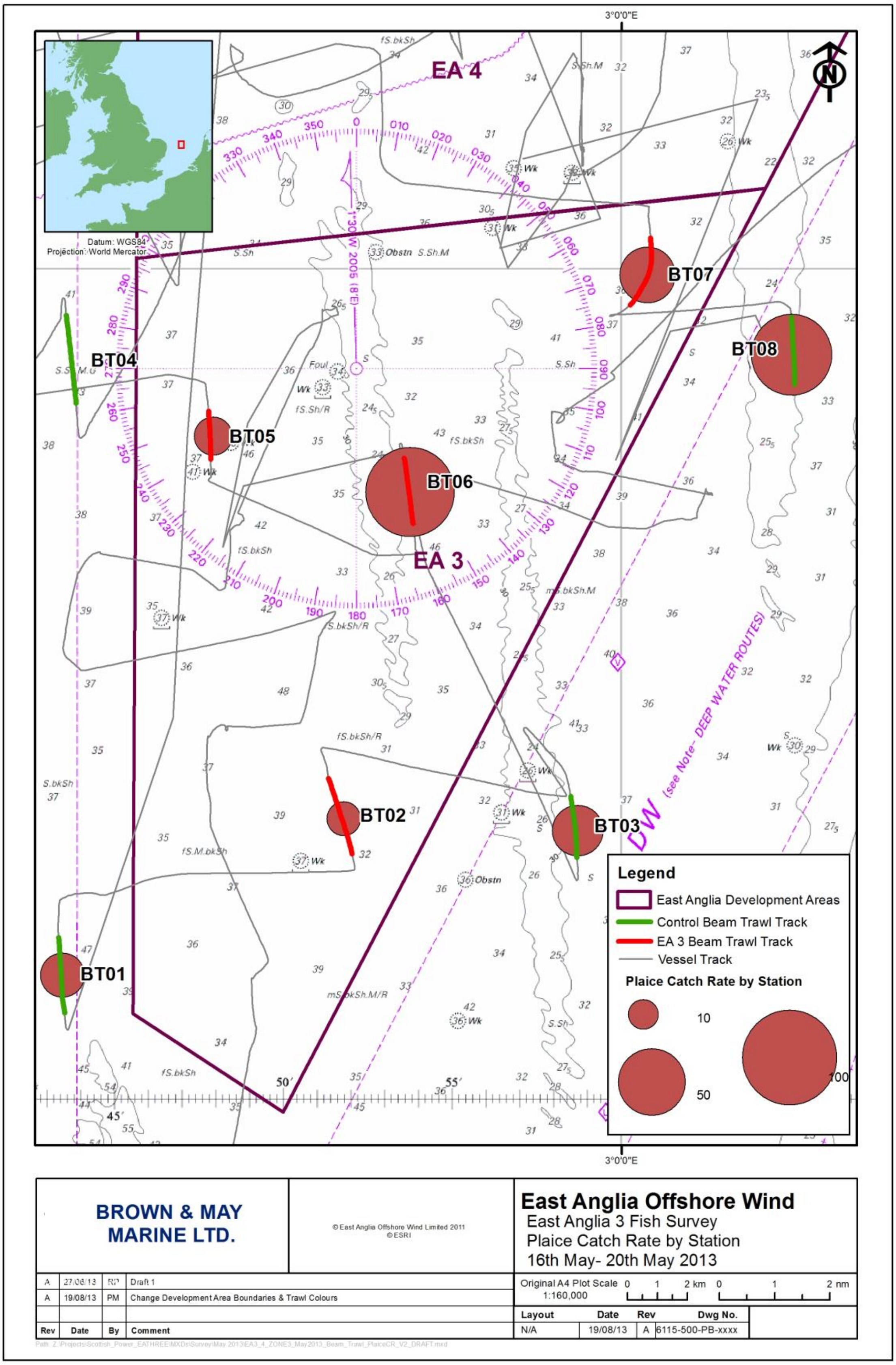


Figure 6.3 Spatial Distribution of Plaice (*P. platessa*) in the Area of East Anglia THREE

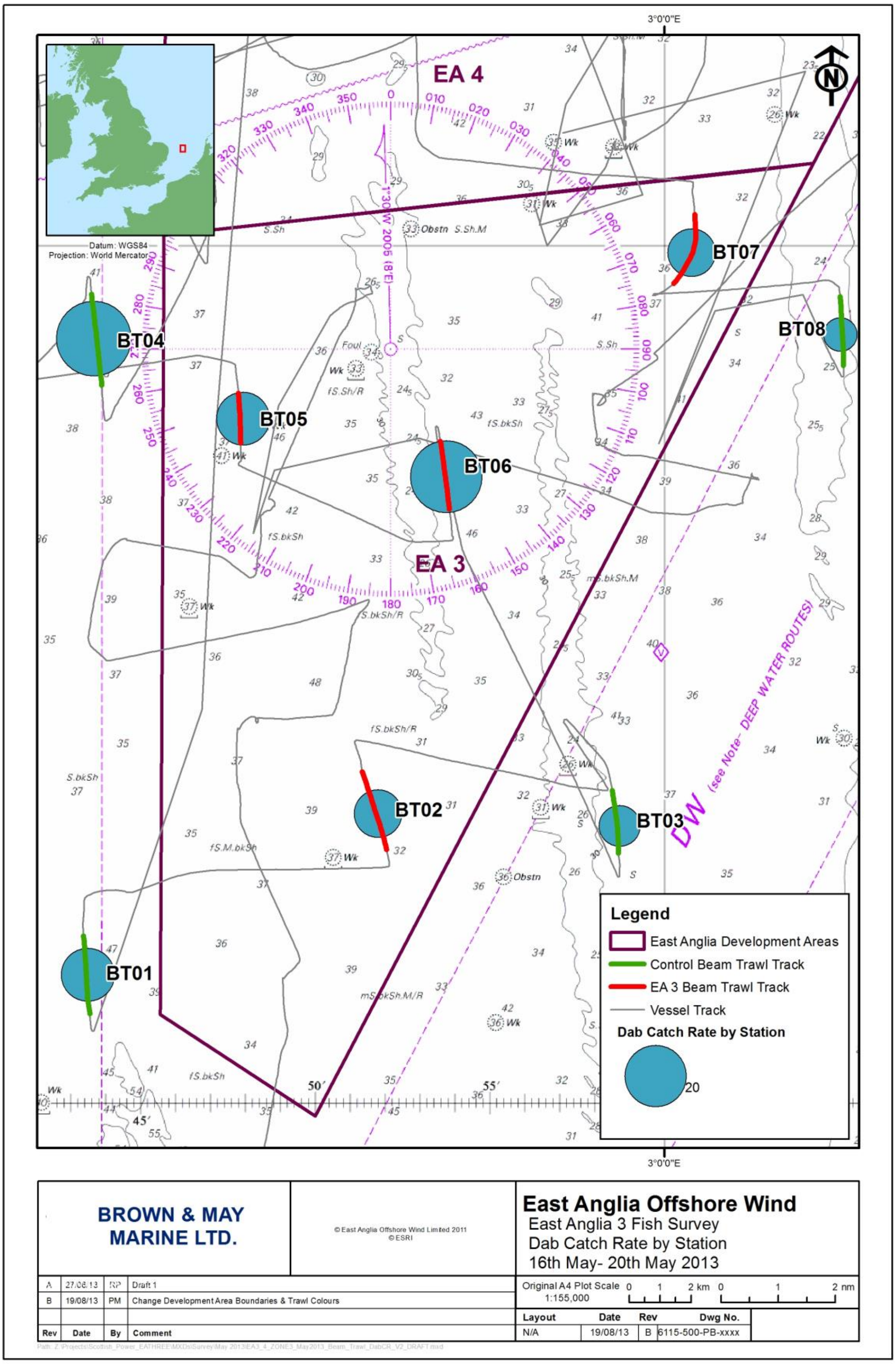
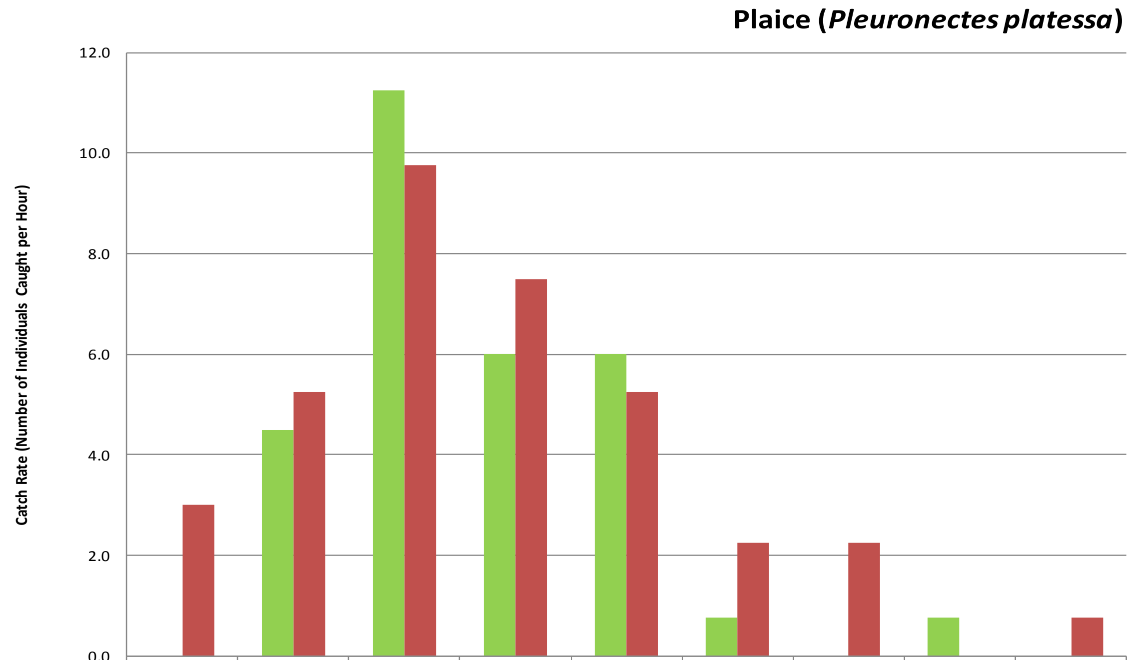


Figure 6.4 Spatial Distribution of Dab (*L. limanda*) in the Area of East Anglia THREE

6.2 Length Distributions

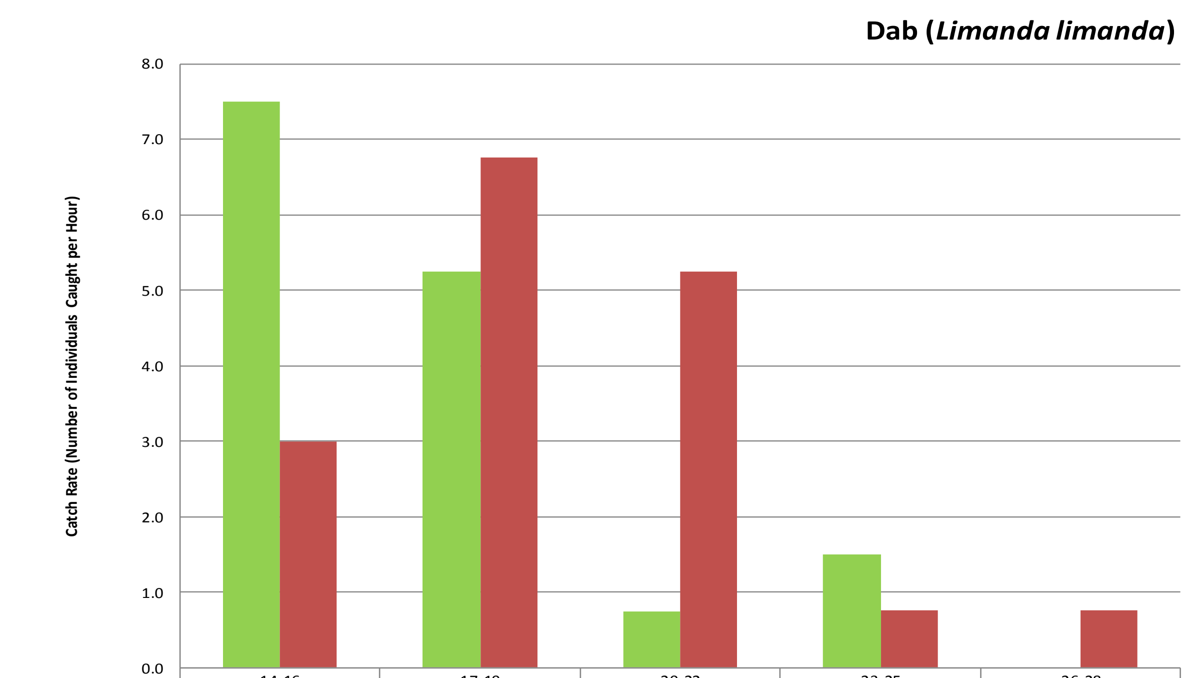
44. The length distributions of the two most abundant species caught during the survey, expressed as the catch rate (number of individuals caught per hour) by length (cm) and by sampling area (control and East Anglia THREE), are shown in Figure 6.5 and Figure 6.6 below.



	14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40
Control	0.0	4.5	11.2	6.0	6.0	0.7	0.0	0.7	0.0
East Anglia THREE	3.0	5.3	9.8	7.5	5.3	2.3	2.3	0.0	0.8

Length Interval (cm)

Figure 6.5 Plaice (*P. platessa*) Length Distribution by Sampling Area



	14-16	17-19	20-22	23-25	26-28
Control	7.5	5.2	0.7	1.5	0.0
East Anglia THREE	3.0	6.8	5.3	0.8	0.8

Figure 6.6 Dab (*L. limanda*) Length Distribution by Sampling Area

6.3 Minimum Landing Sizes

45. Table 6.2 shows the five species of fish and shellfish caught for which a MLS has been set, and denotes their presence or absence by sampling area (control and East Anglia THREE).

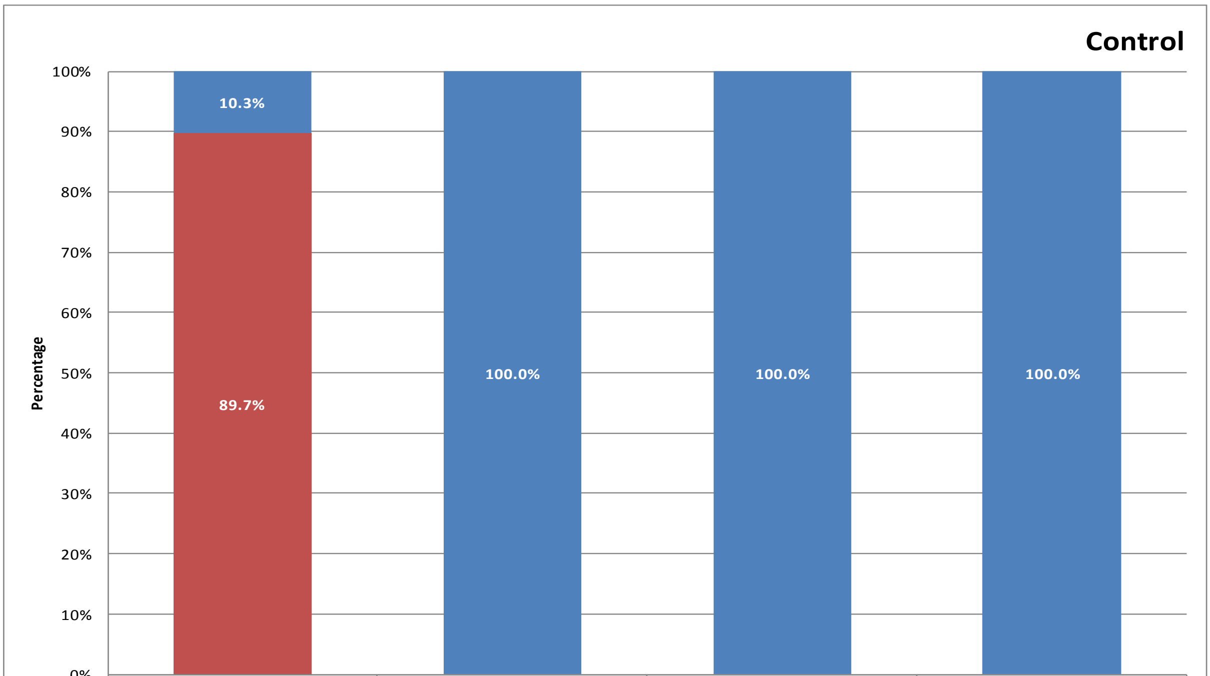
Table 6.2 MLS Set by EC

Species		EC MLS (cm)	Presence	
Common Name	Scientific Name		Control	East Anglia THREE
Dover Sole	*Solea solea*	24	✓	✓
Mackerel	*Scomber scombrus*	30	–	✓
Plaice	*Pleuronectes platessa*	27	✓	✓
Whiting	*Merlangius merlangus*	27	✓	-
Whelk	*Buccinum undatum*	4.5	✓	-

46. The percentage of individuals caught above and below their set MLS by species is shown in Figure 6.7 and Figure 6.8 for control and East Anglia THREE stations respectively.

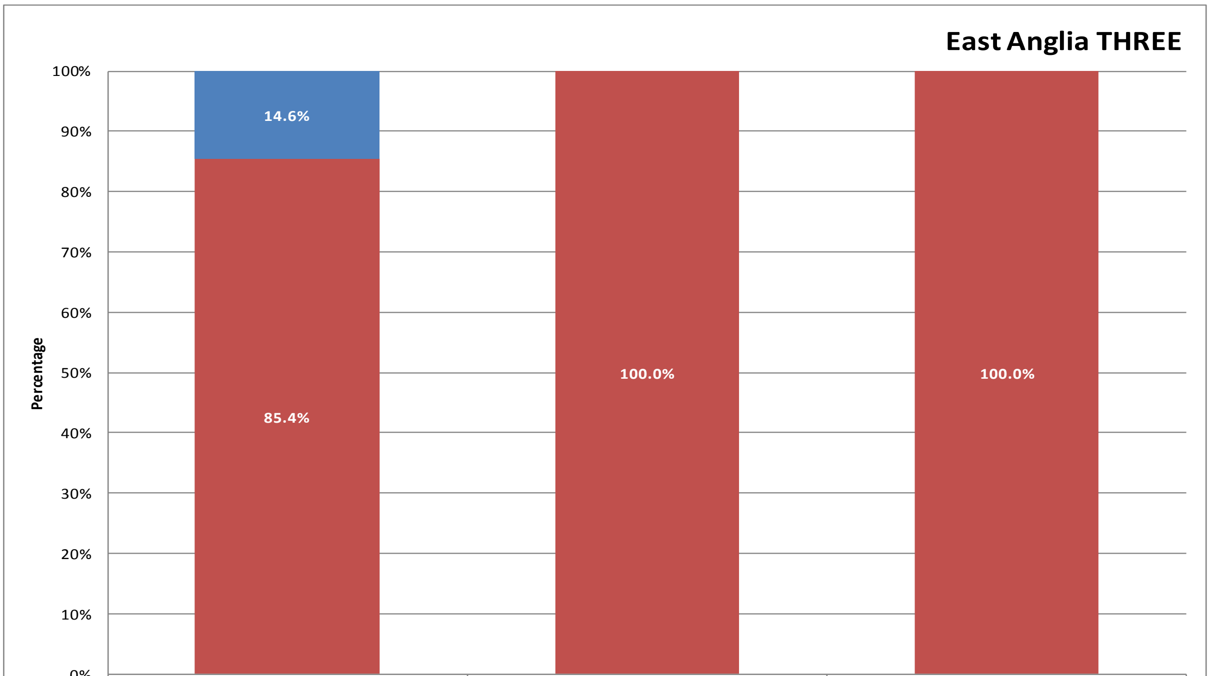
47. Most of the *P. platessa* caught at the control stations (89.7%) and within East Anglia THREE (85.4%) were below the set MLS. All of the *B. undatum* caught at the control

stations were above the MLS. All other species were caught in relatively low numbers.



	Plaice	Whelk	Dover Sole	Whiting
Above	4	36	1	1
Below	35	0	0	0

Figure 6.7 Percentage of the Catch Above and Below the MLS by Species at the Control Stations



	Plaice	Dover Sole	Mackerel
Above	7	0	0
Below	41	1	1

Figure 6.8 Percentage of the Catch Above and Below the MLS by Species within East Anglia THREE

6.4 Sex Ratios

48. The sex ratios of the two most abundant species caught during the beam trawl survey are shown in Figure 6.9 and Figure 6.10 for control and East Anglia THREE stations respectively.

49. The majority of the *P. platessa* caught at the control stations (82.1%) and within East Anglia THREE (83.3%) were male. A higher proportion of the *L. limanda* caught within East Anglia THREE were female (81.8 %), whereas at the control stations the sex ratio was approximately even.

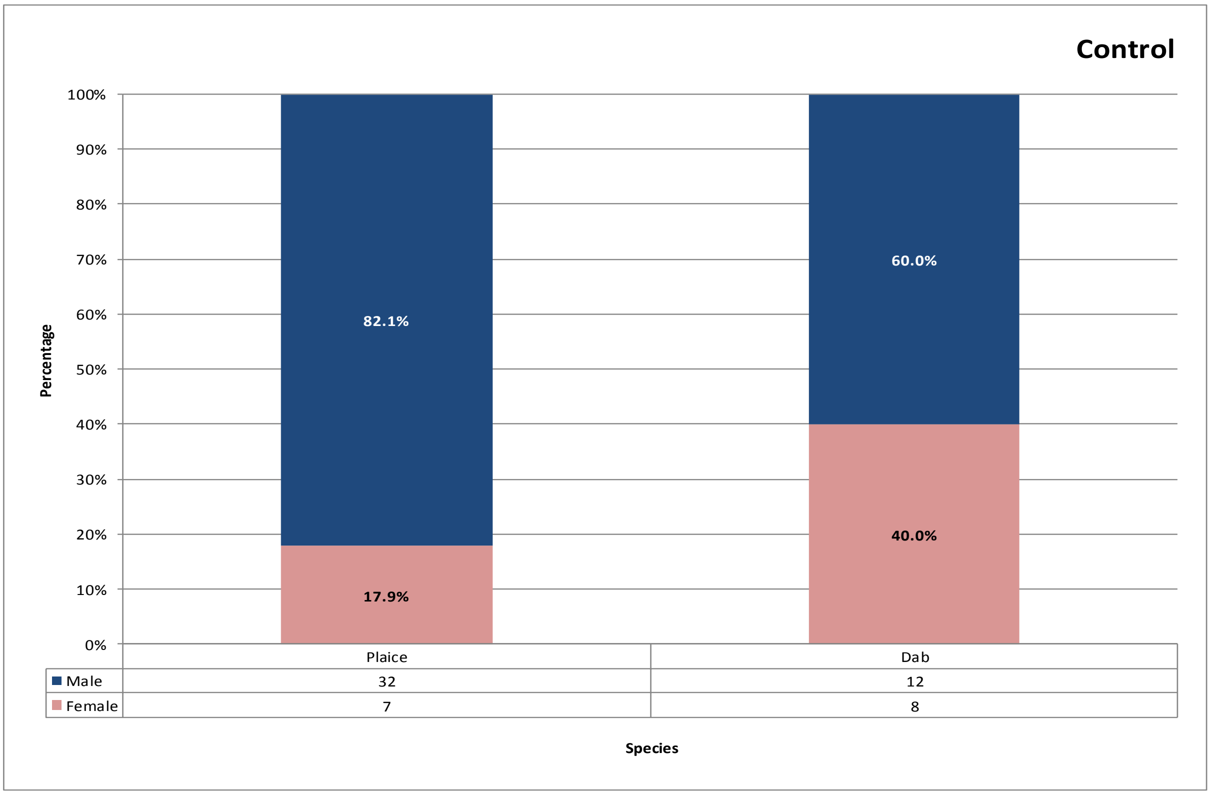


Figure 6.9 Sex Ratio by Species at the Control Stations

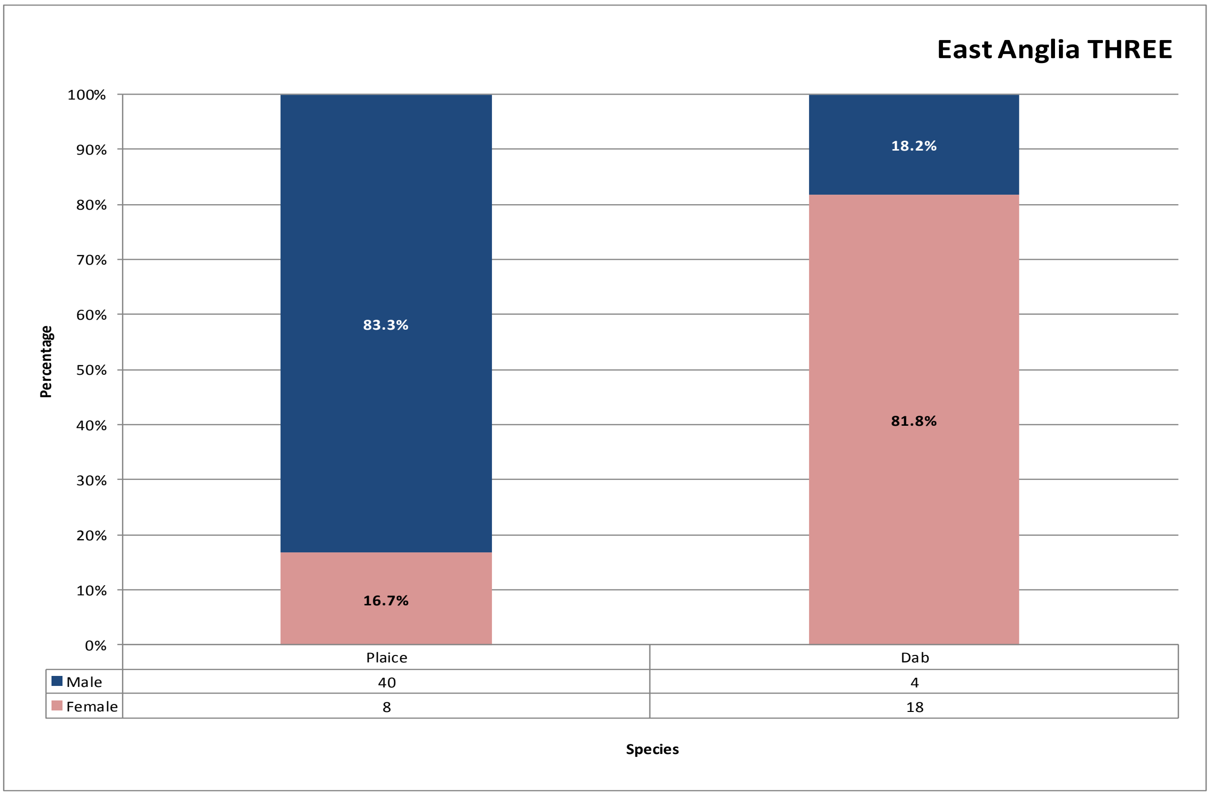


Figure 6.10 Sex Ratio by Species within East Anglia THREE

6.5 Spawning Condition

50. The spawning condition, sex and length range (nearest cm below) for the two most abundant species caught during the beam trawl survey are given below in Table 6.3 and Table 6.4.

51. The highest proportion of the *P. platessa* (control 61.5%, East Anglia THREE 43.8%) caught in both sampling areas were maturing males. Most of the *L. limanda* caught at the control stations were immature males (60.0%), whereas within East Anglia THREE the majority were maturing females (63.3%).

Table 6.3 Plaice (*P. platessa*) Spawning Condition

Plaice							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min	Max
Female	Immature	2	0	2	2.3%	20	23
	Maturing	4	2	6	6.9%	19	26
	Running	1	2	3	3.4%	26	33
	Spent	0	4	4	4.6%	25	39
Male	Immature	4	11	15	17.2%	14	22
	Maturing	24	21	45	51.7%	17	36
	Running	0	4	4	4.6%	22	26
	Spent	4	4	8	9.2%	22	26

Table 6.4 Dab (*L. limanda*) Spawning Condition

Dab							
Sex	Maturity	Individuals Caught			% of Total Catch	Length Range (cm)	
		Control	East Anglia THREE	Total		Min	Max
Female	Immature	3	3	6	14.3%	14	19
	Maturing	3	14	17	40.5%	15	23
	Running	1	0	1	2.4%	17	17
	Spent	1	1	2	4.8%	19	22
Male	Immature	12	1	13	31.0%	14	24
	Maturing	0	1	1	2.4%	21	21
	Running	0	2	2	4.8%	19	26

7.0 Scientific 2-metre Beam Trawl Results

7.1 Fish Catch Rates and Species Distribution

52. The total number of individuals caught and the catch rate (number of individuals caught per hour) by fish species and sampling area are given in Table 7.1 and illustrated overleaf in Figure 7.1. The catch rates for fish species by sampling station are given in Figure 7.2.

53. A total of 28 species of fish were caught in the scientific beam trawl survey; 20 within East Anglia THREE, and 27 along the export cable. *B. luteum* was the most abundant species along the export cable whereas (*P. minutus*) was more abundant within East Anglia THREE, followed by *E. vipera* and (*A. laterna*). All other species were caught in relatively low numbers.

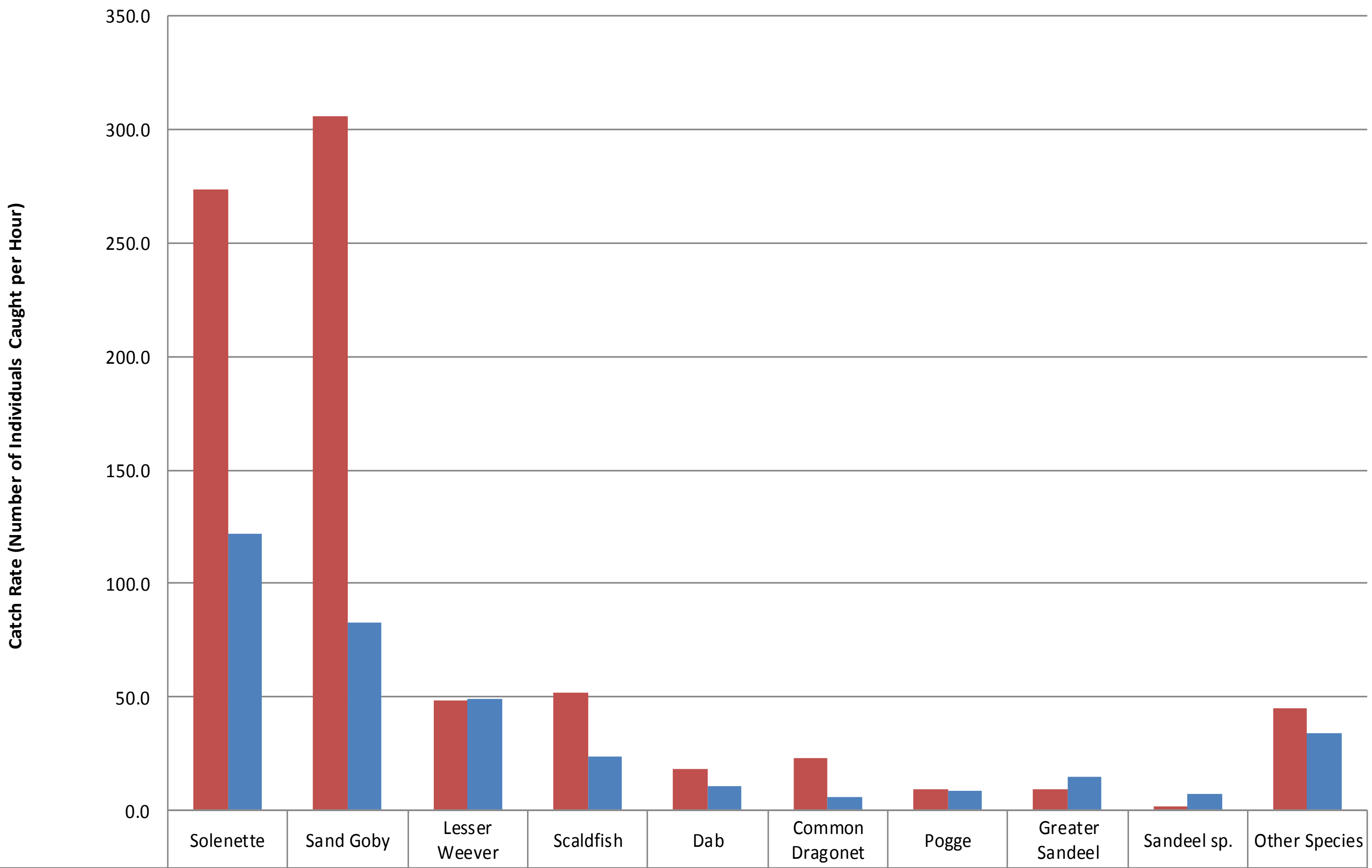
54. Station T12 within East Anglia THREE yielded the highest catch rate (1,222.6/hr), with *B. luteum* and *P. minutus* representing the majority of the catch (43.7% and 42.9% respectively).

55. The total catch rate within East Anglia THREE (785.5/hr) was approximately double that recorded along the export cable (358.8/hr).

Table 7.1 Total Numbers of Individuals Caught and the Catch Rate for Fish Species by Sampling Area

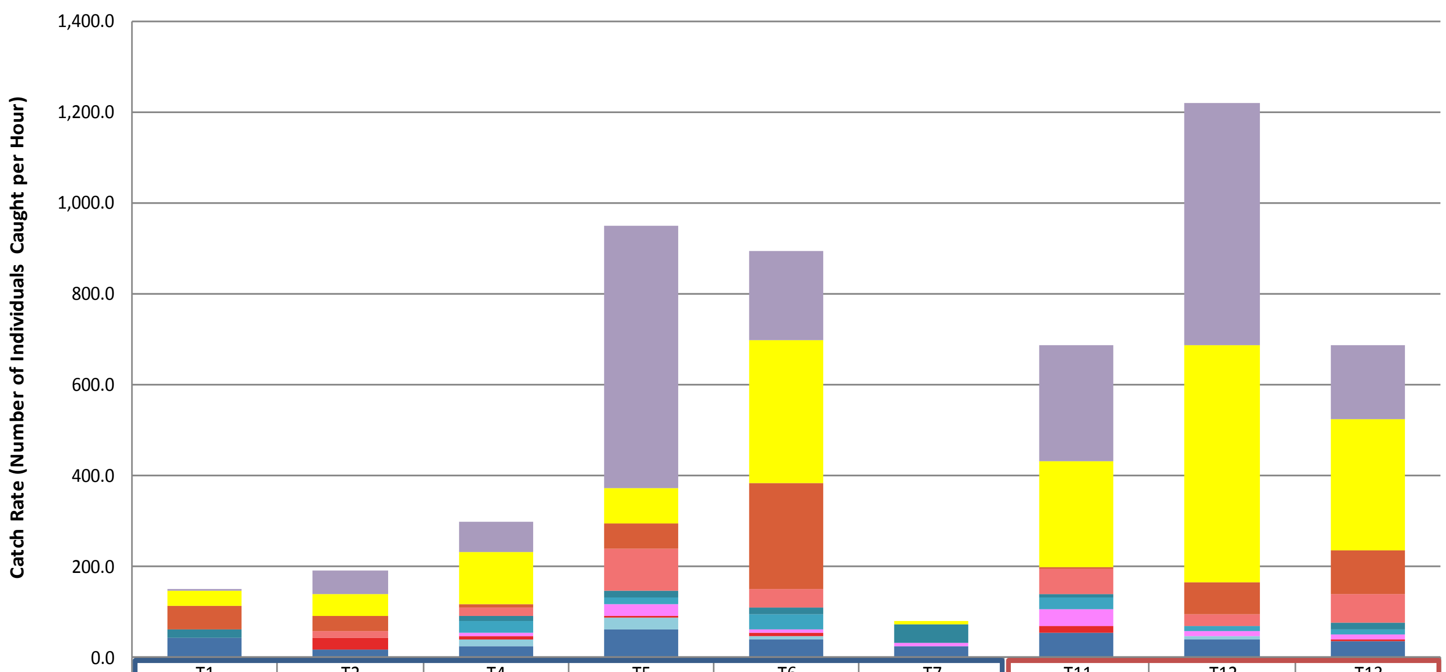
Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	Scientific Name	East Anglia THREE	Export Cable	Total	East Anglia THREE	Export Cable
Solenette	*Buglossidium luteum*	153	159	312	273.8	122.2
Sand Goby	*Pomatoschistus minutus*	171	108	279	306.0	83.0
Lesser Weever	*Echiichthys vipera*	27	64	91	48.3	49.2
Scaldfish	*Arnoglossus laterna*	29	31	60	51.9	23.8
Dab	*Limanda limanda*	10	14	24	17.9	10.8
Common Dragonet	*Callionymus lyra*	13	8	21	23.3	6.1
Pogge	*Agonus cataphractus*	5	11	16	8.9	8.5
Greater Sandeel	*Hyperoplus lanceolatus*	5	19	24	8.9	14.6
Sandeel sp.	*Ammodytes* sp.	1	9	10	1.8	6.9
Dover Sole	*Solea solea*	2	7	9	3.6	5.4
Spotted Dragonet	*Callionymus maculatus*	5	2	7	8.9	1.5
Plaice	*Pleuronectes platessa*	4	2	6	7.2	1.5
Bony Fish Larvae	Osteichthyes (larvae)	1	4	5	1.8	3.1
Smooth Sandeel	*Gymnammodytes semisquamatus*	3	2	5	5.4	1.5
Three-bearded Rockling	*Gaidropsarus vulgaris*	3	1	4	5.4	0.8
Great Pipefish	*Syngnathus acus*	0	4	4	0.0	3.1
Lesser Sandeel	*Ammodytes tobianus*	1	3	4	1.8	2.3
Lesser Spotted Dogfish	*Scyliorhinus canicula*	0	4	4	0.0	3.1

Species		Number of Individuals Caught			Catch Rate (Number of Individuals Caught per Hour)	
Common Name	Scientific Name	East Anglia THREE	Export Cable	Total	East Anglia THREE	Export Cable
Goby	*Pomatoschistus* sp.	1	2	3	1.8	1.5
Reticulated Dragonet	*Callionymus reticulatus*	2	1	3	3.6	0.8
Sprat	*Sprattus sprattus*	0	3	3	0.0	2.3
Gadoid	Gadinae (juv.)	0	2	2	0.0	1.5
Goby	Gobiidae	0	2	2	0.0	1.5
Grey Gurnard	*Eutrigla gurnardus*	0	2	2	0.0	1.5
Sandeel	Ammodytidae	2	0	2	3.6	0.0
Whiting	*Merlangius merlangus*	1	1	2	1.8	0.8
Four-bearded Rockling	*Rhinonemus cimbrius*	0	1	1	0.0	0.8
Thornback Ray	*Raja clavata*	0	1	1	0.0	0.8
Total No. of Individuals		439	467			
Total No. of Species		20	27			
Catch Rate (No. of Individuals Caught per Hour)		785.5	358.8			



	Solenette	Sand Goby	Lesser Weever	Scaldfish	Dab	Common Dragonet	Pogge	Greater Sandeel	Sandeel sp.	Other Species
East Anglia THREE	273.8	306.0	48.3	51.9	17.9	23.3	8.9	8.9	1.8	44.7
Export Cable	122.2	83.0	49.2	23.8	10.8	6.1	8.5	14.6	6.9	33.8

Figure 7.1 Catch Rates for Fish Species by Sampling Area



	T1	T2	T4	T5	T6	T7	T11	T12	T13
Solenette	4.3	51.6	66.2	576.7	196.5	0.0	255.5	533.7	160.1
Sand Goby	34.6	48.4	114.0	75.7	314.4	5.3	232.6	524.0	289.2
Lesser Weever	51.9	32.3	7.4	58.3	235.8	0.0	3.8	67.9	98.1
Scaldfish	0.0	16.1	18.4	93.2	39.3	0.0	53.4	29.1	62.0
Greater Sandeel	17.3	0.0	11.0	11.7	15.7	42.3	7.6	0.0	15.5
Dab	0.0	0.0	25.7	17.5	31.4	0.0	26.7	9.7	10.3
Common Dragonet	0.0	0.0	7.4	23.3	7.9	5.3	38.1	9.7	10.3
Pogge	0.0	22.6	7.4	5.8	7.9	0.0	15.3	0.0	5.2
Sandeel sp.	0.0	0.0	14.7	23.3	7.9	0.0	0.0	9.7	0.0
Other Species	43.2	19.4	25.7	64.1	39.3	26.4	53.4	38.8	36.2

Station

Figure 7.2 Catch Rates for Fish Species by Station (blue and red boxes denote stations along the export cable and within East Anglia THREE respectively)

7.2 Length Distributions

56. The length distributions for *B. luteum*, *P. minutus* and *A. laterna*, expressed as the catch rate (number of individuals caught per hour) by length (cm) and by sampling area, is shown in Figure 7.3 to Figure 7.5. It should be noted that the poisonous *E. vipera* is not measured as a safety precaution, and is therefore excluded from this section.

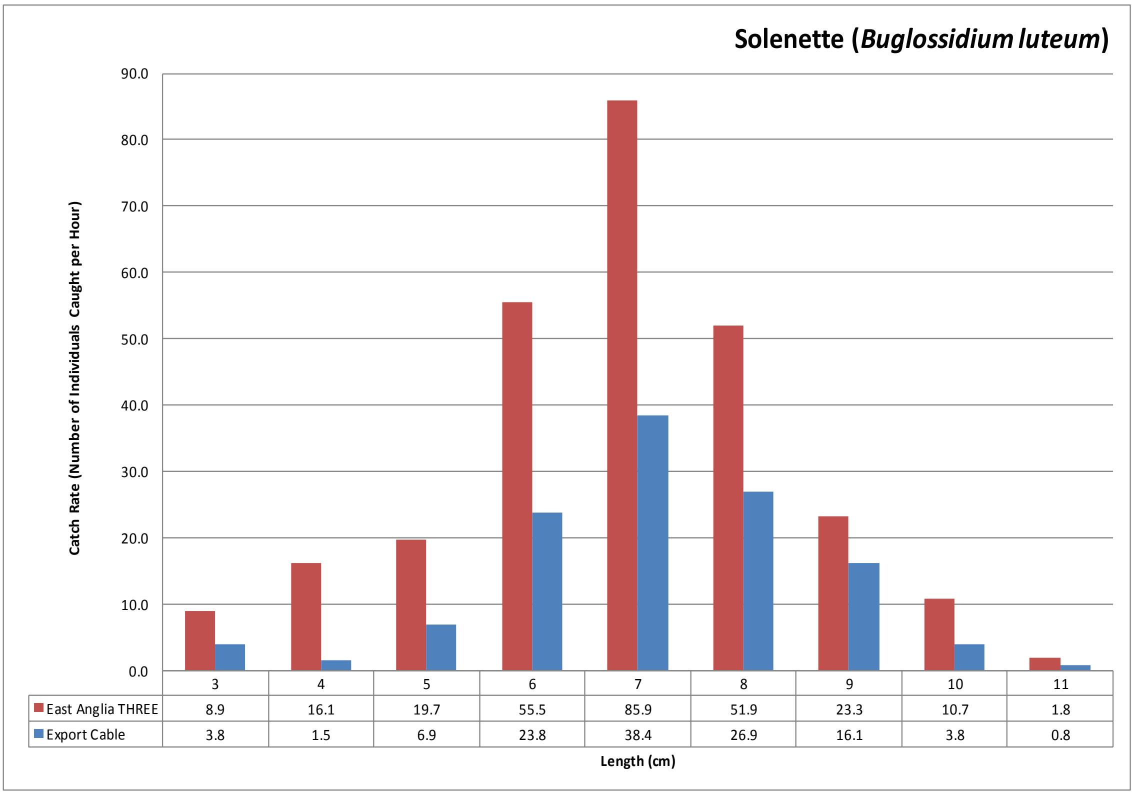
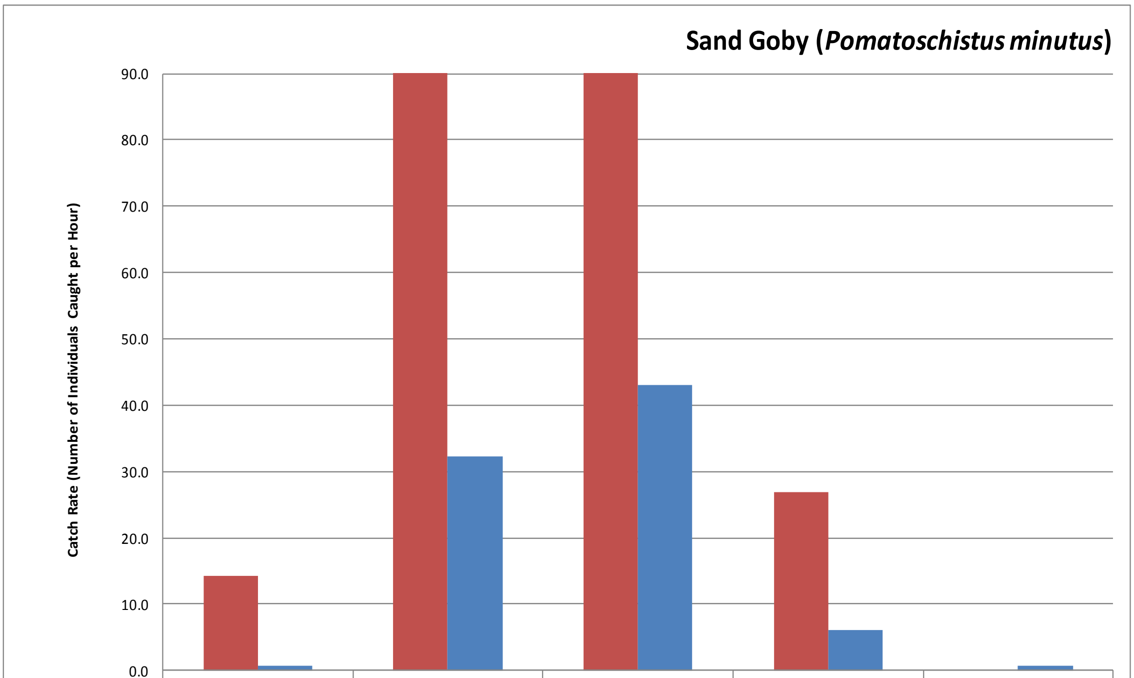


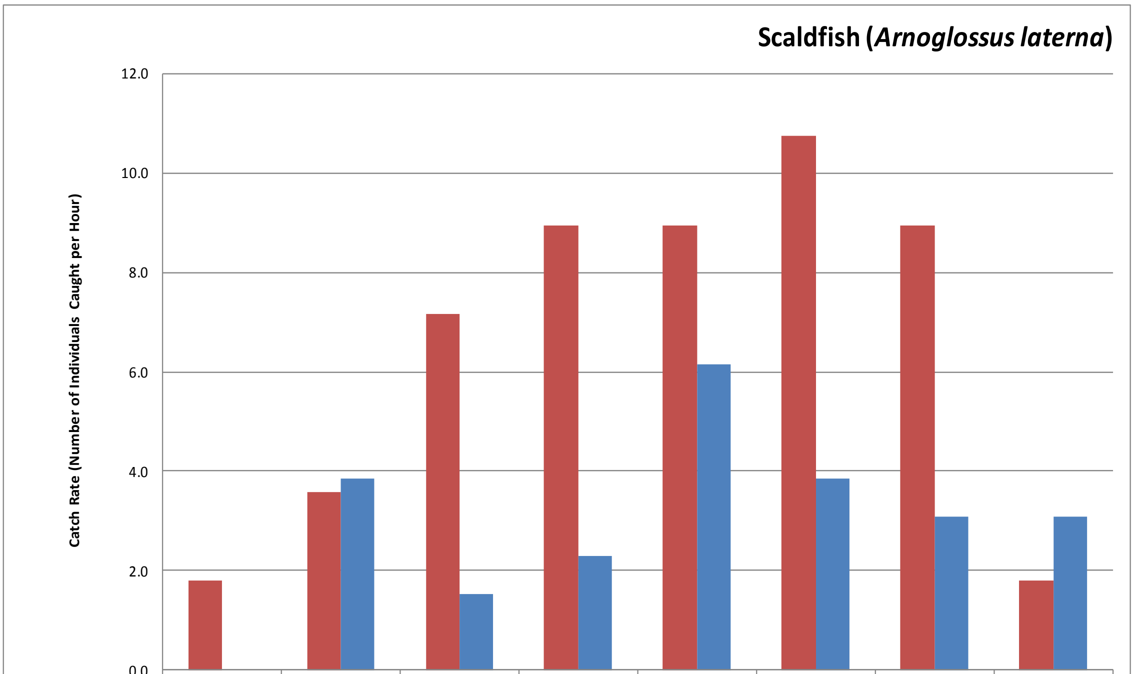
Figure 7.3 Solenette (*B. luteum*) Length Distribution by Sampling Area



	3	4	5	6	7
East Anglia THREE	14.3	123.5	141.4	26.8	0.0
Export Cable	0.8	32.3	43.0	6.1	0.8

Length (cm)

Figure 7.4 Sand Goby (*P. minutus*) Length Distribution by Sampling Area



	4	5	6	9	10	11	12	13
East Anglia THREE	1.8	3.6	7.2	8.9	8.9	10.7	8.9	1.8
Export Cable	0.0	3.8	1.5	2.3	6.1	3.8	3.1	3.1

Length (cm)

Figure 7.5 Scaldfish (*A. laterna*) Length Distribution by Sampling Area

8.0 Appendix

8.1 Appendix 1 – Health and Safety

8.1.1 Personnel

57. Brown and May Marine (BMM) staff protocol followed the standard health and safety protocol outlined in the BMM "Offshore Operational Procedures for Surveys using Commercial Fishing Vessels".

58. All BMM staff have completed a Sea Survival course approved by the Maritime and Coastguard Agency, meeting the requirements laid down in: **STCW 95 Regulation VI/1 para 2.1.1 and STCW Code section A- VI/1** before boarding any vessel conducting works for the company. Employees are also required to have valid medical certificates (ENG1 or ML5), Seafish Safety Awareness, Seafish Basic First Aid and Seafish Basic Fire Fighting and Fire Prevention certificates before participating in offshore works.

8.1.2 Vessel Induction

59. Before boarding the survey team were shown how to safely board and disembark the vessel. Prior to departure the skipper briefed the BMM staff on the whereabouts of the safety equipment, including the life raft, emergency flares and fire extinguishers, and also the location of the emergency muster point. The safe deck areas, man-overboard procedures and emergency alarms were also discussed. The survey team were warned about the possible hazards, such as slippery decks and obstructions whilst aboard. The BMM staff were briefed about trawling operations and the need to keep clear of all winch's when operational and a safety drill was conducted. All hazards were assessed prior to the survey in the BMM health and safety risk assessment.

8.1.3 Daily Safety Checks

60. The condition of the life jackets, EPIRB's, and life raft were inspected daily. Also checked were the survey team working areas, including the fish room and the wheelhouse to ensure these areas were clear of hazards such as clutter and obstructions.

8.1.4 Post Trip Survey review

61. Upon completion of the survey a "Post Trip Survey Review" was filed, see Table 8.1 overleaf.

Table 8.1 Post Trip Survey Review

Project: East Anglia 3	**Vessel:** Jubilee Spirit
Surveyors: Lucy Shuff, Alex Winrow-Giffin, Jake Laws	**Skipper:** Ross Crookes
Survey Area: Southern North Sea	**Total Time at Sea:** 13 Days
Dates at Sea: 15/05/2013 – 27/05/2013	

	Comments	Actions
Did vessel comply with pre trip safety audits?	Yes Passed audit by LOC on 14/02/2013	N/A
Skipper and crew attitude to safety?	Good	N/A
Vessel machinery failures?	Fuel pipe blockage on 17/05/2013 AIS malfunction on 20/05/2013	Repaired by crew at sea Repaired by engineer on 21/05/2013
Safety equipment failures?	None	N/A
Accidents?	None	N/A
Injuries?	None	N/A