Netherlands Institute for Fisheries Research (RIVO)

P.O. Box 68
NL 1970 AB Ymuiden
The Netherlands
Phone: +31 255 564646
Fax: +31 255 564644

P.O. Box 77
NL 4400 AB Yerseke
The Netherlands
Phone: +31 113 672300
Fax: +31 113 573477

Internet:postmaster@rivo.wag-ur.nl

RIVO report

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Base line studies North Sea wind farms: biological data pelagic fish

R.E. Grift, A.S. Couperus, M.S. Ybema, N.S.H. Tiën

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Table of Contents:

Summary

The Dutch Government has decided to allow the construction of a Near Shore Wind Farm (NSW) demonstration project under the condition that a monitoring programme on - among other things - the ecological impacts is carried out. The Dutch government is responsible for providing a thorough description of the present ecological situation in order to evaluate future effects of planned wind farms. The Netherlands Institute for Fisheries Research is responsible for the baseline study on pelagic fish. Within this study, the pelagic fish community was sampled twice in April and September/October 2003. It was sampled with a high spatial resolution in the planned location of the wind farm and in two reference sites, and with a low spatial resolution in a larger area along the coast. This report describes and discusses the biological data for the main species that were observed during these surveys. Biological data comprise information on age, sex, maturity and weight. In addition, a description of the database resulting from the project is presented. This database is delivered simultaneously with this report. The data presented here give a good impression of the population structure of the pelagic fish community in the Dutch coastal zone. In the final report, we will use this data to describe that population and search for literature to interpret the data.

Acknowledgements

The fieldwork described in this report was executed on board of the GO58 and we thank Koos de Visser and his crew for the pleasant and professional co-operation. Kees Bakker and Ronald Bol contributed to the execution of the cruise and André Dijkman Dulkes, Rieneke de Jager and Mario Stoker processed the fish at the lab of the institute. The ages of most pelagic species could not have been determined without the help of our colleagues from abroad. We are grateful to Susanne Hansen, Palle Brogaard, Andres Uriarte, Inaki Rico and Alexandra Silva for their help.

1. Introduction

The Dutch Government has decided to allow the construction of the Near Shore Wind Farm (NSW) demonstration project under the condition that a monitoring programme on - among other things - the ecological impacts is carried out. The most important objective of monitoring is to acquire knowledge and practical experience in the construction and operation of large offshore wind farms in the North Sea[1]. Both the private party that constructs the wind farm as well as authorities (ministries) need this information for future wind farm projects: for construction as well as for developing policy on this topic. Therefore, the (ecological) knowledge acquired with monitoring programmes for NSW must be made available to all parties involved in the realisation of such large-scale wind farms.

The Dutch government is responsible for providing a thorough description of the present ecological situation as a reference for evaluation of future effects. In September/October 2002, the National Institute for Coastal and Marine Management (RIKZ), part of the Directorate-General of Public Works and Water Management, procured a base line study on the North Sea situation for 2003. This study will be on behalf of the Monitoring and Evaluation Programme Near Shore Wind Farm (MEP-NSW) in the North Sea. The baseline study must provide data on the occurrence and density of benthic fauna, demersal fish, pelagic fish, sea mammals, marine birds and non-marine migratory birds. The Netherlands Institute for Fisheries Research of the Animal Sciences Group of Wageningen UR is responsible for the baseline study on pelagic fish.

The baseline study for pelagic fish should establish the occurrence, density, population structure and migration patterns of pelagic fish fauna in the reference situation. Also, the spatial variation of pelagic fish fauna in the reference situation has to be described. This has to be done in such a way that later (outside this assignment) quantitative evaluation is possible of the impact of a wind farm on the occurrence, density, population structure and migration patterns of the pelagic fish fauna. The design of the monitoring programme is justified to meet these goals. The objectives and the sampling design of this study are described in a detailed strategy of approach (Grift *et al.*, 2003). Within this study, the pelagic fish community was sampled twice: in April and September/October 2003. It was sampled with a high spatial resolution in the planned location of the wind farm and in two reference sites, and with a low spatial resolution in a larger area to provide representative data of the pelagic fish community in the Dutch coastal zone. Detailed reports of both surveys are presented in the respective fieldwork reports (Couperus *et al.*, 2003a; 2003b).

During the kick off meeting it was decided that both field work reports would contain data on the occurrence of species and sizes, and that a separate report would be delivered at the end of Phase 2 that contains all biological data, and data on densities and biomass per age and sex. In this report, the biological data are presented but we could not deliver data on biomass per age and sex. In order to estimate this biomass, acoustical estimates of fish need to be converted to estimates per species. This step will be made in the final report. With the delivery

[1] We define offshore wind farms as wind farms at sea outside the 12 miles zone (22 km offshore).

of this report, the database of the project is also delivered and a description of the database is presented in this report (Appendix I).

Chapter 2 summarises the set-up of the survey. Chapter 3 describes the collection of biological data. In Chapter 4, the biological data are presented and briefly discussed. Chapter 5 discusses how these data contribute to the project.

2. Set-up of the sampling programme

In order to be able to assess temporal variation in the pelagic fish community, pelagic fish were sampled twice within the current project, in April and September/October 2003 (weeks 16/ 17 and 40/ 41). The sampling design is discussed in detail in the strategy of approach (Grift *et al.*, 2003) and will be summarised here.

Sampling sites were selected such that they cover the planned location of the Near Shore Wind farm, cover reference sites and provide representative data of the pelagic fish community in the Dutch coastal zone (Figure 1). The reference sites have the same size as the wind farm area, and are similar to the wind farm area regarding species community, water currents, water depth and seabed morphology. Evaluation of the first survey lead to an adapted sampling programme for the second survey. Not all transects could be sampled in the planned two weeks in April and as a result, the survey resolution of the planned location of the wind farm and in the reference sites were reduced by half.

The principle was, however, similar in both surveys: pelagic fish were sampled with a high spatial resolution in the planned location of the wind farm and in the reference sites, and with a low spatial resolution in a larger area in the coastal zone. This resolution is required to be able to detect possible effects of the wind farm on the occurrence of fish in the impact study. If these effects occur, they are small-scaled and a high-resolution sampling scheme is needed. Additional sampling with a lower resolution in a larger area is required to get an overview of the position of the NSW and reference sites in a larger coastal system and to judge the collected data in the perspective of the observed patchiness over a larger area. Because of adverse weather conditions both surveys for this project were not executed as planned but gave a good description of the pelagic fish community (Figure 1).

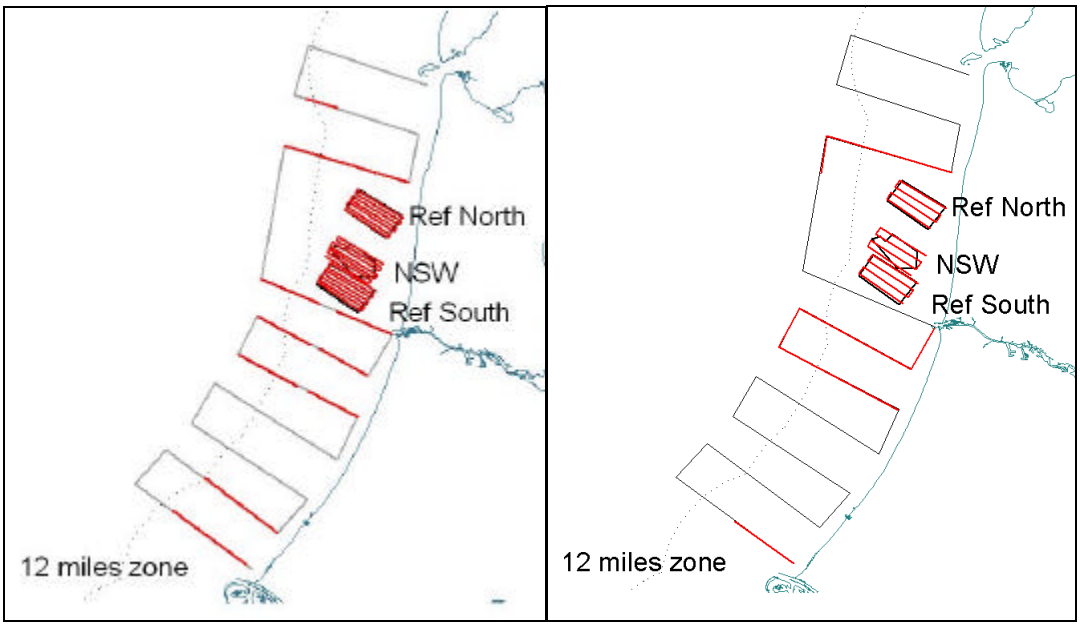

Figure 1. *Planned and* executed *transects of the acoustic survey in April (left panel) and September/October 2003 (right panel). The executed transects are red.*

Raw data were collected using a Simrad EK60 echosounder with a 38 kHz split beam transducer fixed to a towed body, which was towed from the bow of the trawler. The depth of the towed body was approximately 2.5 - 3 meter below the water surface. Data were logged and integrated by 0.5 nautical mile intervals with Echoview software.

Fish samples were taken with a small half-pelagic trawl, with a 1-cm cod end lining. For each haul, the total weight per species was measured or calculated according a length-weight relationship. For each species, length-frequency distributions were assessed with a precision of 0.5 cm for sprat, herring, anchovy and pilchard and of 1 cm for other species. Individuals of species, for which biological data were collected, were stored on ice for later processing at the institute.

3. Collection of biological data

In total, of 647 fish biological data were collected within the baseline study and of 1496 fish biological data were retrieved from other programmes that were executed by the Netherlands Institute for Fisheries Research (Table 1).

Table 1. *Numbers of fish of which biological data were collected (length, weight, sex, maturity and otoliths). Numbers printed in bold represent fish of which data were retrieved from the Baseline study, without bold/italics from programmes in the Dutch coastal zone and in italic from programmes in the entire North Sea. A table with all English, Dutch and scientific names is presented in Appendix II.*

Species	Dutch name	Quarter			Total
		2	3	4	
Anchovy	Ansjovis	**104**	-	**39**	39
Greater Sandeel	Smelt	**36**	-	**9**	9
Herring	Haring	**129**	-	175	175
Horse mackerel	Horsmakreel	*525*	-	250	250
Lesser Sandeel	Kleine zandspiering	**58**	-	-	58
Mackerel	Makreel	*875*	-	50	50
Pilchard	Pelser	**53**	-	**28**	28
Raitt's sandeel	Noorse zandspiering	**93**	-	-	93
Sprat	Sprot	**39**	*151*	-	190
Total		1914	151	78	2143

As described in the strategy of approach, we did not collect data for pelagic species of which these data are collected in other, routine programmes of the institute. Therefore, we did not collect biological data from mackerel and horse mackerel. Instead, for the fourth quarter (second survey time period) data collected by other surveys in the coastal waters of the Netherlands were used. For the second quarter (first survey), no data were available for mackerel and horse mackerel for the coastal areas, and survey data from the entire North Sea had to be used. Of herring and sprat, we only collected new data during the first survey of the baseline study. For herring in the fourth quarter data from the coastal waters could be used. For sprat, no data in the entire fourth quarter were available and data from the third quarter and the entire North Sea had to be used. The additional data from other programmes resulted in a total of 2614 fish of which biological data were collected.

Of all these fish length, weight, sex, maturity stage and age were determined in the laboratory. Length was measured tot the nearest mm and weight to the nearest gram and sometimes decigram. Sex and maturity stage were determined by a visual observation of the gonads. Ages were determined from reading the otoliths.

Because the Netherlands Institute for Fisheries Research had no experience with reading otoliths of anchovy, greater sandeel, lesser sandeel, pilchard and Raitt's sandeel, otoliths of these species were sent to colleagues in Spain, Portugal and Denmark. We tried to read these otoliths but that proved to be very difficult. In addition, the reading of otoliths by colleagues was

also a test for the identification of species. It proved that we had consistently identified Raitt's sandeel (*Ammodytes marinus)* smaller than 15 cm as Lesser sandeel (*Ammodytes tobianus)* and that we had identified lesser sandeel smaller than 11 cm as greater sandeel (*Hyperoplus lanceolatus)*. Checks of our Danish colleagues made it possible to correct these identifications.

Otoliths of herring, sprat, mackerel and horse mackerel are read in routine programmes of the Netherlands Institute for Fisheries Research executed since the 1960s and formed no problem. The ages were read following standard procedures of the Netherlands Institute for Fisheries Research (Bolle *et al.*, 2003). Age-length keys, sex/maturity keys and weight-length keys were constructed with the SAS software package.

4. Results

Tables with age-length keys and length and maturity are presented in Appendix III, sorted in the same order as in the text.

4.1 Anchovy

Anchovy was mainly found in the catches close to the coast. In April, the length frequency distribution was within the range of 11 and 21 cm, with a high peak at 14.5 cm and a lower peak at 19.0 cm. In September/October all fish were within the range of 8 –13 cm.

In the second quarter, in April, two age groups (1 and 2) could be distinguished. One-year-old fish was 12-18 cm and two-year-old fish was 17-20 cm. All anchovy caught in September/October were 0 year old and this born in 2003.

In the spring survey almost all length classes above 12 cm (in fact practically all fish caught) were mature, ripening or ripe. A specimen of 12 cm, determined as "spent" is considered as a misreading. In September/October we were not able to find the gonads, which is probably an indication that the specimens were immature.

4.2 Greater sandeel

Greater sandeel was caught in low numbers, in the order of a few specimens to some tens. In spring the biological information was based on 36 specimens. In September/October only a few specimens showed up in the catches of which 9 specimens were examined for biological data.

Despite the low numbers examined, the age-length key shows relatively clearly distinguishable length ranges that belong to the same age groups: the small specimens of approximately 11-12 cm were 0 year, 18-20 cm fish were 1 year old, although some older fish were of the same size class, fish of 22-25 cm consisted mainly of 2 year old fish. Fish larger than 25 cm was 3 or 4 years old. Unlike both Ammodytes species, in greater sandeel, fish older than 4 years were not found.

Maturity of the small specimens of greater sandeel (age 0) was not detected. In spring all specimens of 18 cm and larger (approximately 1 year old) were mature, mostly ripe or ripening (the specimens recorded as "ripening" were all considered close to "ripe". This suggested that the survey period fell together with the spawning period. Macer (1966) found ripe and running specimen from April to August in the North Sea.

4.3 Herring

The Dutch coast is a nursery area for the herring from the southern North Sea. It is therefore not surprising that young herring were observed in all hauls in both spring and fall.

Within ICES, the age of herring is normally expressed in winter rings for logistic reasons. To avoid confusion within this report, here the birth year is regarded as age 0.

The length age key from spring gives a good overview of the age distribution for the different length classes. In spring all fish smaller than 18 cm were 2 years old (1 winter ring, wr). Herring of 3 years (2 wr) were 18-23 cm and of 4 years (3wr) 21-25 cm.

In spring, herring of 23 cm and larger were mature. Only a few fish smaller than 23 cm were found to be mature. In September/October, when biological data were retrieved from market samples, some herring of 21-22 cm were found to be maturing, meaning that they could take part in the spawning season in autumn in the Channel.

4.4 Horse mackerel

Horse mackerel was caught in spring in low numbers that were equally spread over the area. They had lengths of 21-37 cm and the majority was 21-26 cm. In September/October this species was caught in most hauls as a subdominant species amongst large numbers of clupeids (herring, sprat, pilchard and anchovy), the size being 7-15 cm except for a few specimens that were 21-30 cm.

Horse mackerel is a well-studied species. As a result the age-length key is more extensive compared to other species. The group of 21-26 cm examined in spring consisted mainly of 3 and 4 years old. Overall horse mackerel can become old. The oldest specimen in the sample presented here, was 26 years.

Horse mackerel of 18 cm (spring) and 20 cm (autumn) and smaller, were immature. Beyond 23 cm all fish were mature. The spring survey was executed at the beginning of the spawning season of horse mackerel (May-June).

4.5 Lesser sandeel

Lesser sandeel was found in small numbers amongst the catches of Raitt's sandeel. Species identification was difficult. Length frequency samples were checked at the laboratorium.

The age-length key is based on 58 specimens, but shows that fish smaller than 15 cm were most probably 1 year old. Larger fish may be as old as 9 year.

Maturity determination caused the same problem as with Raitt's sandeel. It was not possible to record the maturity of specimens smaller than 11 cm. The specimens that could be sexed (15 cm and larger), were either ripening, ripe or spent.

4.6 Mackerel

Mackerel was caught in spring and September/October in most hauls, mostly in low numbers. Like horse mackerel, mackerel is a well-studied species. The age-length key is based on sufficient specimens to calculate the population structure of mackerel along the Dutch coast well. Mackerel of 20-26 cm belonged mainly to age group 1 and 2. In September/October these fishes had grown to 25 cm and larger.

Most mackerel matured at 25-30 cm, as 3-year-old fish. The spring survey was at the beginning of the spawning season (May-June), which is confirmed by the high numbers of ripening en ripe fish.

4.7 Pilchard

Pilchard showed up in the offshore catches in April and in a number of catches in September/October. In the spring survey, all fish were 21-28 cm. Fishes of these size classes did not appear (except for 2 specimens) in September/October. In September/October the catches consisted of young fish (8-12 cm).

In spring, virtually all pilchards of 22-24 cm were 4 years old. Fish larger than 25 cm were older, up to 13 years old. The specimens examined in September/October were all born in the year of the surveys (age 0).

All pilchards from the April survey were mature and ripening. In the small-sized fish caught in September/October, the gonads were not yet visible and therefore considered immature. Pilchard is known to spawn in the English Channel in spring and summer (Cushing, 1957). May be these small fish origin from spawning in the channel in (very) early spring.

4.8 Raitt's Sandeel

Raitt's sandeel was caught in almost all hauls in April. In September/October only 6 specimens were caught. No biological data of these specimens for this period could be presented.

2-year-old fish dominated the sandeels of 10-16 cm, which was more than 95 % of the catch. However, some fish were older. Fish of 14 – 16 cm were most likely 2 years old, but may have been of any age up to 12 years.

We were not able to record maturity of all fish smaller than 16 cm. The few fishes, bigger than 16 cm and of which the maturity could be recorded, were all found to be mature. In these specimens, all stages were found (ripening, ripe and spent). The fishes of which the maturity could not be recorded, the gonad was too small to be found during a routine inspection. This may indicate that these fishes were immature or in a very early stage of ripening.

4.9 Sprat

Sprat was by far the most abundant species in April and was caught in 10 out of 21 hauls in September/October. Their lengths varied from 7-15 cm. We were not able to retrieve otoliths from sprat of 7.5 cm and smaller because the otoliths were too small. In the September/October samples, sprat smaller than 9 cm was not present.

When aging sprat, the "birth date" of sprat is by definition the 1st of January. In spring the fish smaller than 10 cm were 1 year old. Fish larger than 10 cm were 2-4 years old. In September/October one year old sprat were larger: the majority of specimen of 12 cm were 1 year old. Fish above that size were likely to be 2, or even 3 year old.

Within the adult fish (> maturity stage 4) group, in September/October and spring, all maturity stages were found, which confirms the fact that sprat is a multiple batch spawner, i.e. each female spawns repeatedly during the spawning season. Sprat from the Baltic spawns at least ten times a year (George, 1987), which may be true for the North Sea as well. However, juvenile sprat was not found in spring. This may indicate some concentration of spawning in time.

5. Discussion

Of the non-commercial species the age-length data were collected for the first time and although they are based on small numbers, it clearly shows which age classes were present in the Dutch coastal zone. Therefore, these data provide new insight into the population structure of pelagic fish in the Dutch coastal zone. However, the limited number of fish on which these data were based, make a detailed description of their population structure difficult. We think for example, that it is of limited information to discuss numbers of males and females observed. For species for which numbers sampled are too low, we will use standard length-weight relationships for converting numbers to biomass. These do, however, not reflect differences in condition between spring and autumn. These differences are reflected in the parameter values in the length-weight relationships presented. Nevertheless, we think that the observations on these species are unique and provide very useful information.

The abundance of pilchard and anchovy in the coastal zone is surprising. In April, ripe pilchards were observed and in September/October only small pilchards (9-11 cm) were observed which might indicate that the 2003 cohort used the Dutch coastal zone as a nursery. In none of the pelagic surveys of the Netherlands Institute for Fisheries Research small pilchards have been observed. Pilchard may have a similar life history as herring and sprat, which spawn in the Canal and use the Dutch coastal zone as a nursery area. In the final report, we will further discuss this and search for additional literature.

In April, virtually only adult anchovy were observed whereas in September/October, the population only comprised 0-group fish. This may indicate that anchovy use the coastal zone as a spawning and nursery area. In all other survey of the institute, anchovy was a rare species. In the 1980s for example, anchovy was not caught in the southern North Sea (Knijn *et al*. 1993). It seems that the abundance of anchovy has increased since then, because anchovy was also abundant in the survey for the Flyland project. In the past, several periods were reported in which anchovy was also abundant in the Dutch coastal zone and it seems that at present such a period occurs again.

The data presented here give a good impression of the population structure of the pelagic fish community in the Dutch coastal zone. In the final report, we will use this data to describe that population and search for literature to interpret the data.

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Appendix I. Description of databases

Description of the databases that were delivered to RIKZ simultaneously with this report. In the filenames the research programme is indicated: NSW: baseline study Near Shore Wind farm; Pelvog: project on birds and fish executed in November 2003.

Filename: **01_NSW acoustic_april.xls** **02_NSW acoustic_oct.xls** **03_Pelvog_acoustic_nov.xls** **Format: DONAR**		
Field	**Description**	**Unit**
XCRDRK	Latitude, position of the half nautical mile for which densities of fish are estimated based on acoustic and trawl data.	Degrees Minutes Seconds Deci-seconds
[YCRDRK]	Longitude, description similar to that of latitude.	Degrees Minutes Seconds Deci-seconds
DATTYD	Date of observations.	Dd/mm/yyyy
	Time of observations.	Hhmm
SPECIES NAME	Scientific name of the species	-
BTCCOD	Biotaxon code	-
SGKCOD		
WAARDE	Density of species.	Numbers per km^2
WAARDE	Density of species	Kg per km^2

Filename: **04_NSW trawlcatch_april.xls** **05_NSW trawlcatch_oct.xls** **06_Pelvog trawlcatch_nov.xls** **Format: DONAR**		
Field	**Description**	**Unit**
XCRDRK	Latitude, position of the haul.	Degrees Minutes Seconds Deci-seconds
[YCRDRK]	Longitude, position of the haul.	Degrees Minutes Seconds Deci-seconds
DATTYD	Date of observations.	Dd/mm/yyyy
	Time of observations.	Hhmm
SPECIES NAME	Scientific name of the species	-
BTCCOD	Biotaxon code	-
SGKCOD	Length, measured to half cm below for herring, sprat, anchovy and pilchard and to the cm below for all other species.	Cm
WAARDE	Density of species.	Numbers per hour trawling.

Filename:
07_Biological data age_april.xls
08_Biological data age_oct.xls

Format: DONAR

Field	Description	Unit
XCRDRK	Latitude, position of the centre of the wind farm area for fish collected in the baseline study. In April, for mackerel and horse mackerel no data from the Baseline study or surveys in the coastal area were available and survey data from the entire North Sea were used. For September/October, no data from the Baseline study were available for horse mackerel, mackerel, herring, sprat, lesser sandeel and Raitt's sandeel. For the latter two, no other data were available from surveys either because they were not caught. For the other species, data from surveys in the coastal zone were used. For data from surveys in the coastal zone, a central location in the wind farm area is chosen, as with data from the Baseline study. For data from the surveys in the entire North Sea, a central position in the North Sea was chosen.	Degrees Minutes Seconds Deci-seconds
[YCRDRK]	Longitude, description similar to that of latitude.	Degrees Minutes Seconds Deci-seconds
DATTYD	Date of the first day on which the survey was executed. These keys are constructed from data collected throughout the survey and thus from a period and not from a specific date. Therefore, a single day was chosen to determine the period the data were collected. For species of which no data within the baseline study were collected, the 1st of April and the 1st of September/October were assigned as dates. Data were collected from the 2nd and 4th quarter respectively. Only for sprat, no data from the 4th quarter were available and data from the 3rd quarter were selected and July 1st chosen as a date.	Dd/mm/yyyy
SPECIES NAME	Scientific name.	-
BTCCOD	Biotaxon code	-
SGKCOD	Length class	Cm
WAARDE	Percentage of the fish of this length class that has this age. For each age group, a separate column of 'waarde' is given.	Percentage

Filename:
09_Biological data sexmat_april.xls
10_Biological data sexmat_oct.xls

Format: DONAR

Field	Description	Unit
XCRDRK	Latitude, position of the centre of the wind farm area for fish collected in the baseline study. In April, for mackerel and horse mackerel no data from the Baseline study or surveys in the coastal area were available and survey data from the entire North Sea were used. For September/October, no data from the Baseline study were available for horse mackerel, mackerel, herring, sprat, lesser sandeel and Raitt's sandeel. For the latter two, no other data were available from surveys either. For the other species, data from surveys in the coastal zone were used. For data from surveys in the coastal zone, a central location in the wind farm area is chosen, as with data from the Baseline study. For data from the surveys in the entire North Sea, a central position in the North Sea was chosen.	Degrees Minutes Seconds Deci-seconds
[YCRDRK]	Latitude, description similar to that of longitude.	Degrees Minutes Seconds Deci-seconds
DATTYD	Date of the first day on which the survey was executed. These keys are constructed from data collected throughout the survey and thus from a period and not from a specific date. Therefore, a single day was chosen to determine the period the data were collected. For species of which no data within the baseline study were collected, the 1st of April and the 1st of October were assigned as dates. Data were collected from the 2nd and 4th quarter respectively. Only for sprat, no data from the 4th quarter were available and data from the 3rd quarter were selected and July 1st chosen as a date.	Dd/mm/yyyy
SPECIES NAME	Scientific name.	-
BTCCOD	Biotaxon code	-
SGKCOD	Length class	Cm
WAARDE	Percentage of the fish of this length class that has this sex and maturity stage. Sex and maturity stage. Sex: F: females; M: male: U: unknown. Maturity stages: 2: juvenile; 4: ripening; 6: ripe: 8: spent. Fish with stages 4, 6 and 8 are considered being mature. For each sex and maturity stage, a separate column is presented, e.g. M2 is males, stage 2.	Percentage

Filename:
11_NSW CTD.xls
12_Pelvog CTD.xls

Format: none

Field	Description	Unit
LATITUDE	Position of the CTD observations. The meaning of position varies by the surveys and periods, depending on how the CTD device was employed. NSW_PEL April: positions are positions of trawl hauls executed before the CTD was towed along the ship. The probe was not attached to the net but continuously towed along the vessel. NSW_PEL October and Vogels_vissen: the CTD probe was attached to the net and only operated during fishing. Positions are trawl positions.	Degrees Minutes Seconds Deci-seconds
LONGITUDE	Position of the CTD observations.	Degrees Minutes Seconds Deci-seconds
DATE	Data of the observations.	Dd/mm/yyyy
TEMP	Water temperature.	°C
SPCOND	Specific conductivity.	mS/cm
DO%	Dissolved oxygen as a percentage of the saturation level.	%
PH	Ph.	-
DEPTH	Depth at which the CTD probe was towed, not the water depth.	Meter
TURBIDITY	Turbidity.	NTU

Filename: **13_NSW Trawllist.xls** **14_Pelvog Trawllist.xls** **Format: none**		
Field	**Description**	**Unit**
SAMPLE_ID	RIVO sample ID for RIVO database	-
LATITUDE	Position of the trawl haul.	Degrees
LONGITUDE	Position of the trawl haul.	Degrees
DATE	Date of the trawl haul.	Mm/dd/yyyy
TIME	Time of the trawl haul.	Hh:mm GMT
AREA	Area code: NSW: Near Shore Wind farm area; RefN: Reference area North; RefZ: reference area south; Coast: the larger transects outside wind farm and reference area; North: area during 'vogels and vissen' project.	-
SHIP	Name of the vessel.	
DEPTH	Water depth at the trawl location	M
HAUL	Number of haul	-
HAUL DURATION	Duration of the trawl haul.	Minutes

Appendix II. Species names

Table II.1. *English, Dutch and scientific names of fish species.*

Name	Dutch name	Species	Family
Allis shad	Elft	Alosa alosa	Clupeidae
Anchovy	Ansjovis	Engraulis encrasicolus	Engraulidae
Bib	Steenbolk	Trisopterus luscus	Gadidae
Bull-rout	Zeedonderpad	*Myoxocephalus scorpius*	Cottidae
Cod	Kabeljauw	*Gadus morhua*	Gadidae
Dab	Schar	*Limanda limanda*	Pleuronectidae
Dragonet	Pitvis	*Callionymus lyra*	Callionymidae
Flounder	Bot	*Platichthys flesus*	Pleuronectidae
Four-bearded rockling	Vierdradige meun	*Enchelyopus cimbrius*	Gadidae
Greater sandeel	Smelt	*Hyperoplus lanceolatus*	Ammodytidae
Grey gurnard	Grauwe poon	*Eutrigla gurnardus*	Triglidae
Herring	Haring	*Clupea harengus*	Clupeidae
Horse mackerel	Horsmakreel	*Trachurus trachurus*	Carangidae
Lamprey	Rivierprik	*Lampetra fluviatilis*	Petromyzonidae
Lesser sandeel	Kleine zandspiering	*Ammodytes tobianus*	Ammodytidae
Lesser weever	Kleine pieterman	*Echiichthys vipera*	Trachinidae
Mackerel	Makreel	*Scomber scombrus*	Scombridae
Pilchard	Pelser	*Sardina Pilchardus*	Clupeidae
Plaice	Schol	*Pleuronectes platessa*	Pleuronectidae
Poor cod	Dwergbolk	*Trisopterus minutus*	Gadidae
Raitt's sandeel	Noorse zandspiering	*Ammodytes marinus*	Ammodytidae
Reticulated dragonet	Rasterpitvis	*Callionymus reticulatus*	Callionymidae
Scaldfish	Schurftvis	*Arnoglossus laterna*	Bothidae
Sole	Tong	*Solea vulgaris*	Soleidae
Solenette	Dwergtong	*Buglossidium luteum*	Soleidae
Sprat	Sprot	*Sprattus Sprattus*	Clupeidae
Transparent goby	Glasgrondel	*Aphia minuta*	Gobiidae
Tub gurnard	Rode poon	*Trigla lucerna*	Triglidae
Whiting	Wijting	*Merlangius merlangus*	Gadidae

Appendix III. Biological data

Data is presented per species per quarter on:

Age-length key.

Per length the fraction of sampled fish over the different ages is given. Also the total amount of sampled fish ("Total fish") is given per length class (cm).

Sex/maturity-length key.

Per length the fraction of sampled fish over the different sexes and maturity stages is given. F=female, M=male, U=unknown sex and maturity. 2=juvenile, 4=ripening, 6=ripe, 8=spent. Fishes with stages 4, 6 and 8 are considered being mature. Per sex the total fraction is also given per length ("Ftot" and "Mtot"). Also the total amount of sampled fish ("Total fish") is given per length class (cm).

Weight-length key.

The relationship between weight and length is described by an exponential function: $W=a \times L^b$, where W=weight (g), L=length. The parameters a and b are given.

Presented keys on:

Anchovy	Second quarter
Anchovy	Fourth quarter
Greater Sandeel	Second quarter
Greater Sandeel	Fourth quarter
Herring	Second quarter
Herring	Fourth quarter
Horse mackerel	Second quarter
Horse mackerel	Fourth quarter
Lesser Sandeel	Second quarter
Mackerel	Second quarter
Mackerel	Fourth quarter
Pilchard	Second quarter
Pilchard	Fourth quarter
Raitt's sandeel	Second quarter
Sprat	Second quarter
Sprat	Fourth quarter

Appendix III.1. Anchovy

Second quarter

fraction length	age 1	2	Total fish
11			
12	1.00		3
13	1.00		10
14	0.93	0.07	15
15	1.00		26
16	1.00		16
17	0.80	0.20	10
18	0.20	0.80	10
19		1.00	10
20		1.00	4
21			

fraction length	sex/maturity F 2	4	6	8	Ftot	M 2	4	6	8	Mtot	U	Total fish
11												
12	0.67				0.67				0.33	0.33		3
13	0.20	0.10			0.30	0.10	0.30			0.40	0.30	10
14		0.07	0.13	0.33	0.53		0.47			0.47		15
15		0.27	0.08	0.08	0.42		0.50	0.04		0.54	0.04	26
16		0.56	0.06		0.63		0.38			0.38		16
17		0.60	0.10		0.70		0.30			0.30		10
18		0.60			0.60		0.30	0.10		0.40		10
19		0.10	0.40	0.10	0.60		0.30	0.10		0.40		10
20			0.75		0.75			0.25		0.25		4
21												

Length-weight	
a	0.004
b	3.148

Anchovy

Fourth quarter 2003

fraction length	age 0	Total fish
7		
8	1.00	6
9	1.00	10
10	1.00	10
11	1.00	8
12	1.00	5

Length-weight	
a	0.009
b	2.776

Appendix III.2. Greater sandeel

Second quarter 2003

fraction length	age 0	1	2	3	4	Total fish
10						
11	1.00					2
12	1.00					1
13						
14						
15						
16				1.00		1
17						
18		0.80	0.20			5
19		0.33			0.67	3
20		1.00				2
21						
22			1.00			2
23			1.00			4
24			0.83		0.17	6
25			1.00			1
26				0.50	0.50	2
27				0.75	0.25	4
28				0.50	0.50	2
29				1.00		1
30						

fraction length	sex/maturity F 4	6	Ftot	M 4	6	8	Mtot	U	Total fish
10									
11								1.00	2
12								1.00	1
13									
14									
15									
16								1.00	1
17									
18	0.20	0.20	0.40			0.20	0.20	0.40	5
19				0.33			0.33	0.67	3
20					0.50	0.50	1.00		2
21									
22		0.50	0.50			0.50	0.50		2
23	0.25	0.25	0.50	0.25	0.25		0.50		5
24	0.50	0.17	0.67		0.33		0.33		6
25		1.00	1.00						1
26				0.50	0.50		1.00		2
27	0.75	0.25	1.00						4
28	0.50		0.50		0.50		0.50		2
29		1.00	1.00						1
30									

Length-weight	
a	0.003
b	3.016

Greater Sandeel

Fourth quarter 2003

fraction length	age 0	1	2	3	4	Total fish
13						
14	1.00					1
15						
16						
17						
18						
19						
20						
21						
22						
23			1.00			1
24			1.00			1
25		1.00				1
26			0.50	0.50		2
27					1.00	1
28				1.00		1
29						
30				1.00		1
31						

fraction length	sex/maturity F 8	Ftot	M 2	Mtot 8	Total fish
13					
14			1.00	1.00	1
15					
16					
17					
18					
19					
20					
21					
22					
23	1.00	1.00			1
24			1.00	1.00	1
25			1.00	1.00	1
26	0.50	0.50	0.50	0.50	2
27	1.00	1.00			1
28			1.00	1.00	1
29					
30	1.00	1.00			1
31					

Length-weight	
a	0.012
b	2.452

Appendix III.3. Herring

Second quarter 2003

fraction length	age 2	3	4	5	6	7	8	Total fish
10								
11	1.00							2
12	1.00							6
13	1.00							7
14	1.00							10
15	1.00							10
16	1.00							10
17	1.00							10
18	0.67	0.33						6
19	0.13	0.88						8
20		1.00						7
21		0.67	0.33					6
22		0.25	0.63	0.13				8
23		0.20	0.40	0.40				10
24			0.44	0.56				9
25			0.11	0.78		0.11		9
26				0.33	0.50		0.17	6
27				0.20		0.60	0.20	5
28								

fraction length	sex/maturity F 2	4	8	Ftot	M 2	4	8	Mtot	Total fish
10									
11					1.00			1.00	2
12	0.17			0.17	0.83			0.83	6
13	0.43			0.43	0.57			0.57	7
14	0.40			0.40	0.60			0.60	10
15	0.40			0.40	0.60			0.60	10
16	0.60			0.60	0.40			0.40	10
17	0.30			0.30	0.60	0.10		0.70	10
18	0.17	0.33		0.50	0.50			0.50	6
19	0.25			0.25	0.63	0.13		0.75	8
20	0.43			0.43	0.57			0.57	7
21	0.33	0.17		0.50	0.33	0.17		0.50	6
22	0.25			0.25	0.75			0.75	8
23		0.20	0.30	0.50		0.40	0.10	0.50	10
24		0.22	0.33	0.56		0.22	0.22	0.44	9
25		0.22	0.33	0.56		0.22	0.22	0.44	9
26			0.50	0.50			0.50	0.50	6
27			0.20	0.20			0.80	0.80	5
28									

Length-weight	
a	0.008
b	2.928

Herring

Fourth quarter 2003 (part 1)

fraction length	age 2	3	4	5	6	7	8	9	10	13	Total fish
19											
20		1.00									1
21		0.80	0.20								5
22	0.04	0.88	0.08								26
23		0.94	0.06								34
24	0.04	0.65	0.27	0.04							26
25		0.24	0.48	0.29							21
26		0.17	0.33	0.50							18
27		0.06	0.06	0.35	0.41	0.12					17
28			0.11	0.11	0.22	0.33	0.22				9
29			0.08		0.08	0.08	0.58	0.17			12
30						0.33	0.67				3
31							0.50		0.50		2
32										1.00	1
33											

Length-weight	
a	0.008
b	3.020

Herring

Fourth quarter 2003 (part 2)

fraction length	sex/maturity F 2	4	6	8	Ftot	M 2	4	Mtot	Total fish
19									
20		1.00			1.00				1
21	0.20	0.20			0.40		0.60	0.60	5
22	0.04	0.54			0.58	0.08	0.35	0.42	26
23		0.59		0.03	0.62		0.38	0.38	34
24		0.35		0.08	0.42		0.58	0.58	26
25		0.29		0.05	0.33		0.67	0.67	21
26		0.39			0.39		0.61	0.61	18
27		0.35			0.35		0.65	0.65	17
28		0.22	0.11		0.33		0.67	0.67	9
29		0.42			0.42		0.58	0.58	12
30		0.67			0.67		0.33	0.33	3
31		0.50			0.50		0.50	0.50	2
32		1.00			1.00				1
33									

Appendix III.4. Horse mackerel

Second quarter 2003 (part 1)

fraction length	age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	21	26	Total fish
14																				
15	1.00																			2
16	1.00																			22
17	0.95	0.05																		60
18	0.89	0.11																		65
19	0.76	0.24																		17
20	0.48	0.52																		21
21	0.34	0.63	0.03																	35
22		0.63	0.38																	16
23		0.17	0.67	0.06	0.11															18
24			0.19	0.53	0.14	0.06	0.06	0.03												36
25			0.02	0.40	0.30	0.14	0.05	0.05	0.02	0.02										43
26				0.06	0.27	0.27	0.12	0.15	0.12											33
27				0.03	0.18	0.18	0.15	0.15	0.13	0.13	0.05									39
28						0.23	0.18	0.13	0.28	0.05	0.10	0.05								40
29						0.06	0.06	0.20	0.29	0.17	0.09	0.06		0.03				0.06		35
30					0.06	0.12		0.12	0.06	0.29	0.06	0.12	0.12			0.06				17
31							0.10	0.10	0.30	0.10	0.20	0.20								10
32							0.20					0.20	0.20	0.20	0.20					5
33											0.67	0.33								3
34												0.33		0.33	0.33					3
35																	1.00			1
36														0.50					0.50	2
37																		1.00		1
38																				

Length-weight	
a	0.026
b	2.614

Horse mackerel

Second quarter 2003 (part 2)

fraction	sex/maturity F				Ftot	M			Mtot	
length	2	4	6	8		2	6	8		Total fish
14										
15						1.00			1.00	2
16	0.41				0.41	0.59			0.59	22
17	0.45				0.45	0.55			0.55	60
18	0.26	0.02	0.02	0.09	0.38	0.45	0.05	0.12	0.62	65
19	0.41		0.06	0.12	0.59	0.18	0.06	0.18	0.41	17
20	0.14		0.19	0.05	0.38	0.10	0.48	0.05	0.62	21
21			0.51	0.06	0.57	0.03	0.31	0.09	0.43	35
22			0.25		0.25		0.69	0.06	0.75	16
23			0.22		0.22		0.78		0.78	18
24			0.67		0.67		0.33		0.33	36
25			0.56	0.02	0.58		0.40	0.02	0.42	43
26			0.64		0.64		0.30	0.06	0.36	33
27			0.62		0.62		0.36	0.03	0.38	39
28			0.38		0.38		0.63		0.63	40
29			0.51		0.51		0.46	0.03	0.49	35
30			0.47		0.47		0.53		0.53	17
31			0.80		0.80		0.20		0.20	10
32			0.40		0.40		0.60		0.60	5
33			0.33		0.33		0.67		0.67	3
34							1.00		1.00	3
35							1.00		1.00	1
36			1.00		1.00					2
37			1.00		1.00					1
38										

Horse mackerel

Fourth quarter 2003 (part 1)

fraction length	age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	21	Total fish
16																	
17	1.00																1
18	1.00																8
19	0.92	0.08															12
20	0.60	0.40															5
21	0.57	0.43															7
22	0.20	0.62	0.16	0.02													50
23		0.63	0.35	0.02													46
24		0.05	0.55	0.41													22
25			0.06	0.65	0.23	0.06											31
26				0.20	0.65	0.15											20
27				0.15	0.54	0.23		0.08									13
28					0.25	0.38	0.38										8
29					0.17		0.17	0.50	0.17								6
30						0.50	0.17	0.17		0.17							6
31							0.25			0.25	0.50						4
32										0.33		0.67					3
33										0.33	0.33		0.33				3
34									0.50						0.50		2
35																	
36													0.33	0.33		0.33	3
37																	

Length-weight	
a	0.005
b	3.204

Horse mackerel

Fourth quarter 2003 (part 2)

fraction length	sex/maturity F 2	4	8	Ftot	M 2	8	Mtot	Total fish
16								
17					1.00		1.00	1
18	0.38			0.38	0.63		0.63	8
19	0.33			0.33	0.67		0.67	12
20	0.40			0.40	0.40	0.20	0.60	5
21			0.57	0.57		0.43	0.43	7
22			0.46	0.46	0.02	0.52	0.54	50
23			0.50	0.50		0.50	0.50	46
24			0.36	0.36		0.64	0.64	22
25			0.58	0.58		0.42	0.42	31
26		0.05	0.35	0.40		0.60	0.60	20
27			0.38	0.38		0.62	0.62	13
28			0.25	0.25		0.75	0.75	8
29			0.33	0.33		0.67	0.67	6
30		0.33	0.17	0.50		0.50	0.50	6
31		0.50		0.50		0.50	0.50	4
32			0.33	0.33		0.67	0.67	3
33			0.67	0.67		0.33	0.33	3
34			0.50	0.50		0.50	0.50	2
35								
36			0.67	0.67		0.33	0.33	3
37								

Appendix III.5. Lesser sandeel

Second quarter 2003

fraction length	age 0	1	2	3	4	5	6	7	8	9	Total fish
8											
9		1.00									4
10		1.00									8
11		1.00									1
12											
13											
14											
15	0.14		0.57	0.14		0.14					7
16			0.25	0.38	0.25	0.13					8
17				0.11	0.33	0.33	0.22				9
18					0.29		0.29	0.29	0.14		7
19						0.29	0.29		0.43		7
20							0.14	0.29	0.29	0.29	7
21											

fraction length	sex/maturity F 2	4	6	8	Ftot	M 4	6	Mtot	U	Total fish
8										
9									1.00	4
10									1.00	8
11									1.00	1
12										
13										
14										
15	0.14	0.14			0.29		0.14	0.14	0.57	7
16		0.25			0.25				0.75	8
17		0.33		0.11	0.44				0.56	9
18		0.29		0.57	0.86	0.14		0.14		7
19		0.14	0.29	0.43	0.86				0.14	7
20		0.14	0.29	0.43	0.86				0.14	7
21										

Length-weight	
a	0.003
b	3.033

Appendix III.6. Mackerel

Second quarter 2003 (part 1)

fraction length	age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total fish
18																
19		1.00														1
20																
21																
22	1.00															6
23	1.00															3
24																
25		1.00														1
26		1.00														9
27		1.00														14
28		1.00														23
29		0.97	0.03													61
30		0.95	0.04	0.02												56
31		0.72	0.17	0.11												53
32		0.46	0.21	0.26	0.03	0.02	0.02									61
33		0.17	0.26	0.40	0.17											47
34		0.07	0.26	0.41	0.16	0.05	0.04									73
35		0.01	0.14	0.43	0.26	0.08	0.05	0.01								76
36		0.01	0.10	0.36	0.28	0.09	0.07	0.03	0.01	0.03						67
37			0.02	0.14	0.45	0.27	0.06	0.04			0.02					49
38		0.02		0.19	0.30	0.25	0.09	0.11	0.02	0.02						53
39			0.02	0.04	0.30	0.23	0.21	0.13	0.05				0.02			56
40				0.03	0.05	0.42	0.14	0.12	0.12	0.08	0.02				0.02	59
41					0.02	0.09	0.30	0.23	0.13	0.19	0.04					47
42						0.03	0.26	0.35	0.16	0.16	0.03					31
43							0.08	0.38	0.31	0.08	0.08	0.08				13
44								0.50		0.30	0.10	0.10				10
45						0.20		0.20		0.20				0.40		5
46									1.00							1

Length-weight	
a	0.007
b	3.001

Mackerel

Second quarter 2003 (part 2)

fraction	sex/maturity F				Ftot	M				Mtot	
length	2	4	6	8		2	4	6	8		Total fish
18											
19						1.00				1.00	1
20											
21											
22	0.33				0.33	0.67				0.67	6
23	0.67				0.67	0.33				0.33	3
24											
25							1.00			1.00	1
26	0.33				0.33	0.56	0.11			0.67	9
27	0.43	0.07			0.50	0.14	0.21	0.14		0.50	14
28	0.35	0.13	0.04		0.52	0.22	0.09	0.09	0.09	0.48	23
29	0.36	0.15	0.02	0.07	0.59	0.15	0.08	0.10	0.08	0.41	61
30	0.18	0.25	0.05	0.07	0.55	0.09	0.13	0.14	0.09	0.45	56
31	0.11	0.15	0.06	0.13	0.45	0.04	0.25	0.19	0.08	0.55	53
32	0.02	0.15	0.11	0.07	0.34		0.18	0.31	0.16	0.66	61
33		0.11	0.28	0.11	0.49		0.15	0.21	0.15	0.51	47
34		0.14	0.22	0.16	0.52		0.08	0.25	0.15	0.48	73
35		0.17	0.22	0.16	0.55		0.09	0.20	0.16	0.45	76
36		0.04	0.30	0.15	0.49		0.03	0.37	0.10	0.51	67
37		0.04	0.29	0.10	0.43		0.04	0.35	0.18	0.57	49
38		0.02	0.34	0.11	0.47		0.02	0.38	0.13	0.53	53
39		0.11	0.27	0.14	0.52		0.02	0.30	0.16	0.48	56
40		0.02	0.34	0.17	0.53			0.31	0.17	0.47	59
41		0.02	0.38	0.15	0.55			0.30	0.15	0.45	47
42		0.03	0.29	0.19	0.52			0.35	0.13	0.48	31
43			0.46	0.23	0.69			0.23	0.08	0.31	13
44		0.10	0.30	0.10	0.50		0.10	0.20	0.20	0.50	10
45			0.20	0.60	0.80		0.20			0.20	5
46		1.00			1.00						1

Mackerel

Fourth quarter 2003

fraction length	age 0	1	2	5	9	Total fish
22						
23	1.00					2
24	1.00					1
25						
26		1.00				5
27		1.00				5
28		1.00				12
29		0.63	0.38			8
30		0.83	0.17			12
31		1.00				1
32			1.00			1
33			1.00			1
34						
35					1.00	1
36						
37						
38				1.00		1
39						

fraction length	sex/maturity F 2	8	Ftot	M 2	8	Mtot	Total fish
22							
23	0.50		0.50	0.50		0.50	2
24				1.00		1.00	1
25							
26	0.40		0.40	0.60		0.60	5
27	0.20		0.20	0.80		0.80	5
28	0.25		0.25	0.75		0.75	12
29	0.50		0.50	0.50		0.50	8
30	0.42		0.42	0.58		0.58	12
31	1.00		1.00				1
32					1.00	1.00	1
33		1.00	1.00				1
34							
35					1.00	1.00	1
36							
37							
38					1.00	1.00	1
39							

Length-weight	
a	0.011
b	2.892

Appendix III.7. Pilchard

Second quarter 2003

fraction length	age 2	4	5	6	7	8	9	10	11	13	Total fish
19											
20	1.00										1
21											
22		1.00									1
23		1.00									10
24		0.90		0.10							10
25		0.30	0.30			0.30	0.10				10
26			0.08	0.17	0.08	0.17	0.25	0.17	0.08		12
27						0.50	0.50				4
28				0.20			0.40		0.20	0.20	5
29											

fraction length	sex/maturity F 6	Ftot	M 4	6	Mtot	Total fish
19						
20				1.00	1.00	1
21						
22			1.00		1.00	1
23	0.10	0.10	0.90		0.90	10
24			1.00		1.00	10
25	0.60	0.60	0.30	0.10	0.40	10
26	0.58	0.58	0.42		0.42	12
27	1.00	1.00				4
28	1.00	1.00				5
29						

Length-weight	
a	0.062
b	2.383

Pilchard

Fourth quarter 2003

fraction length	age 0	4	7	Total fish
8				
9	1.00			8
10	1.00			9
11	1.00			9
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23		1.00		1
24				
25			1.00	1

fraction length	sex/maturity M 4	U	Total fish
8			
9		1.00	8
10		1.00	9
11		1.00	9
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	1.00		1
24			
25	1.00		1

Length-weight	
a	0.005
b	3.141

Appendix III.8. Raitt's sandeel

Second quarter 2003

fraction length	age 1	2	3	4	5	6	7	12	Total fish
10									
11	0.25	0.75							4
12		1.00							9
13		1.00							19
14		0.89	0.06					0.06	18
15		0.91	0.09						11
16		0.70	0.10	0.20					10
17		0.22	0.11	0.11	0.22	0.11	0.22		9
18					0.25		0.75		8
19			0.20		0.20		0.60		5
20									

fraction length	sex/maturity F 4	6	8	Ftot	U	Total fish
10						
11					1.00	4
12					1.00	9
13					1.00	19
14					1.00	18
15					1.00	11
16	0.10			0.10	0.90	10
17		0.22	0.33	0.56	0.44	9
18			0.50	0.50	0.50	8
19	0.20		0.40	0.60	0.40	5
20						

Length-weight	
a	0.005
b	2.738

Appendix III.9. Sprat

Second quarter 2003

fraction length	age 1	2	3	4	Total fish
7					
8	1.00				2
9	1.00				9
10	0.13	0.38	0.50		8
11		0.57	0.43		7
12		0.83	0.17		6
13		0.14	0.57	0.29	7
14					

Length-weight	
a	0.004
b	3.220

fraction length	sex/maturity F 4	6	8	Ftot	M 4	6	8	Mtot	Total fish
7									
8		0.50		0.50	0.50			0.50	2
9		0.56		0.56	0.33	0.11		0.44	9
10		0.50		0.50	0.13	0.38		0.50	8
11		0.43		0.43		0.57		0.57	7
12		0.50	0.33	0.83		0.17		0.17	6
13	0.14	0.71		0.86			0.14	0.14	7
14									

Sprat

Third quarter 2003

fraction length	age 1	2	3	Total fish
8				
9	0.94	0.06		16
10	0.96	0.04		23
11	0.83	0.17		42
12	0.64	0.25	0.11	28
13		0.83	0.17	23
14		0.82	0.18	17
15		0.50	0.50	2
16				

fraction length	sex/maturity F 2	4	Ftot	M 2	4	Mtot	Total fish
8							
9	0.44	0.19	0.63	0.19	0.19	0.38	16
10	0.09	0.48	0.57	0.04	0.39	0.43	23
11		0.48	0.48	0.07	0.45	0.52	42
12		0.50	0.50		0.50	0.50	28
13		0.57	0.57		0.43	0.43	23
14		0.65	0.65		0.35	0.35	17
15		1.00	1.00				2
16							

Length-weight	
a	0.058
b	2.850