

Annual Status Report Nysted Offshore Wind Farm

Environmental Monitoring Program 2002



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ENERGI E2

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1 Introduction

In 1995 Danish Government formed a committee to define the main areas in Danish waters suitable for establishing offshore wind farms. In total an area of approx. 1000 square kilometers has been pointed out, corresponding to the sitting of 7000-8000 MW wind turbines.

In Denmark the possibilities for utilizing shallow waters for offshore turbines were evaluated some years ago in collaboration between the Danish Utilities and the Danish Energy Agency and an action plan was put forward. Two of the main recommendations of the action plan were to concentrate offshore development within a few areas and to carry out a large-scale demonstration program. An agreement between the Government and the production companies to establish a large-scale demonstration program was reached in 1998. The objective was to investigate economical, technical and environmental matters and to speed up offshore development and open up the selected areas for future wind farms.

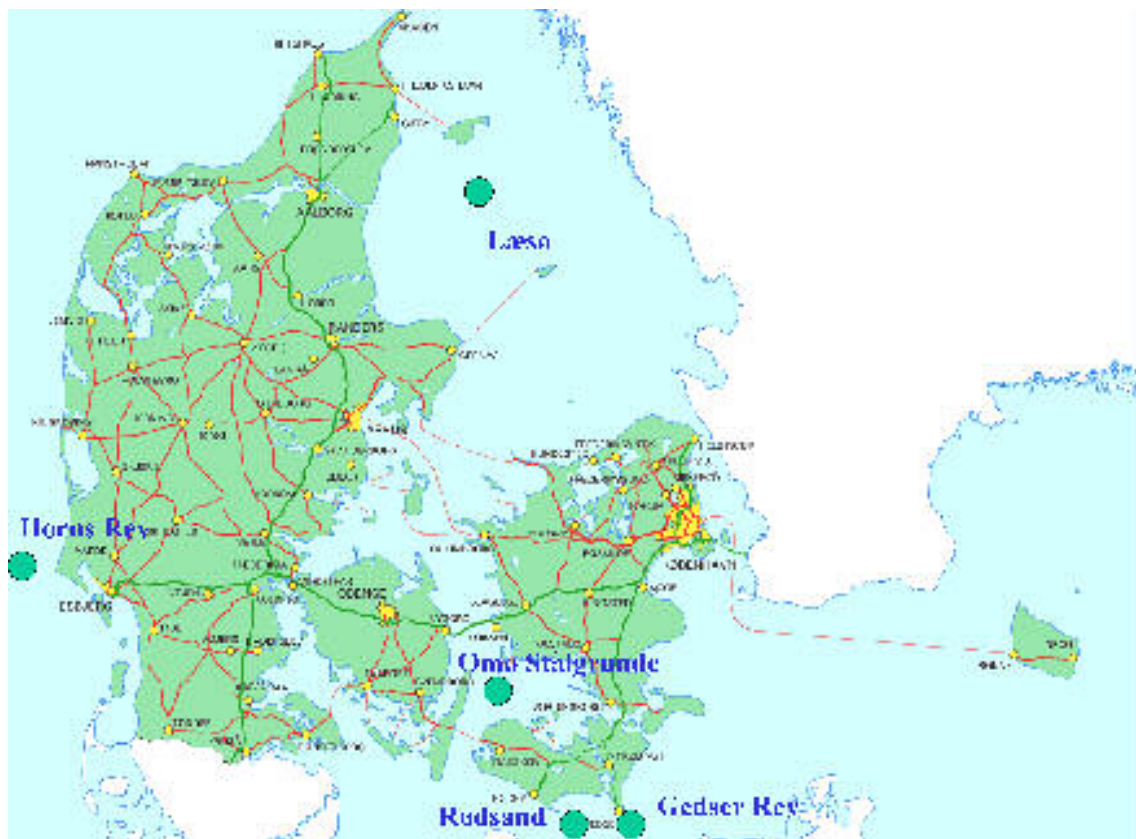


Figure 1. Map of the marine areas appointed for the construction of offshore wind farms in Denmark.

In the Danish action plan for offshore wind farms from 1997 five areas (figure 1) were pointed out as usable for future offshore wind farms. The selection was based on experiences from the first two small demonstration farms (Vindeby and Tunø) and the recommendations from the work of the Governmental Committee in 1995, which included both a mapping of water depth, all interests in the Danish waters and visual

impact assessments of the coastal landscapes. Horns Reef Wind Farm and Nysted Offshore Wind Farm is result of the action plan.

Due to the special status of the demonstration program a comprehensive environmental measurement and monitoring program has been initiated to investigate the effects on the environment before, during and after the completion of the wind farms. The point is to ensure that offshore wind power does not have damaging effects on the natural ecosystems and to provide a solid basis for decisions for the further development of offshore wind power. Also the economic and technical aspects are to be evaluated as part of the demonstration program. A series of studies were initially undertaken in the two wind farm areas on the environmental conditions and the possible impact of an offshore wind farm were undertaken. The studies belong to two different categories, namely, studies which are important for the extension of the offshore wind farm at the specific sites, and studies which has general importance for the establishment of large scale offshore wind farms in Denmark.

In 1999 the Danish Energy Agency approved the installation in principle, and preliminary surveys and planning of Nysted Offshore Wind Farm could be initiated. In the summer of 2000 the Environmental Impact Assessment was submitted to the authorities.

An environmental monitoring program was initiated following the Environmental Impact Assessment. The monitoring program is divided into three steps. A baseline program carried out prior to the construction phase, a monitoring program for the construction phase and a monitoring program for the operation phase.

On July 27th 2001 the application to build an offshore demonstration wind farm was approved by the authorities on a set of specified conditions.

The environmental studies carried out in 2001 in relation to the Nysted Offshore Wind Farm are part of the baseline program which will provide enough data and knowledge to describe the environmental conditions in the area of the wind farm and surrounding the wind farm, prior to constructing the wind farm.

This present report describes and concludes on the environmental studies carried out in 2002 in relation to Nysted Offshore Wind Farm. The report is divided into two parts. The first part contains a description of the wind farm. The second part includes a description of each of the environmental studies carried out in 2002 in connection to Nysted Offshore Wind Farm. The reports on the specific environmental projects are in the list of references, divided into the different topics.

2 Description of Nysted Offshore Wind Farm

Nysted Offshore Wind Farm is placed 10 kilometers south of Nysted on Lolland, and 11-17 kilometers west of the town Gedser on the south tip of Falster.

Two barrier-islands, western Rødsand and eastern Rødsand, separate Rødsand Lagoon from Femer Bælt and from the wind farm. Between the two barrier islands the deep Østre Mærker is approximately 5.5 km wide and on average 3.5 m deep in the deepest parts. The distance from the barrier-islands to the nearest row of wind turbines will be about 2 km (see figure 2).

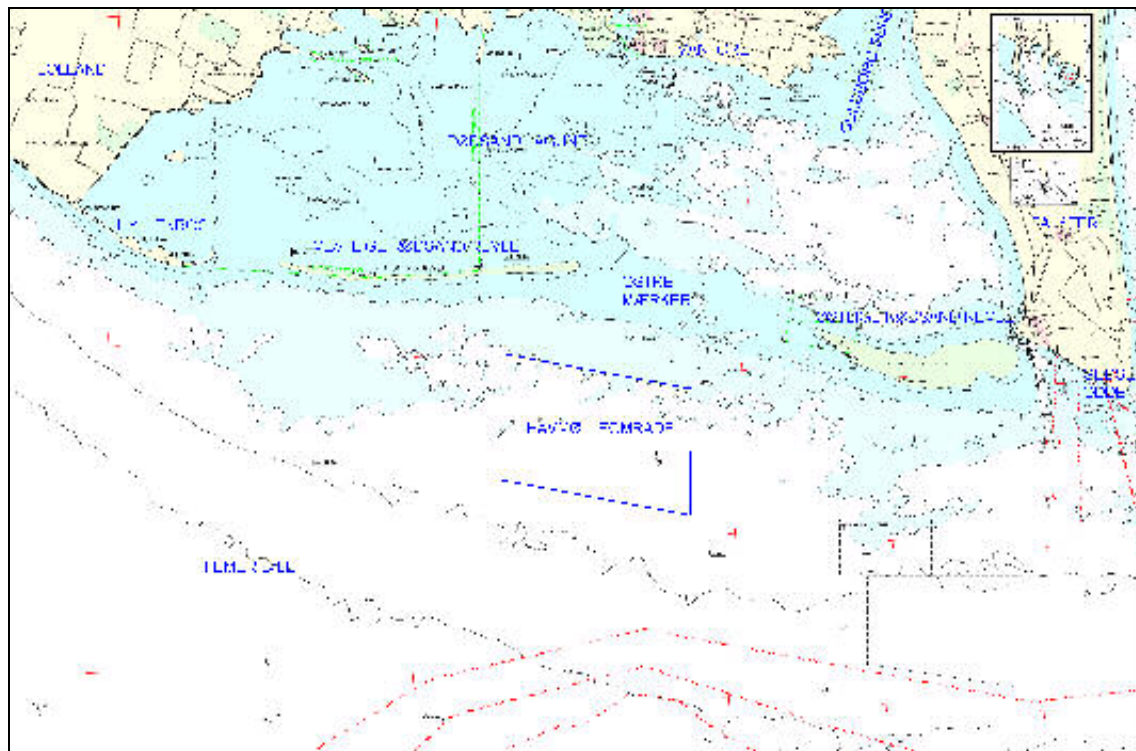


Figure 2. Map of the area south of the island Lolland showing the position of Nysted Offshore Wind Farm (Havmølleområdet).

The wind farm is located on a gently sloping seabed consisting of glacier deposits covered by thin layers of sand. The water depth in the wind farm area is between 6 m and 9.5 m. The wind farm cover an area of approximately 24 km² (indicating the area between the four corner turbines) and a 200 m wide exclusion zone will be established around the wind farm, resulting in an overall area of approximately 28 km².

The wind farm (see figure 3) consists of 72 turbines each of 2.2 MW, with a hub height of 68.6 m and 77.2 m and a rotor diameter of 82.4 m. The turbines are placed in 8 north-south orientated rows separated by a distance of 850 m. Each row holds 9 turbines separated by a distance of 480 m. The wind turbines have a discreet marine grey color and are equipped with warning lights for the sake of sea and air traffic.

The turbine foundations are gravity foundations (figure 4) in concrete with special protection against ice. The expected erosion around the bottom plate of the foundations will be prevented by a stone protection. The foundations take up an area of about 45.000 m², corresponding to 0.2 % of the total area of the wind farm. The foundations cause an increase of the overall surface area of up to 56.000 m².

In connection with the wind farm four meteorology masts (see figure 3) will be erected. The masts will supply information for the operation of the farm and ensure the gathering of knowledge about the impact of the wind farm on the wind speed and turbulence inside and outside the wind farm.

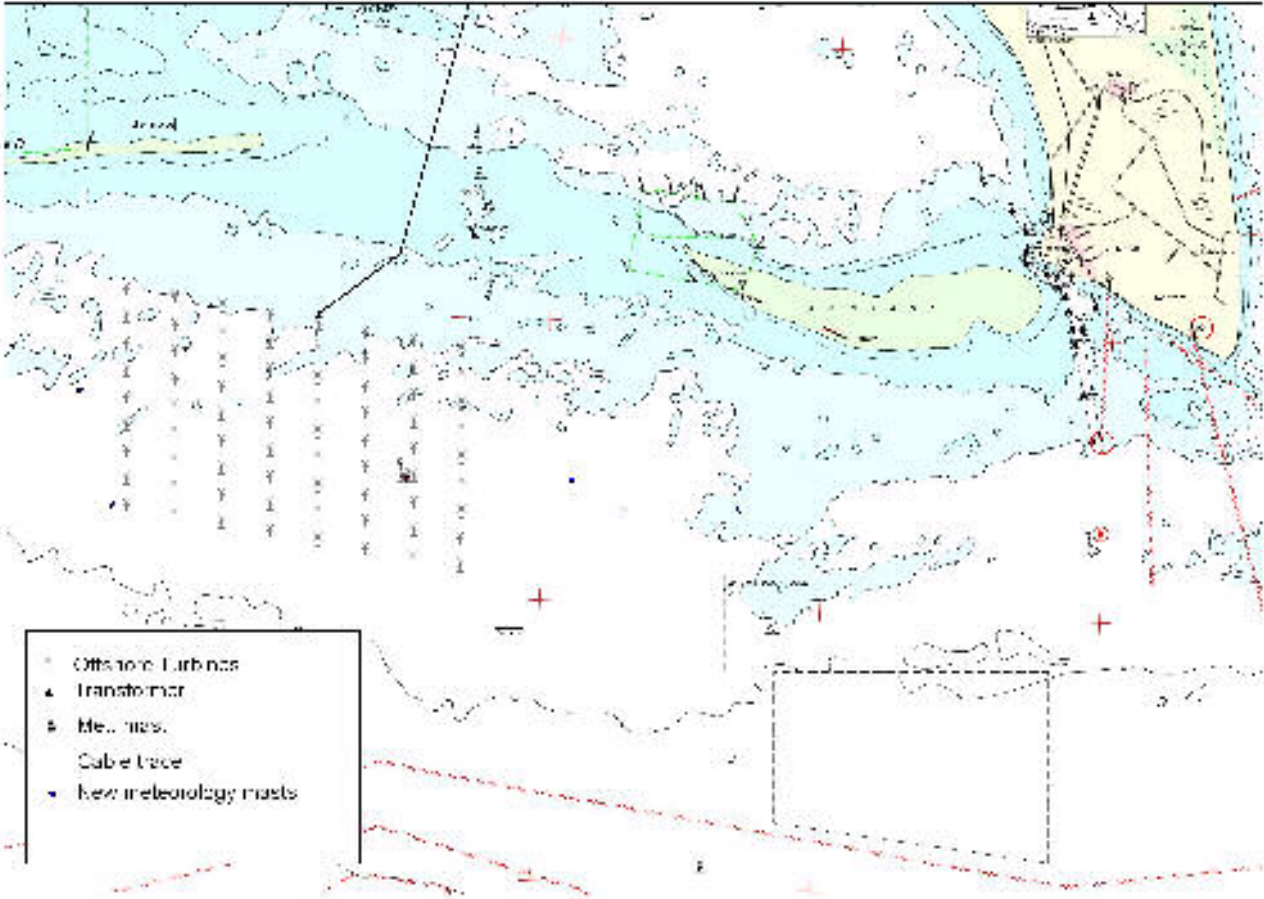


Figure 3. Map of the wind farm area, showing the position of the 72 wind turbines, the transformer station, the meteorology masts and the 132 kV cable to land.



Figure 4. Picture of one of the turbine foundations put in position in the wind farm area.

2.1 Cable connection

The turbines are interconnected with a 33 kV sea-cable, which are sluiced or buried at a depth of 1 metre.

The sea-cable continues from the most northerly turbines to a 33/132 kV transformer platform 200 m north of the most northerly turbine. The total length of the 33 kV sea cable (figure 5) is about 48 kilometers. The transformer is placed on a platform similar to the wind turbine foundations.

From the transformer platform to Vantore Strandhuse east of Nysted, a 132 kV cable are sluiced or buried at a depth of 1 meter. The total length of the 132 kV cable connections to land is about 10 km. Figure 3 shows the cable connection to land. The cables in the Nysted Offshore Wind Farm are Alternating Current (AC) cables.

Along the cable trace the water depth decreases gradually from 6 m to 3.5 m in the outmost 4 km of the cable trace. The bathymetry is complicated in the innermost 6 km of the cable trace and the water depth is highly variable with shallower and deeper parts.

Geologically the cable trace area is generally characterized by the presence of moraine clay deposits with a variable cover of post-glacial sediments in the form of sand and/or mud.

In the outermost part of the cable trace the bottom consists predominantly of sand. In the innermost and more protected part of the Rødsand Lagune the sediment is muddier. Stones are abundant in the middle section of the cable trace.

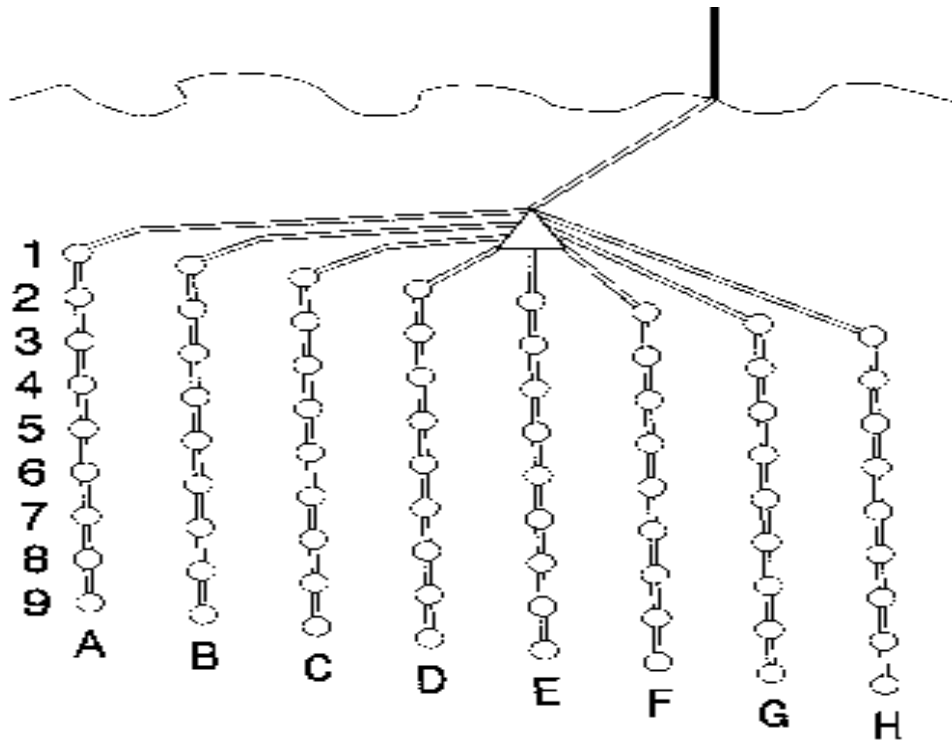


Figure 5. Showing the cable connection between the wind turbines in the wind farm.

2.2 Designated areas

The offshore wind farm at Nysted is located outside an area protected under the EC-Habitat Directive, the EC Bird Directive and the Ramsar Convention. The area from Gedser to Hyllekrog, including the Rødsand Lagune, Bøtø Nor and Guldborg Sund, is designated as Ramsar area no. 25, Special Bird Protection Area (EF83) and EC-habitat area no. 152 (Figure 6).

The area is designated as a EC Bird Protection Area (no. 83) and Ramsar Site (no. 25) due to breeding species like: March Harrier (*Circus aeruginosus*), Avocet (*Recurvirostra avosetta*), Arctic Tern (*Sterna paradisaea*) Common Tern (*Sterna hirundo*), Little Tern (*Sterna albifrons*) and Sandwich Tern (*Sterna sandvicensis*), and due to migrating birds like Mute Swan (*Cygnus olor*), Whooper Swan (*Cygnus cygnus*), Brent Goose (*Branta bernicla*), Bean Goose (*Anser fabalis*), Goldeneye (*Bucephala clangula*) and Coot (*Fulica atra*).

The EC Habitat Areas (SAC) are designated due to: Sandbanks which are slightly covered by sea water all the time; Mudflats and sand flats not covered by seawater at low tide; Large shallow inlets and bays; Perennial vegetation of stony banks; Salicornia and other annuals colonizing mud and sand; Atlantic salt meadows (*Glauco-Puccinellitalia maritima*); Harbour porpoises (*Phocoena phocoena*); Grey seal (*Halichoerus grypus*); Harbour seal (*Phoca vitulina*); Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes); Fixed dunes with herbaceous vegetation (grey dunes).

The 132 kV cable trace to land passes through the protected area.

Around the western tip of the Rødsand sandbank (54°35'N, 11°49'E), east of the channel to Nysted, a seal sanctuary has been established to which access is prohibited between March 1st and September 30th (Ministry of the Environment and Energy 1993). The seal sanctuary was established in 1978. The area of the offshore wind farm lies right next to the seal sanctuary and the nearest turbine will be erected approximately 3 km from the seal sanctuary (figure 6).

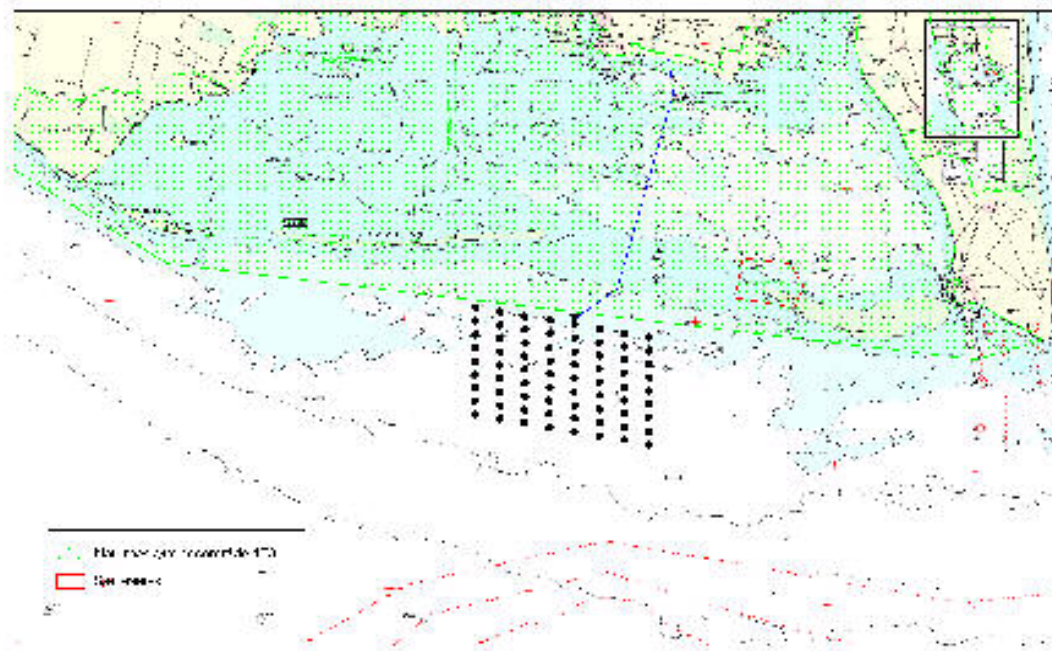


Figure 6. Map showing the designated areas (Naturbeskyttelsesområde 173) north of Nysted Offshore Wind Farm. Sælreservat = seal sanctuary.

2.3 Environmental Management

In connection with the Danish Energy Agency's approval of the project it was a requirement to implement an environmental management system for the wind farm project. The environmental management system for the wind farm project comprises two separate systems:

- Environmental management of the wind farm
- Monitoring of the environment

2.3.1 Environmental management of the wind farm

Environmental management is undertaken at the construction site throughout the construction period and is carried out by an environmental coordinator.

Each of the suppliers to Nysted Offshore Wind Farm is in their contract required to fulfill a number of environmental demands. Some of the demands have been set by the

authorities in their approval of the project and some of the demands have been set by ENERGI E2, to ensure a high environmental standard in the project.

The main purpose of the environmental management system is to ensure that the environmental demands are fulfilled as required and that all kinds of environmental problems or accidents throughout the construction period are handled correctly.

The plan for the environmental management during the construction period is build up around the plans for environmental management from the different contractors. The environmental management consists of inspection of the environmental management carried out by the different contractors. Furthermore, the environmental management will include the environmental preparedness, which is ready if an environmentally damaging situation arises on the construction site.

Another part of the environmental management is superintends and gathering of documentation from the different constructors who must register information about their activities on the construction site.

The construction site consists of three sub-areas (figure 7):

- The construction site in Gedser Harbour
- The transport corridor to the construction area
- The construction area of the offshore wind farm. This area consists of the wind farm area and a 500 m wide security zone to the turbines and the transformer station.

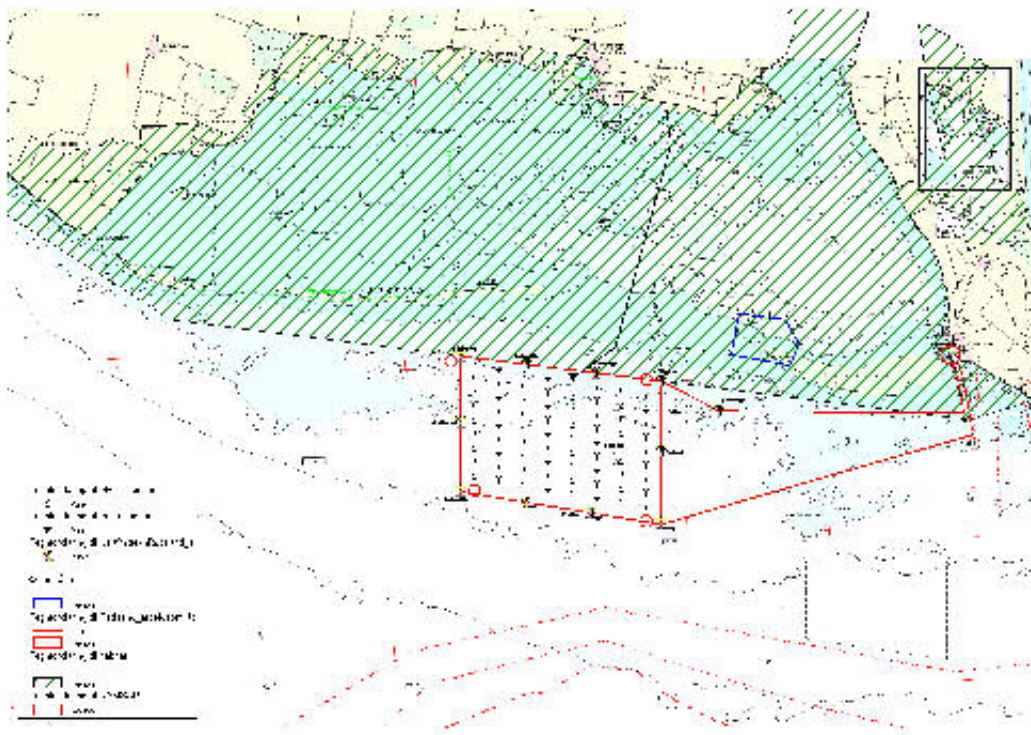


Figure 7. Map showing the three different areas included in the construction site: The construction site in Gedser Harbour, the transport corridor to the construction area and the construction area of the offshore wind farm.

The monitoring of the environment is conducted as a series of studies aiming to describe the possible impact of an offshore wind farm on coastal morphology, benthic vegetation and fauna, fish, birds and marine mammals. The studies carried out in 2002 are described in the following chapters.

3 Environmental Monitoring Program 2002

3.1 Coastal morphology

3.1.1 Objective

In order to facilitate an accurate and unambiguous baseline reference for subsequent morphological surveys in the Rødsand area, a morphological survey campaign was conducted during 2002 (DHI, 2003). The survey area comprised the area along the Rødsand barrier reefs and islands (See figure 8).

3.1.2 Method

The morphological survey was divided in four different campaigns:

- The static GPS campaign
- The bathymetric survey campaign
- The temperature and salinity measurement campaign
- The photogrammetric survey campaign

During the static GPS campaign 23 control stations were established in the Rødsand area, providing the geographical reference for the bathymetric and the photogrammetric campaigns. 3 were 1st order control stations acting as a reference for the paspoints as well as reference stations for the bathymetric RTK-surveys. 16 paspoints were placed in the overlapping zones for the photogrammetric survey, and further 3 ground-based paspoints were placed in the northernmost part of Rødsand. 2 supplementary points were established at the meteorological mast in the wind farm area, and at Nysted harbour, respectively.

The purpose of the bathymetric campaign was to facilitate a geographic reference for the subsequent photogrammetric surveys. The survey was conducted from the vessel "Økoline" in the period between the 5th June and 17th July 2002. A Trimble 4400 GPS receiver with RTK option was used for positioning. Navisound 225 dual frequency, single beam echo sounder operating simultaneously at 33 and 210 kHz, and coupled to a DMS05 heave compensator, was used for the depth measurements.

The temperature and salinity measurements were undertaken with the objective to determine the air to water refraction angle to be used in order to compensate aerial photography. A Seabird CTD-instrument type SBE 16 SeaCAT was deployed at the position "Fugletårn" just north of the Eastern Rødsand barrier from 18th June to 11th September 2002. On the day of aerial photography, the temperature was approximately 20° C, and the salinity varied between 8.6 to 8.8o/oo.

The purpose of the photogrammetric campaign was to establish a digital terrain model (DTM) for the area around Rødsand. The actual flight was done on 3rd September 2002,

with Scankorts Pipe Navajo aircraft equipped with a Zeiss RMKTOP aerial camera system mounted in a gyro stabilized mount. In order to get the best possible orientation of the photos an Ashtech Z-surveyor dual frequency GPS receiver was used in the aircraft in order to establish XYZ-coordinates to the projection centre of each photo. The subsequent aerotriangulation was calculated on the basis of the coordinates of the paspoints as well as on the basis of the coordinates of the projection centres. The DTM was then finally prepared manually in a stereo plotter and subsequently corrected for refraction. Refraction index of the water was calculated based on the actual water temperature and salinity derived from the temperature and salinity measurement campaign.

The DTM was controlled against the bathymetric survey, resulting in an overall accuracy of the morphological campaign of 0.3 m, which is considered acceptable.

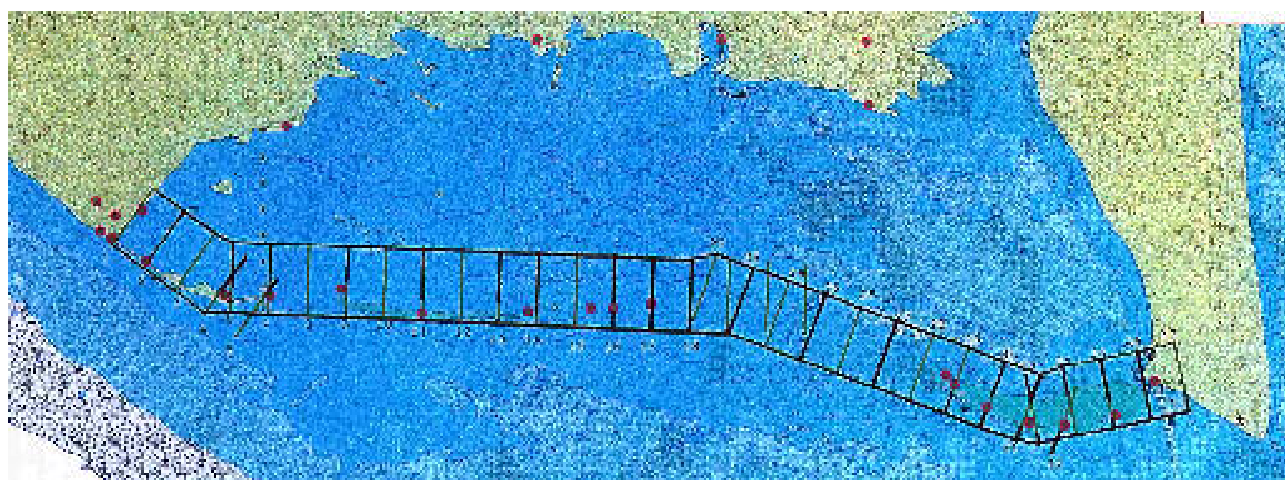


Figure 8. Control stations (red dots) and measured transects at Rødsand during 2002.

3.1.3 Results

The coastal morphological survey has resulted in photo prints, digital orthophoto, digital terrain model and contour curves. In conclusion the survey will serve as a reference for the future coastal monitoring program.

3.2 Benthic vegetation and fauna

In 1999 marine biological surveys were carried out in the wind farm area. The marine biological surveys were updated in May and August 2001 and included a survey along the planned cable connection between the wind farm and the coast of Lolland via the lagoon of Rødsand. These surveys in the wind farm area and along the cable connection between the wind farm and Lolland, included photo sampling carried out in May 2001 and collection of quantitative samples of benthic flora and fauna in August 2001. In addition to these surveys, the benthic communities were mapped at four sites in August 2001, where pound nets were established.

In 2002 there have been no surveys on the benthic vegetation and fauna in the wind farm area. The baseline survey carried out in 1999 and 2001 will possibly be followed by a similar survey after the construction has finished.

3.3 Fish and commercial fishery in the wind farm area

Two baseline fish studies were carried out in the year of 2001 (Bio/consult 2003a). In spring, the program for "Baseline study of fish" was undertaken with two identical sampling sessions in May and June, respectively. In autumn, the sampling program "Baseline study of fry" was executed with three identical sampling sessions in respectively September, October and November.

The investigations carried out in 2001 did not provided a data material which could be used to test the hypothesis.

The classic analytical techniques used in both the baseline study of fish and baseline study of fry could not deal with the many empty samples recorded. Furthermore, high variation was recorded in many samples, which posed a problem concerning the use of the classic statistical methods in the BACI design, which require homogeneity of the variance.

Therefore further monitoring programs on fish and fry in the wind farm area have not been established. Thus there have been no further studies in 2002.

3.4 Fish at the 132kV cable to land

3.4.1 Objective

The possible effects of electromagnetic fields created by underwater power cables on the fish fauna, particularly migratory species is not very well known. Due to this uncertainty, it has been decided to investigate potential effects of the electromagnetic field from the cable trace connecting the demonstration project "Nysted Offshore Wind Farm" at Rødsand with Vantore Strandhuse east of Nysted.

During the autumn 2002, a baseline investigation was undertaken as a follow up to the preliminary baseline investigation during autumn 2001 (Bio/consult 2002, 2003b). The overall objective was to form the investigative foundation of a baseline study prior to the establishment of the wind farm. The planned continuity of the environmental monitoring was affected by the adjustment of the program to the new situation were only 2 of 5 wind farms should be implemented. It resulted in a stop in the field work before the baseline study was completed. Thus the objective was focused more at evaluating improvements in the used gear and methodology rather than the original objective of collecting baseline data.

3.4.2 Method

The field study consisted of time regular series sampling every second day from four-pound nets placed pair wise along the planned cable trace in the outlet of Rødsand Lagoon. To comply with the considerations of the International Advisory Panel of Experts on Marine Ecology (IAPEME) of verifying the direction of the migratory route of mainly the silver eel two of the ordinary pound nets were modified into directional pound nets (figure 9). The general idea behind the modification was to separate the fish that most probably have crossed the cable trace from the fish originating from the other direction.

To compare fish behavioural patterns with local oceanographic parameters an Aquadopp Current Meter with automatic and continuous logging was placed in between the pound nets, and logged continuous measurements of temperature, current speed and direction.

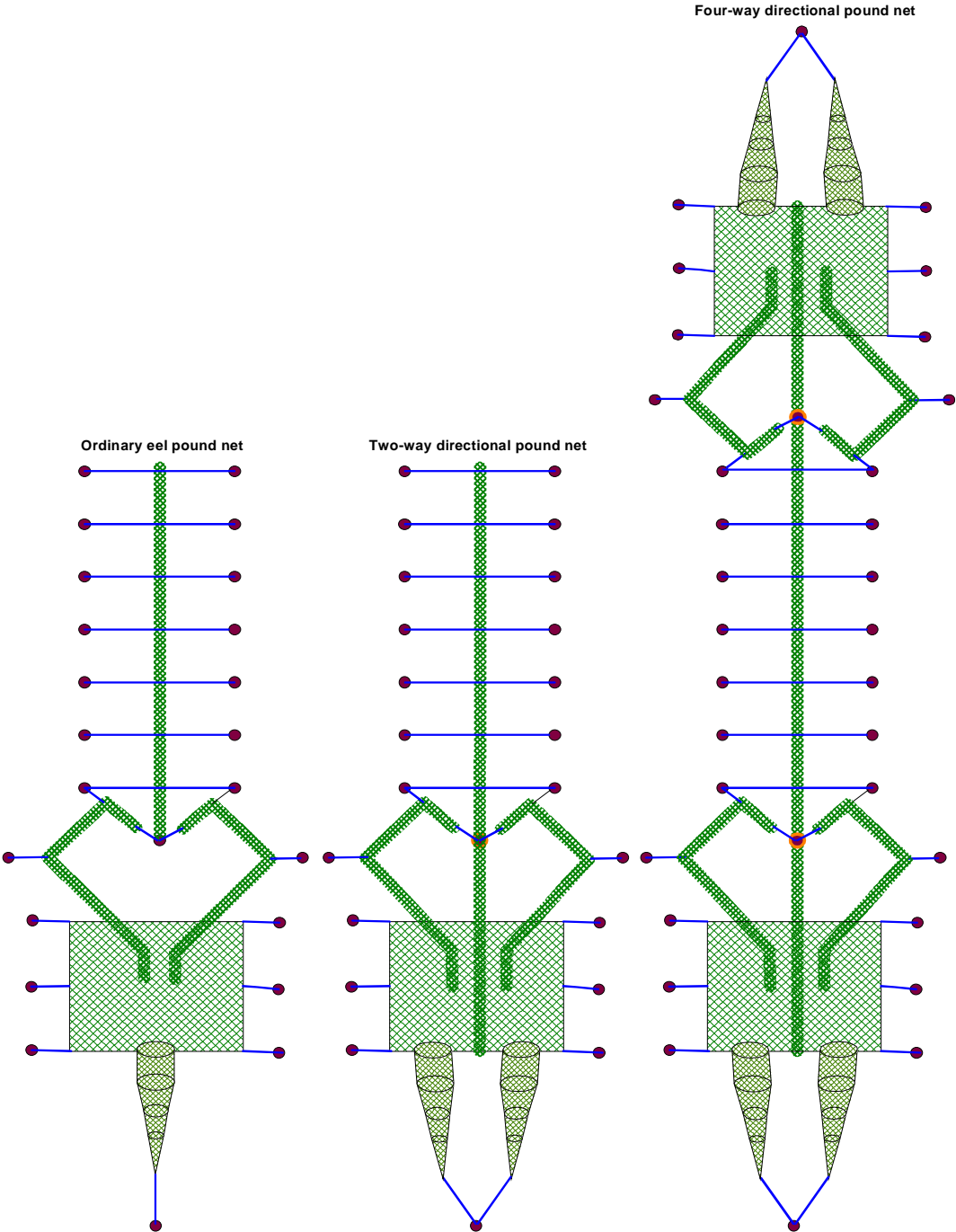


Figure 9. Three different pound nets: Ordinary ell pound net, two-way directional pound net and a four-way directional pound net.

3.4.3 Results

Results of the time series analysis for CPUE number and weight show no indication of equal catches in the directional pound nets. The catch in the two eastward fykes of the directional pound nets were similar and the catch in the westward fykes were similar. The total catch on the west side was approximately two times higher than the total catch from the east side indicating that the prevailing direction of migration is from west towards east. In conclusion, the new modified directional pound net improved the possibility to solve the basic problem: is the catch similar on the east and west side of the cables?

For the two ordinary pound nets the two parameters CPUE number and CPUE weight indicates that catches of common eel, Atlantic cod, Baltic herring, eelpout and short-spined sea scorpion were identical over time.

It was not possible to relate the catch from the pound nets with hydro graphical parameters because of abnormal meteorological conditions and because the area was mainly influenced by the diurnal tide.

3.5 Birds

3.5.1 Objective

With the aim of assessing the possible disturbance/attraction effect of the wind farm on birds, regular aerial counts of staging and wintering birds was initiated in 1999. Along side this study observations on migrating birds was carried out with the aim to assess the possible impact of the wind farm on flying birds passing the wind farm area.

In 2001 and 2002 a baseline investigation of birds in relation to the wind farm was carried out.

3.5.2 Methods

The investigation included mapping of migration routes by use of radar day and night, combined with identification during daytime of migrating bird species by use of telescope. Waterfowl that included staging migrants, wintering or wing moulting birds in the study area at the wind farm, were monitored by aerial surveys (NERI 2002, 2003a, 2003b).

On basis of the mapping of migratory birds a GIS-database of migration tracks was created. Subsets of data were derived from the database to establish a baseline, which describes migration routes before the wind turbines are erected. These baseline data will be used for comparisons with similar data obtained during a monitoring program carried out in a period after start operation of the wind farm.

It should also be mentioned that a project that deals with quantification of avian collision frequency has been introduced in 2001/2002.

3.5.3 Results

The base-line study in 2002 has shown that between 26% (2002) and 49% (2000) of the waterfowl tracks registered by radar pass the eastern edge of the wind farm during autumn. Eider was still the predominant species amongst the migrating waterfowl. Figure 10 shows example of registered tracks of eiders.



Figure 10. Radar registrations of 130 flocks determined as Eiders migrating at Rødsand during autumn 2000. All flocks presented were migrating in a westerly direction (NERI, 2000)

The baseline study in 2002 provided the second year of mapping the migration routes of waterfowl during spring and both in 2001 and 2002 the main spring migration route of waterfowl passed north of the wind farm area. During spring 2002, the percentage of waterfowl (mainly eiders) which passed the eastern edge of the wind farm, was in the same order of magnitude (25%) as in autumn.

Spring migration of raptors, passerines and pigeons was almost absent both during 2000, 2001 and 2002. During autumn Gedser Odde and Hyllekrog northeast and northwest of the wind farm area are placed on a major migration route of these bird species. Due to a temporal suspension of the study during autumn 2002, data of autumn migrating land birds is absent in the 2002 report.

Count surveys of staging, wintering and moulting waterfowl have shown that cormorants and moulting mute swans occur in international important numbers (> 1% of total population in the entire study area) on annual basis. Red-breasted Merganser has not occurred in international important numbers since November 1999.

On the basis of aerial count surveys waterfowl preferences of predefined area was calculated by use of Jacobs selectivity index. Cormorant, Mute Swan, Mallard, Goldeneye, Herring Gull and Little Gull all show significant avoidance of the wind farm area. Red-breasted Merganser showed avoidance of the wind farm site, but preference for the area around the wind farm, while Eider showed neither avoidance nor preference for the wind farm area. Long-tailed Duck and Common Scoter showed significant

preference for the wind farm, making these species susceptible to disturbance effects from the wind farm.

Radar studies revealed that Cormorants might undertake social foraging events during early mornings and late afternoons. Social foraging flocks may hold 5,000 individuals and may occur inside the wind farm area. This behaviour makes cormorant a potential high risk species with respect to collisions with the wind turbines.

As mentioned, a project that deals with quantification of avian collision frequency has been introduced. Collisions will most likely occur as discrete events with low frequency, and previous studies have suggested that collision risk is higher in nocturnal circumstances and during periods of poor visibility. A Thermal Animal Detection System (TADS) meeting the above mentioned requirements and based on infrared video techniques was developed to be used in an offshore environment and be operated from land (NERI 2003c). In 2001/2002 technical tests were performed to investigate and develop the performance of the system.

In general it was concluded that the thermal camera and its related hardware and software are capable of recording migrating birds approaching the rotating blades of a turbine, even under conditions with poor visibility.

3.6 Seals

In 2002 three different types of investigations have been carried out to study the seals in the area around Nysted Offshore Wind Farm. These are aerial surveys (NERI 2003a), remote video registration (NERI, 2003b) and satellite tagging (NERI 2002).

Figure 11 show a map of the area and points out the seal sanctuary at eastern Rødsand and the wind farm area.

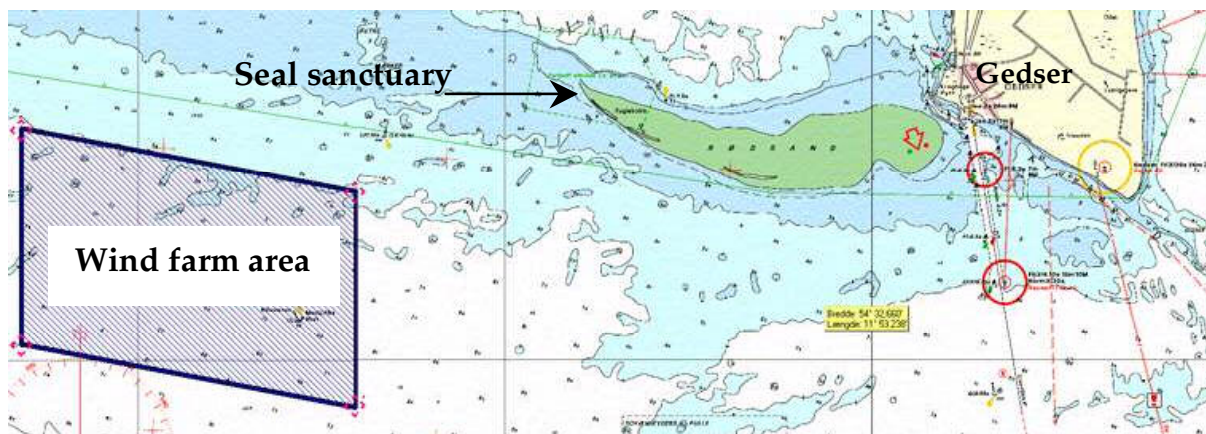


Figure 11. Map of the wind farm area and the seal sanctuary.

3.7 Aerial surveys of seals

3.7.1 Objective

The objective of the surveys is to determine the preference in haul out sites especially in the Rødsand area by season and to test the effect on the use of the seal sanctuary during and after the construction of the wind farm (NERI, 2003a).

From the satellite tagging data it has been shown that both seal species use several other haul out sites besides the Rødsand seal sanctuary.

3.7.2 Methods

Aerial surveys of all seal sites in the south-western Baltic are conducted monthly. The aerial surveys are carried out with the same flight type, pilot and observers each time. To minimize the error from variation in seals hauling out during the day, due to weather, the surveys are conducted at the same time of the day and during similar weather conditions.

The aerial surveys were carried out monthly in 2002 from March to October.

3.7.3 Results

In 2002 the seal epidemic (Phocine Distemper Virus, PDV) struck the Danish seal (*Phoca vitulina*) population. Aerial surveys in the south-western Baltic conducted in August 2002, revealed that about 44% of the expected number of seals were missing, corresponding to a mortality of 440 individuals.

Because of the seal epidemic it has not been possible to evaluate the effect of the construction work so far. This analysis can be done after the construction work ends in fall 2003.

The surveys provide information on the use of the different seal haul out sites, which is believed to have some level of exchange of animals. Based on the aerial surveys an estimated stock of about 200 Harbour seals used the Rødsand area during the moult in late August 2002.

Rødsand seal sanctuary is the most important haul out site in south-western Baltic during summer while it is less important to the Harbour seals during February-March.

3.8 Remote video registration of seals

3.8.1 Objective

The main objective of the remote video registration is to assess the extent to which the erection of the wind farm will cause measurable, temporary or permanent changes in the presence and behaviour of Harbour seals (*Phoca vitulina*) and Grey seals (*Halichoerus grypus*) in the Rødsand area (NERI, 2003b).

3.8.2 Methods

Two visible light cameras are mounted on a 6 m high tower on the sand 600 m from the seals preferred haul out site. With the use of microwave the video signal is send to the control centre in Gedser where a computer receives the signal. Using a remote control program the cameras can be controlled remotely from a computer on land.

With the data obtained in the period March 2002 until February 2003 the probability of the presence of seals on land over time and the time with seals on land, can be calculated and analyzed.

The year-round video monitoring of the seals hauling out in the sanctuary is a manpower low method.

3.8.3 Results

The results confirm that the seals use Rødsand as a haul out site to a higher degree during the summer.

The probability of seals on land ~~as~~ analyzed together with the data on ramming activity and use of a seal scammer on foundation A8 (south-westerly corner of the wind farm area). The analysis showed no systematic effect on the ramming and the seal scammer on seals hauling out in the sanctuary.

The temporal amount of data achieved by this method exceed the data that can be cost realistically collected by an observer, furthermore the presence of the stationary camera is believed not to have an effect on the animal, as seals usually habituate to stationary structures.

3.9 Satellite tagging of seals

3.9.1 Objective

The objective of the study is to provide information on site fidelity, migration and kernel home range of Harbour and Grey seals prior to the construction of Nysted Offshore Wind Farm. Furthermore, to determine the potential vulnerability of the two seal species to the construction and operation of the wind farm and provide information on the haul-out and diving behaviour (NERI 2002).

3.9.2 Method

Seals are caught in nets and tagged with a satellite transmitter on the head. The satellite transmitter transmits data movements, diving behavior and transmitter status. The derived location quality is divided into six classes and software is used to choose the most plausible location. From this material maps showing the seals movements throughout the tagging period can be made, and the different data can be analyzed.

3.9.3 Results

Four Harbour seals and six grey seals were tagged in the period November 16th to April 12th 2002.

The results show that Harbour seals stay within the area of the lagoon and surroundings and that this area is of great importance throughout the year.

The wind farm area constitutes a relatively high percentage (10.8%) of the 95% kernel home range of Harbour seals, whereas the wind farm area is of minor importance to the Grey seals compared to the total kernel home range of these seals

The satellite tagging of both Harbour seal and Grey seal has shown that the Harbour seal is more resident in the area around Rødsand, while the Grey seals are utilizing a much greater area in certain periods of the year.

3.10 Harbour porpoises

3.10.1 Objective

In order to study possible effects from the erection and operation of the wind farm on the Harbour porpoises, stationary acoustic data-loggers, PODs (POrpoise click Detectors) have been used in the area at Nysted Offshore Wind Farm (NERI 2002, 2003).

3.10.2 Method

In the area around Nysted Offshore Wind Farm, a total of six PODs have been deployed. Three PODs in the wind farm area and three in the reference area approximately 10 kilometers east of the wind farm area, where the construction work is taking place (Figure 12).

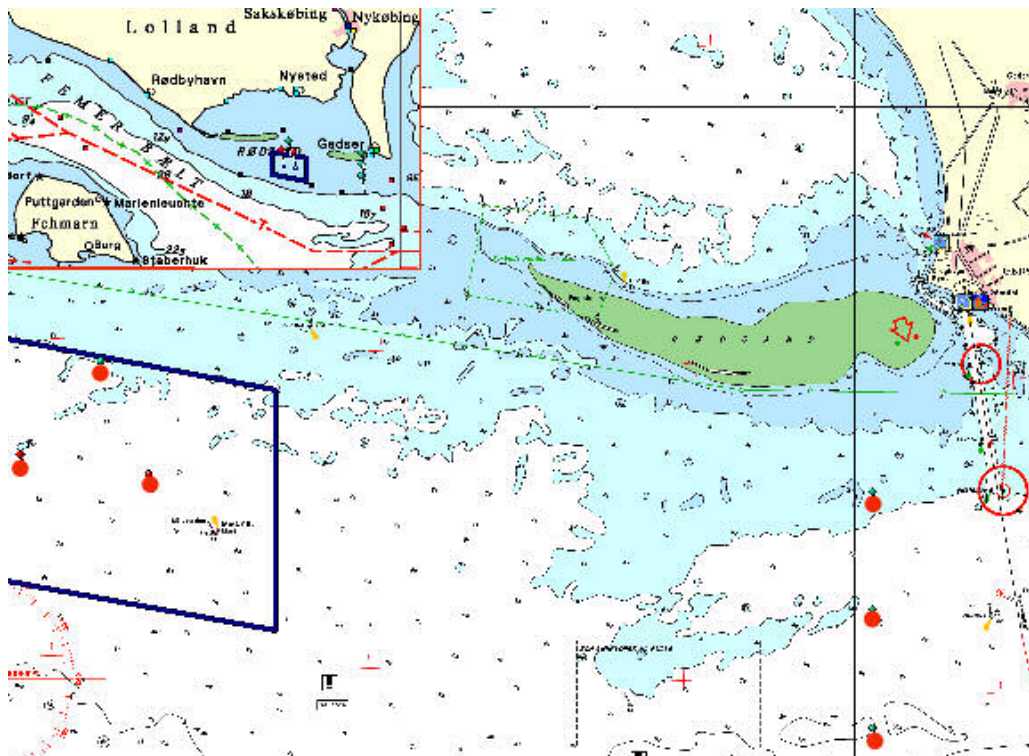


Figure 12. Map of the Rødsand area. The wind farm area is indicated by the blue square and the locations of the POD deployments are indicated with red dots.

3.10.3 Results

The statistical analysis of the gathered POD data has shown that there has been a significant effect from the first months (July-October 2002) of construction of Nysted Offshore Wind Farm on the Harbour porpoise echolocation activity within the construction site (impact area) compared to the control area.

The gathered POD data were analyzed together with data on the vibration activity at foundation A8, in the south-western corner of the wind farm. A significant effect on Harbour porpoise echolocation activity was found in both the wind farm area and the reference area during the vibrations.

It is concluded that the construction has created a measurable, temporary decrease in the activity of Harbour porpoises in the construction site.

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