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RIVO report

Number: C013/03

Base line studies North Sea wind farms: strategy of approach for pelagic fish

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Commissioned by: Ministry of Transport, Public Works and Water Management
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Project number: 3161268002

Contract number: RKZ-1273

Approved by: E. Jagtman
Head of the Department

Signature: _____

Date: 27 March 2003

Number of copies: 10
Number of pages: 20
Number of tables: 6
Number of figures: 6
Number of annexes: 1

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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 ecological reference situation in order to evaluate future effects of planned wind farms. This report describes the detailed plan of approach to establish the occurrence, density, population structure and migration patterns of pelagic fish fauna in the Dutch coastal zone. Sampling sites have been 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. In April and September 2003, pelagic fish will be 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. Sampling methods are acoustic surveys combined with trawl hauls. Length distributions will be assessed for all fish species caught in the trawl, and functional biological data (age, weight, sex and maturity) will be collected for a selection of species. Data collected will be delivered in the standard Donar Interface Format. The final report will focus on a detailed description of the pelagic fish community in the Dutch coastal zone, on an integration of all results and on a discussion of the possible effects of a wind farm on the pelagic fish community.

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 ecological reference (present) situation in order to evaluate future effects. In 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. RIVO Netherlands Institute for Fisheries Research is responsible for the baseline study on pelagic fish. This report presents a detailed strategy of approach for describing the reference situation for pelagic fish in the Dutch coastal zone.

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 specific terms of reference for this study are as follows:

- A detailed survey is needed to describe the reference situation because long-term data on pelagic fish are, in contrast to demersal fish, scattered and incidental;
- Monitoring has at least to result in data on number, density, weight, length-frequency distribution and age-length distribution per species;
- Frequency of monitoring must be sufficient to describe the reference situation not only in space, but also in time (seasonal variability);
- The number of samples that need to be collected must depend on the homogeneity of the seabed morphology in the area (grain size, depth), it is important that enough samples are collected to be able to describe the spatial variation and population structure of the area in the reference situation;
- The sampling programme must be designed in such a way that possible impacts can be shown, the most important impact is expected to be the closure of the area for fishery activities;
- The sample tracks must be registered;
- To be able to select reference areas for the impact study, an area around the wind farm area must be included in the programme. The surface of the area and the number of samples must be large enough to be able to select at least 2 reference areas of the same size as the wind farm area, which are similar to the wind farm area on the following points: seabed morphology, water depth, water currents and species community. In this report, the selection procedure of reference sites based on these criteria will be described.

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

Because RIVO is also involved in the impact study for the Near Shore Wind farm (MEP-NSW), the sampling programme for this baseline study is designed such that it can be copied to the impact study. Similar sampling programmes before and after the creation of the Near Shore Wind farm provide a unique opportunity to assess the impact of a wind farm on the pelagic fish community.

In this report a detailed description of the sampling programme (locations, period and methods) is given in Chapter 2. Chapter 3 describes how the data will be analysed and describes the fieldwork reports, final report and database delivery. In Chapter 4 the planning in time will be discussed and all activities described briefly.

2. Sampling programme

2.1 Sampling period and sampling locations

In order to be able to assess temporal variation in the pelagic fish community, pelagic fish will be sampled twice, in April and September 2003 (weeks 16,17 and 40,41). From the catches of commercial fishermen we know that the occurrence of pelagic species along the Dutch coast varies significantly over time (Figure 1) and between spring and the end of summer/ autumn. In addition, April and September represent periods with low (April) and high (September) water temperatures. Therefore we expect that sampling in April and September represents the variation in community structure well.

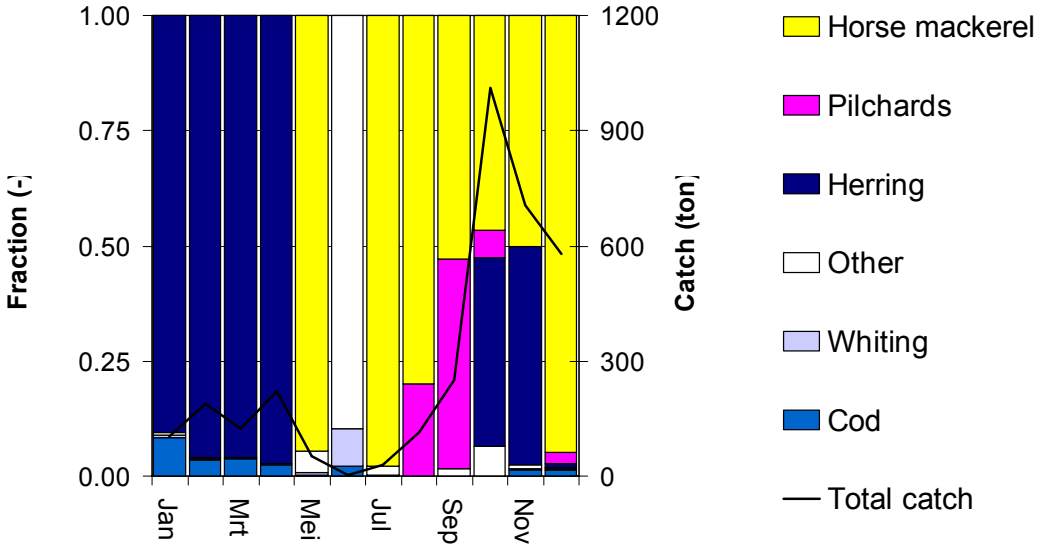

Figure 1. *Average monthly catch (kg) in pelagic gears with ships >300 hp with the fraction of species in the total catch on the left y-axis (in terms of biomass), and the total catch on the right y-axis. Data averaged for 1995-2000 from VIRIS database in which all landings of Dutch fishermen are registered. Data of ships <300 hp are left out because the data were not reliable. Data from the Dutch coastal zone (ICES rectangles 34F3, 34F4, 33F3, 33F4, 32F3, 32F4 en 31F3) extending the 12-miles zone. Therefore, these data are only an illustration and may not be considered fully representative for the fish community that is sampled in the programme described here (Grift et al., 2001).*

Sampling sites will be 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. Therefore, pelagic fish will be 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. The high resolution is required to be able to detect the effect of a wind farm on pelagic fish. If, for example, in the impact study high concentrations of fish in the wind farm are detected, we need to know whether such concentrations also occurred in the reference situation without the wind farm. Additional sampling with a lower resolution in a larger area is required because certain pelagic fish species swim in schools and have very patchy distributions (Figure 2).

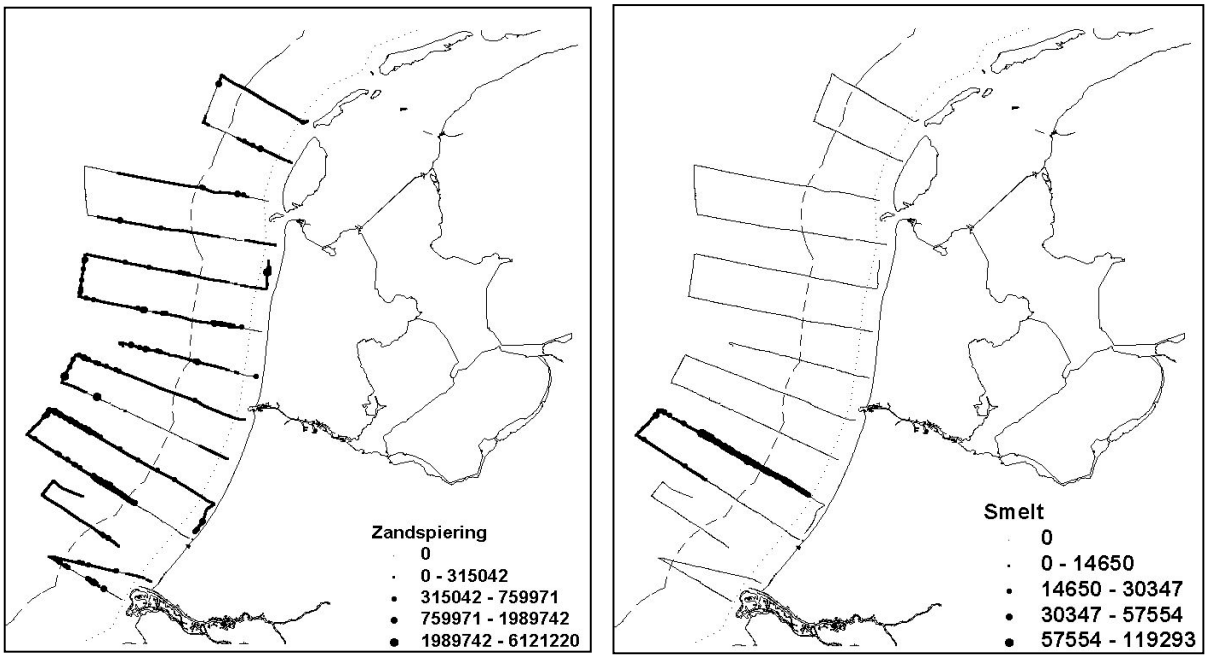

Figure 2. *Spatial distribution of sand-eel ('zandspiering'; left panel) and greater sand-eel ('smelt'; right panel) in the Dutch coastal zone (June 2002). Data from acoustic surveys, combined with trawl catches within the Flyland project. Numbers are numbers per km^2. Greater sand-eel has a very patchy distribution and was only observed in the southern part of the sampling area, whereas sand-eel was more widely spread and was observed throughout the sampling area (Grift et al., 2002).*

As described, two reference areas that 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 must be included in the programme. In June 2002, we observed a gradient in the density of certain pelagic fish species from near shore to off shore. Therefore, a reference site can best be selected at a similar distance from the coast as the planned wind farm area. Because the distribution of pelagic fish over time is variable, we cannot select an area based on this criterium alone. We do not have information on water currents. Therefore we have selected reference areas just south and north of the planned wind farm area and assume that water currents are similar in these areas. Water depth varies slightly within the planned wind farm area, but two reference sites with similar bathymetry and similar distances from the coast can be selected (Figure 3).

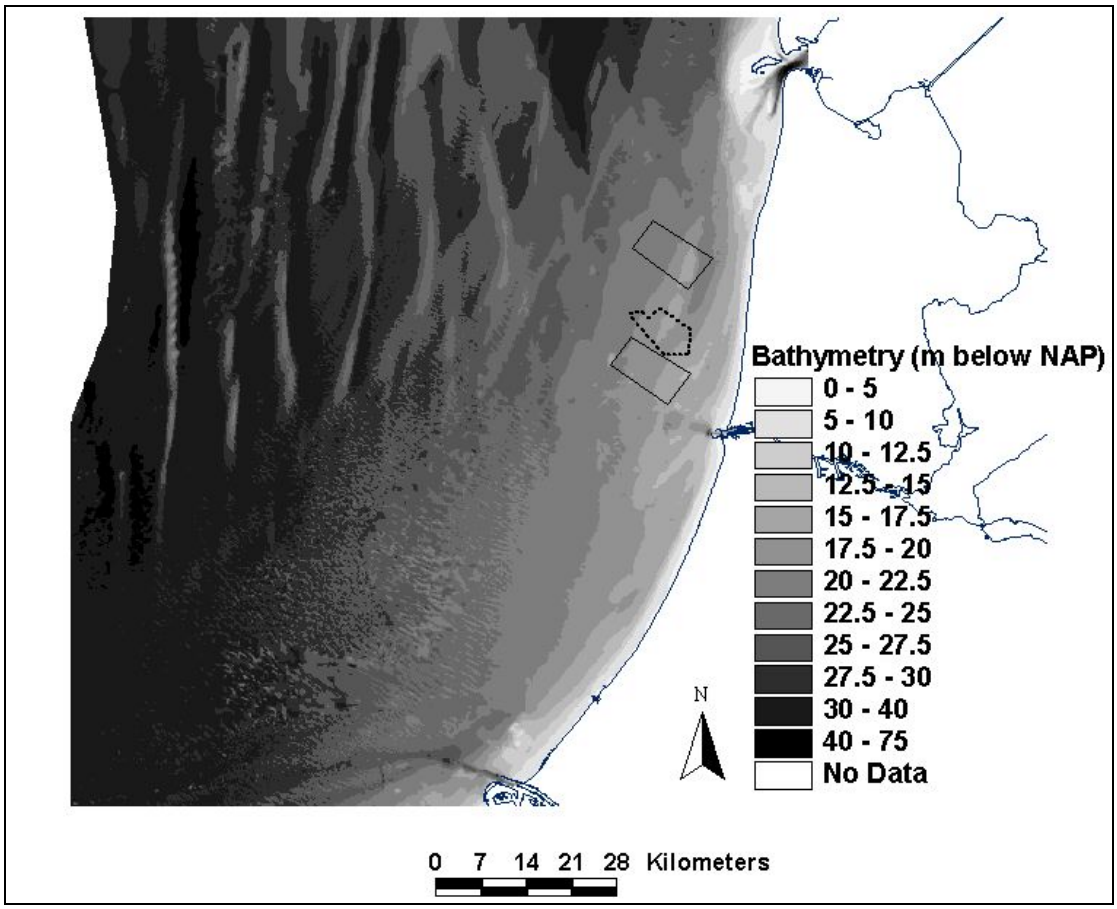

Figure 3. *Bathymetry of the Dutch coastal zone. The dotted line indicates the planned area of the wind farm, the solid squares indicate reference areas. GIS data from the Flyland project (2001).*

Regarding the characteristics of the sediment, only the grain size of the sediment varies in the coastal zone (Figure 4) and not the silt content. Within the wind farm, however, grain size does not vary significantly and within the coastal zone it only varies slightly. One reference area was selected that has a similar sediment structure to the planned wind farm area (the southern area), and one reference area was selected that has a slightly coarser sediment structure (northern area).

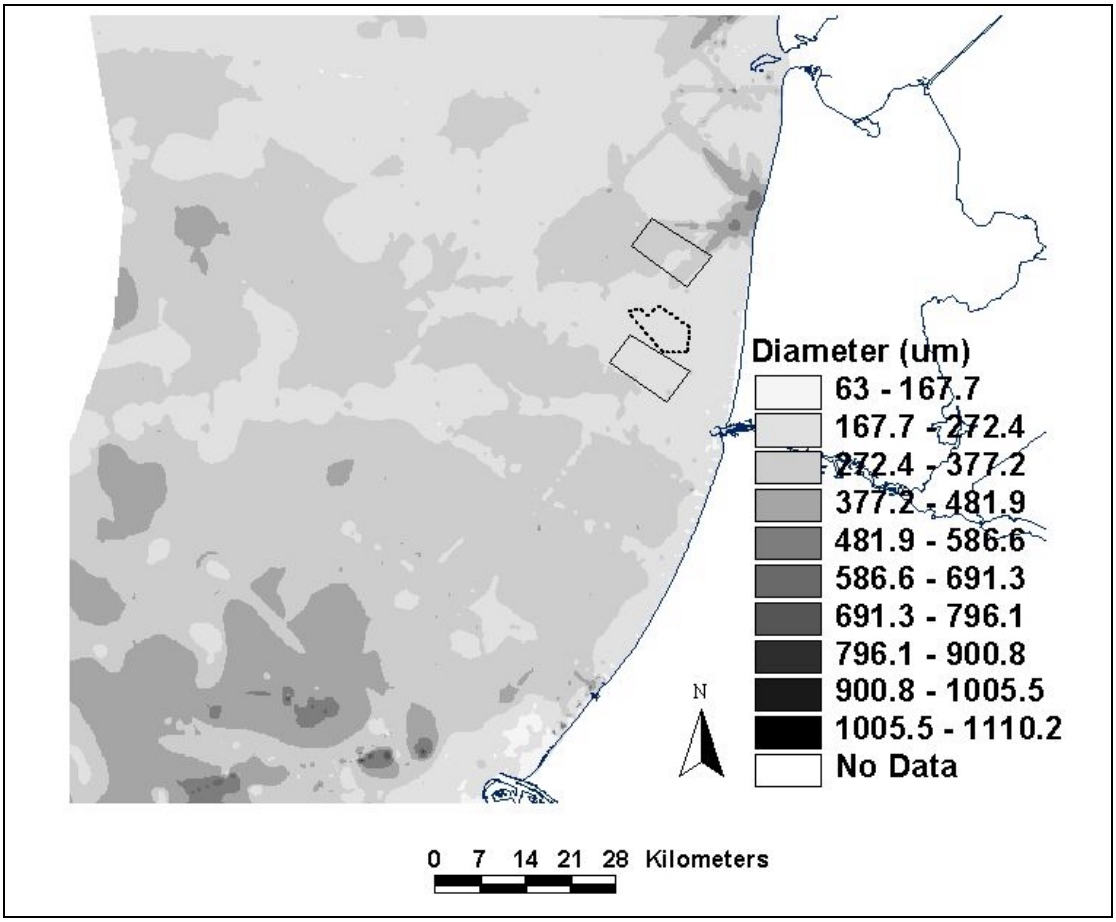

Figure 4. *Grain size of the sediment (diameter in µm) in the Dutch coastal zone.The dotted line indicates the planned area of the wind farm, the solid squares indicate reference areas. GIS data from the Flyland project (2001).*

Now we have selected the reference sites, and have determined the set-up of the sampling programme (high resolution in the planned wind farm area and reference sites, lower resolution in a larger area), we can define the sampling scheme (Figure 5). Pelagic fish will be sampled along the transects that are indicated in Figure 5. This sampling scheme provides a detailed description in the areas of particular interest, but also provides a description of the pelagic fish community in the whole coastal zone. The transects with a high resolution are 8-10 km long (the size of the windfarm) and are 0.5-1 km apart so that several of these transects would fit in the windfarm area. The sampling transects for the larger area are based on the sampling scheme for the Flyland project, carried out in June 2002, which provided good insight in the pelagic fish community in the coastal zone.

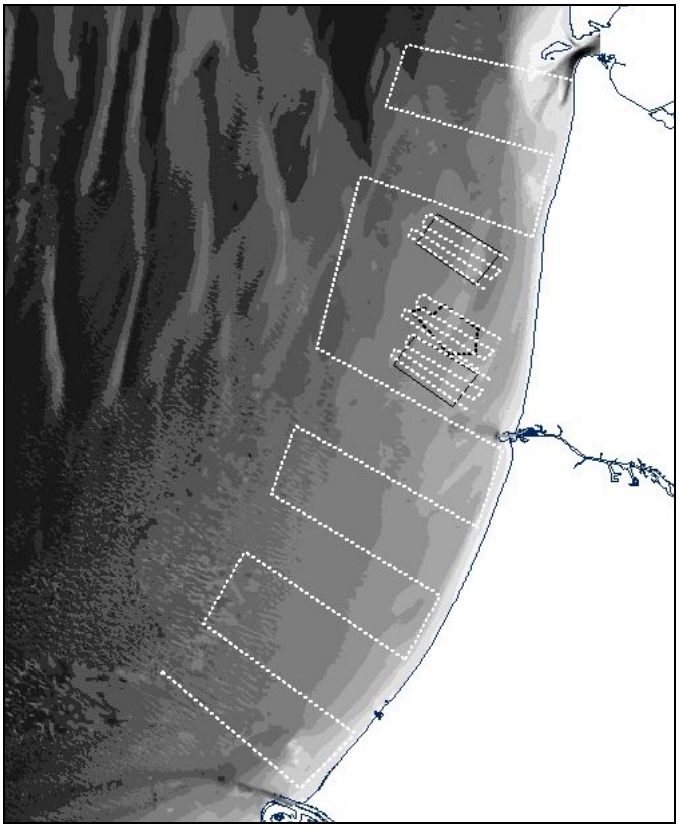

Figure 5. *Survey design to describe the reference situation of the pelagic fish community in the Dutch coastal zone. The white dotted lines indicate the transects along which pelagic fish will be sampled: with a high spatial resolution in the planned wind farm area and both references areas, and with a low resolution in a larger area.*

2.2 Methods and equipment

The occurrence, density and population structure of the pelagic fish fauna in the reference situation will be assessed by means of echo integration and reference trawl hauls during two hydro-acoustic surveys. Echo surveys are an efficient tool in describing spatial distribution and size distributions of pelagic fish over a large area. Additional trawl hauls are, however, required to validate the acoustic fish density and distribution observations and to collect biological data (age, sex, maturity). When with the acoustic equipment a school of fish is observed, the species and length distribution of this school will be assessed by making a trawl haul (Figure 6). The net is shot within 15 to 20 minutes after detecting an aggregation of fish with the acoustic equipment. These hauls cannot be planned in advance because they depend completely on the number of fish observed. For all surveys we will charter the same commercial vessel, the same as has been used in the Flyland project.

We will use a Simrad EK60 echosounder with 38 kHz and 200 kHz splitbeam transducers. The splitbeam transducers will be calibrated at the beginning of each sampling period. For postprocessing we will use Echoview (Sonardata) or BI60 (Simrad) software. For reference hauls and the collection of biological data, we will use a semi pelagic trawl (vertical netopening varying between 5 and 15 m; mesh size 6 mm) with a chartered cutter. Positions of all tracks will be recorded with a dGPS device.

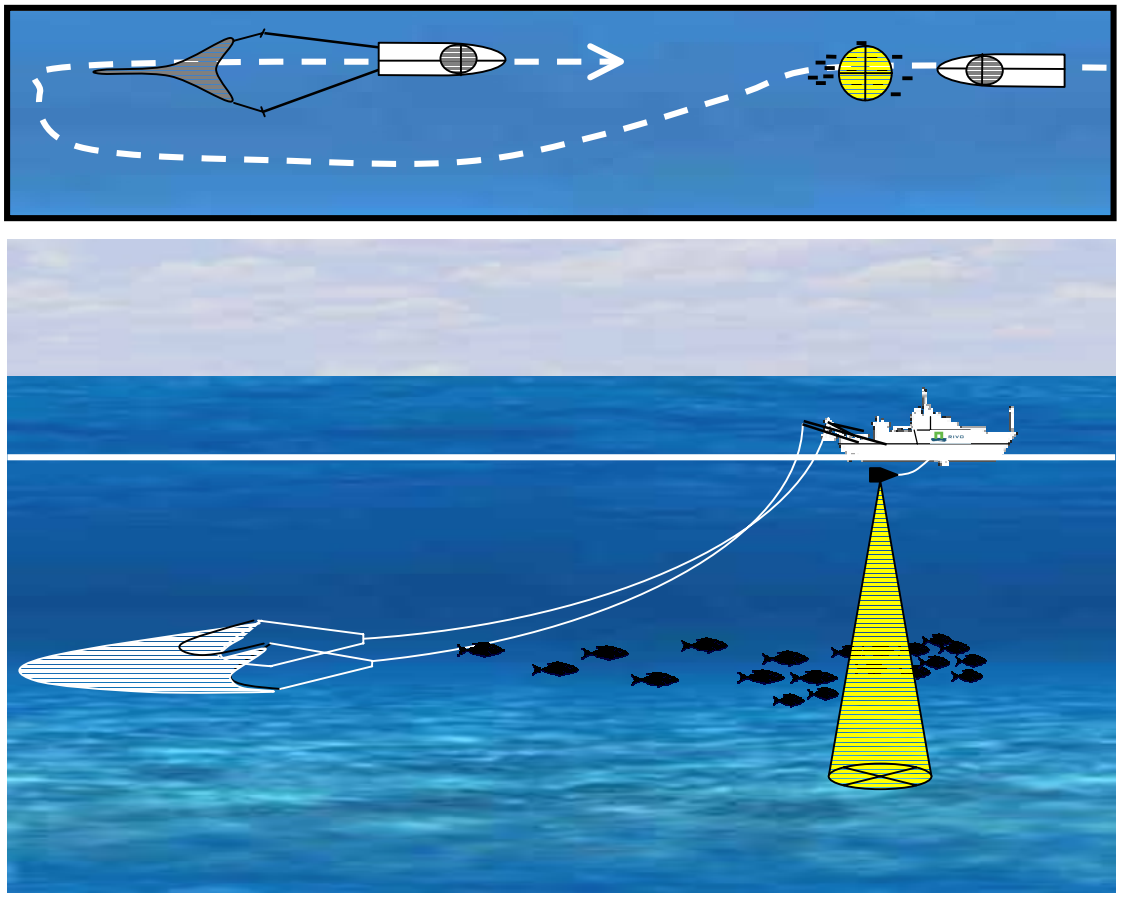

Figure 6. *Scheme of the sampling methods for pelagic fish. The acoustic equipment transmits and receives signals (pings) that are reflected by objects in the water column (fish, bottom). The strength of the reflection of the signal is a measure for the size of the object (fish). The relationship between the strength of the signal and fish length is species specific. The time between transmitting and receiving the signal is a measure for the distance between the transducer and the fish. To identify the species, to assess the length distribution and to collect biological data, a sample of the fish is taken with a pelagic trawl. The net is shot within 15 to 20 minutes after detecting an aggregation of fish with the acoustic equipment.*

Environmental conditions at sampling locations will be measured using a CTD measuring device. This device, attached to the towed body that also contains the transducers, continuously records water temperature, conductivity and turbidity. Positions of all tracks sampled with the CTD will be recorded with a dGPS device. In addition to the CTD, at all trawl stations visibility will be measured with a secchi-disk. The use of the CTD data will contribute to the explanation of the spatial distribution of different species. Hence, variation in species distributions and -composition in the impact study can be explained better and the possible influences of a wind farm on fish can be detected better. In addition, these abiotic data can be combined with abiotic data collected in other lots, such as grain size in lot 1. By combining these data, variation in, for example, turbidity may be explained by factors such as grain size.

During each period, fish will be sampled for two weeks but, the sampling period can be extended with two weeks depending on weather conditions. In the months April and September these extra two weeks are assumed to be sufficient.

2.3 Processing of the acoustic data and trawl catches

The sampling programme yields two types of data: acoustic signals and catch data from the trawl hauls. In addition to the catch data, biological data (age, length, weight, sex and maturity) will be collected from a selection of the catch. The acoustic signals will be translated in densities of fish species using the catch data. Therefore, the acoustic data are scrutinized using the information on species and length distributions in the trawl catches. All data will be used to estimate densities (numbers per km^2) per species, sex, age and length category.

For all fish species caught in the trawl, length distributions will be assessed and of a selection of species, biological data will be collected. Selection criteria to collect biological data are species abundance and the existence of biological data of a species from previous sampling. InJune 2002, RIVO carried out a survey that is comparable to the one proposed here and observed 9 species in the Dutch coastal zone (Table 1). In total, more than 900.000 fish were caught in the trawl. Based on these observations we can plan the collection of biological data in the current project. We must realize, however, that the observations in this project may differ from the observations in June 2002 because we will sample in different periods of the season.

Table 1. Total numbers and minimum and maximum length of fish caught with a trawl in a survey for pelagic fish in the Dutch coastal zone, June 2002 (Flyland project).

	Species	Total	Min. length (cm)	Max. length (cm)
1	Sprat	686445	8	16
2	Herring	104228	5	28
3	Whiting	43663	13	35
4	Sand-eel	39354	6	21
5	Anchovy	22592	10	22
6	Horse mackerel	2663	11	36
7	Mackerel	842	20	40
8	Greater sand-eel	231	13	31
9	Pilchard	141	21	28
Total		900159		

Biological data are available for sprat, herring, whiting, horse mackerel and mackerel from routine market sampling programmes of RIVO. Biological data of these species will only be collected if we have the impression that they may differ from the existing data, if we, for example, observe length classes that are not present in the market samples. At present, no age-length keys are known from sand-eel, anchovy, greater sand-eel and pilchard off the Dutch coast. The baseline study will provide this type of information. These species, however, must be abundant enough to make quantitative relationships possible: it is pointless to read otoliths of rare species.

Age-length keys and weight of fish will be determined in the laboratory. The age of fish will be determined by counting growth zones in the otoliths. After the first sampling period, we will set up the ageing of these species in cooperation with experts from other research institutes. After the second sampling period when all otoliths have been collected, all selected otoliths will be processed. The collection of all data is summarized in Table 2:

Table 2. Summary of data we plan to collect. Planning based on catches in similar surveys in the Dutch coastal zone in June 2002. Symbols: '+' indicates we will collect this type of data in the current project; '-' indicates we will retrieve this type of data from other sampling programmes. The protocol for the age determination of sand-eel, anchovy, greater sand-eel and pilchard needs to be developed in the current project.

	Species	Length	Weight	Sex	Maturity	Age
1	Sprat	+	-	-	-	-
2	Herring	+	-	-	-	-
3	Whiting	+	-	-	-	-
4	Sand-eel	+	+	+	+	+
5	Anchovy	+	+	+	+	+
6	Horse mackerel	+	-	-	-	-
7	Mackerel	+	-	-	-	-
8	Greater sand-eel	+	+	+	+	+
9	Pilchard	+	+	+	+	+

2.4 Quality assurance

RIVO is ISO 9001 certified and its internal procedures and quality system are checked annually by Det Norske Veritas. Within this quality system, procedures for all aspects of the project, from management to report writing are described. The projectleader is responsible for managing the project in accordance with this quality system.

All reports will be reviewed internally by a senior scientist who is also involved in the survey design and the analysis of the data. The projectteam (Table 3) will have at least three plenary meetings, at the beginning, half way and at the end of the project. In addition, meetings with a selection of team members will be organised to discuss specific topics.

Because we only have limited experience with ageing the pelagic fish species which occur in the Dutch coastal zone, we will ask colleagues from other fisheries institutes abroad to check the ageing of fish. Development of expertise on these 'new' species will be assisted by a person who has ample experience on other pelagics such as herring and sprat.

Audits by independent persons can be carried out to check the collection or the analysis of data. The auditors will be appointed by the client (RIKZ).

Table 3. Members and roles of the projectteam.

	Member	Role
1	Dr. Rob Grift	Projectmanagement.
2	Dr. Joep de Leeuw	Senior scientist, advisor, reviewer.
3	Bram Couperus	Expert in acoustics, acoustic survey design, analysis of acoustic data, report writing.
4	Sytse Ybema Msc.	Acoustic surveys, analysis of acoustic data, report writing.
5	Ronald Bol	Acoustic surveys.
6	Kees Bakker	Technical aspects acoustic surveys.
7	André Dijkman Dulkes	Otolith readings, development otolith expertise.
8	Wouter Patberg Msc.	Database manager, export to DIF.
9	Ms. Rieneke de Jager Bsc.	Database management, quality control of data.

3. Data analysis, report writing and database delivery

3.1 Data analysis

The acoustic data will be translated into densities per species, size class, sex and age by combining the acoustic signals with the catch data and biological data. Of all species, density (numbers per area sampled) and size distributions per sampling period and sampling location will be assessed. These results will be presented in tables, figures and in a GIS. The spatial and temporal variation in fish community structure will be described and these results will be discussed. Because the acoustic equipment continuously records density of fish species along the transects, the resolution with which data are analysed and presented has to be selected. We propose to split transects in parts of 500 m and treat these as one location. These transects can be aggregated in later stages. The spatial scale with which data are stored in the final database (DONAR) can deviate from the scale into which the acoustic data are transformed. The scale with which data are stored depends on the spatial variation of densities of fish species. The larger the variation, the higher the resolution with which data need to be stored. The scale for data storage will be determined after the observed spatial variation in fish densities has been judged.

3.2 Report writing

3.2.1 Fieldwork reports

After each survey and laboratory period, a field work report will be delivered that contains:

- a full report on the execution of the monitoring programme, including a description of the circumstances (days, weather conditions, specific situations, etc.), facilities and materials used, and other relevant information;
- a copy of the field work forms or protocols which have been used and filled out;
- all data in the relevant format together with a description of the meta-data.

As discussed with RIKZ during the kick off meeting, both first fieldwork reports will contain data on the occurrence of species and sizes, and a separate report will be delivered at the end of Phase 2 that contains all biological data, and densities and biomass data per age and sex. These data can best be analysed after the second field work period when age-length keys for all fish species have been established. Both fieldwork reports will present preliminary results that give a first impression of the pelagic fish community and also the progress of the project will be discussed.

Table 4. Summary of information presented in reports of Phase 2. Symbols: '+' will be presented in the report; '-' will not be presented.

Report	Report 1 Field work	Report 2 Field work	Report Biological data
Density per species	+	+	-
Length–frequency distributions	+	+	-
Biomass per species	-	-	+
Density per age group	-	-	+
Age-length keys	-	-	+
Length-weight relationships	-	-	+
Maturity stages	-	-	+

3.2.2 Final report

By the end of the project, an extensive final report on the study, both in hard copy and in pdf format, has to be delivered containing:

- a description of the information needed to answer the objective(s);
- a description of the methods used in research, monitoring and analyses;
- a description of the sources used (written and verbal);
- a description of the base line (present) situation in sufficient detail;
- relevant graphics, tables, figures, maps and explanations;
- a description of the knowledge gaps;
- a bibliography;
- a recommendation on an approach for later (quantitative) evaluation of the learning objectives, including how to use gathered knowledge;
- a summary.

As discussed with RIKZ during the kick off meeting, the final report will focus on a detailed description of the pelagic fish community in the Dutch coastal zone, on an integration of all results and on a discussion of the possible effects of a wind farm on the pelagic fish community.

In addition to the data collected in this project, data collected in the Flyland project will be used. In the Flyland project, only densities per species and length-frequency distributions have been assessed, no biological data have been collected. The Flyland results will be used to support the description of the pelagic fish community in the coastal zone.

3.3 Database delivery

By the end of Phase 2 all data that has been collected for this project will be delivered in a database:

- all validated basic data in the DONAR Interface Format (DIF);
- in case of aggregation of the data: all basic data in a database or speadsheet form and validated aggregated data in the DONAR Interface Format;
- a description of the possibilities for RIKZ to check the quality of the data (for example the calibration data of the acoustic equipment and CTD device, results of reference samples (IRM or CRM) or an independent audit of the methods);
- all distribution data will be delivered in GIS-files (ESRI-format),
- a description of used methods and meta-data in Geokey-format, version 3.2.

The project results in five types of datasets:

1) acoustic signals
2) catch data from the trawls
3) biological data (age-length keys, sex and maturity data)
4) agggregated data: densities of fish species, sexes and age classes per location.
5) Environmental data from the CTD.

All datasets will be delivered to RIKZ, but only datasets 2, 4 and 5 will be delivered in the standard DONAR Interface Format. Aggregated data used for Tables and Figures in the final report will be delivered too.

4. Time planning

The project will be divided into three phases; the strategy of approach, the fieldwork and the final reports. An overview of the most important dates and deadlines is presented in Table 5.

Table 5. Overview of important dates and deadlines.

Event		Date
Start Phase 1		March 2003
	Concept plan of approach	15 March 2003
Start Phase 2		1 April 2003
	Concept field work report 1	15 June 2003
	Concept field work report 2	15 November 2003
	Concept products Phase 2	30 November 2003
Start Phase 3		1 January 2004
	Concept final report	30 March 2004
End of project		30 May 2004

A more detailed planning in time is presented in the Appendix and the activities in this planning are briefly discussed in Table 6. The numbers refer to the numbers in Table I.

Table 6. Brief description of activities. The numbers of activities refer to Table I.

No.	Activity	Description
1	Strategy of approach	This report is the concept strategy of approach and has to be judged by RIKZ.
2	Internal review	Review of strategy of approach by senior scientist.
3	Preparing cruise 1	Preparing equipment, reservation of vessel, detailed cruiseplan.
4	Cruise 1	Sampling of fish (acoustics, trawl), preservation of fish for biological data.
5	Biological data	Assessment of sex, weight and maturity at the laboratory.
6	Scrutinizing acoustic data	Translation of acoustic data into densities of fish species, using the trawl data.
7	Otolith analysis	Reading of otoliths for age determination. After the first sampling period, we will select species from which age will be determined. Contacts with foreign fisheries institutes will be made.
8	Data in database	Entering data in computer, all data in standard RIVO database, preparing data for Donar format. CTD data transformed into database format.
9	Fieldwork report 1	Report on cruises, preliminary results, densities of species and length classes.
10	Internal review	Review and discussion with senior scientist.
11	Preparing cruise 2	Preparing equipment, reservation of vessel, detailed cruiseplan.
12	Cruise 2	Sampling of fish (acoustics, trawl), preservation of fish for biological data.
13	Biological data	Assessment of sex, weight and maturity in the laboratory.
14	Scrutinizing acoustic data	Translation of acoustic data into densities of fish species using the trawl data.
15	Otolith analysis	Reading of otoliths for age determination. Of all selected species otoliths will be read. Readings will be checked with experts from abroad.
16	Data in database	Entering data in computer, all data in standard RIVO database. CTD data transformed into database format.
17	Fieldwork report 2	Report on cruises, preliminary results, densities of species and length classes and per sex and age category.
18	Internal review	Review and discussion with senior scientist
19	Database delivery	Transformation of all data in Donar format. Delivery of three databases in DIF and of two databases in alternative format.
20	Products Phase 2	Delivery of all reports and data.
21	Data analysis	Analysis of the distribution of fish (species, age, sex, length), comparison with data from flyland project)
22	Report writing	Writing of final report.
23	Internal review	Review and discussion with senior scientist.
24	Final report	Delivery of concept of final report.

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Table I. Planning baseline wind farm pelagic fish. Activities are numbered (1-24) and described in Table 2. Activities per person are indicated with these numbers in the lower 9 rows.

		Week	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
		Quarter		1								2													3						
		Month	Mar	Mar	Mar	Apr	Apr	Apr	Apr	May	May	May	May	Jun	Jun	Jun	Jun	Jun	Jul	Jul	Jul	Jul	Aug	Aug	Aug	Aug	Sep	Sep	Sep	Sep	Sep
		Day	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	07	14	21	28	04	11	18	25	01	08	15	22	29
Phase 1			■	■	■	■																									
	1	Strategy of approach	15																												
	2	Internal review	■																												
Phase 2							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	3	Preparing cruise 1				■																									
	4	Cruise 1					■	■																							
	5	Biological data					■	■																							
	6	Scrutinizing acoustic data							■	■																					
	7	Otolith analysis									■	■	■																		
	8	Data in database										■	■																		
	9	Fieldwork report 1											■	■		15															
	10	Internal review												■																	
	11	Preparing cruise 2																												■	
	12	Cruise 2																													■
	13	Biological data																													■
	14	Scrutinizing acoustic data																													
	15	Otolith analysis																													
	16	Data in database																													
	17	Fieldwork report 2																													
	18	Internal review																													
	19	Database delivery																													
	20	Products Phase 2																													
Phase 3																															
	21	Data analysis																													
	22	Report writing																													
	23	Internal review																													
	24	Final report																													
Persons		RB						4																							12
		ADD								7																					
		CB				3																								11	
		WP	1								8	8																			
		RdJ									8	8																			
		OASS1					5	5																							13
		OASS2					5	5																							13
		BC	1				4	4	6	6			9	9																	
		SY	1				4		6	6			9	9																	12
		RG	1										9	9		9															
		JdL	2											10																	

		Week	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		Quarter							4													1												2			
		Month	Oct	Oct	Oct	Oct	Nov	Nov	Nov	Nov	Dec	Dec	Dec	Dec	Dec	Jan	Jan	Jan	Jan	Feb	Feb	Feb	Feb	Mar	Mar	Mar	Mar	Mar	Apr	Apr	Apr	Apr	May	May	May	May	May
		Day	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	01	08	15	22	29	05	12	19	26	03	10	17	24	31
Phase 1																																					
	1	Strategy of approach																																			
	2	Internal review																																			
Phase 2			■	■	■	■	■	■	■	■	■	■	■	■	■	■																					
	3	Preparing cruise 1																																			
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	11	Preparing cruise 2																																			
	12	Cruise 2	■																																		
	13	Biological data	■																																		
	14	Scrutinizing acoustic data		■	■																																
	15	Otolith analysis			■	■	■																														
	16	Data in database				■	■																														
	17	Fieldwork report 2					■	■	15																												
	18	Internal review						■																													
	19	Database delivery						■	15																												
	20	Products Phase 2								30																											
Phase 3																	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	21	Data analysis									■	■	■	■																							
	22	Report writing															■	■	■	■																	
	23	Internal review																		■																	
	24	Final report																				■	■						30								
Persons		RB	12																																
		ADD		15	15	15	15																												
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		WP				16	16	19	19																												
		RdJ				16	16																														
		OASS1	13																																		
		OASS2	13																																		
		BC						17	17		21	21	21	21			22	22	22	22		24	24														
		SY	12	14	14			17	17		21	21	21	21			22	22	22	22		24	24														
		RG						17	17	20	21	21	21	21			22	22	22	22		24	24						24								
		JdL							18											23																	