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Concerted Action for Offshore Wind Energy Deployment (COD)

WORK PACKAGE 4: ENVIRONMENTAL ISSUES

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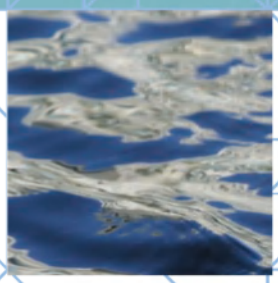

Concerted Action for Offshore Wind Energy Deployment (COD)

WORK PACKAGE 4: ENVIRONMENTAL ISSUES

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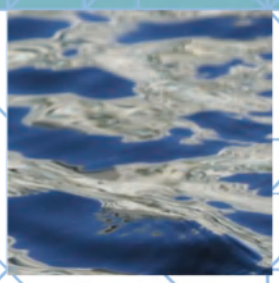

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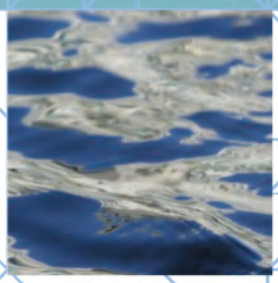

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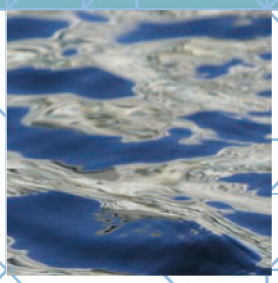
Introduction

Environmental issues are a broad subject. The first step for the COD working group was to set a focus and decide on which issues should be compiled and analysed under this headline. Not only the effects of offshore wind facilities and their impact on the marine environment, but also the instruments of environmental planning and assessment as well as assessment tools (cf. chapter 2.1) are mentioned under this headline.The background to the selection of environmental issues was mainly determined by the legal requirements of the environmental assessment framework. The scope of relevant components of the marine environment studied in this report (cf. Chapter 2.2 and 2.3) is derived from the proceedings and subjects to be covered in Environmental Impact Assessments, which is a compulsory part for consenting processes in all countries. The report details the level of knowledge both on factual effects and on stated (measured or assessed) or assumed impacts on the marine environment. This information is mainly derived from the compilation of published results in the COD database (see in Annex A and Annex B).

As the precautionary principle requires keeping effects of any facilities as low as possible, the state of knowledge on mitigation measures is documented in chapter 2.4). Chapter 2.5 contains a short overview on the state of investigation of effects on other marine uses.

The report ends by summarising the observations made. Furthermore, it gives recommendations, which issues should be a subject of further activities.



Environmental Planning and Assessment

2.1 Terminology and Methodology

Environmental Impact Assessments (EIA[1]) require answers and decisions on behalf of a range of questions, which help to qualify the decision-making in licensing processes. For this reason, the developer of intended projects is obliged to carry out an Environmental Impact Statement (EIS) on the intended project.

Under the headline "environmental impact", a range of aspects is considered.

- Which effects do offshore wind facilities generate?
- Which of these effects cause changes in the environment?
  - Are these changes relevant?
  - Do the changes lead to impacts, which might lead to a refusal of an application?
- Which are the relevant components of the environment, which might be affected?
- What kind of impacts can be stated? How can they be assessed?
- Which measures can be taken to mitigate the effects?
- Which instruments of environmental assessment are appropriate to control the deploy-ment effectively?

Though based on a common EU-directive, the understanding of singular methodological terms and the proceedings of evaluation during assessments is slightly different in the participating countries. The following paragraphs refer to this model, which represents an internationally approved understanding of the interrelationships between actions (pressures) and their impacts on the environment.

2.1.1 Offshore Wind-Related Cause-and-Effect-Chains

Offshore wind facilities exert a range of effects on the environment, however not all of them necessarily lead to relevant or negative changes on the marine environment.

One way to describe the interrelation between the cause of an effect (in the sense of 'pressure') and the change of components of the environment (in the sense of 'receptors') are so called 'cause-and-effect-chains'. There must be a causal connection between a project or its pressures and defined environmental components. This is a precondition when applying the 'costs-by-cause principle'.

[1] European Council Directive 85/337/EEC and 97/11/EC (including amendments and Annex II).

The definition of cause-and-effect-chains for offshore wind projects is an important step towards standardisation. To keep assessments operable, there has to be a review of all possible effects. Therefore: only those that might lead to significant changes of the marine environment are relevant. If these effects lead to significant impacts, they are probably also relevant for decision-making (e.g. for admission or refusal of applications; mitigation measures etc.).

2.1.2 Impact Prognosis

The facilities are likely to exert effects on the environment during construction, operation and deconstruction. Some effects are due to certain activities (e.g. rotation, maintenance), some result from the mere existence (e.g. foundation, scour protection).

For the prognosis of impacts the present state[2] of a marine environment ('State 0') must be described and compared to the state after realisation of a project ('State 1' or 'State 2'). Usually the prognosis is based on a selection of significant indicators. The prognosis has to be performed on a factual level. Intensity and coverage of effects are common indicators to classify the severity of impacts.

The prognosis of impacts should - wherever possible - fall back on measurable indicators. However, in a marine environment the availability of quantifiable indicators is limited. The definition of operable criteria significantly indicating a (positive or negative) change of the state of environment is still under development.

2.1.3 Impact and Risk Assessment

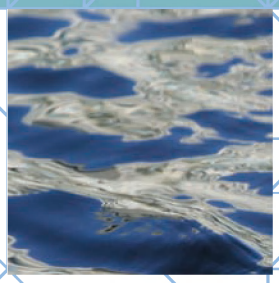
For the assessment procedure, the outcome of the comparison of the state before, and the state after realisation of a project has to be evaluated. This evaluation needs to have approved standards or criteria. However, not every change to the environment is severe but must be considered relevant to the decision making process. The result of evaluation depends on local protection aims and legal regulations. The criteria for evaluation of effects and threshold values obviously differ in the regarded countries.

An assessment as to whether the impacts are tolerable or not is a result of evaluation (see following chapter). Thus, the impact prognosis, which takes place on the factual level, has to be differentiated from the risk assessment, which takes place on an evaluation level.[3]

Discussing the impacts of offshore wind facilities it should be taken into consideration:

[2] Also called 'reference state' or 'baseline' in some countries.

[3] It has to be stressed that the differentiation between factual and evaluation level is an important precondition for evaluating the significance of impacts.



- whether the impacts exist at the factual level (proven or potential impacts),
- how severe the impacts are at evaluation level (damages or benefits)
- what their relevance (significance) to decision making is.

2.1.4 Cumulative Effects

A common definition of cumulative effects or impacts has not been identified yet. One approach is to define it as "combinations of offshore wind farm impacts against the background level of already existing adverse impacts, e.g. pollution, disturbance by ship traffic, and effects of such other projects as sand and gravel quarrying." (see TU Berlin 2005). This definition comprises both direct impacts and additional impacts from the project itself, e.g. increased shipping.

Another definition of cumulative impacts does look rather at the effects of several wind farms and which impacts they have altogether. For example, building several wind farms next to each other would mean longer flight or swimming distances for birds, mammals or fish as a result of the increase of cross border areas. This could result in additional disturbances which would not have occurred if a single wind farm was considered in isolation.

Anyway, from expert's point of view assessments of cumulative impacts should always consider the maximal extent of deployment (e.g. according to the strategic aims of offshore wind production). However, EISs at project level do not regularly consider the entire extent of the aimed state of deployment. Despite the different approaches mentioned for definition it seems to be commonly agreed that assessing cumulative effects consists of more than just adding all the impacts together. Yet, the methods for the assessment of cumulative effects still have to be developed.

Considering both kinds of cumulative effects would only be possible on the level of Strategic Environmental Assessment (SEA). The follow-up effects (consecutive effects) at this level caused by grid connection at sea should also be taken into account.

In the publications that have been analysed, a distinction is made between cumulative or addi-tional effects (effects of the same kind) and combination effects. When looking at combination effects, both impact synergies and interrelationships of effects of different kind and causes must be taken into account.

Besides the pressures caused by human activities, there are also natural cumulative pressures (e.g. naturally poor breeding conditions) which can aggravate the living conditions of populations. It is difficult to discern what is natural-induced variation and what is due to human activity. Therefore it is hardly possible to include these factors in planning processes, as natural pressures are barely predictable.

2.1.5 Recommendations

In the interest of standardisation and harmonisation, definitions have to be made or approaches have to be developed to make issues operable:

- Representative cause-and-effect-chains to be considered in EIAs for offshore wind projects (relevant causal interrelationships); existing approaches (cf. OSPAR Convention 2004; TU Berlin & Bundesamt für Naturschutz 2005) should be pursued and lead to an approved agreement.
- Standards and threshold values for evaluation of the severity of impacts should be agreed upon;
- There should be a common approach to consider relevant cumulative or combination effects both in SEA and in project related EIA.
- Existing knowledge gaps should be handled by applying the precautionary principle.

The consideration of different kinds of cumulative impacts is an issue in spatial planning processes and SEA-like assessments (see chapter 2.3).

2.2 EIA-Practise and Requirements of Investigation

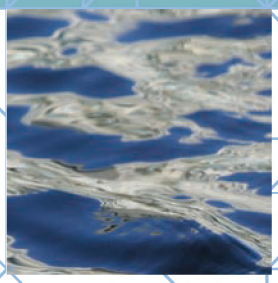
EISs are performed on different scales and detailing according to the formulated EIA- requirements on national level.[4] At last, the national licensing regulations determine which issues have to be considered. All EIS's require the investigation and assessment of men (local population), mammals, birds and visual landscape as important subjects. Compared to these subjects, issues concerning non-biotic components play a minor role. Assessments are mostly based on estimations. This is mainly due to the lack of data on the state of marine environment, but also on the difficulty in predicting the effects on individuals and populations effectively.

Fish and benthos are investigated in less detail in most countries; in general the possibilities of assessment are restricted. Data on hydrography and soils and sedimentation are indeed reported, but effects are usually not assessed.

Nevertheless, decisions have to be taken in ongoing licensing procedures despite prognostic uncertainties. Fulfilling the precautionary principle (i.a. also by assuming worst-case-scenarios) investigations tend to be more comprehensive than is essentially necessary.

In most cases, commercial developers tolerate this, as they are eager to underline the positive environmental effects of offshore wind.

[4] A comparison of specific investigation requirements (scope, depth, duration etc.) for the mentioned EIS-subjects was not possible on the basis of reported documents.



Investigation requirements (scope, depth, duration etc.) for EIS[5] show different levels of investigation needs. This is partly due to differing interpretations of EIA regulations by the consenting authorities.

So for instance in Germany developers are obliged to carry out monitoring studies at their expense, whereas this is not required to this extent e.g. in Ireland. Thus, the duration of investigation differs (e.g. different duration before and/or during construction and during operation) dependent on monitoring duration and scheduling.

It must be kept in mind, that the level of investigation (= obligation for the developer) must be kept operable. Requirements for investigation in demonstration projects are likely to be higher than in commercial projects.

The more data and information (e.g. via maps or geographic information systems) are available from official boards, the more commercial developers are relieved from time and cost consuming investigations.

2.3 Strategic Environmental Assessment[6] (SEA) and Spatial Planning

After the legal regulations, any formal application of SEA on offshore wind requires offshore wind exploitation to be subject of an official plan or programme. If this is not the case, SEA-like strategies in context of spatial planning will have to be applied.

In view of the relevance of cumulative effects (see chapter 2.1.4) for a proper assessment, the Strategic Impact Assessment (SEA) is gaining importance. It is the appropriate instrument on the appropriate level to investigate, assess and handle cumulative effects.

Information on procedures and applied methodology concerning SEA are still few in number, as the implementation of SEA on national level is just beginning. Only a few experiences exist on performing SEA-like assessments on larger scale. Up to now, little information is available on environmental requirements, which should be considered within the scope of spatial planning on sea (see e.g. COD-D-042).

Regarding spatial planning as a tool to diminish conflicts between different marine uses, the implementation of comprehensive marine spatial planning should be enforced.

Strategic assessment and spatial planning require interconnecting environmental data which refer to delineable areas. In this context, it can be a special challenge to integrate data on non-stationary or migrating species and populations as well as varying population densities.[7]

[5] Though all based on a common EC-directive on EIA (97/11EC).

[6] "Assessment of the effects of certain plans and programmes on the environment (Directive 01/42 EC), meanwhile adopted and transformed into national law in the participating countries. SEA requires to produce an Environmetal report.

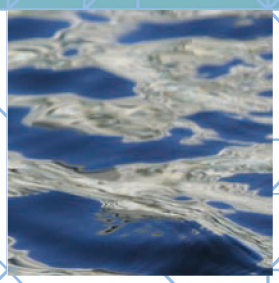
[7] One possible approach concerning birds is to apply a species-specific sensitivity index (see COD-D-27).

To consider protection needs or restrictions for offshore wind facilities in spatial planning procedures, there have to be delineated national and international protected areas of sea. The delineation of protection areas is still ongoing. It should be of great interest to analyse information on how the designation of marine protected areas (e.g. NATURA 2000 sites) on one hand and the selection of suitable areas for wind farms on the other hand is progressing in the different countries.

Near shore wind farms in coastal zones (or within the 12-sm-zone) should also be an issue of informal planning instruments, such as integrated coastal zone management (ICZM[8]) strategies.

It should be encouraged to improve the availability of maps of national and international protection areas in the internet.

[8] See http://europa.eu.int/comm/environment/iczm/



Environmental Impacts

3.1 Environmental Impacts on the Marine Wildlife

Investigations of the effects on marine wildlife (also referred to as the biotic components) are a focal point in EIS, monitoring reports and of course effect studies.

The scope of 'receptors' sensitive to effects caused by offshore wind facilities compromise of marine mammals, seabirds and resting birds, migratory birds, fish and benthos.[9] Bats are also considered to be an issue[10], but are left out in this report, as there is only very little information on this issue.

The following tables show a selection of publications dealing with different components of the marine environment. The availability of further information in the database is indicated e.g. by using brackets (...). The use of italics indicate that studies deal with the subject in question among others.

(Impacts described here are not necessarily severe. The following text shows the variety of interconnections as well as results of singular case study, which under the scientific point of view still pose quite a scope of questions not sufficiently answered yet.)

3.1.1 Marine Mammals

3.1.1.1 Availability of Information

The database shows a considerable number of publications dealing with marine mammals and methods of their survey (see table 1). Only a few studies allow the estimation of impacts of offshore wind farms on marine mammals, and only a subsection quantifies the effects. Up to now, most studies provide assumptions on possible effects.

Table 1: Studies and Publications on Marine Mammals

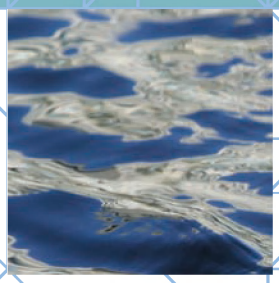
Reference	Title	Marine Mammals - Results
COD-D-003	MINOS – Marine warm-blooded animals in the North and Baltic Seas: Foundations for assessment of offshore wind farms (2004)	Distribution, density and number of harbour porpoises. The number of porpoises in the Baltic Sea decreases from west to east. This should be confirmed statistically. First indications of areas, which are of particular importance for harbour porpoises / which are highly frequented by harbour porpoises. Use of space by seals.

[9] See OSPAR COMISSION (2004): Problems and Benefits Associated with the Development of Offshore Wind Farms, p. 8-9.

[10] See OSPAR COMISSION (2004): Problems and Benefits Associated with the Development of Offshore Wind Farms, p. 8.

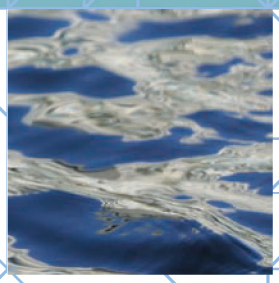
Reference	Title	Marine Mammals - Results
COD-D-013	Survey of marine mammals in the German EEZ of the North Sea (2003)	Distribution of harbour porpoises mainly from south to north along coastline; Distribution area of grey and harbour seals from the coast to a depth of 35 m and a distance of maximally 50km from the resting area; but more data on this area needed. The distribution areas of porpoises and seals are the same. The small number of Harbour seals justifies a special status.
COD-D-014	Survey of marine mammals in the German EEZ of the Baltic Sea (2003)	The abundance of harbour porpoises is much larger in the west of the Baltic Sea the in the east. A clear borderline between species from east and west exists. The Oderbank and 'Pommersche Bucht' form the main points for the presence of harbour porpoises. The population in the Baltic Sea should be protected.
COD-D-019	Survey of harbour porpoises in the German EEZ of the Baltic Sea by means of porpoise detectors (2003)	The examined areas 'Kadetrinne' and 'Fehmarnbelt' are very important areas for the harbour porpoise in the German Baltic Sea. The investigation with acoustic methods (PODs) points out a frequent presence of harbour porpoises in the "Kadetrinne" and the associated near shore area. Germany has a special responsibility for the continuity of the species in the Baltic Sea with respect to the total population (except for the Belt Sea and Kattegat).
COD-D-030	MINOS plus: Ongoing research on seabirds and marine mammals for the evaluation of offshore wind turbines (Project in progress)	Extension of the monitoring and field investigations is done in the preliminary MINOS-project (see COD-D-003). In progress until 2007.
COD-D-038	Collision risk for migrating birds and disturbance effects on harbour porpoises at the offshore wind farms Horns Rev and Nysted in Denmark [11] (Project in progress)	No results published yet.
COD-D-056	Potential impact of offshore wind turbine related sound on the sound detection of harbour porpoises in the North Sea. Project number: 2020-01013-10-002 (2005)	The results indicate that the perception of low frequency signals would be masked by operational wind turbines for the harbour porpoise at close ranges to the wind turbine. From an ecological point of view, the results indicate that overall effect of the operational sound emissions of the planned wind turbines is very likely to be small for individual harbour porpoises and negligible on a population level.
COD-DK-002	Investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef (2000)	Distribution of harbour porpoise in an investigation area is linked to hydrography; in the eastern part of Horns Reef, a high-density area throughout the year is stated.

[11] Ongoing project, until January 2007. The projects is held within the framework of the German-Danish cooperation on accompanying ecological research offshore.



Reference	Title	Marine Mammals - Results
COD-DK-005	Effects of marine wind farms on the distribution of fish, shellfish and marine mammals in the Horns Rev area (2000)	Also see table 6 in this report
COD-DK-015	Harbour seal satellite monitoring program, Horns Reef, North Sea (2002)	It is obvious that the porpoise activity in the western part of the reef is lower in the winter period compared to July-October. This variation is explained by variations in salinity and the frequency of westerly winds, which was higher in November-December compared to the summer and early autumn period. It is likely that monitoring data from several years may show a consistent seasonal pattern, and that the seasonal variation can be included into future analyses.
COD-DK-016	Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef (2003)	Individual ramming had an effect on the behaviour of harbour por-poises on the reef, lasting up to 3-4 hours after end of each ramming operation. Furthermore, more general effects on abundance and behaviour of the animals in the construction period were stated. It is not clear, however, whether this change in behaviour is truly attributable to the construction or whether it is related to overall temporal variation.
COD-DK-017	Satellite tracking of Harbour Seals on Horns Reef (2003)	The resolution in positional information is not sufficiently high to allow for a detailed study of the effects of the construction phase on the tagged seals. It was observed however, that tagged seals moved across the reef also during the construction period.
COD-DK-021	Investigations of harbour porpoises at the planned site for wind turbines at Horns Reef (2002)	Power analysis of POD data; enforcement of power analysis by addition of salinity data Interference from fishermen on data collection.(...)
COD-DK-025	Monitoring effects of offshore wind farms on harbour porpoises using PODs (2002)	The field deployment of PODs revealed large spatial differences at even small scales. For all indicators there were large spatial variations between the four investigated areas, but also large spatial variations between stations within areas (~10 nautical miles apart).
COD-DK-071	Porpoise detectors (PODs) as a tool to study potential effects of offshore wind farm on harbour porpoises at Rødsand (2001)	The PODs deployed in Kerteminde were used to obtain information on how harbour porpoise activity obtain information on how harbour porpoise activity is encapsulated in the POD signal. The data recorded in Kerteminde was used to develop indicators that can be used in a statistical test for analysing the impact of offshore wind farms on harbour porpoises.
COD-DK-073	Monitoring effects of offshore wind farms on harbour porpoises using PODs (2002)	See COD-DK-025

Reference	Title	Marine Mammals - Results
COD-DK-084	Aerial surveys of seals at Rødsand seal sanctuary and adjacent haul-out sites (2003)	Rødsand seal sanctuary is the most important haul out site in southwestern Baltic during summer while it is less important to the harbour seals during February-March. However, two live grey seal pups were observed in late February-early March, which indicate that the sanctuary is very important to grey seals during spring
COD-DK-086	Movements of seals from Rødsand seal sanctuary monitored by satellite telemetry (2003)	Harbour seals remained within 50 km of the tagging site year-round, while grey seals made extensive movements up to 850 km away from Rødsand to Sweden, Germany, Estonia and Latvia. The average Kernel home range (95% fixed Kernel) of the harbour seals was 394 km2 ranging from 237 to 709 km2, whereas the corresponding Kernel home range was 130 times larger for grey seals namely 51,221 km2 ranging from 4,160 to 119,583 km2. All the tagged harbour seals stayed year-round in the Rødsand area, whereas, the grey seals on average only remained in the area for 17.8% (range: 2.6 - 58.3%) of the monitored time. Rødsand the locality is more important for harbour seals than for grey seals.
COD-DK-087	Remote video registration of seals at Rødsand seal sanctuary - Technical improvements and feasibility for detecting effects of the construction of Nysted Offshore Wind Farm (2003)	On 36 % of the days from April through August, there are more than 20 seals on land at a time. In September, there is only a maximum of 10 to 20 seals on land. From October to January, there are many days without seals, but for 12 of those days with seals on land the number tends to exceed 20 seals. From February to March, there have only been few days with seals present and only 2 - 10 seals at the time.
COD-DK-106	Effects of the Horns Reef wind farm on harbour porpoises. Interim report to Elsam Engineering A/S for the harbour porpoise monitoring program 2004 (2004)	Statistical conclusions cannot be drawn at this point. Porpoises were observed inside the wind farm on several occasions on ship surveys and acoustic activity recorded inside the wind farm (positions 5 and 6) are at levels not immediately discernible from 2003.
COD-DK-107	Harbour porpoises on Horns Reef - effects of the Horns Reef wind farm. Annual status report 2003 (2004)	Comparison with baseline data from 1999-2001 and with control areas outside the wind farm did not show a statistical significant change in sighting rates inside the wind farm area in the first year following construction relative to baseline
COD-DK-108	Effects of the Nysted offshore wind farm construction on harbour porpoises - annual status report for the acoustic T-POD monitoring programme during 2003 (2004)	A significant decrease of harbour porpoise activity was found because of the construction work in the wind farm area. (...) Most harbour porpoises therefore avoided the area during the construction probably due to noise disturbance or lack of appropriate food.



Reference	Title	Marine Mammals - Results
COD-DK-109	Effects of the Nysted offshore wind farm construction on harbour porpoises - the 2002 annual status report for the acoustic T-POD monitoring programme (2003)	A significant general decrease in the echolocation activity was found in the wind farm area under the construction. (...) It is concluded that the construction of the Nysted Offshore Wind Farm has created a measurable, temporary decrease in the activity of harbour porpoises in the construction area.
COD-DK-110	Effect from the construction of Nysted offshore wind farm on seals in Rødsand seal sanctuary based on remote video monitoring (2004)	The seasonal variations in the presence of seals in the Rødsand sanctuary were clearly distinctive with a generally low presence during winter months increasing in spring and reaching its maximum in August when seals were almost permanently present at the sand bank. The diurnal variation showed the highest presence during the middle of the day. There was no change in the disturbance rate during the construction period, probably due to a regulation on boats to pass the sanctuary in adequate distance. Remote boat traffic and other activities that the seals have experienced previously, although intensified during construction, did not affect the number of seals on land. A significant decrease in the number of seal on land during the ramming periods, of a single foundation located approximately 10 km SW of the seal sanctuary was stated. The construction work on the wind farm situated approximately 4 km away from the Rødsand seal sanctuary had in general no or little effect on the presence of seals. Even two grey seal pups were recorded during the construction period.
COD-DK-112	Effects on seals at Rødsand seal sanctuary from the construction of Nysted offshore wind farm based on aerial surveys (2004)	The seal epidemic killed between 11 and 44% of the seals in management area 4 but in 2003 the population was recovering. Repeated counting indicates that the population increase at Rødsand was similar to the increase for the total area and that there was no effect on the population increase from the wind farm. (or further results see database)
COD-DK-118	Progress report of the acoustic T-POD monitoring during January-July 2004 (2004)	Daily frequency and waiting time between encounters indicate that fewer harbour porpoises were present in the wind farm area in the first half of 2004 as compared to the baseline, but the same time some recovery from the disturbance caused by construction of the wind farm may have occurred.
COD-NL-008	Detailed strategy of approach, lot 4 Assessment of the reference situation of the near Shore Wind park (NSW) for Harbour Porpoises (2003)	No results
COD-NL-017	Baseline data on the harbour porpoise, Phocoena phocoena, in relation to the intended wind farm site NSW, in the Netherlands (2004)	This study documents the status of the harbour porpoise in a localised coastal area west of the Dutch province of North-Holland. It discusses research methods, and results.

The overview shows that a notable part of publications refer to methodological questions such as different techniques for mapping individuals and populations. Habitats of high importance for marine mammal populations are mapped by aerial surveys on a large scale. Due to research or monitoring activities, also the behaviour of singular individuals was traced in singular cases.

From the scientific or statistical point of view, data on marine mammals in the North Sea and Baltic Sea are not yet sufficient. Systematic observations cover only a small section of the reviewed area up to now. More data on distribution and abundance of species is needed to establish densities and locations at which populations occur throughout the year.

In the Danish monitoring studies, effects on the hearing abilities of marine mammals turned out to be less invasive than expected. Individuals reacted by avoidance. It could be concluded that as long as there are sufficient suitable sites (habitats) to relocate to, effects may be of low significance.

It is still in question whether disturbances by follow-up effects like boat traffic (tourism, maintenance) will have significant long-term effects.

3.1.1.2 Main Relevant Effects

The effects are mainly caused during the construction phase. Noise emissions can reach a high intensity in the short term. Whereas noise caused by pile ramming can exceed damaging levels, noise emissions during operating phases are unlikely to reach a damaging level.[12]

The following potential impact correlations and pressures characterise the main effects on marine mammals due to offshore wind farms[13]:

- Physiological damage leading to direct and indirect loss of individuals (e.g. acute hearing damage due to ramming or pile-driving noise).
- Temporary reduction of habitat size and displacement of species due to construction and maintenance activities.
- Permanent reduction of habitat size due to operational noise emissions from the wind farm and other activities
- Disturbance of intra-species communications (e.g. masking of communication)
- Barrier effects for migrating animals due to noise emissions during the operational phase, or to electromagnetic fields.

[12] For further information on the investigation of noise emissions see Greenpeace 2005.

[13] See TU Berlin& Bundesamt für Naturschutz (2005)

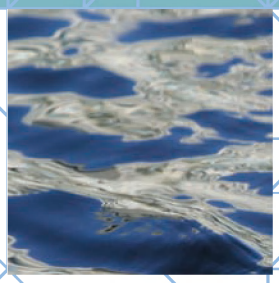


Table 2: Offshore Wind-related Impact Correlations Regarding Marine Mammals (cf. TU Berlin & Bundesamt für Naturschutz 2005)

Potential Impacts	CODs preliminary results - Marine Mammals
Physiological damage leading to direct and indirect loss of individuals (e.g. acute hearing damage due to ramming or pile-driving noise).	Yet, no case of direct loss of individuals was documented. Impacts of noise and vibration (i.e. during construction) on the mortality or birth rate of marine mammals has not yet been studied.
Temporary reduction of habitat size and displacement of species due to construction and maintenance activities.	Monitoring results at Danish Horns Rev Wind farm confirm that during construction seals and cetaceans avoid the area. Supposed reactions that for instance curiosity might attract seals and cetaceans to the building site, could not be stated. In all sites known as sites frequented by seals or cetaceans, impacts arising from boat movements and the installation of piles have to be assessed.
Permanent reduction of habitat size due to operational noise emissions from the wind farm and other activities	To which extent wind farms lead to a diminution of suitable habitats is still being discussed. There are observations that marine mammals avoid wind farm areas whereas others observe that after construction marine mammals do not show any change in behaviour. It is still in question whether disturbance by follow-up effects like boat traffic (tourism, maintenance) will have significant long-term effects.
Disturbance of intra-species communications (e.g. masking of communication)	Noise emissions are expected to be at lower frequencies than those used by dolphins and porpoises for echolocation to hunt prey, so they should not be affected.
Barrier effects for migrating animals due to noise emissions during the operational phase, or to electro-magnetic fields.	It is widely agreed that no significant barrier effects for migrating animals are known to date.

Overall, the listed adverse effects appear to be less invasive then expected at the beginning of investigations. Direct physical damage is unlikely, unless marine mammals are exposed to high noise levels especially during construction phases. Monitoring results at Danish Horns Rev Wind farm confirm that during construction seals and cetaceans avoid the area.

No impacts are predicted on seals and cetaceans during the operational phase.

Noise emissions caused by pile driving and ramming for the wind-power-plant foundations might affect the hearing abilities of marine mammals. The risk can be reduced by mitigation measures (repelling by pingers, bubble curtains, avoiding construction in sensitive stages in life cycle). Construction work should generally be scheduled according to sensitive life cycles.

In planning processes underwater noise spreading models could support the spatial delineation of 'risk zones', which are relevant above all during construction phases. This would allow consideration in decision making (inflicting mitigation, e.g. repelling measures).

To what extent wind farms lead to a diminution of suitable habitats is still being discussed. There are

observations that marine mammals avoid wind farm areas whereas others observe that after construction marine mammals do not show any change in behaviour.

If no fisheries are allowed in wind farm areas, an offshore wind farm may also have positive effects on the abundance of marine mammals.[14] Reduced disturbance and increased food stock (particularly fish stock) improve the nutrition conditions for marine mammals.

3.1.1.3 Cumulative Effects

Marine mammals are exposed to a high background stress level. Direct loss of individuals by fishery[15], noise and disturbances caused by ship traffic are main stress factors. This is why they are paid a comparable high amount of attention. However, the stress level cannot be quantified. Additional impacts from the wind farm project itself, e.g. increased shipping tourism, should also be considered in the assessment.

Compared to the losses and physical damage caused by fishery (esp. demersal trawling or anchored gillnets) the risk of physical impacts caused by singular offshore wind facilities seems to be low. However, the evaluation of impacts is interconnected with the total scale of offshore wind exploitation in North Sea and Baltic Sea.

3.1.1.4 Impact Prognosis

The impact prognosis mainly based on three main impact factors:

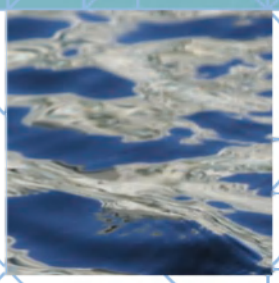
- Specific impact intensity (e.g. impact area of noise-emission, type of equipment used for the installation, timing and duration of the construction activities).
- Specific sensitivities of marine mammals (e.g. stage in life cycle, hearing range, avoidance reaction).
- Status and occurrence of marine mammals in the impact area (e.g. density, concentration area, possible seasonal variation).

At present, impact prognosis is based on the consideration of areas with high concentrations of harbour porpoise populations. Offshore wind developments should avoid these areas for pre-cautionary reasons.

Impact prognosis should focus on mother-calf groups or female harbour porpoises, as they are specifically sensitive most of the year.

[14] See OSPAR COMMISSION (2004): Problems and Benefits Associated with the Development of Offshore Wind Farms, p. 10.

[15] There are estimations that about 2000 harbor porpoises/year are killed in the North Sea due to bycatch.



3.1.1.5 Assessment of Impacts on Marine Mammals

For the risk assessment in spatial planning processes it might be an option to list all main impact areas, as well as the main areas of importance and the main sensitivities of marine mammals, and finally compile them all in a GIS system.

The countries have specific responsibilities for the subsistence of certain species. For example, grey seals are currently in the process of building up a population in the German North Sea. This special situation must be considered in the assessment of impacts upon the grey seal population. If windfarm projects prevented grey seals from building up their population in Germany, these impacts were to be assessed as highly significant.

3.1.1.6 Recommendations

Regarding site selection, the precautionary principle should be applied to protect endangered populations of mammals:

- Avoidance of "hot spots" like densely populated areas or sanctuaries to reduce potential risks to a minimum.
- Appliance of mitigation measures, i.e. reduce noise emissions, avoiding sensitive life cycles, repelling mammals during construction phase.
- Reduction or limitation of boat traffic, if it turns out to be a long-term disturbing factor.

3.1.2 Sea Birds and Resting Birds

3.1.2.1 Main Relevant Effects on sea birds / resting birds

Where sea birds and resting birds are concerned the following effects should be taken into consideration:

- Permanent loss of habitat due to displacement (avoidance);
- Collisions (bird strike);
- Barrier effects (e.g. fragmentation effects on units of the ecological habitat network, such as breeding or feeding areas).

Out of these, experts consider disturbance and collision as the main effects for sea birds and resting birds. Birds react to disturbance effects by avoiding the sites. The less they are able to avoid a site, the

higher is the collision risk. This indicates that the aforementioned effects are unlikely to appear simultaneously. In fact, there will either be (species-specific) avoidance or - if this is not the case - a risk of collision for certain species.

However, large-scale wind farms are likely to diminish the availability of suitable habitats. Thus, the significance of avoidance behaviour and its follow-up effects depend on behaviour/the survival strategy of the affected species and the overall availability of suitable areas.

Exact collision numbers cannot be derived from the analysed studies. Any numbers mentioned are based on estimations or assumptions. At present, no reliable numbers are available.

Sea birds and resting birds show avoidance and/or habituation to wind farms. Thus, compared to migrating birds, sea birds and resting birds seem less endangered, as they may adapt to the wind farm facilities.

As collision rates are not available at present, the magnitude of the assumed habitat losses is used as the main indicator to quantify the effects. Still it is a problem to evaluate the significance of certain habitat losses for populations of endangered species.

3.1.2.2 Cumulative Effects

Cumulative effects on populations of sea birds/resting birds can be caused by disturbance (ship traffic, tourism), pollution and general loss of suitable habitats, esp. for breeding and feeding.

Natural cumulative pressures (e.g. naturally poor breeding conditions) can aggravate the pressures caused by human activities. From the methodological point of view, is difficult both to predict the occurrence of natural pressures and to distinguish natural and project-related pressures.

Construction activities for grid connection (laying of cables) have to be considered; construction works should be scheduled according to sensitive life cycles.

3.1.2.3 Availability of Information

Data on stocks of sea birds and resting birds are acquired by counting (on fixed spots) or by aerial survey. Though there has been some baseline investigation, according to the scientific point of view the data situation has still to be improved to better interpret e.g. seasonal variations of occurrences.

As there are a large number of bird-specific studies and publications in the COD database, the following table contains only a selection.

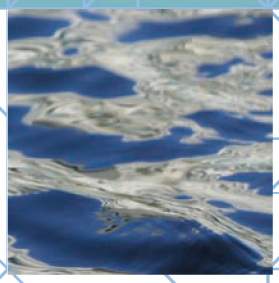
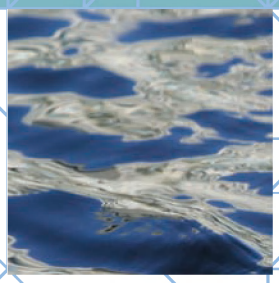


Table 3: Studies and Publications on Sea Birds and Resting Birds (Selection)

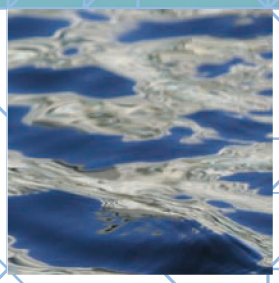
Reference	Title	Sea Birds and Resting Birds - Results
COD-D-015	Survey of resting birds in the German EEZ of the North and Baltic Seas (2003)	Information on the distribution of the most important seabirds in the German EEZ of the North and Baltic Sea. Furthermore, endangering factors and protection aims for seabirds in the EEZ have been pointed out. Proposals for EU special protection areas have been formulated and existing proposals for suitable areas for offshore wind farms have been discussed with regard to the distribution of seabirds.
COD-D-027	Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index (2004)	Species differed greatly in their sensitivity index (SSI). (...) The developed wind farm sensitivity index might be useful in strategic environmental impact assessments.
COD-D-030	MINOS plus: Ongoing research on seabirds and marine mammals for the evaluation of offshore wind turbines (Project in progress)	Extension of the monitoring and field investigations done in the preliminary MINOS-project (see COD-D-003). Ongoing until 2007.
COD-DK-003	Effects on birds of an offshore wind park at Horns Rev: Environmental impact assessment (2000)	It is assessed that the specific construction area of the projected wind park is of very limited significance for water- and seabirds judged by their overall distribution in the waters around Horns Rev.
COD-DK-010	Base-line investigations of birds in relation to an offshore wind farm at Horns Rev, and results from the year of construction (2002)	The within-year variation recorded in the most abundant species during the base-line study did not show any major deviation from what could be expected from comparison with the seasonal occurrence of these species at Blåvandshuk 1963-1999.
COD-DK-052	Rødsand Offshore Wind Farm EIA Technical Background Report Nr 16 Birds (2000)	It was shown that more than 90% of the waterfowl migration consisted of Eiders. In general, 20% of the total waterfowl migration passed through the planned wind park area. During the autumn period app. 10% of the Cormorants, gulls and Eiders passed the wind park area within the critical rotor height (30-110 m). A 10 m lowering of the hub height will increase this percentage 6-8%.
COD-DK-069	Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions. (2001)	Radar data showed that a substantial proportion of both the waterfowl and the terrestrial migrants crossed the wind farm area during their autumn migration. (...) In one out of three social foraging events, several thousand cormorants moved through the wind farm area, a situation that could be critical in terms of risk of collisions with the turbines.

Reference	Title	Sea Birds and Resting Birds - Results
COD-DK-072	Base-line investigations of birds in relation to an offshore wind farm at Rødsand: Results and conclusions, 2001. (2002)	Numbers of waterfowl may add up to 300,000 individuals. The base-line study has shown that between 37% (2001) and 49% (2000) of the waterfowl tracks registered by radar pass the eastern edge of the wind farm area. Count surveys of staging, wintering and moulting waterfowl have shown that cormorants (up to 5,200 individuals) and moulting mute swans (up to 9,700 individuals) occur in internationally important numbers. Some species showed a preference for the wind farm area + a 275 m zone. Radar studies revealed that large flocks of cormorants may undertake social foraging events and may occur inside the wind farm area. This behaviour makes cormorant a potential high-risk species. (...) *COD-DK-072 is a continuation of the study COD-DK-069.*
COD-DK-088	Base-line investigations of birds in relation to an offshore wind farm at Rødsand: Results and conclusions, 2002. (2003)	Investigations during spring and autumn 2002 confirmed the importance of the study area at Rødsand for migrating waterfowl species (...). Eider was still the predominant species amongst the migrating waterfowl. *COD-DK-088 is a continuation of COD-DK-072*
COD-DK-094	Visual and radar observations of birds in relation to collision risk at Horns Rev offshore wind farm. Annual status report 2003. (2004)	The aim of the project is to assess the collision risk between birds and wind turbines at the Horns Rev wind farm. Bird movements generally followed a southwesterly orientation and the intensity was highest during night. Only a small percentage of bird tracks entered the wind farm (14-22%). The majority of tracks either changed their orientation and passed around the wind farm, most reacting 400 m from the wind farm (north side) or 1,000 m (east side), or disappeared from the radar screen. Since most bird tracks disappeared c. 400 m from the outer turbines of the wind farm (north side) or 1,000 m (east side), these distances may represent the general extent to which flying birds avoid such structures. (...) Observations suggest that birds approaching the wind farm adjusted their flight direction and those that did pass through the wind farm did so along the open corridors between turbine rows, thereby further reducing the potential collision risk. Analyses showed that adjustment of the flight direction (in respect of the turbine rows) was more accurate during the day than at night, which may relate to a more precise recognition of individual turbines by the birds during the hours of daylight.



Reference	Title	Sea Birds and Resting Birds - Results
COD-DK-095	Bird numbers and distribution in the Horns Rev offshore wind farm area. Annual status report. (2004).	This report presents data from six aerial surveys of birds in the Horns Rev wind farm area in 2003. Common Scoter was by far the most numerous bird species in the study area in 2003 as well as during the previous years of investigations. Herring Gull was the second most numerous species in 2003 (...) Divers, Red-necked Grebe, Fulmar, Gannet, Cormorant, Eiders, Great Black-backed Gull, Little Gull, Arctic/Common Tern and Guillemot/ Razorbill were relatively regular in the study area. They are treated in detail in this report. The number of divers, Common Scoter and Little Gull increased in the study area in 2003, as compared to the previous years of surveys. Avoidance behaviour appears to be species specific: Divers, Gannets, Common Scoters and Guillemots/ Razorbills showed an increased avoidance of the wind farm area (and zones within 2 and 4 km of it) after the erection of the wind turbines. In contrast, Herring Gulls showed a decreased avoidance of the wind farm area, while Great Black-backed Gulls, Little Gulls and Arctic/Common Terns showed a shift from avoidance preconstruction to a preference for the wind farm area post-construction. Common Scoter showed a difference in the spatial distribution within the study area in 2003 compared to previous years. An area southeast of the wind farm, previously used by Common Scoter particularly in February through April, became less attractive to the species. Simultaneously areas west and north of the wind farm, with previously very few Common Scoters, supported greater numbers of this species in 2003. The reason for the change in avoidance of the wind farm area for divers, Gannet, Common Scoter and Guillemot/Razorbill is unknown. Various assumptions are proposed.
COD-DK-098	Investigation of birds during the operational phase of the Nysted offshore wind farm. Preliminary notes on the issue of potential habitat loss	Report describes presence and distribution of the most widely occurring species in the study area. The majority of water birds avoided the area of the wind farm (as in the base-line period). Only three species occurred with any abundance in the wind farm area (eider, long-tailed duck and herring gull)
COD-DK-099	Bird numbers and distribution in the Horns Rev offshore wind farm area. Annual status report 2004. (2005)	This report presents data from four aerial surveys of birds in the Horns Rev wind farm area in 2004. Three surveys from the winter and spring of 2004 are thoroughly reported here (see also COD-DK 95). Divers, Common Scoter and Guillemots/Razorbills showed an increased avoidance of the wind farm area (and zones within 2 and 4 km of it) after the erection of the wind turbines. In contrast, Herring Gulls, Little Gulls and Arctic/Common Terns showed a decreased avoidance of the wind farm area. Common Scoter showed a difference in the spatial distribution within the study area in 2004 compared to previous years. Shallow offshore areas west of the

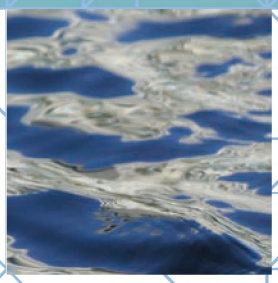
Reference	Title	Sea Birds and Resting Birds - Results
		wind farm became important to the species, with occurrence of birds in the westernmost parts of the survey area. Furthermore, the seasonal shift in offshore appearance of Common Scoter described in previous reports seems to have changed into a more permanent presence during winter. This leads to the hypothesis that a food resource has formed in these areas, which was not present during the pre-construction period. Given the apparent general changes in Common Scoter distribution in the study area, comparison of pre- and post-construction distribution analyses for this species must be interpreted with caution. Still there are only assumptions on the causal interconnections for changing of abundance or avoiding behaviour.
COD-NL-001	Nocturnal flight activity of sea ducks near the wind farm Tunø Knob in the Kattegat. (1999)	Besides the results regarding nocturnal flight movements of Eiders: general, regarding nocturnal flight movements of Common Scoters: general and flight movements of Eiders in the vicinity of the wind farm, the following consequences for effects of offshore wind farms were found: 1. flight activity in the direct vicinity of wind farm is lower than far away from it. The effect was strongest in moonlit nights and relatively low at dusk. 2. In the trade-off of Eiders to fly outside or through the wind farm or leave the area altogether, different factors are important: the size of the gap between turbines, the length of the detour and the availability of alternative feeding/resting areas. 3. Long continuous formations perpendicular to general flight direction of ducks must be avoided. 4. Distance between turbines within clusters should be minimised.
COD-NL-002	Monitoring of birds in the Near Shore Wind farm. (2002)	Description of possible research methods with advantages and disadvantages; A. for researching collision victims a new method should be developed. B. for researching disturbing effects the existing methods and resources fulfil all needs. Guidelines: 1. initial investigation of characteristics of NSW-location; 2. Determining the chance of collision; 3. Survey of change in behaviour of local birds; 4. Survey of change of flight patterns of migratory birds; 5. Interpretation and report of the obtained data.
COD-NL-009	Detailed strategy of approach, lot 5 Marine Birds (2003).	Not reported
COD-NL-014	Preliminary Study into Bird Research Methods for the MEP-NSW (RIKZ/2003.045) (2003)	Overview of advantages and disadvantages of Bird research Methods
COD-NL-018	Baseline studies North Sea Wind Farms: Lot 5 Marine Birds in and around the future site Near shore Wind farm (NSW). (2004)	18 species of seabirds were seen in sufficient numbers to warrant further examination. Seabird behaviour, including flight heights, flying directions, several different foraging and feeding behaviours, association behaviour (to fishing vessels, marine



Reference	Title	Sea Birds and Resting Birds - Results
		mammals, offshore platforms, hydrographical fronts, etc.) were noted for the birds seen. The aim was two-fold: to find the most vulnerable birds with respect to collisions into turbines and to help explain some obvious anomalies in distribution patterns.
COD-SE-001	Studies of birds near an off shore wind power unit (1994).	Domiciled birds got used to the power station. The influence on resting birds was difficult to see since they were so few. Migratory birds changed their flying behaviour by flying further away from the unit.
COD-SE-003	The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden (2005).	See table 4 (migrating birds)
COD-UK-002	Assessment of the Effects of Offshore Wind Farms on Birds (2001)	The study reviews the current (at the time) status of the effects of offshore wind farms on birds. It concludes that there are considerable gaps in knowledge and that further studies are required, as well as an approach to deal with uncertainties in the meantime. It recommends priority needs as follows (1) more data on distribution and abundance of offshore birds and factors affecting their site use, (2) more data on actual effects of existing wind farms on key species, (3) population studies of key species, (4) information on indirect impacts, (5) development of standardised methodologies for baseline data collection, assessment of effects and appropriate monitoring programmes.
COD-UK-010	The effect of wind turbines on the bird population at Blyth Harbour. (1996)	Relatively few collisions were recorded (34 to 1995). Cormorants avoided flying close to turbines. Eiders are relatively more prone to collision in the early years (but rates thought to decline in later years). Purple sandpiper showed high tolerance to construction activity.
COD-UK-014	Wind farms and Birds: An analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues. (2002)	The purpose of the report was to analyse the impact of wind farms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for wind farms. It reviews the outcome of studies for onshore and offshore wind farms. The main results of the analysis were: (1) Disturbance: the effects are variable and species-, season- and site-specific. (2) Collision risk and mortality: the majority of studies show very low collision mortality rates, but this can be significant in numbers, e.g. Altamont pass, Tarifa. The importance of wind farm location and layout onshore and offshore is apparent from studies. (3) Habitat loss: direct habitat loss offshore small-scale, but postulates that it may be an issue for future larger schemes. The report provides a matrix of sensitivity of different species and covers disturbance, barrier to movement, collision and direct habitat

Reference	Title	Sea Birds and Resting Birds - Results
		loss/damage. It also makes recommendations as follows: (1) research by government and industry to improve understanding of wind farm impacts, with dissemination of results in international journals and English summaries. (2) SEAs by national governments of wind energy plans and programmes. SEAs should include bird population mapping, bird habitats, flyways and migration routes. (3) It recommends mapping of no-go locations for nature conservation reasons, such as migration crossings. (4) Incentives and technology development to reduce dependency on shallow waters.
COD-UK-031	Aerial Surveys of Birds in Proposed Strategic Areas for Offshore Wind Farm Development, Round 2: Preliminary Report, Winter 2002/2003. (2003)	This report provides preliminary results from aerial surveys in the Greater Wash strategic area, undertaken by WWT in early 2003. A series of transects were flown at 4km intervals, and observers recorded the number of birds encountered. This was combined with data from a GPS, used to record the flight path of the plane, so that location was accurately recorded. A series of maps shows the distribution of key bird species or species groups in 4x4 km cells, calculated as the number of birds encountered corrected for survey effort.
COD-UK-035	Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. (2004)	The aim of this document is to provide guidance for bird counts in relatively small areas of sea, using either ships or aircraft, or both. Existing methods are reviewed and compared. The aim is to provide a standardised protocol for conducting surveys at any UK offshore wind farm. A matrix is provided which assesses the effectiveness of a variety of census techniques for a variety of objectives such as assessment of collision risk or estimation of sea bird abundance.
COD-UK-037	Predicting the displacement of common scoter Melanitta nigra from benthic feeding areas due to offshore wind farms - Interim Reports 1 to 4. Project in progress	The aim of this document is to address the disturbance/ displacement of birds from the vicinity of the turbines and provide a tool for predicting impacts that are currently uncertain. It focuses specifically on Common Scoter. Expected results are (1): A model to assist in predicting the effect of offshore wind farms (individually and cumulatively) on Common Scoter due to habitat loss and change and (2) Guidance material on the use of the model to assist developers in carrying out EIAs
COD-UK-057	Aerial Surveys of Water Birds in Strategic Wind farm areas. Project in progress	The Round 2 wind farm Strategic Environmental Assessment (Offshore Wind Energy Generation: Phase 1 Proposals and Environmental Reports for consideration by the Department of Trade and Industry April 2003) identified a significant baseline data gap for Round 2 areas on the distribution and main flight paths of seabirds including migratory, feeding/roosting patterns and their behavioural response to wind farms. The study will address these issues.

As table 2 shows, results and progresses have been achieved regarding the development of methods



for bird counting and survey. Meanwhile there are methodological guidelines, which help to ensure the application of defined methods as a precondition for the comparison of survey results.

However, apart from stock surveys, possibilities of standardisation on behalf of effect studies are restricted as birds reactions depend on various factors: species, behaviour, location, season, weather conditions, natural factors like food supply etc. Thus, the interpretation and generalisation of effect study results is very restricted, too. At present, effect studies dealing with the reaction of birds on wind turbines are provided mostly from the Danish demonstration programme.

Though a notable number of baseline studies and surveys on abundance of bird stocks in North Sea and Baltic Sea have been carried out in the last few years, the information basis on bird stocks and spatial patterns of diurnal and seasonal occurrence still needs improvement.

3.1.2.4 Aspects of Impact Prognosis and Assessment

Conservation value, national responsibility or statutory importance are relevant criteria upon which assessments should be based. Criteria as habitat loss[16], the proportion (number) of displaced individuals, or the proportion of lost individuals do play a significant role for assessing the significance. The main question being controversially discussed among experts is, which population size of marine and resting birds is appropriate as a reference or evaluation scale for impact assessments. It is still in question if the assessment should refer to

- bio-geographic population or
- national population, broken down by administrative units or
- national North Sea/Baltic Sea population or
- regional natural landscape units.

However, the choice of the reference or evaluation population size affects the result and the decision-making process. Up to now, there is no agreement as to which reference size should be considered for the determination of impact intensity of offshore wind farms.

3.1.2.5 Recommendations

Following the precautionary principle protected areas like Special Protection Areas (SPA) should be avoided.

The investigation and monitoring of collision risks still is essential. Research methods regarding collision victims should be improved.

[16] The assessment of "habitat loss" is highly relevant for decision making, esp, if the regulations as in the German Maritime Facility Act (Seeanlagenverordnung) name the affection of sea birds as a reason to reject a project.

Methods of how to gain information on the number and circumstances of bird collisions such as the development of camera systems for observation, accomplishment with a platform to facilitate the counting of collided birds and acoustic survey are still under discussion. Approaches to quantifying collision risks by modelling should be enforced.

To provide a tool for predicting impacts that are still uncertain, existing knowledge gaps have to be closed. Models could assist to predicting the effects due to habitat loss and change (see COD-UK-37).

3.1.3 Migrating Birds

3.1.3.1 Main Relevant Effects

The main adverse species-specific effects on bird migration can be characterised as follows:

- collisions (bird strikes): Increased mortality due to collisions of birds with wind turbines
- disturbance by barrier effect: Increased consumption of energy reserves during migration due to avoidance reactions, possible loss or impairment of orientation
- disturbances at important stopover-sites.

Out of the effects mentioned, the main effects on migrating birds are collisions and disturbance.

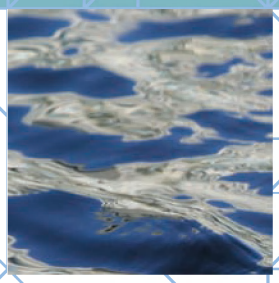
It is still controversial as to what extent collisions actually happen. There is a consensus that collisions are more frequent under bad weather and sight conditions. Assessing the magnitude of the collision is mainly a technical problem, as collisions seem to happen mostly at nightime. Injured or dead birds fall into the water and disappear. For to cost reasons intricate technical surveillance methods (e.g. infrared cameras or thermal animal detection system (TADS); see COD-DK-092) are rarely applied. So far, this has been done only for eiders (DK).

Giving reason for deviation of flight routes and obstruction of potential resting areas, offshore wind farms of large extent diminish foraging and resting conditions, which may decrease reproduction rates. The effect of diminishing unaffected areas has to be seen in the context of the overall intense use.

Nevertheless migrating birds are more sensitive towards disturbances on their flight route (lack of foraging areas, energy losses endanger the survival of individuals) than local sea birds.

In areas with a high risk of bird collision, the exerted barrier effect must be low and vice versa: a strong barrier effect diminishes the collision risk.

The significance of both effects depends on the overall availability of suitable areas.



3.1.3.2 Cumulative Effects

Any facilities or buildings at sea might cause bird strikes. In addition, habitat losses due to general deterioration of habitat conditions should be considered. Up to now, the effects are not measured, predictions are uncertain.

Cumulative effects on bird migration need to be discussed and addressed at an international level (e.g. a directive or regulation from the EC on the assessment of cumulative impacts, or a quota system, where each country can have a certain level of impact). But also the national authority is obliged to assess cumulative effects with regard to project applications. Thus, cumulative effects need to be addressed at different scales.

From the scientific point of view the selection of the reference area/reference population is the most important criterion for the assessment of cumulative impacts. All activities that affect the defined reference population must be taken into account to determine cumulative impacts. There is a great need to consider each species for itself, and it is necessary to look at a species-specific level to decide which reference population (e.g. sub-population) to assess for population effects.

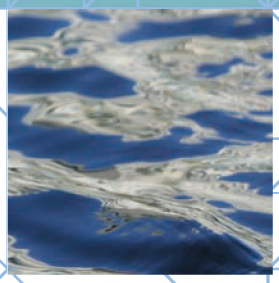
3.1.3.3 Availability of Information

Most of the available studies and data, which specify on migrating birds, are linked to German and Danish research activities. In Germany, the interest is focused on delineation of protection areas or sensitive areas. Correspondent activities like the designation of NATURA 2000-sites or SPAs (Special Protection Area) should also be an issue in other countries.

Table 4: Studies and Publications on Migrating Birds

Reference	Title	Migrating Birds - Results
COD-D-034	Species related levels of impact to migrating birds for the area of the south-west Baltic Sea and hazard to bird migration caused by offshore wind turbines. (Project in progress)	Quantification of migration rates and calculation of a specious related collision risk. Modelling of the population dynamics of migratory bird in the Baltic sea. Determination of specious related levels of impact to migrating birds. (ongoing project, until June 2006)
COD-D-038	Collision risk for migrating birds and disturbance effects on harbour porpoises at the offshorre wind farms Horns Rev and Nysted in Denmark. (Project in progress)	Studies on the collision risk for migrating birds and disturbance effects on harbour porpoises at the offshore wind farms Horns Rev and Nysted in Denmark. The project is held within the framework of the German-Danish cooperation on accompanying ecological research offshore. (ongoing project, until January 2007)
COD-D-039	FINOBIRD: Impacts on bird migration – accompanying research in the offshore area	Studies on the spatial and temporal distribution of bird migration over the North Sea. With regard to potential sites for offshore wind farms the impacts of

Reference	Title	Migrating Birds - Results
	at research platforms in the North Sea. (Project in progress)	wind farms on migration routes will be discussed, and avoidance measures with regard to bird strikes. (Ongoing project until July 2006)
COD-DK-081	Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency between migrating birds and offshore wind turbines (2003)	The report presents data from equipment tests and software development for the project 'Development of a method for estimating collision frequency between migrating birds and offshore wind turbines'. TADS is capable of recording migrating birds approaching the rotating blades of a turbine, even with the conditions of poor visibility. If the TADS were used in a vertical viewing scenario it would comply with the requirements for a set-up used for estimation of the avian collision frequency at offshore wind turbines.
COD-DK-092	Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of thermal animal detection system (TADS). (2005)	This report presents data on infrared monitoring investigations by use of Thermal Animal Detection System (TADS) of migrating water birds. Information presented covers the autumn period of 2003 and spring period of 2004. During operation the thermal trigger software saved 1,223 thermal video sequences on hard disc (see Table 1), of which only three were triggered by birds passing the field of view all in a 45° viewing mode. No birds were recorded passing the sweep area of the rotating turbine blades. There was no collision with any part of the turbine during the 11,284 minutes of monitoring. The final quality control of the offshore utility of the TADS produced excellent results. It can be concluded that TADS can be considered as a fully developed monitoring set-up capable of detecting migrating birds flying over offshore areas and passing at the range of distances planned for the equipment. (...) However, comparison with data gathered from other sources confirm the extremely low intensity of water bird migration in the near vicinity of the turbines: (...) the radar data on bird flocks migrating within the wind farm show significant avoidance responses towards individual turbines, resulting in a higher probability of flying more than 50 m from the turbines than expected by chance alone. NERI therefore proposes future collision studies to include a combination of data collected by radar and TADS for use as input to a more accurate and statistically robust model of the probability of daily number of avian collisions. For further information see database
COD-DK-093	Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Annual status report 2003 and Preliminary analysis of data from spring 2004. (2004)	The observations of migrating birds at Rødsand were conducted from an observation tower placed 6 km southwest of Gedser Odde and 5 km northeast of the wind farm area. From this position it was possible to monitor bird migration by performing both visual and radar observations. The study on migratory birds during operation of the Nysted wind farm in spring 2004 generally



Reference	Title	Migrating Birds - Results
		supported the results from the first provisional operation period, autumn 2003. It must be emphasised that transposing results to other sites may only be applicable on a very general level, e.g. that eiders are likely to show some avoidance response to wind farms. More specific issues such as estimates associated with relative use of different migration routes around the wind farm are likely to be site-specific. (...) Prevailing wind and light conditions are important determinants of the relative importance of migration routes.
COD-DK-96	Investigations of migratory birds during operation of Horns Rev offshore wind farm: Preliminary note of analysis of data from spring 2004	Preliminary results available. No actual collisions were observed. Very few birds were recorded inside of the wind farm. Most bird species generally exhibit an avoidance reaction towards the wind turbines, which reduces the probability of collisions. Most birds actually entered the wind farm seemed to adjust flight orientation to pass through the wind farm in parallel with turbine row and do not cross over several rows. A less accurate adjustment of flight orientation was recorded during nightimes.
COD-DK-097[17]	Investigations of migratory birds during operation of Horns Rev offshore wind farm. Annual status report 2004. (2005)	The aim of the project is to assess the collision risk between birds and wind turbines at the Horns Rev wind farm. (...; for more details see database) As also recorded in 2003, many radar tracks of birds disappeared from the radar within close range of the wind farm, e.g., due to change of flight direction, or landing on water. This is confirmed through the behavioural observations of Common Scoters approaching the wind farm during spring 2004. Whatever the precise nature of these disappearances, the loss of tracks on the radar screen in all probability reflects a behavioural response to the wind farm by approaching birds. Since most bird tracks disappeared at distances of about 400-500 m from the outer turbines of the wind farm this distance may represent a threshold distance for several bird species. This change in migration orientation in relation to the wind farm may have started at much longer distance, as seen for northward migrating birds. As expected, no collisions were observed. Birds that flew in closer than ca. 400 m from the wind farm during southward movements showed an adjustment in orientation to make a perpendicular passage in between the rows of turbines, either flying south or west when approaching the north and east side of the wind farm, respectively. As recorded during autumn 2003, birds that passed in between turbines during daytime generally tended to make more precise adjustment in relation to the orientation of turbine rows than birds that passed in between turbines during night. Consequently, the risk of collision seems to be higher during periods of low visibility, i.e. during night or foggy conditions,

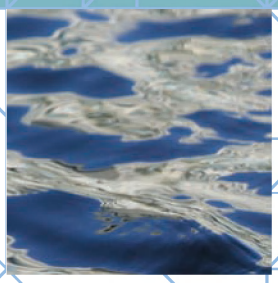
[17] Also see COD-DK-096.

Reference	Title	Migrating Birds - Results
		compared to situations when birds have visual contact with the turbines.
COD-DK-100	Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Annual status report 2003 and Preliminary analysis of data from spring 2004. (2004)	Autumn migrating waterfowl showed significant differences in their mean orientation within the approaching area of the wind farm between all four years of investigation. For more detailed results see database.
COD-SE-003	The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden (2005).	During four years of observation with 1,5 million birds passing only one bird collision was observed. A calculation of collision risk based on data collected from the Kalmar Sound studies shows that 1–4 flocks during the spring and about 10 flocks during the autumn (and only one bird in each flock) run the risk of colliding with the existing wind turbines. This translates into one waterfowl killed per wind turbine per year. About 30% of the waterfowl that migrate through Kalmar Sound are affected to some extent by the wind farms Utgrunden and Yttre Stengrund. The majority of Eider and other migrant waterfowl avoid the immediate vicinity of the wind farms. The birds generally start an evasive manoeuvre 1–2 km before the wind farms. The birds' behaviour is generally similar, irrespective of time and visibility – the majority of all waterfowl react to avoid the wind farms at night as well as daytime, in poor visibility as well as in clear conditions. The waterfowl that make an evasive manoeuvre extend their migration distance and thus time by 0.2–0.5%. This entails only a marginal increase in energy expenditure for the whole migration. Very few waterfowl flocks fly so near the wind turbines (100m) that they risk a collision.

In Denmark (Baltic Sea) and Germany (North Sea and Baltic Sea) comprehensive studies have been carried out, which help to identify some "hot spots" of migration flight routes. Yet, localisation and delineation of bird migration routes is still a problem, because changing flight conditions (wind, visibility, day or night) lead to varying behaviour and routes.

Danish effect studies focus on identifying flight routes, flight patterns and the magnitude of collisions. The migrating and staging birds on and within the vicinity of the Horns Reef and Rødsand area (= Nysted) have been studied extensively. The within-year and year-to-year variation of the most abundant species is known now, giving a good basis for the monitoring of the actual effects of the Danish offshore wind farm on birds.

Overall, still more data on bird migration is needed, such as site-specific information on migratory routes and scale of passage, species-specific flight altitudes, also including local movements. The need for more data is due to the great variability of factors influencing migrating behaviour and conditions.



3.1.3.4 Aspects of Impact Prognosis and Assessment

The impact prognosis can be based on the classification of pressure intensity. The pressure intensity depends on the features of the intended wind farm (location of the wind farm, number of wind turbines, extension and configuration) the height and rotor diameter of turbines, the lighting[18] and the coloration on one hand and on the characteristics of migration on the other.

To determine the extent of migration it is necessary to investigate the intensity of bird migration in the impact area during daytime and nightimes. The altitude distribution by daytime/night-time has to be classified. Seasonal variability concerning altitude distribution should be considered, too.

Identification of flight patterns is most helpful to avoid negative effects. Nevertheless, depend-ent on the species composition, flight routes and species-specific migration behaviour (e.g. narrow-band or broad-front migration) vary considerably.

Specific weather conditions; such as fog, rain, wind conditions and visibility (daytime/night-time) during migration can have a great effect on collision risk, especially change of weather during flight. In addition, the angle of approach of the migrating birds toward the wind farms seems highly relevant. The problem is the determination of the probability of bad weather conditions or wind directions coinciding with bird migration.

Most important for the probability of collisions is species-specific avoidance and evasion behaviour. Also important is the above-mentioned attraction to light and more general aspects, such as manoeuvrability. For determining the ensuing impact on population, the condition and the reproduction dynamics of each species must be taken into account.

The assessment of collision risk during both day and night time is greatly impeded by the lack of fundamental knowledge of the behaviour of birds shown towards wind turbines and wind parks in general for the species in question. Most of the environmental impact studies are based on qualitative data on collision risks of birds; evaluation of collision risks is still a field of expert opinion. Reliable data is still missing or allows for more than one possible interpretation.

The probability of collisions must be assessed in a species-specific approach and case-by-case. It is difficult to assess the magnitude of the collision problem. But so far, this has been done only for eiders.

Assessing the impacts on migrating birds, the total number of offshore wind farms along the flight path has to be taken into consideration. Assessing the magnitude of cumulative effects appears to be the major problem.

The reference population must be defined species-specific and based on either flyway or bio-geographic population, and threshold levels should be population-specific or species-specific.

[18] Illumination by navigational lights, particularly blinking lights are likely to attract most bird species, rather than preventing them from collision. Though, illumination increases collision risk (see OSPAR COMMISSION 2004).

3.1.3.5 Recommendations

Ensuring the protection needs for migrating birds along the flight path is a transnational issue. The data collection on migrating birds should be continued; the appliance of standardised methods for further survey is highly desirable. Data should be exchangeable on transnational level.

Diminishing suitable habitat areas has to be evaluated considering the already existing strains caused by exploitation, fishery, ship traffic etc.

Standards for assessment, esp. a definition of reference areas or populations have to be developed and applied on transnational level.

With reference to the impact assessment for migrating birds, the development of a collision risk model seems to be of high importance. The avoidance behavior of migrating bird species is the most important factor to be included in models to make them realistic.

Cumulative effects must be addressed at an international level (EU). While a proper level must be discussed, the need for more international co-operation has been stated.

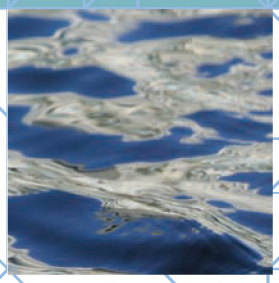
3.1.4 Benthos

3.1.4.1 Main Relevant Effects

Foundations and scour protection exert effects on benthos communities:

- Change of species composition/loss of (protected) species due to the introduction of artificial substrates.
- Long-term elimination of benthic communities or benthic species due to covering of the seabed by windturbine foundations.
  Damaging biogenic reefs by scouring or smothering by scour protection is considered a serious risk, because of their conservation interest and low capacity for regeneration.
  However, the area of reclaimed sea bottom covered by establishing the Horns Reef wind farm is expected to be less than 0.1% of the total area of the site.
- Change of habitat conditions by altered sedimentation and current

  It is unclear, what amount additional sediment flow is released during the construction phase. One British local EIA concludes that the maximum total volume of sediment that could be released during construction is approximately one thousandth of the level of sediment habitually in motion across the site.



An assessment of the release of metals and other organic chemicals indicate very small increases in concentrations arising during construction, less than 10% of the background concentrations and well below environmental standards. If a re-suspension of contaminated sediments in localised, sediment 'sink' areas such as estuaries is to be assumed, it would require consideration during project specific EIAs.

- Change caused by the increase of sediment temperature in the area of electric cables.

  Burying cables in the sea bottom would reduce a rise in temperature.

The significance of the mentioned effects on benthos communities is widely discussed. Presently they do not play an important role in the admission of offshore wind farms, though the expenses for investigation and monitoring of effects are notable.

Further impact correlations, which, from the scientific point of view - might be of any relevance, are electromagnetic fields. Risks caused by electromagnetism presently are low to unknown, as well as impacts on benthos communities caused by vibration.

If fisheries, esp. demersal trawling, are excluded from wind farm areas, this is expected to have significant positive effects on the abundance of benthos communities, as recurrent disturbance of habitats would cease.

3.1.4.2 Cumulative Effects

Benthos communities are highly stressed by all activities leading to a loss or a change of habitat conditions (laying of cables, sediment extraction) and above all by fisheries. Compared to the disturbance effects caused by recurrent demersal trawling the habitat changes e.g. caused by introduction of hard substrates can be considered to be low.

Regarding the effects of the introduction of artificial substrates, the significance of impacts cor-responds to the status (protection/endangerment) and the total scale of habitat loss respectively habitat change.

The follow-up effects of changes in benthos communities (combination of species, competition, abundance) for the stability of the marine environment cannot be predicted presently.

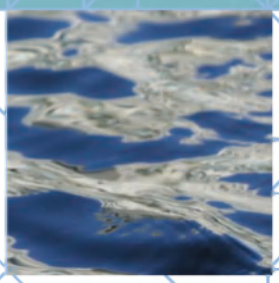
3.1.4.3 Availability of Information

There is a clear focal point on benthos in context of the monitoring programme linked to the demonstration projects in Denmark. Apart from Denmark, there are German activities on behalf of benthos connected to the FINO-research platform.

Table 5: Studies and Publications on Benthos Communities

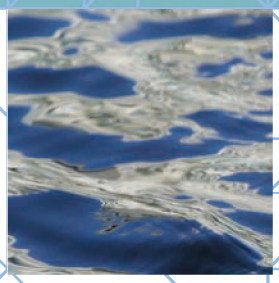
Reference	Title	Benthos Communities - Results
COD-D-004	BEOFINO – Accompanying Ecological Research on Offshore Research Platforms in the North and Baltic Seas[19]. (In progress).	The final report of the project also concerning benthos is presumably published in summer 2005. (www.fino-offshore-com).
COD-D-016	Benthic surveys in the potential suitable areas for offshore wind farms "Kriegers Flak" and "Westlicher Adlergrund" in the Baltic Sea. (2003)	77 species of macrozoo-benthos on Kriegers Flak with a density between 386 and 8.875 ind/m2; 69 species of macrozoo-benthos on Westlicher Adlergrund with a density between 750 and 21.250 ind/m2; The populations in both sites contain endangered species. Installation of an offshore wind park is expected to have a disturbing influence on the zoo- and phytobenthos.
COD-D-040	Impacts of offshore wind farms on the benthos in the North Sea (BEOFINO II) (Project in progress until December 2007)	Selected results of the measurements and investigations on the research platform will be published on the FINO-website (www.fino-offshore-com).
COD-DK-004	Environmental Impact Assessment of Sea Bottom and Marine Biology. (2000)	The area of reclaimed sea bottom covered by establishing the wind farm is calculated to less than 0.1% of the total area of the site. It amounts to an area with a potential biomass of benthic animals of approximately 600 kg. An increased copper contamination of filter-feeding benthic animals can be expected because of the total annual discharge of 206 kg copper from the slip rings in the wind turbines.
COD-DK-018	Horns Rev Offshore Wind Farm - Introducing Hard Bottom Substrate Sea Bottom and Marine Biology, Data Report 2001. (2002)	Baseline study on benthos and seabed; The annexes describe the benthos characteristics.
COD-DK-029	Control and monitoring programme. Artificial reef. Progress memorandum 2 (2002).	(...) Closer examination of the sediment characteristics revealed that there is only a very slight difference in the median grain size of the reference and wind farm areas. (...)
COD-DK-035	Sand eels and clams (Specula sp.) in the wind turbine park at Horns Reef. (2003)	The most common species of shellfish on Horns Reef in both the Wind Turbine park and control area were brown shrimps (Crangon crangon) at an abundance of between 15,000 and 31,000 pr. km2. Syndosmya (Abra) alba was observed at an abundance of around 16,500 pr. km2 in the wind turbine park and around 2,500 in the control area. The clam (Spisula solida) was observed at an abundance of 1,300 pr. km2, which is much lower than observed in 1993, when the abundance was around 17,000 pr. km2. Prediction of future abundances of S. solida is hardly possible.

[19] The first research platform (FINO I) is situated in the North Sea about 45 km north of the island Borkum, with a water depth of about 30 m. The operation of this platform started in September 2003.



Reference	Title	Benthos Communities - Results
COD-DK-066	Distribution of benthic communities at the proposed wind farm at Rødsand and along the cable connection between the wind farm and Lolland in May 2001. (2001)	Results of baseline survey (...) Common mussels appear to be scarce in the lagoon. The bottom vegetation consists of populations sections of the cable connection and attached algae on stones along the middle section of the alignment. Detached algae were abundant in the interior part of the lagoon.
COD-DK-067	Sampling stations and results of photo sampling along the cable connection in May 2001. (2001)	Results of photo sampling. No detailed results reported in the database.
COD-DK-068	Marine Biological Surveys along the Cable Connection in the Lagoon of Rødsand in 2001. (2002)	Common mussels (Mytilus edulis) were observed, but were only abundant at station 11 at pound net 2. At all other stations common mussels were absent or few and scattered. For results on distribution of detached and decaying filamentous macro algae see database.
COD-DK-101	Development of the fouling community on turbine foundations and scour protections in Nysted offshore wind farm, 2003. (2004)	Common mussels and barnacles were the quantitatively dominant organisms and the biomass on the vertical shafts was about ten times higher than on the stones. The biomass was uniform independent of direction (W, E, N and S) but changed due to a decline in barnacles and mussels with increasing depth.
COD-DK-102	Infauna monitoring. Horns Rev offshore wind farm. Annual status report 2003. (2004)	The main difference between the survey in 2001 and in 2003 was the decline of the Pisione remota population and an increase in the population of Goodallia triangularis. (...) The particle size of the sediment in the wind farm area increased from a range of 228–426 µm in September 2001 to a range of 404–699 µm in September 2003. A comparable increase in particle size was also found for the reference area. (...) Reductions in current regimes are modelled to less than 15% within 5 m from the edge of the scour protection of turbine foundations (....) No significant impact on the infauna in the wind farm area was detectable concerning distance-related effects.
COD-DK-104	Hard Bottom substrate monitoring. Horns Rev offshore wind farm. Annual status report 2004. (2005)	Fauna communities on the introduced hard substrates are completely different. (...) A typical epifaunal community has replaced the native infaunal community. (...) More species found on wrecks in other parts of the North Sea are likely to be found at Horns Rev in the future.
COD-DK-105	Infauna monitoring. Horns Rev offshore wind farm. Annual status report 2004. (2005)	There was a decline in the number of species occurred both inside the wind farm and in reference areas, which indicates that the decline could be a combination of changes in sediment characteristics and natural variation rather than an effect from the establishment of the wind farm. More species were not associated with the hard substrate at the turbine

Reference	Title	Benthos Communities - Results
		sites in 2004 compared to 2003. (about change in sediment structure see database). No significant impact on the infauna in the wind farm area was detectable concerning distance-related effects. The infauna community at Horns Rev showed no obvious sign of stress response as a consequence of possible impact from construction and operating activities. New species were observed in 2003 and 2004 and some of these might be a result of sediment characteristics (...)
COD-DK-114	Sand eels in the wind farm area at Horns Reef. (2004)	In the impact area a markedly increase in density of sandeels (all species combined) was observed from 2002 to 2004. This increase coincides with a small decrease in densities in the control area (away from the wind farm/impact area). Average densities of sand eels in the impact area increased about 300% from 2002 to 2004, whereas densities decreased about 20% in the control area. It is therefore concluded that the construction of the wind farm has had no negative impact on sand eels in this area. A large change was found in the species composition and densities of sand eels from 2002 to 2004.
COD-DK-119	Sand eels and clams in the wind turbine park at Horns Reef (In this report, the results of the survey carried out in February and March 2002 before the wind turbine park was constructed. are evaluated. (2003)	The distribution and relative abundance of sand eels and shellfish in the area of the wind turbine park at Horns Rev was mapped in conjunction of seabed sampling during three surveys in February and March 2002. The mean density of sand eels in the sediment was 0.0102 m2 (10,200 km2) in the control area and 0.0096 m2 (9,600 km2) in the impact area. The most abundant species of sand eel in both the impact and the control area was H. lanceolatus followed by A. marinus and A. tobianus. No G. semisquamatus was caught during the surveys. (regarding prediction of expected effects due to construction / sediment change see database)
COD-NL-005	Strategy of approach, Lot 1 Benthic. (2003)	--/--
COD-NL-013	North Sea Wind Farms: NSW Lot 1 Benthic Fauna. Final Report (ZBB607.2-F-2004). (2004)	Overview of benthic species in the NSW area and the two reference areas
COD-SE-006	BIOVIND, Windpower units, a method to increase the biological diversity in the Baltic sea? (Project in progress)	(...) Blue mussels and barnacles covered most of the submerged parts of the wind power plants. On the bottom, more blue mussels and a lower cover of red algae around the power plants than elsewhere were recorded. Results from this study suggest that an offshore wind power plant attract marine life.
COD-UK-034	A Baseline Assessment of Electromagnetic Fields Generated by Offshore Wind Farm Cables.	EMF emitted by industry standard 3-core power cable will induce E-fields; in the case modelled, this resulted in a predicted E-field of approximately 91_V/m (=0.9_V/cm) in seawater above a cable



Reference	Title	Benthos Communities - Results
	COWRIE-EMF-01-2002. 8 (2003)	buried to 1m. (...) However, unless highly specialised materials and manufacturing processes are used with high permeability values, the E-field will remain within the lower range of detection by elasmobranches. (...) See further information in the database

According to experts there is a need for more basic research, representing different sites, different water depths etc. The set-up of monitoring procedures to gain basic information on benthos communities is most important from the scientific point of view.

Data on the potential impacts on the benthic environment are not yet available to a sufficient extent. Thus, risk assessment is hardly operable. Currently assumptions on changes are prevailing. Qualifying the significance of changes is hardly possible. Tracing changes back to the cause (natural fluctuation or effects caused by wind farms) is still a major problem to date.

3.1.4.4 Aspects of Impact Prognosis and Assessment

The impact prognosis regarding the loss of benthos habitat caused by foundation and scour protection can be quantified. However, prediction of the effects related to the change of habitat condition in the vicinity of offshore wind facilities is difficult. Studies indicate effects are largely restricted to the very area of introduced material.

Still in many cases, there is no common expert opinion on how effects are to be evaluated. In EIA-practice the significance of impacts is assumed to correspond to the status (protection/endangerment) and the total scale of habitat loss respective to change. Presently there is still a knowledge gap, which would allow secured assessments.

As the assessment of impacts on benthos is hardly operable, in most cases it is not possible to address consequences regarding the deployment of facilities. Thus, benthos is an issue, which is regularly investigated, but it is hardly of high significance for decision making in licensing procedures now.

From the scientific point of view, the state of research on impacts on benthos is not sufficient to standardise assessment methods. This makes it difficult to consider effects on benthos communities in the licensing process appropriately. The development of assessment indicators might be improved, when there is more knowledge from e.g. the FINO-platform, Horns Rev and Nysted.

The majority of studies report little effects on zoo- and phytobenthos, except if endangered or threatened, benthic species that are locally restricted in occurrence and with low population densities were affected. The problem is to know, where such species or benthos communities do occur and in which cases they are affected.

In many cases, positive effects on habitat conditions for benthos communities are assumed. This is because of the reduced disturbance by fishery and because of the increase of biodiver-sity due to the repopulation of brought-in substrates or pole-materials with new communities ('wreck-effect' or 'reef-effect').

It differs from country to country whether these effects (i.e. bringing in species using hard sub-strates in areas of mainly soft substrate seabed) are evaluated as positive or negative. For ex-ample, in Ireland and the United Kingdom the described re-population of hard substrates and poles is considered a positive effect ('artificial reef effect'). In Germany, the intrusion of hard substrate in soft bottom areas is considered a negative effect that may lead to 'alienation' of species. Alienation could furthermore be a threat to existing soft bottom communities.

Introduction of new species can be regarded as positive if 'rising the biodiversity' or 'rising biomass production' is a local aim. In conservation areas, however habitat change leading to 'alienation of species composition' is considered as an undesirable and therefore negative effect. Alien species could displace the original species.

Obviously, nature or species conservation targets differ in the mentioned countries, so at present evaluation will depend on the singular case.

3.1.4.5 Recommendations

Effects on benthos communities induced by offshore wind facilities should also be considered on the scale of cumulative effects (see ongoing alienation processes caused by ship transport, fishery etc).

The avoidance of known 'hot spots' of protected benthos communities (NATURA 2000-sites, national protection areas) as wind farm sites is mandatory.

Mitigation measures to minimise the scale of scour protection should be imposed case by case in the licensing statement. They should be mandatory if endangered benthos communities are affected.

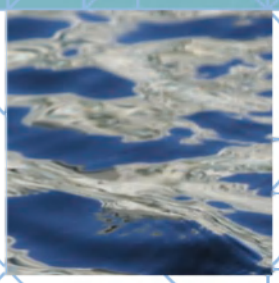
3.1.5 Fish

3.1.5.1 Main Relevant Effects

As main relevant effects, which might aggravate existing strains are considered:

- Introduction of new habitats (artificial hard substrate) which might change the abundance and occurrence of fish,
- Electromagnetic fields influencing the orientation, especially concerning sharks and rays.[20]

[20] See chapter 3.3: Mitigation of electro-magnetic effects of subsea cables (insulation, burying in the seabed)



Negative effects of turbine construction and operation on fish are avoidable by mitigation measures.

If fishery, esp. demersal trawling, is excluded from wind farm areas, this is expected to have significant positive effects on the abundance of fish stocks.

3.1.5.2 Cumulative Effects

The effects on fish stocks have to be considered with regard to the existing strains caused by fishery, pollution, already existing cables and other disturbances. Additional effects caused by offshore wind deployment to a large extent might aggravate the situation.

On the other hand, the prohibition of fishery in wind farm areas is supposed to have a positive effect on fish stocks. The increase of biomass (benthos communities) as a nutrient source for fish would support this effect.

Grid connection (laying and operation of cables) is a cumulative effect to be mitigated.

3.1.5.3 Availability of Information

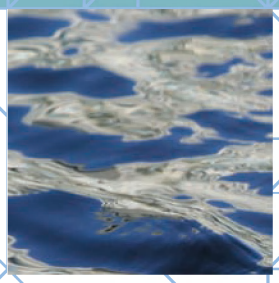
The following table indicates, to which extent attention is given to the effects on fish. Again, there is a concentration of investigation linked to Danish demonstration projects, where different kinds of effects were investigated. On the one hand the focus lies on presumably negative effects exerted by electromagnetism or subsea noise, on the other hand also on presumably positive effects caused by the so called 'artificial reef effect'.

It is obvious, that investigation of the latter subject is also of interest for the fishing industries.

Table 6: Studies and Publications on Fish

Reference	Title	Fish - Results
COD-D-020	Survey of Annex II fish species in the German EEZ of the North and Baltic Seas	Due to the few data, no final judgement is possible concerning potential protection sites. With regard to the Annex II, species of fishes the results of the investigations do not point out any emphasis of distribution for these species. The knowledge about occurrence and distribution is incomplete (except Alosa fallax).
COD-D-021	Spatial analysis of the anadromous migrating fish species twaite shad 'Alosa fallax' in the North Sea	The data did not allow identifying and implementing any Special Area of Conservation in the German EEZ for Alosa fallax.
COD-DK-005	Effects of marine wind farms on the distribution of fish, shellfish and marine mammals in the	The description of the fish fauna in the Horns Reef area is based on eleven years trawl surveys carried out by the Dutch Institute for Fisheries Research. The

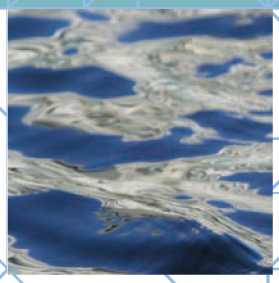
Reference	Title	Fish - Results
	Horns Rev area. (2000)	most common species are dab, plaice, hooknose, whiting, dragonet and grey gurnard. A total of 42 different fish species are listed. The relative abundance of the ten most common species is given for three different areas within and outside the windmill area. (...) However, there have been large fluctuations from year to year in the abundance of the species.
COD-DK-007	Investigations on the artificial reef effect on fish from marine wind turbine park at Horns Reef. (2002)	A total of 186 fish distributed in 14 species were caught in this preliminary survey. The most predominant fish species in the catches were whiting and plaice. On the basis of 6 gillnets (=samples) an average of 22.7 and 3.3 whiting and plaice were caught with a variability of 80% and 35% respectively.
COD-DK-020	Investigations on the artificial reef effect on fish from a marine wind turbine park at Horns Reef. (2002)	No results. Status report of the baseline study.
COD-DK-027	Investigations on the artificial reef effect on fish from marine windmill parks at Horns Reef. (2001)	No results. Status report.
COD-DK-029	Control and monitoring programme. Artificial reef. Progress memorandum 2. (2002)	Investigations of the bottom composition in the reference area in connection with the food resource studies appear to show that the sediment in this area is slightly coarser than in the wind farm area. There is, however, no immediate difference between the two areas in the amount of sediment dry matter and combustion loss. Closer examination of the sediment characteristics revealed that there is only a very slight difference in the median grain size of the reference and wind farm areas. However, the sediments within the reference area at stations 3-5, which lie in the shallower water, are markedly coarser than at stations 1-2, which lie in the deeper area.
COD-DK-064	Evaluation of the Effect of Noise from Offshore Pile-Driving on Marine Fish. (2000)	The purpose of this memo is to evaluate the possible effects of noise from offshore pile driving activity on fish. The construction noise of an offshore wind farm at Rødsand may temporarily potentially affect the fish population in the area during construction and operation.
COD-DK-065	Evaluation of the Effect of Sediment Spill from Off-shore Wind Farm Con-struction on Marine Fish. (2000)	Possible effects of sediment spill from different construction-types of offshore wind facilities on fish are to be evaluated. Different life stages of fish have different sensitivity to suspended sediment. Sediment spill from construction type 1 is expected to have some effect on the survival of the eggs and larvae of fish in near the vicinity of the windmills, but is not considered to have lethal effects on juvenile and adult fish. Some avoidance by juvenile and adult



Reference	Title	Fish - Results
		fish is expected from construction type 1. The spill from construction 2 and 4 is of less importance. Spill from no. 3 will be big, but the period was shorter.
COD-DK-082	Baseline study Fish, fry and commercial fishery Nysted offshore Wind Farm at Rødsand, Status report. (2003)	The objective of this baseline study was to establish a basis for the proceeding monitoring programme by selecting the optimal investigations and parameters to assess the basic condition of the area and to collect an adequate amount of baseline data to distinguish the natural variation from the environmental impact caused by the operation of the offshore wind farm. This is especially with regard to changes caused by noise, vibrations, and changes in the food basis, sediment and magnetic fields, including other unexpected effects. The catch data of all selected indicator species in the baseline study of fry suffer from lack of variance homogeneity both in consideration to number and biomass . Thus it was not possible to show the effects of interaction to established temporal and/or spatial differences. Though, especially eelpout but also two spotted goby indicated the effect of interaction. Detailed baseline data see report.
COD-DK-113	Hydro-acoustic monitoring of fish communities in offshore wind farms. Annual report 2004. Horns Rev offshore wind farm. (2005)	From the hydro acoustic results, little or no effect from the wind farm or from hard bottom substrates was found on the fish densities at Horns Rev Wind Farm at the time of the survey. The execution of the field study and the subsequent analysis of recorded data of the project have exposed the need for minor alterations including extended night surveys, the addition of more or longer transects, and considerations of the seabed topography, time of year and weather conditions. In conclusion: • The hydro acoustic technique is a suitable technique to evaluate fish densities. • A large diurnal variation of fish densities was encountered in the entire study area. • The results indicate that offshore wind farms attract fish beyond a distance of 500 metres and it is recommended to select reference areas further away. • A significant higher density of fish in connection to turbine foundations (hard bottom substrates) was only found in one out of four transects.
COD-DK-116	Monitoring programme - status report 2003. Fish at the cable trace. Nysted offshore wind farm at Rødsand. (2004)	The total number of 15023 individuals with a total weight of 881.4 kg representing 36 species was caught during the sampling period. The cable trace did not cause a major change in overall distribution of number and weight of the total catch before and after the cable was put into use in 2003. A chi square analysis of the distribution of fish before and after the cable was put into use showed that only eel and brisling had changed their distribution significantly (eel was caught in higher numbers on the west side of the cable). There is a

Reference	Title	Fish - Results
		need for further investigation in the very vicinity of the cable to definitely establish if electromagnetic field from the cable has an impact on the fish fauna.
COD-NL-006	Strategy of approach, Lot 2 Demersal Fish Fauna. (2003)	No results
COD-NL-007	Base line studies North Sea wind farms: strategy of approach for pelagic fish (lot 3). (2003)	No results
COD-NL-015	Baseline studies wind farm for demersal fish. (2004)	For all species of flatfish, the annual variation in abundance in the Dutch coastal zone is large, though most species were found in every season investigated. For demersal fish largest effect of NSW is closure of the area to fishing, indirectly via sediment structure and availability of benthos and directly of zero fishing mortality. Detection of an effect on fish biomass through a monitoring programme is not completely unfeasible.
COD-NL-016	Base line studies North Sea wind farms: Final report pelagic fish. (2004)	Pelagic fish community in the Dutch coastal zone consists of nine species that show large temporal variation. Small-scaled effects of wind farms on pelagic fish may be detected if they alter spatial patters to a notable extent, though this remains difficult to predict. In the baseline situation, there were no patters in the spatial distribution of pelagic fish in and just around the planned wind farm area.
COD-SE-004	VINDREV: Offshore wind power as artificial reefs: Effects on fish. (Project in progress)	The amount of fish around the bottom piles of the towers was highly increased compared to bottom areas 20 m away. It was found that the towers have reef effect. (Further results in progress)
COD-SE-006	BIOVIND, Windpower units, a method to increase the biological diversity in the Baltic sea? [21] (Project in progress)	The total fish numbers were higher on the bottom in the near vicinity of the wind power plants than in surrounding areas, while species richness and diversity were similar. On the power plants, fish community structure was different, total fish abundance was higher, and species richness as well as diversity were lower, compared to the bottom. Results from this study suggest that an offshore wind power plant attract marine life and may function as a combined artificial reef and fish aggregation device.
COD-UK-003	Assessment of the Effects of Noise and Vibration from Offshore Wind Farms on Marine Wildlife (DTI/Pub URN 01/1341, ETSU W/13/00566 /REP). (2001)	The report was commissioned to assess the effect of noise and vibration from offshore wind farms on marine wildlife. Its key aims were to review relevant studies, reports and other available information, identify any gaps and uncertainties in the current data and make recommendations, with outline methodologies, to address these gaps. (...) It is expected that effects on fish population dynamics will be determined by immigration/ attraction of fish to wind farms following construction. No adverse noise-related impacts on marine invertebrates are expected. (...)

[21] Fish community and habitat composition were investigated using visual transects in the wind power farms of Yttre Stengrund and Utgrunden off the south-eastern coast of Sweden, central Baltic Sea.



Reference	Title	Fish - Results
COD-UK-015	The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon elasmobranch fishes. (2001)	The report starts with a literature review relating to electroreception in elasmobranches and relevant literature on offshore wind farm developments. After literature review, neurobiology of electroreception has been widely researched (...) but no published research was found on the effects of electromagnetic fields produced by undersea cables on fish. An experimental study took a worst-case scenario of an unburied 150kV cable with a current of 600A. Results: S. canicula avoids electric fields at 1000_V/m; the avoidance response was highly variable among individuals and had a relatively low probability of occurring; the same species were attracted to a current of 8_A. This is consistent with the predicted bioelectric field emitted by prey species. Recommendations were: further biological research, concentrating on species use of the inshore habitats and behavioural responses to electric fields; electric field research, in particular quantification of fields within different substrate and 'in-situ' measurement; GIS mapping and interrogation, to guide decisions on wind farm location.
COD-UK-034	A Baseline Assessment of Electromagnetic Fields (EMF) Generated by Offshore Wind Farm Cables. COWRIE-EMF-01-2002. (2003)	In terms of the potential significance of the modelled results to electro sensitive fish, the following conclusions were made: EMF emitted by industry standard 3-core power cable will induce E-fields; in the case modelled, this resulted in a predicted E-field of approximately 91_V/m (=0.9_V/cm) in seawater above a cable buried to 1m. This level of E-field is on the boundary of E-field emissions that are expected to attract.. While those that repel elasmobranches; the induced E-fields calculated from the B-fields measured in-situ were also within the lower range of detection by elasmobranches; the options for mitigation using either changes in permeability or conductivity indicate that the induced E-field can be effectively reduced. However, unless highly specialised materials and manufacturing processes are used with high permeability values, the E-field will remain within the lower range of detection by elasmobranches. Hence any reduction in E-field emission using existing materials could minimise the potential for an avoidance reaction by a fish. If it is encountered, the field may still result in an attraction response. Another important consideration is the relationship between the amount of cable, either buried or unburied, producing induced E-fields and the available habitat of an electrosensitive species. There is also a need to determine if the power cable operating frequency (50Hz) and associated sub-harmonic frequencies have any effect on the EMFs that are detectable by IK electrosensitive fish; Further studies are

Reference	Title	Fish - Results
		recommended to direct future research to fully understand the interaction of the induced E-fields from subsea power cables with electrosensitive fish and any implications of the B-fields for organisms that rely on a magnetic sense.
COD-UK-042	Potential Impact of Underwater Noise and Vibration - Interim Report Nov 04. (Project in progress)	A detailed desk study identifying marine organisms in UK coastal waters which may be affected by noise and or vibration arising from construction and operation of a wind farm. The study also details where available, information on their hearing spectra and sensitivities, and likely behavioural changes from exposure to different levels of noise and vibration. Review should include distances over which marine mammals can communicate, and collation of information on noise data available from existing wind farms. Interim reports including measurements taken at a selection of depths, distances and directions and in a variety of tidal, climatic and season conditions with and without background noise, using an appropriate range of frequencies. This data will provide an early indication of the frequency and amplitude of noise levels and levels of vibration and will assist in the determination of present and future applications. Data from this exercise should be fed to the various stakeholders at the earliest opportunity in the form of mitigation guidance and development of good management practices.

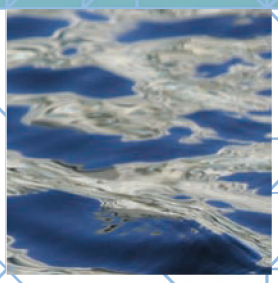
As the availability of data on fish stock and abundance is low, experts underline the need for extensive monitoring of fish stocks and behaviour (esp. migration).

3.1.5.4 Aspects of Impact Prognosis and Assessment

Based on present knowledge no significant negative impact on fish by building and operating wind turbines has been stated. Presently the authorities decide on applications without explicitly considering these aspects, as the concern is hardly operable in assessment procedures.

Following the precautionary principle, the consideration of protection sites is an adequate approach on a superior planning level. However, delineation of protection sites for fish Is not very common. This is due to large fluctuations from year to year in abundance of the species. It prevents planning authorities to take fish stock protection needs into consideration in spatial planning. Securing restrictions on behalf of the protection needs of endangered fish species is not possible at present.

The prognosis of impacts due to electromagnetic fields (EMF) is still not sufficiently operable, as the reach of effects, particularly behavioural changes like avoidance can neither reliably be predicted nor quantified.



3.1.6 Summary

The informational basis concerning abundance of marine wildlife is - due to a series of baseline studies and surveys - slowly improving, though not yet sufficient. Danish effect studies within the Danish monitoring programme provide comparably best results.

Considering the importance of cumulative effects, further investigations should focus on qualifying the impact assessment on SEA-level.

According to Danish studies affecting the hearing abilities of marine mammals turned out to be a less severe problem than expected. Individuals widely avoided sites during construction. The effectiveness of mitigation measures like pingers or bubble curtains should be monitored in projects under construction.

The main effects concerning birds are losses of habitat in consequence of disturbance and avoidance, both effects cannot be quantified up to now. Migratory birds may collide with wind turbines particularly if they are less accustomed to the situation and if they are handicapped by various influences (weather, sight, nightime migration) which make evasion manoeuvres less exact.

In Danish studies, avoidance behaviour of different species was monitored. The significance of impacts due to diminution of habitats is related to the overall availability of suitable habitats.

As can be concluded from licensing statements (or reasons for the rejection of projects) issues of the protection of marine mammals and birds do play a role in decision making, also with regard to mitigation.

Planning offshore wind facilities on near shore sites may lead to rejections due to the impacts on visual landscape/seascape. As the local population regards the change of visual landscape as very significant. Therefore, strategies for gaining public acceptance (e.g. information, participation) must be an essential part of planning near shore sites.

While the development of operable standards (e.g. sensitivity index for birds) is on the way, the prognosis of effects and assessment of impacts on benthos and fish are still not operable to a large extent. Thus, their relevance to decision-making in project related EIAs and licensing procedures is comparably low. Nevertheless, they belong to the scope of subjects to be investigated, unless a decision is made in the singular EIA procedure to leave it out.

3.2 Environmental Impacts on Non-biotic Components

3.2.1 Visual Landscape / Seascape

3.2.1.1 Main Relevant Effects

The main relevant effects on visual landscape are described as

- change of specific or typical features or appearance of landscape by wind turbines,
- disturbance by intrusion of technical elements in a natural environment,
- decrease of recreational qualities due to change in the appearance of the landscape.

The effects on visual landscape are an important issue, if the developer intends to build a wind farm a short distance from the coast (near shore site). Only near shore locations are likely to affect people living close by.

Effects are evaluated differently dependant on the acceptance of wind energy use by the local population.

3.2.1.2 Cumulative Effects

Under aspects of the cumulative effects on visual landscape, also changes of the visual quality of the coastline (e.g. by tourist habitations) should be considered.

3.2.1.3 Availability of Information

There are only few specific studies available concerning effects on visual landscape, some containing methodological approaches for the assessment of effects on visual landscape.

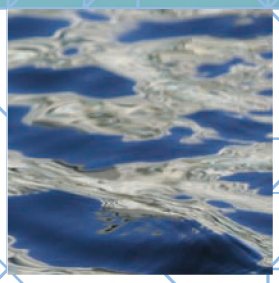


Table 7: Studies and Publications on Visual Landscape/Seascape

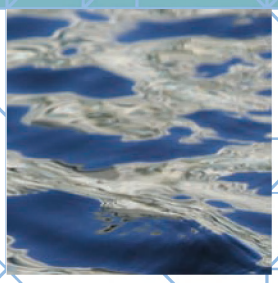
Reference	Title	Visual Landscape/Seascape - Results
COD-BE-008	Wind farms at the North Sea: integrated assessment of effect on landscape (visual intrusion) (2002)	Assessment of visual intrusion at the sea horizon for various wind farms (individually and cumulative). Visual intrusion of project 'C-Power' is not acceptable. Visual intrusion of the project 'Electrabel' is acceptable. Regarding the cumulative effects, realisation of both is unacceptable.
COD-D-036	Changes in cultural landscape of coastal areas – Methodology of landscape analysis for the planning of offshore wind farms. (2004)	The paper describes a method of landscape analysis that has been developed for near shore wind farm planning. It refers to the following aspects: - General notations regarding wind energy and coastal landscape, - Inventory survey, - Character of the project and visual impacts on coastal landscape, - Evaluation standards, - Avoidance and mitigation of impacts. Of importance for the impact assessment is the sensitivity of the representative viewpoints, which should be described by a set of criteria, e.g., topographical, environmental, structural and shape analytical criteria. A main aspect of the landscape analysis is the photographic visualisation of the planned project from different viewpoints. Additionally schematic and graphical detailing and comparisons are necessary.
COD-DK-085	Sociological investigation of the reception of Horns Rev and Nysted offshore wind farms in the local communities (2005)	The report presents the work related to the sociological part of the socio-economic project on the local communities' reception of Horns Rev and Nysted wind farms. The report covers the phase before construction and one year after erection of Horns Rev wind farm. Before the construction, a strong opposition was noted on both sites. The interviewers were concerned if the presence of the turbines would alter the scenery negatively and at both sites the regional and local authorities made efforts to build the wind farms further off the coast. At Horns Rev the opposition was based on substantial business interest in Tourism. In Nysted opponents wished to preserve the natural landscape. It was noted that newspapers reported in a negative attitude. From the beginning there was scepticism noted, and when the local population felt ignored by authorities, scepticism changed to opposition. The supporters of the wind farms base their opinion on environmental concerns and export interests related to the wind power. In further projects, it may be appropriate to establish a dialogue and professional information through the entire process. After the construction of Horns Rev the attitude of opponents was changed - opposition was replaced by acceptance. It was concluded that being accustomed to the new situation changed the attitude towards offshore wind farms at last.

Reference	Title	Visual Landscape/Seascape - Results
COD-DK-089	Economic valuation of the visual externalities of offshore wind farms. Annual status report 2003. (2004)	No results available at the reporting period, only preliminary activities were developed
COD-UK-006	Guide to Best Practice in Seascape Assessment (Report No.5). (2001)	The guide offers a method of assessing the value and quality of coastal landscapes and sea views. It draws on well-established methods for landscapes assessment in Britain and Ireland and modifies them to suit the very different environment of the coastline and sea - the 'seascapes'. (...) The report concludes that seascapes can usefully be grouped according to particular characteristics that are valued or as complete units where some similarity has been identified as important. This seascape characterisation can be used as a tool of exploration, for example to establish the distribution of character types, or of seascapes with low susceptibility, high capacity or any other factor. The increasing use of GIS computer techniques can enable maps showing the distributions to be available at a glance. Decisions can then be made on which seascape units of particular character (or derived) types can best assimilate specific kinds of the development or change and what areas require similar special attention to conserve, enhance or restructure character. Hence to form the most appropriate mitigation measures for development located in each character type. Above all, it concludes that these key characteristics can be identified for protection from adverse change and guidelines can be produced to show the actions required where it is necessary to introduce change.

3.2.1.4 Aspects of Impact Prognosis and Assessment

As mentioned, the effects on visual landscape are evaluated differently, dependent on the local acceptance of offshore wind exploitation. If the acceptance is high, significant effects are not necessarily regarded as negative. In some cases, wind farms are also be regarded as tourist attractions. Information campaigns and in case of conflict mediation are effective means to influence acceptance.

The visibility of offshore wind facilities depends on their distance to the seashore. Dependent on the bend of the earth and the localisation of viewpoints, the facility can be seen as a whole or in parts (only the turbine). Weather conditions such as haziness and other meteorological effects influence the visibility. To evaluate the significance, an impact prognosis has to consider these aspects of visibility.



3.2.1.5 Recommendations

Information campaigns and in case of conflict mediation are effective means to influence the acceptance (see COD-DK-085). The importance of a positive attitude towards wind energy must not be underestimated. Effects on tourism should be investigated to qualify discussions on potential objections.

3.2.2 Soil and Seabed

3.2.2.1 Main Relevant Effects

The loss of seabed is caused by foundation and scour protection; the effect chain coincides with the loss of benthos communities (see chapter 3.1.4).

Another effect might be changes in sedimentation. However, monitoring studies at a Danish wind farm (Horns Reef) show no measurable influence on hydrography and sediment transport.

Redistribution and re-suspension of sediments after construction will have, if at all, only small effects, e.g. on spawning fish (herring).

3.2.2.2 Cumulative Effects

Against the background level of sediment transport by natural forces, disturbances of sediment structure and soil by fishing as well as by extraction of sand and gravel material the additional influence caused by offshore wind facilities seems to be negligible.

3.2.2.3 Availability of Information

Table 8: Studies and Publications on Soil and Seabed / Sediment

Reference	Title	Soil and Seabed / Sediment - Results
COD-D-004	BEOFINO – Accompanying Ecological Research on Offshore Research Platforms in the North and Baltic Seas. (in progress)	The final report of the project also concerning benthos is presumably published in summer 2005. (www.fino-offshore-com).
COD-DK-004	Environmental Impact Assessment of Sea Bottom and Marine Biology. (2000)	The area of reclaimed sea bottom covered by establishing the wind farm is calculated to less than 0.1% of the total area of the site. It amounts to an area with a potential biomass of benthic animals of approximately 600 kg. An increased copper contamination of filter-feeding benthic animals can

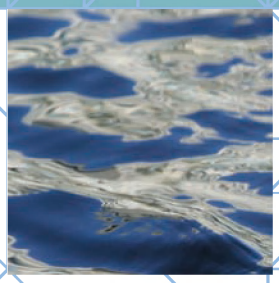
Reference	Title	Soil and Seabed / Sediment - Results
		be expected as a result of the total annual discharge of 206 kg copper from the slip-rings in the wind turbines.
COD-DK-018	Horns Rev Offshore Wind Farm - Introducing Hard Bottom Substrate Sea Bottom and Marine Biology, Data Report 2001. (2002)	Baseline study on benthos and seabed; The annexes describe the benthos characteristics.
COD-DK-019	Horns Rev Offshore Wind Farm - Introducing Hard Bottom Substrate Sea Bottom and Marine Biology, Status Report 2001. (2002)	Both in the wind farm area as well in the reference area the values for sediment characteristics indicate sediments to be very homogeneous and well sorted. Especially in the shallow part of the reference area, the fine sand is very well sorted, whereas a lower sorting index generally is found for coarser sand especially at wind turbine site M95. The general characteristic of the sediments is pure sand with an ignition loss of less than 1%.
COD-DK-024[22]	Horns Rev. Introducing hard substrate habitats. (2002)	The wind farm area and the reference area are characterised by bottom conditions that are relatively uniform. The sediment consists of pure medium-grained sand with no organic matter. The particle sizes were found to be in the range of 228 µm to 426 µm with a median of 345 µm in the wind farm area. There is a tendency to more variation in the sediment structure in the reference area. More coarse-grained sediments with a median particle size of 380 µm (range 198-478 µm) are found. In the deeper part of the reference area the seabed is characterised by more coarse-grained sediments.
COD-UK-056	Development of Generic Guidance for Sediment Transport Monitoring Programmes in Response to Construction of Offshore Wind farms. (in progress)	This research will assess the magnitude and significance of changes to the near shore sediment transport and sediment transport pathways as a result of the construction of an offshore wind farm on Scroby Sands. Results are due in the fourth quarter of 2005.

3.2.2.4 Aspects of Impact Prognosis and Assessment

Available information describes changes of the grain structure of sediments around pile foundations. For impact prognosis, models are under development.

There is no information/statement (assessment tools, evaluation standards) available on the assessment of effects on soil and seabed.

[22] This memorandum summarises results from the baseline survey on benthos in June 2001 and the results from a comparative survey in September 2001. See also DK-018 (table 4 of this report) and DK-019.



3.2.2.5 Results from Singular Case Studies

Effects on soil and seabed have been investigated in monitoring studies at Danish wind farms (Horns Reef). The results show no measurable influence on hydrography and sediment transport. From that point of view, there are no objections to construction of an offshore wind farm.

3.2.3 Water Quality and Hydrography

3.2.3.1 Main Relevant Effects

Foundations and scour protection of wind turbines might influence the current and/or the wave regime. This could have side effects on benthic habitats and fish occurrence.

During the construction phase there is a risk of spilling harmful substances (e.g. oil) and thus to deteriorate the water quality. On the background of general water pollution, threshold values might be exceeded on short term.

Also during operating phases, there might be oil spillage due to damages to the gear unit. Thus, to avoid these risks gear-less turbines are recommended for installation on sea. Whether this is technically feasible cannot be answered here.

3.2.3.2 Cumulative Effects

There is no information/statement available on cumulative effects on hydrography and/or water quality. Availability of the required data about already existing strains is limited.

3.2.3.3 Availability of Information

Table 9: Studies and Publications on Effects on Hydrography

Reference	Title	Hydrography and Water Quality - Results
COD-DK-001	Environmental Impact Assessment of hydro-graphy. (1999)	The report is a baseline study the purpose of which is to describe possible consequences of establishing and running the power plant. The following aspects are covered in the report: hydrography, coastal morphology and sediment transport. It is assessed that the erection of a wind power plant at Horns Rev will cause no measurable influence on the environment with respect to hydrography and sediment transport.

Reference	Title	Hydrography and Water Quality - Results
COD-UK-055	Assessment of the Significance of Changes to the Inshore Wave Regime as a Consequence of an Offshore Wind Array (in progress)	This research will assess the significance of changes to the near shore wave regime because of the construction of offshore wind farms, based primarily on unique field measurements, but including scenario-testing using numerical modelling techniques. The research is concentrated at a specific site (i.e. Scroby Sands), which was identified as the worst-case scenario for impact on coastal processes, from the 1st round of applicants for wind farm development to the Crown Estate.

3.2.3.4 Aspects of Impact Prognosis and Assessment

From the analysed studies, there is no methodological information on how to make a prognosis or assess changes in water quality and hydrography.

3.2.4 Conclusions / Recommendations

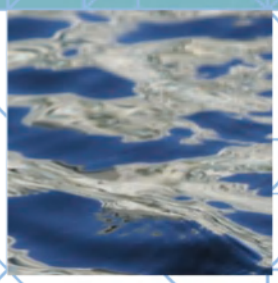
Soil and Sediment: Also, concluded from benthos studies, a change of sediment structure (grain fraction) is likely. This influences habitat qualities, which might be of significance for benthos and fish stocks. The assessment of impacts mostly refers to impacts on soil and sediment structure as less important or even negligible.

Hydrography: Apart from Danish demonstration locations, the data supply provided by baseline studies is for the most part not sufficient to predict the impact of offshore wind farms on the marine environment in any location of the North and Baltic Sea. Assessments are hardly ever possible; most of them are more or less speculative.

3.3 Mitigation Measures

Considering environmental requirements during site selection is the most effective way to avoid negative impacts. To stay away from sensitive areas or protected areas may diminish the tech-nical measures which otherwise would have to be taken to reduce facility related impacts.

The following list contains facility-related mitigation measures to reduce or eliminate impacts on the environment.



- Reduction of visual intrusion:

  Keeping a large distance to the coast minimises visual intrusion for local population.
  Humans perceive three rotor blades running at constant velocity as least disturbing. Absorbing paint and compact, systematic placement of the poles also reduce visual impacts.
  Lowering visual intrusion for men can collide with safety interests: to avoid collisions with planes, illumination during nightimes is required. Light colouration of the poles, lights on top the turbines support visibility. For illumination techniques should be used which minimize radiation to the sides.

- Reduction of collision risks by (manoeuvrable) boats

  Closure of the wind farm an in a zone 500 m around the park minimises the risk of boat collision. If boats are allowed through wind farm areas, a high visibility of the poles during day and night is necessary.

- Reduction of collision risks by birds.

  It is doubtful, if stopping turbine operation during periods of high collision risks is an appropriate mitigation measure. Avoiding bird migration corridors or routes (if known) when selecting the site contributes most to diminish collision risks.

- Reduction of noise and vibration

  Measures of noise reduction during pile driving are needed, but not yet available. Still there is a need for technical innovation at this point.
  As noise can hardly be reduced at the source, measures to deter sensitive species (e.g. by bubble curtains or pingers) are recommended though the effectiveness of pingers has not been fully proven yet.
  To ensure minimal impact on both fish and mammals pile driving should start gently to allow individuals to move away from the noise source. The times, in which construction work should be avoided, depend on the affected species' main periods of foraging, resting and breeding.
  Minimising vibration is an issue of the facility development. Vibration during operation can be minimized by detachment of rotor, gondola and pole. It is doubtful, whether these measures are technically feasible for offshore facilities.

- Reduction of electromagnetic fields

  The cable has to be insulated to prevent electromagnetic fields and heating of the sur-rounding seabed. Monitoring the electromagnetic emissions from operating wind farms could lead to guidance on appropriate burial depths to minimise emission levels. A common recommendation is to bury the cable in a depth of at least 1 m in the sea bottom. The development of electromagnetic emission limits would help to assess the significance.

Besides, the laying of cables has to be scheduled according to sensitive phases of species foraging, reproduction periods. For instance, to minimise any adverse effects in the estuary significantly, cables should be buried during the winter period when the numbers of species such as salmon and sea trout are expected to be at their lowest.

- Reduction of scour

  Scour protection is likely to be an essential requirement to ensure the stability and safety of the facility and to limit the extent of changes of the sea bottom around the foundation. On the other hand, scour protection material might mean an additional stress. This might be the case when hard bottom material is used for scour protection in areas where soft bottom structures predominate. As hard bottom material attracts different species than had lived there originally, the application of scour protection material might lead to an alienation of species.

3.4 Impacts on Other Uses

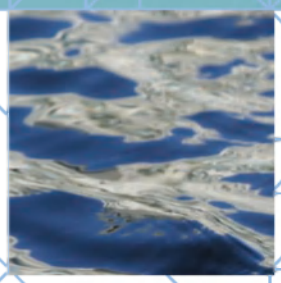
There are some uses, which exclude wind exploitations due to safety regulations (e.g. ship traf-fic). Other uses may be affected, but there is no general need for the closure of sites to wind exploitation.

3.4.1 Ship Safety, Transport and Navigation

Interferences with safety interests have been investigated in the United Kingdom and Germany. The following list just indicates where further information can be found:

- COD-UK-061: Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues.
- COD-UK-062: Effects of offshore wind energy developments on navigation and com-mercial shipping. URN 99/1344
- COD-D-009 Evaluation of foundations for offshore wind farms with a view to potential shipping collisions. (2004)
- COD-D-032: Collisions of Ships and Offshore Wind Turbines: Risk of nacelle impact (in progress).

Studies and guidance regarding navigation mostly consist of technical recommendations on how to avoid or diminish interferences. Also, technical advise is given on how to find technical solutions for navigational aids. All of the listed studies were performed in the United Kingdom, where avoiding



potential conflicts between offshore wind and navigational systems (amongst others radar) obviously are of higher interest than in other countries.

Table 10: Studies and Publications on the Effects of Offshore Wind on Navigation

Reference	Title	Effects on Navigation - Results
COD-UK-007	Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues (Marine Guidance Note 275) (2004)	No results. These Guidance Notes are to be used by wind farm developers seeking consent for marine works from the Secretary of State for Transport, Local Government and the Regions under Section 34 of the Coast Protection Act of 1949.
COD-UK-033	Monitoring & Evaluation of Blyth Offshore Wind Farm: Navaid Requirements for UK Offshore Wind Farms (ETSU W/35/ 00563/REP/2, DTI/Pub URN 01/787) (2001)	The report details the navigational aid requirements laid down for Blyth offshore wind farm, as specified by Trinity House. It reviews the effectiveness of the aids, and difficulties encountered, and comments on the practicalities of using a similar system for larger offshore wind farms. The navigational aid specification appears to be correct, with the exception of radar reflectors, which were not proving very effective (but this has not caused difficulties as the turbine towers are providing an adequate radar reflection). It is thought the radar reflectors may work better further offshore, and so it is recommended that they are not eliminated for future projects. Installation of the Navigational aids was problematic as it necessitated the use of scaffolding for installation on the pre-installed turbines. It is thus recommended that in future, they are as far as possible fitted on the turbines pre-installation.
COD-UK-039	Wind farm impacts on Radar aviation interests. (2003)	The aim of this document is to provide a detailed understanding of the interaction between wind farms and radar systems. The study has focused on the development and validation of a computer model that can be used to predict the radar reflection characteristics (Radar Cross Section) of wind turbines and understand the complex interaction between radar energy and turbines. Results are: Single wind turbines do not create a significant 'radar shadow`. The design of the tower and nacelle should have the smallest Radar Cross Section (RCS) as possible. (...) Large turbines do not necessarily lead to large RCS. Spacing the turbines within a wind farm such that only one turbine can appear in any radar range cell has advantages in identifying the wind farm, filtering out the turbines and in tracking aircraft over the farm area.
COD-UK-049	Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken	QinetiQ and MCA carried out experimental field tests, for the first time in the UK, investigating the potential effect of wind farm structures on marine radar, communications and navigation systems. No problems with basic GPS reception, - No

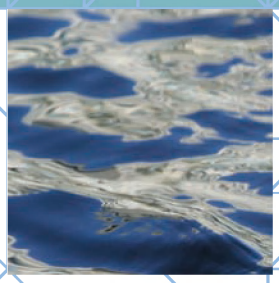
Reference	Title	Effects on Navigation - Results
	at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency (2004)	compass deviation created by the turbines and their cabling, - The wind farm structures had no noticeable effects on any voice communications system, vessel to vessel or vessel to shore station, - The wind turbines produced blind and shadow areas in which other turbines and vessels could not be detected unless the observing vessel was moving, - etc
COD-UK-058	Production of a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind farms	The purpose of this project is to develop a consistent methodology to assess the effect of offshore wind farms on navigation risk and marine safety.

3.4.2 Fishery

Offshore wind exploitation means restrictions for fishery, especially when wind farms are closed to other uses. Of course, fishery is regarding the closure of offshore wind farms to fishing as a constraint, which would require an appropriate comensation. The studies are dealing with the question how to measure the effects or constraints of offshore wind on fishery (socio-economic effects) and effects on fish stocks, amongst others by electromagnetic fields (see chapter 3.1.5.3).

Table 11: Studies and Publications on the Effects of Offshore Wind on Fishing

Reference	Title	Effects on Fisheries - Results
COD-DK-074	EIA study of the proposed offshore wind farm at Rødsand. Technical background report concerning fishery. (2000)	This report attempts to assess the current significance of the area for commercial fishery according to the different types and scale of fishing. The expected temporary and permanent impacts on the various forms of fishing are examined.
COD-DK-090	Possible Effects of the offshore wind farm at Vindeby on the outcome of fishing. (2002)	This report is an investigation to determine whether electromagnetic fields and/or noise from Vindeby Offshore Wind Farm affect fish and fishery within the turbine area (especially turbot). (...) As a consequence of the large amount of annual algae and the sparse catch of turbot, it was decided to cancel further fish investigations at that point.
COD-UK-046	BWEA Recommendations for Fisheries Liaison (2004)	The recommendations are intended as guidelines for developers of offshore wind and the fishing community. They are based on best practice developed through the experience of the UK's fishing community, and the offshore oil & gas and cable industries.
COD-UK-054	Study of the Socio-Economic Impacts of Round 2 Offshore Wind farms on Fishing Activities	The socio-economic study will provide quantitative information about the potential effects of the proposed development. Objectives of the study are:



Reference	Title	Effects on Fisheries - Results
		1. Provide a description of the fishing activities in the three strategic areas of Round 2 wind farm developments. 2. Consult with representative parts of the fishing industry for the purpose of describing and evaluating key concerns of fishery stakeholders, determining the socio-economic implications and developing ideas for mitigation options to fleets that may be disadvantaged. 3. and discussion how to assess the cumulative effects of the wind farm developments on fisheries.
COD-UK-060	Study to assess fishing activities that may be carried out in and around offshore wind farms	The objectives of the study are to: 1. identify which fishing activities might be possible in or around offshore wind farms, 2. determine whether the interactions between offshore wind farms and fishing will necessarily produce conflicts of interest or whether they can work together successfully, 3. understand the impacts of wind farms on fisheries, 4. review fish and shellfish species and their related fisheries, 5. review fishing vessel types, 6. see how seabed infrastructure might affect fishing operations, 7. investigate how the physical marine environment can affect fishing operations.

Guidelines mentioned in the database (e.g. COD-UK-054 and UK-060) aim at demonstrating best practise examples for a co existence of fisheries and offshore wind exploitation.

3.4.3 Aviation

There is but one study (COD-UK-008) which deals with 'Wind Turbines and Aviation Interests'. The aim of this report is to establish the European approach to the effects of wind turbines on civil and military aviation, and to determine the applicability of these experiences and practices to the concerns and needs of stakeholders in the United Kingdom (UK).

In the report, it is stated that different countries have different methods of approaching wind farms and the potential effect on aviation. Pre-planning consultation process in the UK is one of the most developed in Europe. Safeguarding of technical sites and equipment for civil aviation, and military technical sites is less stringent in other countries than in the UK. The UK is unique in permitting low flying in a relatively populated country. The issue of Search and Rescue Operations was more prominent in other countries than in the UK, as was illumination and marking of wind farms. In summary, broadly speaking, the conflict of interest between wind energy and aviation is regarded as less significant in other countries than in the UK, albeit to varying degrees.

Observations on the State of Ongoing Research

Offshore wind exploitation is a new type of marine use, whose effects were widely unknown respectively based on assumptions. Offshore wind deployment is obviously considered as an opportunity to improve the informational basis on the marine environment.

On the national scale, the participating countries have chosen different approaches to investi-gate both preconditions and effects of offshore facilities on the marine environment.

- Denmark is gaining very valuable information on actual effects on the marine environment. Investigation and monitoring the effects of already built projects is part of a demonstration programme covering the wind farms Nysted and Horns Rev. This programme, including monitoring, is still ongoing and will be running until 2006. Thus, more results can be expected in the years to come.

- Germany on the other hand performs a basic environmental investigation programme, publicly funded within the framework on offshore wind energy research.[23] At present, results are available from the phase of precursory research, which was accompanying the deployment strategy in Germany. To gain project-related information effect studies and monitoring studies are carried out on a research platform, which has been implemented. Two more are planned in the near future. A co-operation between Germany and Denmark is being prepared in the framework of the 'Joint Declaration on Environmental Research'. As no offshore wind projects have been realised up to now, results from project-related monitoring studies are not available.

- In the Netherlands, two project related impact assessments have been performed; up to now, no projects have been built. A potentially suitable area is presently undergoing baseline studies on defined components of the environment.

- In the United Kingdom, the information on environmental issues is mainly concentrated in project-related impact studies. In the future, in the United Kingdom and in Sweden, further research studies will focus on the areas designed as suitable for offshore wind exploitation.

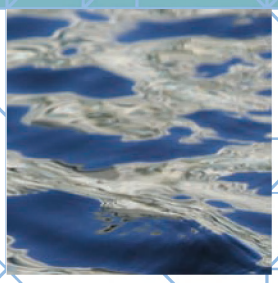
In many countries, guidelines or terms of reference have been issued to standardise methods and requirements. Delivering the required environmental data and assessments does not seem to be a major constraint to offshore development any more.

Based on the EU-Directive on EIA the scope of subjects to be investigated in project-related EIS are similar in each country. Nevertheless, the depth and duration of investigation of the single subjects for EISes differ due to the specific legal consenting requirements.[24]

In many countries, guidelines on investigation requirements have been issued to standardise methods and assessment approaches. Compiling the required environmental data and assessments does not seem to be a major constraint to getting a licence for offshore projects any more.

[23] Also in Sweden, there is publicly funded research in the context of offshore wind deployment stategies.

[24] The German EIA standards on Offshore Wind (cf. COD-D-001) represent one of the most demanding approaches to meeting environmental requirements (cf. Greenpeace 2005, 45).



Though knowledge about the components of the marine environment has been growing, knowl-edge on factual effects of offshore wind is still limited and widely based on assumptions. This is partly due to constraints regarding the predictability of effects under natural conditions. Never-theless, decisions have to be taken even in view of prognostic uncertainties. Generalising results is restricted due to the large site-specific differences (e.g. differences due to location in North Sea or Baltic Sea; water depth, structure of seabed, location to the coast; occurrence of endangered species).

Nevertheless, compared to the state in 2002, progress in knowledge is evident.

Still there are controversial discussions on the relevance or significance of effects. It has to be made clear that these discussions mainly concern the evaluation level. The development of criteria and standards for evaluation of impacts is still at the beginning. Results of evaluation differ dependent on the prevailing protection aims or development aims. Validation of criteria still needs more research on the causal interferences of the marine environment and offshore wind facilities.

Fulfilling the precautionary principle (i. e. by assuming worst-case scenarios) investigations of effects on the marine environment may be more comprehensive than necessary for licensing. In most cases, commercial developers tolerate this, as they are eager to underline the positive environmental effects of offshore wind.

Some of the countries (e.g. United Kingdom, Germany, and Sweden) have preselected preferred or suitable areas, some selected under consideration of avoidance of cumulative effects. For selection of sites, approaches of strategic environmental assessments have been applied. This may indicate that in view of the prevailing cumulative effects and problems evoked by follow-up effects is has become evident, that impacts of offshore wind cannot sufficiently be handled on project level.

Cumulative effects and follow-up effects appear to be a major problem. Yet, common methodology or tools to address cumulative impacts are still missing. Exchange of knowledge and information on environmental information has successfully been started. The need for transnational approaches seems to be obvious.

Recommendations

In view of knowledge gaps, it has to be discussed in which way the basis of decision making in EIA and consenting procedures could be improved and qualified in the most effective way.

Progress in knowledge can best be achieved by implementing more pilot offshore wind farms, being compulsory submitted to an effect monitoring. This appears to be the only way to both gain knowledge on large-scale effects and potential cumulative effects.

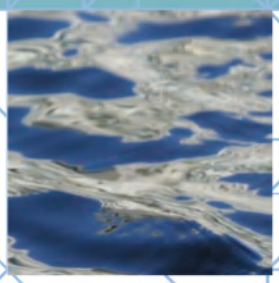
Delineation of suitable areas for offshore wind deployment and Strategic Environmental Assessments, which allow the consideration of cumulative effects, are helpful planning instruments to provide planning reliability for intending developers. Viewing the prevailing occurrence of cumulative effects and large-scale effects it is a promising approach to pursue a strategy of delineation of suitable areas or protected areas.

Research should focus on the supply of survey data which can be fed in e.g. at the scale of Strategic Environmental Assessment.

The development of evaluation standards should be enforced. In addition, assessment tools for cumulative effects need further development to meet the requirements of this special assessment case.

To improve the comparability of results, competent authorities should specify standards for project related investigations in EIA and monitoring obligations (duration, number of reference sites, method and frequency of baseline investigations).

In view of the results, which are expected until 2007, the compilation and exchange of knowledge should be systematically continued in the future.



References

COD database: see http://www.offshorewindenergy.org/index_cod.php.

IEA R&D Wind (2002): 40th IEA Topical Expert Meeting – Environmental Issues of Offshore Wind Farms. Husum/Germany, September 2002. 184 pages.

Greenpeace (ed) (2005): Offshore Wind – Implementing a new powerhouse for Europe. 164 pages.

OSPAR COMMISSION (2004): Problems and Benefits Associated with the Development of Offshore Wind Farms. 28 pages.

NEW (New Energy Works) 2004: COD – Overview on Environmental Impacts of Offshore Wind Energy. Utrecht/Netherlands. 47 pages.

TU Berlin & Bundesamt für Naturschutz (2005): International Exchange about Ecological Research on Offshore Wind farms. Part A: International Exchange of Experiences on the Assessment of the Ecological Impacts of Offshore Wind Farms. Proceedings of the International Expert Workshop held at the Berlin University of Technology, March 17th-18th 2005. Preliminary report – 01.09.2005. 28 pages.

Annex A: Overview and Comment on the COD Database

A 1 Introduction

A 1.1 Objectives

In order to fulfil the legal requirements for licensing, developers of offshore wind farms are obliged by national authorities to undertake project-related environmental baseline surveys and monitoring studies and/or to undergo environmental impact assessments. Hence offshore wind is a relatively new activity, developers often face knowledge gaps as well on the state of the concerned marine environment, as on the actual effects wind turbines will emit during construction and operation phases. However, the major question turns out to be the evaluation whether these effects lead to negative impacts on the marine environment, and which significance these impacts will have.

The participating countries have started different actions to support developers fulfilling the requirements of licensing and consenting. For instance, some have started generic environmental research projects at sea. Others gather information by performing project-related monitoring studies.

To facilitate international exchange of information and thus support responsible deployment of offshore wind in Europe, one aim of COD was to collect existing publications and give access to existing knowledge on environmental issues of offshore wind in the participating countries. Titles and information (key words) were gathered in a database and made accessible on the COD-website (see: http://www.offshorewindenergy.org/index_cod.php).

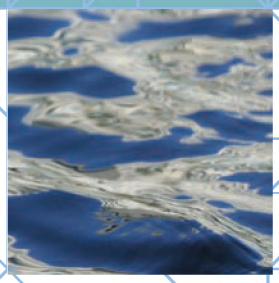
A 1.2 Structure and handling of the COD Database

To support the compilation of the information and facilitate dissemination COD developed an Access database[25]. This database was designed to feed and be updated regularly by all participating countries. The responsible working group members of each country decided self-dependent, which of the available publications and projects on environmental issues are relevant and should enter into the database. Finally, each country submitted its completed environmental database to TU Berlin, where the national databases were merged to an over-all version.

For each recorded publication or research project three forms had to be filled in, which would provide information on the publication or project. They consisted of general information (Form I), specification of the content of the publication or project (Form II) and other details of publication or project (Form III). More information about the contents of the forms and the filling in of the forms can be obtained from Annex C or on the COD website (see: pdf-file "user's guide for the database").

When interpreting the content of the database it has to be taken into consideration that while the database supports a standardised action, the information provided by the countries is quite heterogeneous. This refers to the kind of publications, which were considered by the countries as relevant

[25] The Access database was designed by New-Energy-Works (NEW, Utrecht/The Netherlands) as a subcontractor of the working group coordinator NOVEM.



to include. It also included different ideas for the technical terms used (same word, but different meaning). The latter sometimes complicated the categorisation of the collected information within the database fields.

However, a wide range of publications and information on ongoing projects in the eight European countries is made accessible by the database. Though not complete, it provides a good overview on the major activities regarding environmental issues of offshore wind in each country and on the available reports.

The database should be updated regularly, e.g. once a year. Dividing the database into subsections concerning

- Basic information on marine environment,
- Assessment procedures and instruments,
- Monitoring procedures,

would optimise the application as an information system.

A 2 Overview on the accessible information

A 2.1 Reports captured in the database

The COD environmental database contains more than 280 entries, provided from Belgium, Denmark, Germany, Ireland, the Netherlands, Poland, Sweden and the United Kingdom (see Table A1).

Annex B of this report provides a synoptic list with the reference numbers[26], titles, publication years and editing institutions of all publications and ongoing projects contained in the data-base.

Table A1: Amount of data records per country

Country	Amount of data records	Last update
BE (Belgium)	9	July 2005
D (Germany)	56	July 2005
DK (Denmark)	119	July 2005
IRL (Ireland)	5	September 2004 (confirmed June 2005)
NL (Netherlands)	19	July 2005
PL (Poland)	1	July 2005
SE (Sweden)	6	July 2005
UK (United Kingdom)	69	June 2005
Σ	284	

The greatest number of reports was recorded by Denmark. This is due to the extensive environmental monitoring programme at the demonstration wind farms Horns Rev and Nysted, with annual reports.

[26] The reference numbers of the data records (e.g. COD-UK-001) reflect the country that inserted the publication or project into the database (and thus normally the country where the editing institution of the study comes from).

United Kingdom (with a notable share of project-related Environmental Impact Studies and licensing statements) and Germany followed.

It should be noted, that interpretations of these numbers must be handled with care, as the database is not exhaustive.

The publication dates of the recorded reports vary from 1994 to 2005 (see Table A2). The first year with a considerable number of published reports on environmental issues of offshore wind was 2000. The majority of publications accrued from the last three years.

Table A2: Publication date of the recorded reports

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005 [27]	Projects in progress or planned [28]	Unknown or other [29]	Σ
BE	-	-	-	-	-	-	-	-	4	3	2	-	-	-	9
D	-	-	-	-	-	-	1	-	2	13	8	1	16	15	56
DK	-	-	-	-	-	2	39	10	24	15	22	7	-	-	119
IRL	-	-	-	-	-	-	2	-	3	-	-	-	-	-	5
NL	-	-	-	-	-	1	1	-	3	8	5	1	-	-	19
PL	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
SE	2	-	-	-	-	-	-	-	-	-	-	2	2	-	6
UK	-	-	1	-	1	2	1	6	19	15	12	-	10	2	69
Σ	**2**	**-**	**1**	**-**	**1**	**5**	**44**	**16**	**55**	**55**	**49**	**11**	**28**	**17**	**284**

A great number of generic research projects and project-related monitoring studies are currently in progress, hence much more publications are expected in the coming months and years.

A 2.2 Kind of accessible information on environmental issues

The COD data collection set a focus on a scope of environmental key issues[30] related to offshore wind deployment:

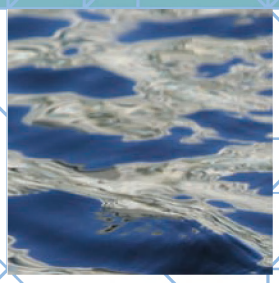
- components of the marine ecosystem (and any impacts on):
  - birds (sea birds, resting bird, migrating birds),
  - marine mammals,
  - fish,

[27] Not complete; latest update July 2005.

[28] The database also provides information on ongoing or planned research projects which have not had any reports or internal drafts published so far. (Please note, this category of the table does not include the published intermediate reports of the ongoing Danish monitoring programme, these are registered under the appropriate publication years.).

[29] That publication dates are "unknown" may, for example, be due to that recorded documents were not available. By "other" e.g. recorded information on relevant websites is included (thus no clear publication date applicable).

[30] See: IEA Topical Expert Meeting on environmental issues of offshore wind farms. September 2002, Husum/Germany.



- benthos,
- soil/seabed,
- hydrology,
- visual landscape,
- men,

- effects or influencing factors caused by offshore wind farms:
  - noise/vibrations (during construction and operation),
  - barrier and scaring effects,
  - collision risks (birds/bats)
  - disturbing effects (extrusion) due to construction/maintenance,
  - electromagnetic fields,
  - introduction of hard substrates (especially in soft bottom areas),
  - sedimentation/turbidity,
  - visual intrusion,
  - ship collision,
- investigation and evaluation methods (e.g. for EIA and monitoring),
- environmental risk assessment and planning procedures:
  - methods and requirements for Environmental Impact Studies (EIS),
  - Strategic Environmental Assessment (SEA),
  - Habitats Assessment (appropriate assessment),
  - spatial planning / site selection (including the designation of marine protected areas and the selection of suitable areas for wind farms),
- avoidance and mitigation measures.

A 2.2.1 Components of the marine ecosystem

Components of the marine ecosystem which have to be taken under consideration are generally derived from the national EIA-legislation. Specifying the applicance of these regulations, some countries have issued guidelines which specify the investigation requirements as well as methodological requirements.

In all countries the assessment of effects on the marine environment biota has to comprise of birds (sea/resting birds, migrating birds), marine mammals, fish, benthos and (sometimes) bats, as these components are considered as potentially affected and have usually to be investigated in an EIS.

Non biotic features such as soil/seabed and hydrology also belong to the scope of relevant subjects. Effects on the visual landscape are important when offshore turbines are to be erected in coastal waters and thus near to the shore.

In the database information on these issues can be found in project-related reports like EIS and monitoring studies as well as in generic research projects. They may focus on only one or on a selection of these subjects.

As it turns out, many of the publications and projects refer to a cross-section of subjects or components of the environment (see Table A3), which seems logical in consideration of the recorded EIS. Many generic research projects are also composite projects that address several issues.

Publications or projects which refer to single subjects of the marine ecosystem are mostly related to birds and marine mammals, followed by fish and benthos. This clearly reflects the discussions on environmental impacts of offshore wind so far. These subjects are usually deemed to be most important with regard to the decision making process.

Not all of the provided publications and projects on the marine ecosystem are directly connected with offshore wind energy deployment. Particularly in Germany, many baseline data on the different marine biota were collected by surveys in connection with the recent designation of marine protected areas (Natura 2000 sites) in the EEZ.

Table A3: Components of marine environment addressed by the recorded publications and projects

	Birds	Marine mammals	Fish	Benthos	Soil/seabed	Hydrology	Visual landscape	Men	Several marine subjects or environment in general	Other[31]	n/a	Σ
BE	-	-	-	-	-	-	1	-	7	-	1	9
D	4	4	2	3	2	1	1	-	26	9	4	56
DK	19	29	17	13	8	4	1	5	12	6	5	119
IRL	-	-	1	-	-	-	-	-	2	2	-	5
NL	6	2	4	2	-	-	-	-	4	-	1	19
PL	-	-	-	-	-	-	-	-	1	-	-	1
SE	2	-	2	-	-	-	-	-	-	-	2	6
UK	10	1	2	-	2	-	2	2	23	20	7	69
Σ	**41**	**36**	**28**	**18**	**12**	**5**	**5**	**7**	**75**	**37**	**20**	**284**

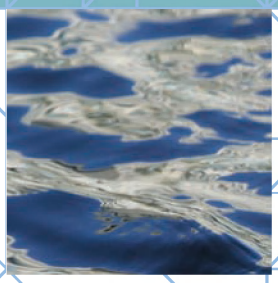
A 2.2.2 Effects of offshore wind turbines/farms

The cause of an effect[32] which might lead to negative impacts on the environment, might be an action (like construction, operation, maintenance) or the turbine (as a facility) itself.

In EIAs the description of the effects and an evaluation of the expected level (intensity) is an essential step. Besides, some research studies provide information on singular effects (like noise) or singular risks (like ship collision).

[31] If recorded publications or projects are not directly related to the mentioned components of the marine ecosystem.

[32] Effect: Any change in the physical, natural or cultural environment brought about by a development project.



Many of the collected reports/studies are project-related (specific wind farm) and cover the range of concerned EIA-subjects. As they are single case studies, a generalization of the outcomes of impact prognosis and assessment is limited.

The so far existing "real" effect studies – those which base on first practical experiences with offshore wind farms – are mostly generated in connection with the Danish demonstration programme conducted at Horns Rev and Nysted. Besides, also from Sweden and the UK a few effect studies are available.

Taking into account the huge number of environmental baseline and monitoring studies provided over the last years from the Danish demonstration programme, these results are of great value for future offshore wind developments in Europe.

Overall, a large number of the collected publications and projects (generic research projects as well as project-related risk assessments and monitoring studies) refer especially to the following potential environmental effects of offshore wind farms:

- habitat loss, barrier effects and collisions risks for resting and migrating birds,
- effects of noise emissions and vibrations, particularly with regard to marine mammals,
- effects due to the introduction of artificial hard substrate on fish and benthos (reef effect),
- effects of electromagnetic fields,
- navigational risks (risk of ship collision).

A range of other potential effects is also addressed.

However, there are only few publications and projects which primarily focus on the prognosis and assessment of cumulative effects.

A 2.2.3 Investigation and evaluation methods

The gathered publications refer mainly to investigation methods in connection with baseline and monitoring studies regarding specific marine biota (e.g. marine mammals, seabirds, fish), to describe which methods have been or should be applied for the surveys.

Such investigation methods comprise for example: ship-based surveys, aircraft-based surveys, radar-based observations, telemetry, the use of porpoise detectors (POD), beam trawling and research on offshore platforms.

In connection with generic research projects on environmental impacts of offshore wind farms also literature studies, calculations, computer modelling and laboratory experiments are mentioned.

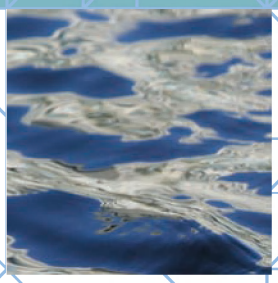
There are only a few publications, solely referring to investigation and evaluation methods (see Table A4). These are mostly guidances or terms of reference which describe thematic, technical and/or methodological requirements for environmental investigations and evaluations/assessments.

Table A4: Examples for publications on investigation and evaluation methods

Reference	Title	Editor
COD-BE-008	Wind farms at the North Sea: integrated assessment of effect on landscape (visual intrusion)	BMM
COD-D-001	Standards for Environmental Impact Assessments of Offshore Wind Turbines in the Marine Environment	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
COD-D-005	Standard procedures for the determination and assessment of noise emissions by offshore wind farms	University of Hanover (CRI), DEWI, itap
COD-D-018	Standards for site investigation - Minimum requirements for the foundation of offshore wind energy plants	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
COD-NL-003	Terms of reference, procurement base line studies North Sea Wind	RIKZ/National Institute for Coastal and Marine Management
COD-UK-006	Guide to Best Practice in Seascape Assessment	Countryside Council for Wales, Brady Shipman Martin, Dublin, University College Dublin
COD-UK-012	Development of a methodology for the assessment of cumulative effects of marine activities using Liverpool Bay as a case study	Oakwood Environmental Limited
COD-UK-018	Offshore Wind Farms - Guidance note for Environmental Impact Assessment in respect of FEPA and CPA Requirements	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-035	Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK	COWRIE, Crown Estate
COD-UK-053	Best Practice Guidance for the Use of Remote Techniques for Observing Bird Behaviour in Relation to Offshore Windfarms (Draft)	COWRIE, Crown Estates

A 2.2.4 Environmental risk assessment and planning procedures

Most of the provided publications which refer to environmental assessment are Environmental Impact Statements (EIS) for specific wind farms projects. Regarding the total number of recorded EIAs, one can assume that meanwhile there is good practical experience in how to perform an offshore wind impact assessment.



However, the database contains very few reports dealing with environmental assessment and planning procedures in principle (e.g. How to perform an EIA for offshore wind farms? How to assess the significance of expected impacts?), see Table A5.

In Germany some research projects are concerned with best practices for environmental as-sessment instruments like SEA, EIA and Habitats Assessment (see e.g. COD-D-006, COD-D-028, COD-D-031) and also environmental requirements which should be considered within the scope of spatial planning (see e.g. COD-D-042). The designation of marine protected areas and the selection of suitable areas for wind farms is addressed too.

Furthermore, in one publication a "wind farm sensitivity index" (WSI) for seabirds was developed which is considered of importance for site selection and SEA (see COD-D-027). It is thus an example of how aspects of bird protection can find access to spatial planning considerations.

Also a few publications from the United Kingdom are provided, which refer to environmental assessment and planning procedures. Some of them provide guidances (see e.g. COD-UK-018, COD-UK-044), but also report on specific assessments like the SEA carried out for offshore wind energy (see COD-UK-017, COD-UK-048).

Apart from some German reports, there is only little information contained in the database which refers to general aspects of spatial planning at sea, like the designation of marine protected areas (Natura 2000 sites) and the selection of suitable areas for wind farms (see e.g. COD-D-017, COD-NL-019). In particular, information is scarce on criteria and methods for such area selections as well as the subsequent handling of those areas in connection with wind farm applications. Also, there is hardly any information concerning the implementation of a comprehensive marine spatial planning (see e.g. COD-D-042).

Table A5: Examples for publications and projects referring to environmental risk assessment and planning procedures

Reference	Title	Institution/Editor
COD-D-006	Accompanying Ecological Research to the Offshore Wind Energy Deployment - Instruments of Environment Protection and Nature Conservation: Strategic Environmental Assessment, Environmental Impact Assessment and Habitats Assessment	Technische Universität Berlin, Planungsgruppe Ökologie + Umwelt, Hannover, Ostseeinstitut für Seerecht und Umweltrecht der Universität Rostock
COD-D-028	Consideration of effects on the marine environment within the licensing procedure of wind parks in the German EEZ: Discussion of methods and practical advise for the drafting and the quality assurance of EIA studies and of Habitat Assessment studies	Technische Universität Berlin (Berlin University of Technology, Department of Landscape Planning and EIA)
COD-D-031	Strategic Environmental Assessment and strategical monitoring for offshore wind farms	University of Lüneburg, OECOS Umweltplanung, BioConsult SH

Reference	Title	Institution/Editor
COD-D-042	Technical and Legal Nature Conservation Requirements for New Spatial Planning Instruments in the German Exclusive Economy Zone	Technische Universität Berlin, OECOS Umweltplanung, Döhren Mohr Rechtsanwälte, Prof. Dr. Rainer Wolf
COD-UK-018	Offshore Wind Farms - Guidance note for Environmental Impact Assessment in respect of FEPA and CPA Requirements - Version 2	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-044	Consultation for Offshore Wind Energy Developments - Best Practice Guidelines	British Wind Energy Association (BWEA)

A 2.2.5 Avoidance and mitigation measures

Proposals on how to avoid or mitigate the adverse effects of the construction and operation of wind farms are usually contained the project-related EIS.

Besides that some generic research projects refer to avoidance and mitigation measures. These are mostly connected with selected marine biota (e.g. birds, marine mammals) which are addressed by these projects.

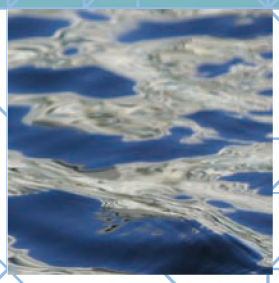
There are only few publications and projects which focus primarily on avoidance and mitigation measures (see e.g. COD-D-007, COD-D-008).

A 2.3 What types of studies have been recorded?

The COD data collection is aimed at any publications and ongoing projects which deal with at least one of the environmental issues of offshore wind development specified above. Publication means in the broadest sense any kind of written report. Many research projects are currently carried out, often without having reports published yet. The database provides information on such projects .

Types of publications and studies recorded in the database are, for example:

- reports on planning and assessment instruments (e.g. EIA, SEA and Habitat Assessment),
- reports regarding research projects (e.g. generic R&D, project-related monitoring studies),
- expert opinions,
- guidelines / terms of reference (e.g. for ecological examinations or for EIA proceedings),
- programmes / strategy papers,
- conference reports,
- maps (e.g. of suitable areas for wind farms).



Overall it can be divided into publications and research projects which refer to specific offshore wind farms (hence they are project-related) and general studies (not connected to a specific wind farm), see Table A6. Whereas for example nearly all of the Danish studies are project-related since they were conducted in connection the existing demonstration wind farms, in Germany reports deal mainly with generic research projects (as no wind farms are realised there yet).

Table A6: Proportion of the recorded publications and projects connected to specific wind farms

	Related to specific offshore wind farm (project-related)	Not connected to specific wind farm (general)	Σ
BE	7	2	9
D	12	44 [33]	56
DK	117	2	119
IRL	2	3	5
NL	17	2	19
PL	1	-	1
SE	5	1	6
UK	25	44	69
Σ	**186**	**98**	**284**

A 2.4 In which context information about environmental issues has been generated?

A 2.4.1 Research projects

A good deal of the information gathered on environmental issues of offshore wind energy was and is generated by generic research projects. This refers in particular to countries were accompanying research programmes were established by the government (e.g. COWRIE in the UK, or the ZIP-programme in Germany).

Most of those research projects are not related to specific wind farms, however some of them are carried out at offshore research platforms.

The collected generic research projects mainly comprise of baseline studies on selected marine biota and abiota (e.g. occurrence/distribution of marine mammals, delineation of reefs). Other projects look at research into the prognosis and assessment of specific environmental effects (e.g. noise assessment, collision risks). The methodological aspects of environmental risk assessment and planning procedures are also addressed.

[33] A few of those are connected to offshore research platforms.

A 2.4.2 Project-related assessments and monitoring

In countries where the first offshore wind farms were already realised many of the publications and projects on environmental issues are provided by project-related studies.

Of particular importance is the Danish monitoring programme at Horns Rev and Nysted, where extensive environmental monitoring studies are conducted. Also from wind farms in the UK and Sweden a few monitoring studies are available.

Besides those effect studies, the collected project-related publications also comprise of a number of EIS's prepared prior to construction as a requirement of the licensing procedure. Such EIS exist for several projects in all participating countries. Also a few SEA documents are available, mainly from the UK.

A 2.4.3 Guidelines

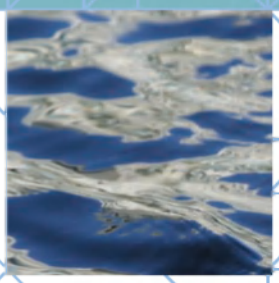
As binding guidelines are mostly published on national level (government or competent authority) the total number of those cannot be very high.

However, most of the "guidelines" collected in the database seem rather to be "guidances", and thus are often recommendations than binding guidelines in the narrower sense (see Table A7).

They mainly describe thematic, technical and/or methodological requirements for environmental investigations and assessments. Some also refer to licensing procedures.

Table A7: Examples for recorded guidelines/guidances

Reference	Title	Institution/Editor
COD-D-001	Standards for Environmental Impact Assessments of Offshore Wind Turbines in the Marine Environment	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
COD-D-018	Standards for site investigation - Minimum requirements for the foundation of offshore wind energy plants	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
COD-NL-003	Terms of reference, procurement base line studies North Sea Wind	RIKZ/National Institute for Coastal and Marine Management
COD-UK-007	Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues (Marine Guidance Note 275)	Maritime & Coastguard Agency (MCA) HM Government
COD-UK-018	Offshore Wind Farms - Guidance note for Environmental Impact Assessment in respect of FEPA and CPA Requirements	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)



Reference	Title	Institution/Editor
COD-UK-044	Consultation for Offshore Wind Energy Developments - Best Practice Guidelines	British Wind Energy Association (BWEA)
COD-UK-045	Guidance Notes - Offshore Windfarm Consents Process for England and Wales	Department of Trade and Industry (DTI), Offshore Renewables Consents Unit, Marine Consents and Environment Unit (MCEU)

A 2.4.4 Other

Most of the collected information on environmental issues on offshore wind was generated in the context of research projects, project-related assessments and monitoring studies, and guidance notes.

However, besides that there are also a few data records which refer to other types of publications, for example:

- strategy papers (see e.g. COD-D-025, COD-UK-001, COD-UK-013),
- conference reports (see e.g. COD-D-002, COD-D-012, COD-UK-019, COD-UK-036),
- websites (see e.g. COD-D-017, COD-UK-048),
- maps (see e.g. COD-D-026, COD-UK-041),
- information on the construction of research platforms (see COD-D 010, COD-D-044)

A 2.5 What kind of institutions/organisations are involved in the studies?

Most of the generic research projects as well as project-related assessment and monitoring studies are conducted by research institutes/universities and environmental consultancies/engineering companies. Also, many of the reports collected were published by wind farm developers and by governmental departments, particularly licensing authorities and nature protection agencies. Only a few of the publications on environmental issues of offshore wind are from NGOs, like wind energy associations or nature conservation organisations.

A 3 Background on national approaches to gain environmental information

The description of programmes or project-related proceedings to gather information on environmental impacts is meant to support the understanding and classification of the different types of publications from each country.

A 3.1 Belgium

The total of offshore wind power that could realistically be installed in the Belgian EEZ until 2020 has been estimated to be around 2,000 MW. However, no strategic plans have been drawn in order to develop this potential. As a consequence, no strategic approaches exist regarding research on environmental issues of offshore wind energy either.

Parties who want to carry out research on different aspects of offshore wind energy should identify opportunities in the more general research framework for sustainable development (SPSD)[34] and make suited research proposals by own initiative.

The only major research work on offshore wind energy in the Belgian EEZ has been carried out in the SPSD 2 project "Optimal Offshore Wind Energy Developments in Belgium". This study focuses on spatial planning, grid issues, the wind potential, available turbine technology and the sea bed. A recommendation on designating zones to offshore wind power recommends to take proper care of environmental factors and make use of the best available knowledge on species present and if needed undertake dedicated studies.[35]

Thus collecting data to assess environmental impacts seems to be fully left to the individual developer. There is a lack of other studies on environmental effects of offshore wind energy in Belgium. The database contains environmental impact studies carried out by applicants and the respective assessments by the Belgian Management Unit of the North Sea Mathematical Models (MUMM)[36]. The MUMM is advising the Belgian government. The database contains the environmental impact studies of all applications that have been handled up to now regardless of whether these have finally been accepted.

A 3.2 Denmark

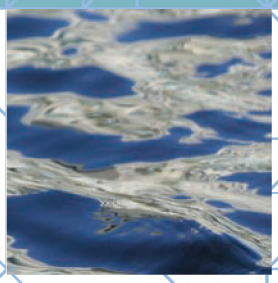
After the realisation of some small nearshore-projects in Denmark, it was decided in the late 90's to establish large-scale demonstration projects for offshore wind energy. These were based on the "The Offshore Wind Turbine Action Plan for Danish Waters". In this context an environmental programme has been initiated, too, which was a pre-condition for the approval of the demonstration projects and includes environmental measurements and monitoring much more comprehensive than the EIA's. A 11 Mio. € monitoring programme to investigate the effects of offshore wind farms on the marine environment is financed as a public service obligation. The programme began with the baseline studies initiated in 1999 at Horns Rev and Nysted and runs until end 2006.

The environmental monitoring that is currently carried out at the demonstration wind farms Horns Rev and Nysted comprises baseline studies over two years, monitoring during construction and monitoring over approximately two years during operation. The surveys comprise of sea and migrating birds,

[34] Belgian Science Policy, http://www.belspo.be/

[35] F. Van Hulle, S. Le Bot, Y. Cabooter, J. Soens, V. Van Lancker, S. Deleu, J.P. Henriet, G. Palmers, L. Dewilde J. Driesen, P. Van Roy, R. Belmans. Optimal offshore wind energy developments in Belgium, SPSD II, Final report, CP/21, Brussels, May 2004.

[36] Management Unit of the North Sea Mathematical Models (MUMM), see: http://www.mumm.ac.be/



marine mammals, fish, benthic communities, hydrography/geomorphology and visual landscape. Other aspects include acoustic emissions, electromagnetism and socio-economic issues.

All Danish studies contained in the database result from this monitoring programme.

A 3.3 Germany

In 2002 the "Strategy of the German Government on the use of Off-shore Wind Energy" (see COD-D-025) was published. According to this an installed offshore wind capacity of up to 20,000-25,000 MW is expected in Germany by 2025/30. Its implementation will take place in phases in order to ensure the compatibility with environment and nature. Most of the German offshore wind farms are planned in the Exclusive Economic Zone (EEZ). Approvals for more than 2,500 MW were already granted by the licensing authority (Federal Maritime and Hydrographic Agency, BSH), but so far none of these projects is realised.

Accompanying the federal deployment strategy is an ecological research programme which has been established and funded by the German governments Future Investment Programme (ZIP). In this context more than 4.2 Million € (timeframe 2001-2003) were allocated by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) to several environmental research projects. In 2004, a further 6.9 Million € were granted for ecological research accompanying the development of offshore wind energy. Additional funds were provided for the construction of offshore research platforms. Platform FINO 1 in the North Sea is already in operation and monitoring studies started. The second research platform FINO 2 is intended to be constructed during 2005 in the Baltic Sea. Besides, several other environmental R&D projects are carried out, mainly on behalf of the Federal Agency for Nature Conservation (BfN) and the Federal Environmental Agency (UBA).

Most of these projects are carried out in a broad co-operation of German research institutes. They cover a wide range of themes, aiming mainly at generic research and baseline investigations to close knowledge gaps concerning the reference state of the marine environment. Closing knowledge gaps is regarded as a fundamental precondition to effect studies resp. impact prognosis.

The projects include for example surveys on the distribution and sensitivity of seabirds, migrating birds, marine mammals, fish and benthos. Aspects like acoustic emissions, electromagnetism and the risks of ship collisions are also taken into account. Issues referring to environmental planning instruments (e.g. adaptation of SEA, EIA and Habitats Assessment methods to the special conditions of the marine environment and the legal requirements in the EEZ) and spatial planning are addressed, too. Some of the research projects were already completed and first reports are available[37]. Supplementary to the extensive reports of the individual research projects, a summary is currently under preparation by TU Berlin and will feature the main results of the projects (see COD-D-028).

[37] Generally, the final reports are made available by the respective research institutions, or can be obtained from the German National Library of Science and Technology, University Library Hannover (see: http://www.tib.uni-hannover.de/en/).

Apart from government funded research projects, all planned offshore wind farms projects have to carry out project related studies at the expense of the developer. The studies are based on the licensing authority's standard programme for environmental examinations (BSH 2003, see COD-D-001). These studies are a precondition to fulfil the legal requirements for the licensing. They include baseline surveys (before construction) for the implementation of EIA and Habitats Assessment, and a monitoring (during construction and operation) in the wind farm area and reference areas.

As the developers' studies on project level are part of the licensing procedures, these reports are for the most part not (yet) published. Thus they are only accessible to a limited extent. A look at the full EIA documents for offshore wind farms in the German EEZ can only be taken in person during public consultation or later[38] in the office of the licensing authority, the Federal Maritime and Hydrographic Agency (BSH). Due to this restriction, within the COD database only short information on the EIS of approved and refused wind farm projects in the German EEZ is provided.

In Germany, so far no offshore wind farm has been realised. Apart from research platform FINO I, opportunities to gain practical experiences by effect studies are still missing.

A 3.4 Ireland

Ireland has some of the best offshore wind resources in Europe. It is ideally exposed to great wind speeds. The drive to harness this potential is being supported by the Irish Wind Energy Association (IWEA), which set up an Offshore Committee to promote and support the development of offshore wind energy in Ireland. The Committee's members were drawn from all those active in the industry including manufacturers, developers, consultants and marine institutions. Airtricity[39] have recently completed phase one (7 turbines – 25 Megawatts installed) of Ireland's first offshore wind farm on the Arklow Banks.

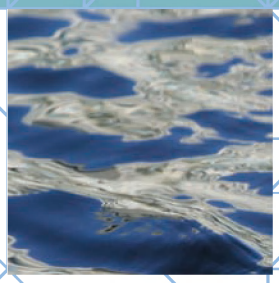
Before an offshore wind farm site may be developed, approval must be sought from the Department of the Marine, Communciations and Natural Resources for a Foreshore Licence and a Foreshore Lease under the Foreshore Act. When considering a Foreshore Licence certain areas are prohibited. Safety at sea, established shipping lanes, air navigation, telecommunication, gas pipelines and/or defence requirements may not be endangered.

Each project requires an Environmental Impact Assessment as part of the Foreshore Lease application. This will cover, where relevant, impacts on the following: fisheries and fishing, birds, marine mammals, sediment transport, currents including scouring effects, air quality including noise levels, climate, the landscape and seascape, benthic and other seabed life, noise, commercial shipping and pleasure craft, tourism, and other users of the sea (telecommunication cables, oil and gas etc). [40]

[38] In accordance with the German Environmental Information Act (UIG) and the European Directive on Public Access to Environmental Information.

[39] See: http://www.airtricity.com/opencontent/default.asp?itemid=396&section=WIND+FARMS

[40] See also: www.iwea.com/offshore/



No evidence was found that the offshore wind deployment is supported by research programmes on environmental issues in Ireland. Environmental issues are obviously mainly dealt with in a single case project related approach.

Still it is not clear, if developers are obliged to carry out environmental monitoring studies during and after construction.

A 3.5 The Netherlands

The 'Near Shore Wind Farm' (NSW) is intended to help gain knowledge and experience and thus to create the opportunity to build and exploit large wind farms further out on the North Sea. To collect this know-how and experience an extensive Monitoring and Evaluation programme has been linked to the NSW. It is called the 'MEP-NSW'. The results will be available for all the parties that are involved in offshore wind energy.

The MEP-NSW has been organised around eleven learning objectives, subdivided into a group named 'Technology and Economy' and a group dealing with 'Nature, Environment and Use Functions'. For the latter group baseline studies are being made from the end of 2002 by order of the national government. After the installation of the windfarm data will be collected by the NoordzeeWind Consortium, which will realise and exploit the NSW.

These baseline studies are meant to record the reference status for the monitoring of effects. Monitoring consists of a reference study and an impact assessment. The procurement of these reference studies is divided into six lots (subjects), based on the disciplines of research.

For every lot the reference situation in the study area is investigated. The lots are:

1. Benthic fauna (both endo- and epifauna);

2. Demersal fish[41] fauna;

3. Pelagic fish[42] fauna;

4. Sea mammals;

5. Marine birds;

6. Non-marine migratory birds and flight patterns of migrating birds (both marine and non-marine).

For the NSW project environmental impacts have to be monitored as mentioned. For the other wind farm project (the so-called Q7-project) monitoring of these effects is the developer's obligation via specific permit conditions. [43]

[41] Fish species living on or near to the seabed and feed on bottom-living organisms.

[42] Fish species, some of them migratory, living in the open waters between the coast and the edge of the continental shelf in depths of 20-400 metres.

[43] No permits have been issued for other offshore wind projects/initiatives than for NSW and Q7 yet.

A 3.6 Poland

There is no official offshore wind energy development programme in Poland, current development is based on individual projects owned by private developers (no demonstration projects at the moment).

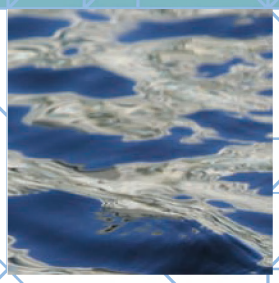
All of the offshore wind energy projects in Poland at the moment are at a preliminary phase of permitting procedure (pre-phase), which means there are applications to the Marine Office for the building conditions on the marine area. The procedure requires an investor to submit the Environmental Impact Assessment with the application. Before issuing the decision the Marine office is obliged to ask for the opinion of all interested actors (public accessible procedure), i.e. local and regional authorities, Ministry of Environment, nature conservation authorities. After a positive decision the investor is obliged to conduct a monitoring programme (the concept of the programme is a part of application of the permission, usually done as a part of preliminary EIA).

There is no specific research programme dedicated for offshore wind energy development. Some general studies were done up to now (i.e. ordered by Ministry of Environment). Most of site-specific information is included in the EIA's of individual projects (example included in COD data base) and current results of monitoring programmes of individual projects, which means the information is accessible only to some extent.

The most advanced studies were done in the context of the preparation of "Pomerania" offshore wind farm, especially valuable studies concerning bird populations and migration in the area (Karwia-Debki region). The visual surveys were done during 2003-2004 (also ship-based) and the terrain of the planned wind farm was preliminary assessed as very low attractive for birds. Consequently, the potential "Pomerania" wind farm was seen not to have significant impacts including collision risk, migration changes as well as distribution of protected bird species. All detailed study results are owned by the investor and are not available to the public at this moment.

The main problems reported by developers are connected with:

- lack of baseline studies: on the marine environment to assess all possible impacts; the environmental value of possible offshore wind farm locations is usually assessed as low in all aspects except for birds, where the necessity of research is emphasised,
- NATURA 2000 areas: all the projects are located in areas which belong to the regime of protected areas in the framework of NATURA 2000. Official guidelines on the preconditions for investments in such areas are still missing.
- Public acceptance: there is a strong local opposition to the wind farms which is based usually on two main problems: possible lowering of the quality of life of the inhabitants (visual intrusion) and negative impact on business opportunities (tourism and fishery). The local communities are focusing on the lack of direct compensation for possible negative effects.



It is expected that the situation will change, because offshore wind energy is mentioned as one of the preferential technology options in the project Polish National Energy Policy, therefore some more strategic research concerning offshore wind energy development is to be expected. Also, according to the latest amendment of Environmental Law (improved from 28th of July 2005), some changes in the investment procedure (applicance and consenting) will be necessary.

A 3.7 Sweden

In 2002, the Swedish parliament adopted a "planning target" for wind energy. The target is to achieve 10 TWh/year of electricity from wind energy before 2015. However, the interpretation of the goal varies. In principle, this means that wind energy should be considered in the spatial planning process so that it will be possible to actually build wind power to produce 10 TWh/year by 2015. The Swedish Energy Agency (STEM) has further defined the target as follows:

- 60 % of the 10 TWh is planned to be constructed in the Swedish EEZ; and
- 40 % should be planned for onshore and/or offshore in Swedish territorial waters.

If the exploration follows this scheme, in practise this means that it is likely that capacity to produce 6–8 TWh/year will be built offshore. The actual speed of offshore development will be settled by the licence process and economic conditions.

To support offshore wind development, the Swedish Government has started a "Windpilot-project" to support wind energy, mainly offshore. Two large projects have been granted support within this programme. The Lillgrund park of around 120 MW in the Öresund straight and Utgrunden of around 90 MW in the Kalmarsund straight.

Parallel to the partial funding of these parks there is also a research programme on environmental issues of offshore wind (coupled with the pilot project). The programme is called "VINDVAL". There is a programme secretariat at the Swedish Environmental Protection Agency.[44] The VINDVAL programme will run from 2005 to 2009. The VINDVAL programme covers investigations and research on all relevant aspects for environmental impact of wind energy. The aim of the programme is to facilitate the development of wind power through increased knowledge of environmental impact so that the results can be used in EIA's. Another aim is to build up knowledge in universities and institutes. Investigations will be focused on effect studies around the two wind parks funded by the Windpilot-project. A number of research projects for investigations before construction of the farms have recently started.

Developers applying for permits are required to carry out monitoring studies necessary to estimate the environmental impact of a project. This applies to all projects. A permit for an offshore wind farm will have conditions on necessary monitoring studies to be carried out during construction and operation

[44] See: http://www.naturvardsverket.se/index.php3?main=/dokument/omverket/forskn/vindval/vindval.htm (information only in Swedish)

of the farm. The bird study and reef effect study in the database are such studies. The two studies mentioned have been conducted with the help of co-funding from the government.

The Swedish Environmental Protection Agency[45] is commissioned by the government to make an inventory of offshore banks that could be of interest for wind energy exploitation. A report is planned to be made available in 2006. In a first stage the Environmental Protection Agency has selected four marine areas (banks) of high protection value which will presumably be excluded from any exploitation.

A 3.8 United Kingdom

As part of the first round of consents for offshore wind farms The Crown Estate has established a trust fund based on the refundable financial deposits made by developers. The interests accruing are intended to support research purposes and are administered by the COWRIE steering group. COWRIE (Collaborative Offshore Wind Research into the Environment)[46] has identified four priority areas for generic research: the potential effects of electromagnetic fields from cables on fish, the comparison of bird survey methodologies, predicting the displacement of birds from benthic feeding areas and the potential effects of underwater noise and vibration on marine mammals. Contracted research institutes are currently working on these projects. COWRIE will probably be extended for the second round of consents but no research projects have been specified or started yet. Beyond COWRIE there are also a few other R&D projects on offshore wind energy and the environment funded by the Department for Environment, Food and Rural Affairs (DEFRA) and by the Department of Trade and Industry (DTI). Latterly, the Government has created the Research Advisory Group (RAG) to co-ordinate and oversee research into the potential impacts of offshore wind.[47]

The abovementioned generic research projects are quite separate from the requirements on developers to undertake site investigations to inform the environmental impact assessments, or site monitoring requirements which will be specified in conditions attached to licences. Detailed conditions apply to all construction licences for offshore wind farms regarding the implementation of environmental baseline and monitoring studies.

A 4 Conclusions

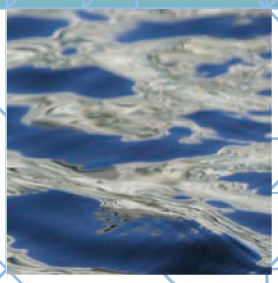
The EU-wide access to information on offshore wind related environmental issues has been improved by the COD-database (survey). The database has already been used for comprehensive studies on a European level (cf. Greenpeace 2005).

Many documents (e.g. Danish research reports, political programmes etc.) listed in the database are available on the internet. Thus, preconditions for information exchange are generally good. However,

[45] See: http://www.naturvardsverket.se/

[46] See: http://www.offshorewindfarms.co.uk

[47] See: http://www.dti.gov.uk/renewables/renew_2.1.3.7.htm



the availability of basic data (surveys, maps documenting the present state of environmental components, particularly on transnational scale) is still limited.

Project-related EISes[48] represent the highest share of the registered reports. Regarding the total number of recorded EIAs one can assume that there is good practical experience in performing an offshore wind impact assessment.

Thus, environmental studies and EIA procedures do not seem to be a bottleneck any more, though - from the scientific point of view - sufficient data on the state of marine environment are still missing.

Apart from these project-related approaches, some countries like Denmark and Germany established comprehensive demonstration or research programmes.

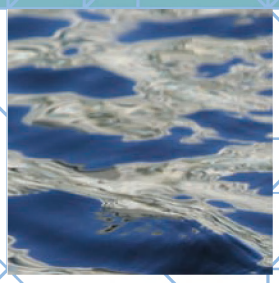
Finally, although many studies are currently underway and planned on the environmental effects of offshore wind – it seems that there are some issues which are not yet on the agenda of all participating countries. Up to now information is scarce on SEA procedures and on the assessment of cumulative effects. The first practical experience was gathered in the United Kingdom on that issue. Also, the precise criteria and methods for area selections (marine protected areas, suitable areas for wind farms) as well as the subsequent handling of those areas in connection with wind farm applications are scarcely available. Besides that there is almost no information concerning the implementation of a comprehensive marine spatial planning (except Germany where this process is currently underway).

[48] From the methodological point of view these studies cover single-case related baseline investigations (reference studies) and effect studies.

Annex B: Reference list of entries in the COD database

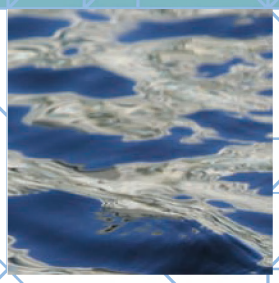
The following table (status 31 July 2005) provides an overview of the content of the COD database on environmental issues. Each data record (thus each publication or research project) contained in the Access database is listed with reference number, English title, original title, publication year and editing institution(s).

Reference	English Title	Original Title (if not English)	Publication Year	Institution
BE				
COD-BE-001	Environmental Impact Analysis Report for a wind energy farm near Zeebrugge	Milieueffectrapport voor een windturbinepark te Zeebrugge	2003	SGS Environmental Services
COD-BE-002	Environmental Impact Assessment Report for a Wind Farm at the Thornton Bank	Milieueffectenrapport voor een Windturbinepark op de Thorntonbank, Deel 2: Hoofddocument MER	2003	C-Power
COD-BE-003	Environmental impact assessment for construction and exploitation of a wind farm at the Thornton Bank (North Sea)	Milieueffectenbeoordeling bouw en exploitatie windmolenpark op de Thorntonbank	2004	BMM
COD-BE-004	Non-technical summary of a EIA-report on the construction and exploitation of a wind farm in the Belgian territorial sea	Niet-technische samenvatting van een milieueffectenrapport voor de bouw en exploitatie van een windmolenpark in de Belgische territoriale zee	2003	FINA EOLIA NV
COD-BE-005	Environmental impact assessment for construction and exploitation of a wind farm at the Wenduine Bank (North Sea)	Milieueffectenbeoordeling bouw en exploitatie windmolenpark op de Wenduinebank	2002	BMM
COD-BE-006	EIA-assessment of the "Seanergy" project (joint venture Electrabel-Jan de Nul)	Milieu-effectenbeoordeling van het project "Seanergy" ingediend door de tijdelijke vereniging Electrabel-Jan de Nul	2002	BMM
COD-BE-007	Assessment EIA for construction and exploitation of cables for the wind farm Electrabel - Jan de Nul	Milieueffectenbeoordeling voor de aanleg en exploitatie van zeekabels nodig voor het windmolenpark de t.v. Electrabel - Ondernemingen Jan de Nul	2002	BMM
COD-BE-008	Wind farms at the North Sea: integrated assessment of effect on landscape (visual intrusion)	Windmolenparken in de Noordzee: geïntegreerde beoordeling van het voornaamste landschapseffect: percentage bezetting van de horizon	2002	BMM
COD-BE-009	SPSD II: Optimal Offshore Wind Energy Developments in Belgium		2004	Belspo



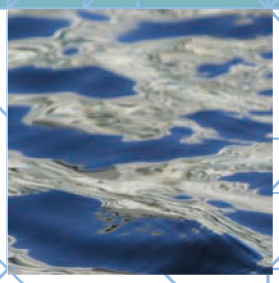
Reference	English Title	Original Title (if not English)	Publication Year	Institution
D				
COD-D-001	Standards for Environmental Impact Assessments of Offshore Wind Turbines in the Marine Environment (Status 25th February 2003)	Standarduntersuchungskonzept (StUK) für die Untersuchung und Überwachung der Auswirkungen von Offshore-Windenergie-anlagen auf die Meeresumwelt	2003	Bundesamt für Seeschifffahrt und Hydrographie, BSH (Federal Maritime and Hydrographic Agency)
COD-D-002	Accompanying Ecological Research to the Offshore Wind Energy Deployment. Workshop 28./29. May 2002 Bremerhaven, Proceedings	Ökologische Begleitforschung zur Offshore-Windenergienutzung. Fachtagung des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit und des Projektträgers Jülich, Bremerhaven 28./29. Mai 2002, Tagungsband	2002	Forschungszentrum Jülich, Projektträger PTJ
COD-D-003	MINOS – Marine warm-blooded animals in the North and Baltic Seas: Foundations for assessment of offshore wind farms	MINOS – Marine Warmblüter in Nord- und Ostsee: Grundlagen zur Bewertung von Windkraftanlagen im Offshore - Bereich	2004	Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning, Universität Kiel, Institut für Meereskunde, Universität Kiel, Forschungs- und Technologiezentrum Westküste, Deutsches Meeresmuseum Stralsund, Ruhr-Universität Bochum, Bundesforschungsan-stalt für Fischerei, Hamburg
COD-D-004	BEOFINO – Accompanying Ecological Research on Offshore Research Platforms in the North and Baltic Seas	BEOFINO – Ökologische Begleitforschung auf Offshore-Forschungsplattformen in der Nord- und Ostsee	in progress	Alfred-Wegener-Institut (AWI), Institut für Vogelforschung, Vogelwarte Helgoland, Institut für Ostseeforschung (IOW), Warnemünde
COD-D-005	Standard procedures for the determination and assessment of noise emissions by offshore wind farms	Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmissionen von Offshore-Windenergieanlagen	2004	Universität Hannover, Curt-Risch-Institut für Dynamik, Schall- und Messtechnik, Deutsches Windenergie Institut (DEWI), Institut für technische und angewandte Physik (itap), Oldenburg

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-006	Accompanying Ecological Research to the Offshore Wind Energy Deployment – Instruments of Environment Protection and Nature Conservation: Strategic Environmental Assessment, Environmental Impact Assessment and Habitats Assessment	Ökologische Begleitforschung zur Offshore-Windenergienutzung: Teilbereich Instrumente des Umwelt- und Naturschutzes: Strategische Umweltprüfung, Umweltverträglichkeitsprüfung und FFH-Verträglichkeitsprüfung	2003	Technische Universität Berlin, Institut für Landschafts- und Umweltplanung, Planungsgruppe Ökologie + Umwelt, Hannover, Ostseeinstitut für Seerecht und Umweltrecht der Universität Rostock
COD-D-007	Measures of avoidance and reduction of negative ecological impacts according to the grid connection of offshore windfarms	Maßnahmen zur Vermeidung und Verminderung negativer ökologischer Auswirkungen bei der Netzanbindung und –integration von Offshore-Windparks	2004	Schreiber Umweltplanung, Bramsche, Deutsche WindGuard GmbH, Prof. Dr. Martin Gellermann
COD-D-008	Investigations to avoid and reduce possible impacts of wind energy parks on the marine environment in the offshore areas of North and Baltic Sea	Untersuchungen zur Vermeidung und Verminderung von Belastungen der Meeresumelt durch Offshore-Windenergieanlagen im küstenfernen Bereich der Nord- und Ostsee	2003	Alfred-Wegener-Institut (AWI), Germanischer Lloyd WindEnergy GmbH, Hamburg, Institut für Vogelforschung, Vogelwarte Helgoland, Deutsches Windenergie Institut (DEWI)
COD-D-009	Evaluation of foundations for offshore wind farms with a view to potential shipping collisions	Rechnerische Bewertung von Fundamenten von Offshore-Windenergieanlagen bei Kollisionen mit Schiffen	2004	Technische Universität Hamburg-Harburg (TUHH), Arbeitsbereich Schiffstechnische Konstruktionen und Berechnungen
COD-D-010	FINO 1 (Research Platforms in the North and Baltic Seas)	FINO 1 (Forschungsplattformen in der Nord- und Ostsee)	n/a	Germanischer Lloyd WindEnergie GmbH
COD-D-011	Development of environmental criteria for the identification of especially suitable areas for offshore wind farms in the German EEZ	Entwicklung von naturschutzfachlichen Kriterien zur Abgrenzung von besonderen Eignungsgebieten für Offshore-Windparks in der Ausschließlichen Wirtschaftszone (AWZ) von Nord- und Ostsee	2004	Technische Universität Berlin, Institut für Landschafts- und Umweltplanung
COD-D-012	Technical intrusions upon the marine habitats	Technische Eingriffe in marine Lebensräume	2000	Bundesamt für Naturschutz (Federal Agency for Nature Conservation)
COD-D-013	Survey of marine mammals in the German EEZ of the North Sea	Erfassung von Meeressäugetieren in der deutschen AWZ der Nordsee	2003	Forschungs- und Technologiezentrum Westküste (FTZ), Büsum



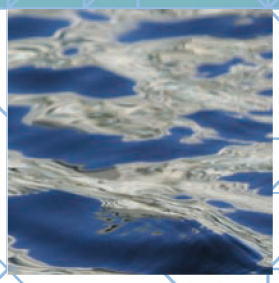
Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-014	Survey of marine mammals in the German EEZ of the Baltic Sea	Erfassung von Meeressäugetieren in der deutschen AWZ der Ostsee	2003	Forschungs- und Technologiezentrum Westküste (FTZ), Büsum
COD-D-015	Survey of resting birds in the German EEZ of the North and Baltic Seas	Erfassung von Rastvögeln in der deutschen AWZ von Nord- und Ostsee	2003	Forschungs- und Technologiezentrum Westküste (FTZ), Büsum
COD-D-016	Benthic surveys in the potential suitable areas for offshore wind farms "Kriegers Flak" and "Westlicher Adlergrund" in the Baltic Sea	Benthologische Arbeiten zur ökologischen Bewertung von Windenergie-Anlagen-Eignungs-gebieten in der Ostsee. Bericht für die Areale „Kriegers Flak" und „Westlicher Adlergrund"	2003	Institut für Ostseeforschung Warnemünde (IOW)
COD-D-017	Maps on nominated NATURA 2000 sites in the German EEZ of the North and Baltic Seas	Karten der NATURA 2000-Schutzgebietsvorschläge in der AWZ der Nordsee und Ostsee	n/a	Bundesamt für Naturschutz (Federal Agency for Nature Conservation)
COD-D-018	Standards for site investigation – Minimum requirements for the foundation of offshore wind energy plants	Standard Baugrunderkundung – Mindestanforderungen für Gründungen von Offshore-Windenergieanlagen	2003	Bundesamt für Seeschifffahrt und Hydrographie, BSH (Federal Maritime and Hydrographic Agency)
COD-D-019	Survey of harbour porpoises in the German EEZ of the Baltic Sea by means of porpoise de-tectors	Erfassung von Schweinswalen in der deutschen AWZ der Ostsee mittels Porpoise Detektoren	2003	Deutsches Meeresmuseum
COD-D-020	Survey of Annex II fish species in the German EEZ of the North and Baltic Seas	Erfassung von FFH-Anhang II-Fischarten in der deutschen AWZ der Nord- und Ostsee	2003	Bundesforschungsan-stalt für Fischerei, Institut für Seefischerei, Bundesforschungsan-stalt für Fischerei, Institut für Ostseefischerei
COD-D-021	Spatial analysis of the anadromous migrating fish species twaite shad 'Alosa fallax' in the North Sea	Analyse der Verteilungsmuster der anadromen Wanderfischart Finte (Alosa fallax) in der Nordsee	2003	Carl-von-Ossietzky-Universität Oldenburg, Institut für Chemie und Biologie des Meeres (ICBM)
COD-D-022	Delimitation of sandbanks as proposals for areas of conservation according to the Habitats Directive	Abgrenzung von Sandbänken als FFH-Vorschlagsgebiete	2003	ARGUMENT GmbH
COD-D-023	Derivation of scientific criteria for identification and delimitation of marine Special Protection Areas (SPA) according to Art. 4, Para. 1 and 2 of the Wild Birds Directive, respectively proposed Sites of Community Interest under the Habitats Directive in the German Exclusive Economic Zone (EEZ)	Ableitung fachlicher Kriterien für die Identifizierung und Abgrenzung von marinen Besonderen Schutzgebieten (BSG) nach Art. 4 Abs. 1 und 2 der Vogelschutzrichtlinie bzw. Vorschlagsgebieten gemäß Art. 4 Abs. 1 der FFH-Richtlinie für die deutsche ausschließliche Wirtschaftszone	2003	Schreiber Umweltplanung, Bramsche

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-024	GIGAWIND – Structure, Design and Environmental Aspects of Offshore-Windenergy-Converters	GIGAWIND – Bau- und umwelttechnische Aspekte von Offshore Windenergieanlagen	2004	Universität Hannover, Institut für Strömungsmechanik und Elektronisches Rechnen im Bauwesen, Universität Hannover, Curt-Risch-Institut für Dynamik, Schall- und Messtechnik, Universität Duisburg-Essen, Institut für Grundbau und Bodenmechanik, Universität Hannover, Institut für Stahlbau
COD-D-025	Strategy of the German Government on the use of off-shore wind energy – in the context of its national sustainability strategy	Strategie der Bundesregierung zur Windenergienutzung auf See – im Rahmen der Nachhaltigkeitsstrategie der Bundesregierung	2002	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Federal Ministry of Economics and Technology, Federal Ministry of Transport, Building and Housing, Federal Ministry of Consumer Protection, Food and Agriculture, Federal Ministry of Defence, German Energy Agency (dena)
COD-D-026	Continental Shelf Information System (CONTIS)	CONTIS-Informationssystem	n/a	Bundesamt für Seeschifffahrt und Hydrographie, BSH (Federal Maritime and Hydrographic Agency)
COD-D-027	Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index		2004	Forschungs- und Technologiezentrum Westküste (FTZ), Büsum, Institut für Vogelforschung, Vogelwarte Helgoland
COD-D-028	Consideration of effects on the marine environment within the licensing procedure of wind parks in the German EEZ: Discussion of methods and practical advise for the drafting and the quality assurance of EIA studies and of Habitat Assessment studies	Berücksichtigung von Auswirkungen auf die Meeresumwelt bei der Zulassung von Windparks in der Ausschließlichen Wirtschaftszone: Methodendiskussion und Praxishinweise für die Erarbeitung und Qualitätssicherung von Umweltverträglichkeitsstudien und FFH-Verträglichkeitsstudien	Project in progress	TU Berlin (Berlin University of Technology, Department of Landscape Planning and Environmental Impact Assessment)



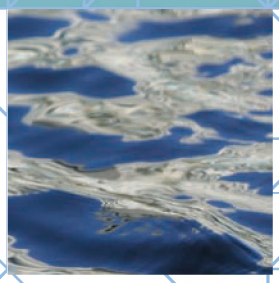
Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-029	Development of an environmental strategy for the use of wind energy onshore and offshore	Entwicklung einer Umweltstrategie für die Windenergienutzung an Land und auf See	Project in progress	Universität Hannover, Geographisches Institut, Rechtsanwalt Dr. Stefan Klinski, Institut für Technik und Umweltrecht, Juristische Fakultät der TU Dresden, Deutsche WindGuard GmbH
COD-D-030	MINOS plus: Ongoing research on seabirds and marine mammals for the evaluation of offshore wind turbines	MINOS plus: Weiterführende Arbeiten an Seevögeln und Meeressäugern zur Bewertung von Offshore-Windkraftanlagen	Project in progress	Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Tönning, Universität Kiel, Leibniz-Institut für Meereswissenschaften, Universität Kiel, Forschungs- und Technologiezentrum Westküste, Deutsches Meeresmuseum Stralsund
COD-D-031	Strategic Environmental Assessment and strategical monitoring for offshore wind farms	Strategische Umweltprüfung und strategisches Umweltmonitoring für Offshore-Windparks	Project in progress	Universität Lüneburg, Professur Öffentliches Recht, insbes. Energie- und Umweltrecht, OECOS Umweltplanung, Hamburg, BioConsult SH, Hockensbüll
COD-D-032	Collisions of Ships and Offshore Wind Turbines: Risk of nacelle impact	Rechnerische Bewertung des Risikos herabstürzender Gondeln von Offshore-Windenergieanlagen bei der Kollision mit Schiffen	Project in progress	Technische Universität Hamburg-Harburg (TUHH), Arbeitsbereich Schiffstechnische Konstruktionen und Berechnungen
COD-D-033	Standardised methods for measurement and assessment of impact of sound on the marine environment by offshore-wind turbines	Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch Schallimmissionen von Offshore-Windenergieanlagen	Project in progress	Universität Hannover, Institut für Statik und Dynamik
COD-D-034	Species related levels of impact on migrating birds for the area of the south west Baltic Sea and hazard to bird migration caused by offshore wind turbines	Artbezogene Erheblichkeitsschwellen von Zugvögeln für das Seegebiet der südwestlichen Ostsee bezüglich der Gefährdung des Vogelzuges im Zusammenhang mit dem Kollisionsrisiko an Windenergieanlagen	Project in progress	Institut für Angewandte Ökologie Forschungsgesellschaft mbH

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-035	Use of biomarkers for the registration of possible effects of electromagnetic fields and temperatures on marine organisms under laboratory conditions	Einsatz von Biomarkern für die Erfassung möglicher Wirkungen von elektromagnetischen Feldern und Temperaturen auf marine Organismen (Miesmuscheln und Schlickkrebs) unter Laborbedingungen	Project in progress	Institut für Angewandte Ökologie Forschungsgesellschaft mbH
COD-D-036	Changes in cultural landscape of coastal areas – Methodology of landscape analysis for the planning of offshore wind farms	Kulturlandschaftsveränderung in Küstenzonen – Methodik der Landschaftsbildanalyse bei der Planung von Offshore-Windparks	2004	OECOS GmbH, Hamburg
COD-D-037	QuantAs-Off: Quantification of Water Mass Transformation Processes in the Arkona Sea – Impact of Offshore Wind Farms	QuantAs-Off: Quantifizierung von Wassermassen-Transformationsprozessen in der Arkonasee – Einfluss von Offshore-Windkraftanlagen	Project in progress	Baltic Sea Research Institute Warnemünde (IOW), University of Rostock, Institute of Maritime Systems and Fluid Engineering, University of Hannover, Fluid Mechanics Institute
COD-D-038	Collision risk for migrating birds and disturbance effects on harbour porpoises at the offshore wind farms Horns Rev and Nysted in Denmark	Untersuchungen über die Kollisionsgefahr von Zugvögeln und die Störwirkung auf Schweinswale in den Offsnore-Windenergieanlagen Horns Rev und Nysted in Dänemark	Project in progress	Universität Hamburg, BioConsult SH
COD-D-039	FINOBIRD: Impacts on bird migration – accompanying research in the offshore area at research platforms in the North Sea	FINOBIRD: Auswirkungen auf den Vogelzug – Begleitforschung im Offsnore-Bereich auf Forschungsplattformen in der Nordsee	Project in progress	Institut für Vogelforschung, Vogelwarte Helgoland
COD-D-040	Impacts of offshore wind farms on the benthos in the North Sea (BEOFINO II)	Benthosökologische Auswirkungen von Offshore-Windenergieparks in der Nordsee (BEOFINO II)	Project in progress	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung
COD-D-041	Long-term field studies on possible impacts of offshore wind farms in the Baltic Sea (BE-OFINO II)	Langfristige Felduntersuchungen zu möglichen Auswirkungen von Offshore-Windenergieparks in der Ostsee (BEOFINO II)	Project in progress	Institut für Ostseeforschung Warnemünde (IOW)
COD-D-042	Technical and Legal Nature Conservation Requirements for New Spatial Planning Instruments in the German Exclusive Economy Zone	Naturschutzfachliche und naturschutzrechtliche Anforderungen im Gefolge der Ausdehnung des Raumordnungsregimes auf die deutsche Ausschließliche Wirtschaftszone	Project in progress	TU Berlin (Berlin University of Technology, Department of Landscape Planning and Environmental Impact Assessment), OECOS Umweltplanung, Döhren Mohr Rechtsanwälte (Dr. Rüdiger Nebelsieck), Prof. Dr. Rainer Wolf



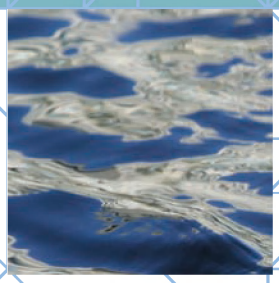
Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-043	International Exchange of Experiences on the Assessment of the Ecological Impacts of Offshore Wind Farms	Internationaler Erfahrungsaustausch zur ökologischen Begleitforschung von Offshore-Windkraftanlagen	Project in progress	TU Berlin (Berlin University of Technology, Department of Landscape Planning and Environmental Impact Assessment)
COD-D-044	FINO 2 (Research Platforms in the North and Baltic Seas)	FINO 2 (Forschungsplattformen in der Nord- und Ostsee)	n/a	Schifffahrtsinstitut Warnemünde e.V. an der Hochschule Wismar
COD-D-045	Environmental Impact Statement for the Offshore Wind Farm "Borkum West"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Borkum West"	n/a	Prokon Nord Energiesysteme GmbH
COD-D-046	Environmental Impact Statement for the Offshore Wind Farm "Butendiek"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Butendiek"	n/a	Offshore-Bürger-Windpark Butendiek GmbH & Co. KG
COD-D-047	Environmental Impact Statement for the Offshore Wind Farm "Borkum Riffgrund"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Borkum Riffgrund"	n/a	Projektgesellschaft PNE2 Offshore mbH
COD-D-048	Environmental Impact Statement for the Offshore Wind Farm "Borkum Riffgrund West"	Umweltverträglichkeitsstudie für den Offshore-Windpark, "Borkum Riffgrund West"	n/a	Energiekontor AG
COD-D-049	Environmental Impact Statement for the Offshore Wind Farm "Amrumbank West"	Umweltverträglichkeitsstudie für den Offshore-Windpark, Amrumbank West"	n/a	Amrumbank West GmbH
COD-D-050	Environmental Impact Statement for the Offshore Wind Farm "Nordsee Ost"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Nordsee Ost"	n/a	WINKRA Offshore Nordsee Planungs- und Betriebsgesellschaft mbH
COD-D-051	Environmental Impact Statement for the Offshore Wind Farm "Sandbank 24"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Sandbank 24"	n/a	Sandbank24 GmbH & Co. KG
COD-D-052	Environmental Impact Statement for the Offshore Wind Farm "Pommersche Bucht"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Pommersche Bucht"	n/a	WINKRA
COD-D-053	Environmental Impact Statement for the Offshore Wind Farm "Adlergrund"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Adlergrund"	n/a	OWP Adlergrund GmbH
COD-D-054	Environmental Impact Statement for the Offshore Wind Farm "Enova Offshore North Sea Windpower"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Enova Offshore North Sea Windpower"	n/a	Enova Projektent-wicklungsgesellschaft mbH & Co. KG
COD-D-055	Environmental Impact Statement for the Offshore Wind Farm "Kriegers Flak"	Umweltverträglichkeitsstudie für den Offshore-Windpark "Kriegers Flak"	n/a	Offshore Ostsee Wind AG

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-D-056	Potential impact of offshore wind turbine related sound on the sound detection of harbour porpoises in the North Sea (Project number: 2020-01013-10-002)		2005	FTZ Westküste, Chistian-Albrechts-Universität zu Kiel, Büsum, Germany, Applied Signal Processing Group, Dept. Electronic & Electrical Engineering, Loug-borough University, UK
DK				
COD-DK-001	Environmental Impact Assessment of hydrography		1999	DHI
COD-DK-002	Investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef		2000	Fisheries and Maritime Museum, Esbjerg
COD-DK-003	Effects on birds of an offshore wind park at Horns Rev: Environmental impact assessment		2000	NERI
COD-DK-004	Environmental Impact Assessment of Sea Bottom and Marine Biology		2000	Bio/consult as
COD-DK-005	Effects of marine windfarms on the distribution of fish, shellfish and marine mammals in the Horns Rev area		2000	Danish Institute for Fisheries Research
COD-DK-006	Offshore Wind Power Farm - Environmental Impact Assessment on Water Quality		2000	I/S ELSAM
COD-DK-007	Investigations on the artificial reef effect on fish from marine wind turbine park at Horns Reef		2002	n/a
COD-DK-008	Elsam. Offshore Wind Farm. Horns Rev - Annual Status Report for the Environmental Monitoring Programme		2003	Tech-wise A/S
COD-DK-009	Base-line investigations of birds in relation to an offshore wind farm at Horns Rev: results and conclusions 2000/2001 marine windmill parks at Horns Reef		2001	Tech-wise A/S
COD-DK-010	Base-line investigations of birds in relation to an offshore wind farm at Horns Rev, and results from the year of construction		2002	Tech-wise A/S
COD-DK-011	n/a	Horns Rev havmøllepark Fremdriftsrapport for miljøundersøgelser 1. januar - 30. juni 2002	2002	Tech-wise A/S



Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-DK-012	n/a	Horns Rev. Kontrol- og overvågningsprogram. Kunstigt rev	2001	ELSAM
COD-DK-013	n/a	Horns Rev. Overvågningsprogram. Introduktion af hårdbundssubstrat	2002	ELSAM
COD-DK-014	n/a	Fremdriftsrapport – Effektstudie på marsvin 1. halvår 2002	2002	Ornis Consult A/S
COD-DK-015	Harbour seal satellite monitoring program, Horns Reef, North Sea		2002	Fiskeri- og Søfarsmuseet, Esbjerg
COD-DK-016	Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef		2003	Hedeselskabet Miljø- og Energi
COD-DK-017	Satellite tracking of Harbour Seals on Horns Reef		2003	Fisheries and Maritime Museum, Esbjerg
COD-DK-018	Horns Rev Offshore Wind Farm - Introducing Hard Bottom Substrate Sea Bottom and Marine Biology, Data Report 2001		2002	Bio/consult A/S
COD-DK-019	Horns Rev Offshore Wind Farm - Introducing Hard Bottom Substrate Sea Bottom and Marine Biology, Status Report 2001		2002	Bio/consult A/S
COD-DK-020	Investigations on the artificial reef effect on fish from a marine wind turbine park at Horns Reef		2002	n/a
COD-DK-021	Investigations of harbour porpoises at the planned site for wind turbines at Horns Reef		2002	Ornis Consult A/S
COD-DK-022	n/a	Marinarkæologisk Survey i de lavvandede områder i kabeltracéet fra vindmølleparken ved Horns rev	2001	Nationalmuseets Marinarkæologiske Undersøgelser
COD-DK-023	Porpoise project	Marsvine projekt	2002	n/a
COD-DK-024	Horns Rev. Introducing hard substrate habitats		2002	Bio/consult A/S
COD-DK-025	Monitoring effects of offshore windfarms on harbour porpoises using PODs (porpoise detectors)		2002	Ornis Consult
COD-DK-026	Horns Rev wind farm: Progress report: 1. January - 30. June 2002		2002	NERI
COD-DK-027	Investigations on the artificial reef effect on fish from marine windmill parks at Horns Reef		2001	n/a

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-DK-028	Monitoring programme. Hard Bottom Substrate. Progress memorandum 3		2002	Bio/consult AS
COD-DK-029	Control and monitoring programme. Artificial reef. Progress memorandum 2		2002	Bio/consult AS
COD-DK-030	Seals using the Area of Horns Rev Satellite Tracking of Seals		2002	Tech-wise A/S
COD-DK-031	Basic Study/Surveillance of Porpoises at Horns Rev		2002	Tech-wise A/S
COD-DK-032	Status report of seabird surveys at Horns Rev, 2000-2001		2002	Tech-wise A/S
COD-DK-033	Elsam. Offshore Wind Farm Horns Rev Annual Status Report for the Environmental Monitoring Programme 1st Jan 2001 - 31st Dec 2001		2002	Tech-wise A/S
COD-DK-034	n/a	Status for fugleundersogelser samt forslag til opfolgende fugleundersogelser 2002 og 2003 for Horns Rev vindmollepark	2001	DMU
COD-DK-035	Sandeels and clams (Spisula sp.) in the wind turbine park at Horns Reef		2003	Danish Institute for Fisheries Research
COD-DK-036	Windfarm at Rødsand VVM-review Background report no 1	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 1	2000	DHI
COD-DK-037	Windfarm at Rødsand VVM-review Background report no 2	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 2	2000	Geoteknisk Institut
COD-DK-038	Windfarm at Rødsand VVM-review Background report no 3	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 3	2000	Geoteknisk Institut
COD-DK-039	Windfarm at Rødsand VVM-review Background report no 4	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 4	2000	DHI
COD-DK-040	Windfarm at Rødsand VVM-review Background report no 5	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 5	2000	Bio/consult as
COD-DK-041	Windfarm at Rødsand VVM-review Background report no 6	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 6	2000	SEAS
COD-DK-042	Windfarm at Rødsand VVM-review Background report no 7	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 7	1999	Nationalmuseets Marinarkæologiske Undersøgelser
COD-DK-043	Windfarm at Rødsand VVM-review Background report no 8	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 8	2000	Nationalmuseets Marinarkæologiske Undersøgelser
COD-DK-044	Windfarm at Rødsand VVM-review Background report no 9	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 9	2000	Risø



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COD-DK-045	Windfarm at Rødsand VVM-review Background report no 10	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 10	2000	Carl Bro Intelligent Solutions
COD-DK-046	Windfarm at Rødsand VVM-review Background report no 11	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 11	2000	DHI
COD-DK-047	Windfarm at Rødsand VVM-review Background report no 12	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 12	2000	Bio/consult as
COD-DK-048	Windfarm at Rødsand VVM-review Background report no 13	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 13	2000	DHI
COD-DK-049	Windfarm at Rødsand VVM-review Background report no 13a	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 13a	2000	DHI
COD-DK-050	Windfarm at Rødsand VVM-review Background report no 14	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 14	2000	Ødegaard & Danneskiold-Samsøe A/S
COD-DK-051	Environmental Impact Assessment (EIA) of offshore windfarms at Rødsand and Omø Stålgrunde, Denmark	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 15	2000	Rambøll
COD-DK-052	Rødsand Offshore Wind Farm EIA Technical Background Report Birds nr 16	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 16	2000	NERI
COD-DK-053	Windfarm at Rødsand VVM-review Background report no 17	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 17	2000	Bio/consult as
COD-DK-054	Windfarm at Rødsand VVM-review Background report no 18	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 18	2000	Bio/consult as
COD-DK-055	Windfarm at Rødsand VVM-review Background report no 19	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 19	2000	DHI
COD-DK-056	Windfarm at Rødsand VVM-review Background report no 19a	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 19a	2000	DHI
COD-DK-057	Windfarm at Rødsand VVM-review Background report no 20	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 20	2000	Water Consult ApS
COD-DK-058	Windfarm at Rødsand VVM-review Background report no 21	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 21	2000	Rambøll
COD-DK-059	Windfarm at Rødsand VVM-review Background report no 22	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 22		
COD-DK-060	Windfarm at Rødsand VVM-review Background report no 23	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 23	2000	Geoteknisk Institut
COD-DK-061	Windfarm at Rødsand VVM-review Background report no 24	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 24	2000	NERI
COD-DK-062	Windfarm at Rødsand VVM-review Background report no 25	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 25	2000	Water Consult ApS

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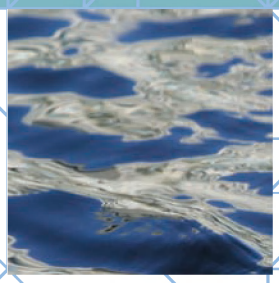
COD-DK-063	Windfarm at Rødsand VVM-review Background report no 26	Havmøllepark ved Rødsand VVM -redegørelse Baggrundsraport nr 26	2000	Hasløv & Kjærsgaard
COD-DK-064	Evaluation of the Effect of Noise from Offshore Pile-Driving on Marine Fish		2000	Bio/consult as
COD-DK-065	Evaluation of the Effect of Sediment Spill from Offshore Wind Farm Construction on Marine Fish		2000	Bio/consult as
COD-DK-066	Distribution of benthic communities at the proposed wind farm at Rødsand and along the cable connection between the wind farm and Lolland in May 2001		2001	DHI
COD-DK-067	Sampling stations and results of photosampling along the cable connection in May 2001		2001	DHI
COD-DK-068	Marine Biological Surveys Along the Cable Connection in the Lagoon of Rødsand in 2001		2002	DHI
COD-DK-069	Base-line investigations of birds in relation to an offshore wind farm at Rødsand: results and conclusions, 2000		2001	NERI
COD-DK-070	Satellite tracking as a tool to study potential effects of offshore wind farm on seals at Rødsand		2001	NERI
COD-DK-071	Porpoise detectors (PODs) as a tool to study potential effects of offshore wind farm on harbour porpoises at Rødsand		2001	NERI
COD-DK-072	Base-line investigations of birds in relation to an offshore wind farm at Rødsand: Results and conclusions, 2001		2002	NERI
COD-DK-073	Monitoring effects of offshore windfarms on harbour porpoises using PODs (porpoise detectors)		2002	NERI
COD-DK-074	EIA study of the proposed offshore wind farm at Rødsand, Technical background report concerning fishery		2000	Bio/consult as
COD-DK-075	Review Report 2003 The Danish Offshore Wind Farm Demonstration Project: Horns Rev and Nysted Offshore Wind Farm. Environmental impact assessment and monitoring		2004	ELSAM Engineering A/S
COD-DK-076	EIA for An Offshore Wind Farm at Rødsand Technical report concerning Marine Biological Conditions (bottom vegetation and bottom fauna) in the park area		2000	DHI



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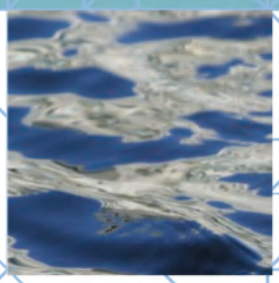
COD-DK-077	EIA-review for windfarm at Rødsand, Technical report concerning seals	VVM-redegørelse for havmøllepark ved Rødsand, Teknisk rapport vedrørende sæler	2000	NERI
COD-DK-078	Environmental assessment and management for Nysted offshore wind farm, Denmark. From theory to practice		2003	ENERGI E2, SEAS
COD-DK-079	Development of the Fouling Community on Turbine Foundations and Scour Protections in Nysted Offshore Wind Farm, 2003		2000	DHI
COD-DK-080	Offshore Wind-Turbine Construction, Offshore Pile-driving Underwater and Above-water Noise measurement and Analysis		2000	Ødegaard & Danneskiold-Samsøe A/S
COD-DK-081	Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency between migrating birds and offshore wind turbines		2003	NERI
COD-DK-082	Baseline study Fish, fry and commercial fishery Nysted off-shore Wind Farm at Rødsand, Status report		2003	Bio/consult as
COD-DK-083	Morphological Survey Campaign		2003	DHI
COD-DK-084	Aerial surveys of seals at Rødsand seal sanctuary and adjacent haul-out sites		2003	NERI
COD-DK-085	Sociological investigation of the reception of Horns Rev and Nysted offshore wind farms in the local communities		2005	Econ Analyse
COD-DK-086	Movements of seals from Rødsand seal sanctuary monitored by satellite telemetry		2003	NERI
COD-DK-087	Remote video registration of seals at Rødsand seal sanctuary - Technical improvements and feasibility for detecting effects of the construction of Nysted Offshore Wind Farm		2003	NERI
COD-DK-088	Base-line investigation of birds in relation to an offshore wind farm at Rødsand - Results and conclusion 2002		2003	NERI
COD-DK-089	Economic valuation of the visual externalities of offshore wind farms. Annual status report 2003.		2004	KVL

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-DK-090	Possible Effects of the offshore wind farm at Vindeby on the outcome of fishing		2002	Bio/Consult as
COD-DK-091	Annual Status Report Nysted Offshore Wind Farm Environmental Monitoring Program 2003		2004	Energi E2
COD-DK-092	Preliminary investigations of bird-turbine collisions at Nysted offshore wind farm and final quality control of thermal animal detection system (TADS)		2005	NERI
COD-DK-093	Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: Preliminary analysis of data from spring 2004		2004	NERI, Energi E2
COD-DK-094	Visual and radar observations of birds in relation to collision risk at Horns Rev offshore wind farm. Annual status report 2003		2004	NERI
COD-DK-095	Bird numbers and distribution in the Horns Rev offshore wind farm area. Annual status report 2003		2004	NERI
COD-DK-096	Investigations of migratory birds during operation of Horns Rev offshore wind farm: Preliminary note of analysis of data from spring 2004		2004	NERI, Elsam Engineering A/S
COD-DK-097	Investigations of migratory birds during operation of Horns Rev offshore wind farm. Annual status report 2004		2005	NERI
COD-DK-098	Investigation of birds during the operational phase of the Nysted offshore wind farm. Preliminary notes on the issue of potential habitat loss		2004	NERI
COD-DK-099	Bird numbers and distribution in the Horns Rev offshore wind farm area. Annual status report 2004		2005	NERI
COD-DK-100	Investigations of migratory birds during construction and operation of Nysted offshore wind farm at Rødsand. Annual status report 2003		2004	NERI
COD-DK-101	Development of the fouling community on turbine foundations and scour protections in Nysted offshore wind farm, 2003		2004	DHI, Energi E2 A/S
COD-DK-102	Infauna monitoring. Horns Rev offshore wind farm. Annual status report 2003.		2004	Elsam Enginering



Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-DK-103	Hard Bottom substrate monitoring. Horns Rev offshore wind farm 2004, Survey report No. 1		2004	Elsam Engineering
COD-DK-104	Hard Bottom substrate monitoring. Horns Rev offshore wind farm. Annual Status report 2004		2005	Elsam Engineering
COD-DK-105	Infauna monitoring. Horns Rev offshore wind farm. Annual status report 2004		2005	Elsam Engineering
COD-DK-106	Effects of the Horns Reef wind farm on harbour porpoises.Interim report to Elsam Engineering A/S for the harbour porpoise monitoring program 2004		2004	NERI
COD-DK-107	Harbour porpoises on Horns Reef - effects of the Horns Reef wind farm. Annual status report 2003		2004	NERI
COD-DK-108	Effects of the Nysted offshore wind farm construction on harbour porpoises - annual status report for the acoustic T-POD monitoring programme during 2003		2004	NERI
COD-DK-109	Effects of the Nysted offshore wind farm construction on harbour porpoises - the 2002 annual status report for the acoustic T-POD monitoring programme		2003	NERI
COD-DK-110	Effect from the construction of Nysted offshore wind farm on seals in Rødsand seal sanctuary based on remote video monitoring		2004	NERI
COD-DK-111	Progress report on aerial surveys of seals at Rødsand seal sanctuary and adjacent seal haulout sites during January-July 2004		2004	NERI
COD-DK-112	Effects on seals at Rødsand seal sanctuary from the construction of Nysted offshore wind farm based on aerial surveys		2004	NERI
COD-DK-113	Hydroacoustic monitoring of fish communities in offshore wind farms. Annual report 2004. Horns Rev offshore wind farm		2005	Elsam Engineering
COD-DK-114	Sandeels in the wind farm area at Horns Reef		2004	Danish Institute for Fisheries Research
COD-DK-115	Statistical analysis of data from the fisheries survey. Nysted offshore wind farm at Rødsand		2003	Bioconsult A/S

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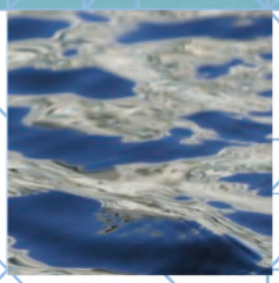
COD-DK-116	Monitoring programme status report 2003. Fish at the cable trace. Nysted offshore wind farm at Rødsand		2004	Bioconsult A/S
COD-DK-117	Progress report on remote video monitoring of seals at Rødsand seal sanctuary during January-July 2004		2004	NERI
COD-DK-118	Progress report of the acoustic T-POD monitoring during January-July 2004		2004	NERI
COD-DK-119	Sandeels and clams in the wind turbine park at Horns Reef		2003	Danish Institute for Fisheries Research
IRL				
COD-IRL-002	Cost Benefit Analysis of Government Support Options for Offshore Wind Energy		2002	Sustainable Energy Ireland
COD-IRL-003	Assessment of the Impacts of Offshore Wind Energy Structures on the Marine Environment		2000	The Marine Institute
COD-IRL-004	Assessment of Offshore Wind Energy Resources in the Republic of Ireland & Northern Ireland		2000	Department of Communications Marine & Natural Resources
COD-IRL-005	Environmental Impact Statement, Arklow Bank Wind Park, Non Technical Summary		2002	Fehilly Timony
COD-IRL-006	Offshore Wind Farm At Codling Bank - Non Technical Summary Volume 2 of 43		2002	Natural Power
NL				
COD-NL-001	Nocturnal flight activity of sea ducks near the windfarm Tunø Knob in the Kattegat	Nachteliike vliegbewegingen van zee-eenden bij het windpark Tunø in de Oostzee	1999	Bureau Waardenburg bv, Instituut voor Bos- en Natuuronderzoek (IBN-DLO)
COD-NL-002	Monitoring of birds in the Near Shore Windfarm	Monitoring van vogels op het NSW	2002	TAUW B.V., OpdenKamp Adviesgroep
COD-NL-003	Terms of reference, procurement base line studies North Sea Wind		2002	RIKZ/National Institute for Coastal and Marine Management
COD-NL-004	Environmental Impact Assessment Off Shore Windfarm Q7-WP	Milieueffect rapport Offshore Windpark Q7-WP	2002	E-Connection



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COD-NL-005	Strategy of approach, Lot 1 Benthic		2003	Institute of Estuarine and Coastal Studies (IECS), University of Hull
COD-NL-006	Strategy of approach, Lot 2 Demersal Fish Fauna		2003	Royal Haskoning, RIVO
COD-NL-007	Base line studies North Sea wind farms: strategy of approach for pelagic fish (lot 3)		2003	RIVO
COD-NL-008	Detailed strategy of approach, lot 4 Assessment of the reference situation of the near Shore Windpark (NSW) for Harbour Porpoises		2003	Alterra, NERI (Denmark), Ecologic (Scotland)
COD-NL-009	Detailed strategy of approach, lot 5 Marine Birds		2003	Alterra, Bureau Waardenburg, CSR Consultancy/NIOZ
COD-NL-010	Strategy of approach Non marine birds (Lot 6)		2003	Waardenburg, Alterra
COD-NL-011	Environmental Impact Assessment Near Shore Windfarm	Inrichtings-milieueffectrapport Near Shore Windpark	2003	Grontmij Advies & Techniek BV
COD-NL-012	Strategic Environmental Assessment Near Shore Windfarm	Milieu-Effectrapport Locatiekeuze Demonstratieproject Near Shore Windpark	2000	Royal Haskoning
COD-NL-013	North Sea Wind Farms: NSW Lot 1 Benthic Fauna. Final Report (ZBB607.2-F-2004)		2004	IECS, University of Hull
COD-NL-014	Preliminary Study into Bird Research Methods for the MEP-NSW (RIKZ/2003.045)		2003	Vertegaal Ecologisch Advies en Onderzoek
COD-NL-015	Baseline studies wind farm for demersal fish		2004	Royal Haskoning
COD-NL-016	Base line studies North Sea wind farms: Final report pelagic fish		2004	RIVO
COD-NL-017	Baseline data on the harbour porpoise, Phocoena phocoena, in relation to the intended wind farm site NSW, in the Netherlands		2004	Alterra
COD-NL-018	Baseline studies North Sea Wind Farms: Lot 5 Marine Birds in and around the future site Nearshore Windfarm (NSW)		2004	Alterra
COD-NL-019	Areas of specific ecological value on the Dutch continental shelf	Gebieden met bijzondere ecologische waarden op het Nederlands Continentaal Plat	2005	Rijksinstituut voor Kust en Zee

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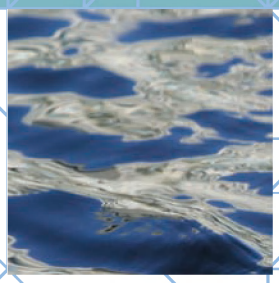
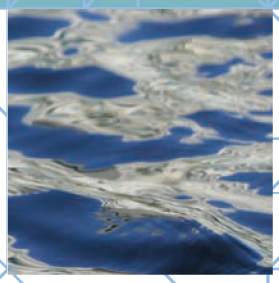
PL				
COD-PL-001	Environmental Impact Assessment report for planned wind farm "Pomerania"	Raport oddziaeywania zespo eu elektrowni wiatrowych "Pomorze" na srodowisko	2003	Wiatropol International sp. z o.o., Marine Research Institute Gdansk, Geo-Protect Sp. z o.o.
SE				
COD-SE-001	Studies of birds near an off shore windpower unit	Fågelstudier i anslutning till havsbaserat vindkraftverk	1994	Biokonsult
COD-SE-002	Investigation of fish at the wind power unit "Svante 1" during 1990-1993	Fiskeriundersökningar vid vindkraftverket "Svante 1" 1990-1993	1994	Fiskeriverket, utredningskon-toret i Jönköping
COD-SE-003	The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden	Havsbaserde vindkraftverks inverkan på fågellivet i södra Kalmarsund	2005	JP Fågelvind
COD-SE-004	VINDREV: Offshore windpower as artificial reefs: Effects on fish	VINDREV, Havsbaserade vindkraftverk som artificiella rev: effekter på fisk	Project in progress	Stockholm University, Zoological institution
COD-SE-005	Environmental aspects of offshore wind energy	Miljöaspekter på havsförlagd vindkraft, Elforsk rapport 05:09	2005	Elforsk AB
COD-SE-006	BIOVIND, Windpower units, a method to increase the biological diversity in the Baltic sea?	BIOVIND, Kraftverkskonstruktioner i havet, en metod för att lokalt öka den biologiska mångfalden i Östersjön ?	Project in progress	Stockholm University, Botanical institution
UK				
COD-UK-001	Offshore Wind Energy. Building a New Industry for Britain.		1998	Border Wind (now bought by AMEC)
COD-UK-002	Assessment of the Effects of Offshore Wind Farms on Birds (DTI/Pub URN 01/1434, ETSU W/13/00565/REP)		2001	Ecology Consulting
COD-UK-003	Assessment of the Effects of Noise and Vibration from Offshore Wind Farms on Marine Wildlife (DTI/Pub URN 01/1341, ETSU W/13/00566/REP)		2001	University of Liverpool, Centre for Marine and Coastal Studies, Environmental Research and Consultancy
COD-UK-004	An Assessment of the Environmental Effects of Offshore Wind Farms (ETSU W/35/00543/REP)		2000	Metoc Plc
COD-UK-005	Continuation of bird studies at Blyth Harbour Wind Farm and the Implications for Offshore Wind Farms (ETSU W/13/00495/REP)		1999	Border Wind (now bought by AMEC)



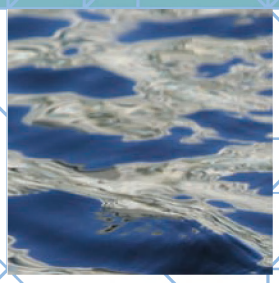
Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-UK-006	Guide to Best Practice in Seascape Assessment (Report No.5)		2001	Countryside Council for Wales, Brady Shipman Martin, Dublin, University College Dublin
COD-UK-007	Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues (Marine Guidance Note Coastguard Agency 275)		2004	Maritime & (MCA) HM Government
COD-UK-008	Wind Turbines and Aviation Interests. European Experience and Practice (ETSU W/14/00624/REP)		2002	STASYS Ltd
COD-UK-009	Potential Effects of Offshore Wind Developments on Coastal Processes (ETSU W/35/00596/00/REP)		2002	ABP Marine Environmental Research Ltd , Metoc plc
COD-UK-010	The effect of wind turbines on the bird population at Blyth Harbour (ETSU W/13/00394/REP)		1996	Border Wind (now bought by AMEC)
COD-UK-011	High Level Environmental Screening Study for Offshore Wind Farm Developments - Marine Habitats and Species Project (ETSUW/35/00632/00/00)		2002	Marine Biological Association
COD-UK-012	Development of a methodology for the assessment of Cumulative effects of marine activities using Liverpool Bay as a case study - CCW Contract Science Report 522		2002	Oakwood Environmental Limited
COD-UK-013	Safeguarding Our Seas: A Strategy for the Conservation and Sustainable Development of our Marine Environment		2002	Department of Environment, Food and Rural Affairs (DEFRA)
COD-UK-014	Windfarms and Birds : An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues		2002	BirdLife International
COD-UK-015	The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon elasmobranch fishes		2001	University of Liverpool
COD-UK-016	Barrow Offshore Wind Farm Environmental Impact Assessment		2002	RSK Environment Ltd
COD-UK-017	Offshore Wind Energy Generation: Phase 1 Proposals and Environmental Report		2003	BMT Cordah Limited

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-UK-018	Offshore Wind Farms - Guidance note for Environmental Impact Assessment in respect of FEPA and CPA Requirements - Version 2		2004	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-019	UK Offshore Wind 2003		2003	British Wind Energy Association (BWEA)
COD-UK-020	Burbo Offshore Wind Farm Environmental Statement		2002	Seascepe Energy Ltd
COD-UK-021	Norfolk Offshore (Cromer) Wind Farm Project - Environmental Statement		2002	Norfolk Offshore Wind Ltd
COD-UK-022	UK Offshore Wind Farm at Gunfleet Sands - Environmental Impact Assessment		2002	Metoc plc, GE Windenergy
COD-UK-023	Inner Dowsing Offshore Wind Farm - Environmental Impact Statement (EIS)		2002	Offshore Wind Power Limited
COD-UK-024	Kentish Flats Offshore Windfarm - Environmental Statement		2002	Global Renewable Energy Partners (GREP)
COD-UK-025	Lynn Offshore Wind Farm - Environmental Statement		2002	AMEC Wind
COD-UK-026	North Hoyle Offshore Wind Farm - Environmental Statement		2002	National Wind Power Offshore Ltd
COD-UK-027	Rhyl Flats - Environmental Statement		2002	National Wind Power Ltd
COD-UK-028	Scroby Sands - Environmental Statement		2001	Powergen Renewables (now Eon Uk Renewables)
COD-UK-029	Robin Rigg - Environmental Statement		2003	Solway Offshore Ltd (subsidiary of TXU Energi), Offshore Energy Resources Ltd
COD-UK-030	Scarweather Sands Offshore Windfarm - Environmental Statement		2003	United Utilities Scarweather Sands Ltd
COD-UK-031	Aerial Surveys of Birds in Proposed Strategic Areas for Offshore Wind Farm Development, Round 2: Preliminary Report,Winter 2002/2003		2003	The Wildfowl & Wetlands Trust (WWT)
COD-UK-032	Wind Energy and Aviation Interests: Interim Guidelines		2002	British Wind Energy Association (BWEA), Department of Trade and Industry (DTI), Civil Aviation Authority (CAA), Ministry of Defence (MoD)



Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-UK-033	Monitoring & Evaluation of Blyth Offshore Wind Farm: Navaid Requirements for UK Offshore Wind Farms (ETSU W/35/00563/REP/2, DTI/Pub URN 01/787)		2001	Amec Wind
COD-UK-034	A Baseline Assessment of Electromagnetic Fields Generated by Offshore Wind Farm Cables. COWRIE-EMF-01-2002		2003	COWRIE, Crown Estates
COD-UK-035	Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK		2004	COWRIE, Crown Estates
COD-UK-036	UK Offshore Wind 2004		2004	British Wind Energy Association (BWEA)
COD-UK-037	Predicting the displacement of common scoter Melanitta nigra from benthic feeding areas due to offshore windfarms - Interim Reports 1 to 4		Project in progress	COWRIE, Crown Estates
COD-UK-038	Steps taken to address navigational safety in the consent regime for establishment of wind farms off the UK coast		2003	Maritime and Coastguard Agency (MCA)
COD-UK-039	Wind farm impacts on Radar aviation interests		2003	Qinetic
COD-UK-040	Marine Renewable Energy and the Natural Heritage: an Overview and Policy Statement		2004	Scottish Natural Heritage (SNH)
COD-UK-041	Atlas of UK Marine Renewable Energy Resources		2004	ABP Marine Environmental Research Ltd (ABPmer)
COD-UK-042	Potential Impact of Underwater Noise and Vibration - Interim Report Nov 04		Project in progress	COWRIE, Crown Estates
COD-UK-043	Burbo Bank Offshore Wind Farm - Navigation Risk Assessment		2002	Anatec UK Ltd
COD-UK-044	Consultation for Offshore Wind Energy Developments - Best Practice Guidelines		2002	British Wind Energy Association (BWEA)
COD-UK-045	Guidance Notes - Offshore Windfarm Consents Process for England and Wales		2004	Department of Trade and Industry (DTI), Offshore Renewables Consents Unit, Marine Consents and Environment Unit (MCEU)

Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-UK-046	BWEA Recommendations for Fisheries Liaison		2004	British Wind Energy Association (BWEA)
COD-UK-047	A Pilot Study of Breeding Tern Foraging Ranges in NW England and East Anglia in Relation to Potential Areas for Offshore Windfarms		2003	Royal Society for the Protection of Birds (RSPB), The Wildfowl & Wetlands Trust (WWT), Joint Nature Conservation Committee (JNCC)
COD-UK-048	Public Consultation website for Strategic Environmental Assessment prior to licensing for offshore energy		n/a	SEA Management Team
COD-UK-049	Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency		2004	Maritime and Coastguard Agency (MCA), QinetiQ
COD-UK-050	Marine Wind Farms and Cetaceans		2003	Whale and Dolphin Conservation Society (WDCS)
COD-UK-051	Blyth Harbour Wind Farm - Operational Aspects		2004	Amec Energy Ltd
COD-UK-052	Teesside Offshore Wind Farm Environmental Impact Assessment (EIA)		n/a	ENTEC UK Ltd
COD-UK-053	Investigation into Best Practice Guidance for the Use of Remote Techniques for Observing Bird Behaviour in Relation to Offshore Windfarms		Project in progress	COWRIE, Crown Estates
COD-UK-054	Study of the Socio-Economic Impacts of Round 2 Offshore Windfarms on Fishing Activities		Project in progress	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-055	Assessment of the Significance of Changes to the Inshore Wave Regime as a Consequence of an Offshore Wind Array		Project in progress	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-056	Development of Generic Guidance for Sediment Transport Monitoring Programmes in Response to Construction of Offshore Windfarms		Project in progress	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
COD-UK-057	Aerial Surveys of Water Birds in Strategic Wind farm areas		Project in progress	Wildfowl & Wetlands Trust (WWT), the Wetlands Advisory Service (WAS)



Reference	English Title	Original Title (if not English)	Publication Year	Institution
COD-UK-058	Production of a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind farms		Project in progress	BMT Renewables Limited
COD-UK-059	Guidance for Offshore Wind Farm Developers on Seascape Impact Assessment		Project in progress	Enviros Consulting Ltd
COD-UK-060	Study to assess fishing activities that may be carried out in and around offshore wind farms		Project in progress	Sea Fish Industry Authority (Seafish)
COD-UK-061	Proposed UK Offshore Renewable Energy Installations (OREI) - Guidance on Navigational Safety Issues.		2004	Maritime and Coastguard Agency (MCA)
COD-UK-062	Effects of offshore wind energy developments on navigation and commercial shipping. URN 99/1344		1999	n/a
COD-UK-063	Inquiry into Proposed Offshore Windfarm at Scarweather Sands off Port Talbot and Porthcawl (and Addendum)		2004	The Planning Inspectorate
COD-UK-064	Food and Environment Protection Act (1985) Licence - North Hoyle		2003	Department of Environment Food and Rural Affairs (DEFRA)
COD-UK-065	Food and Environment Protection Act (1985) Licence - Rhyl Flats		2002	Department of Environment Food and Rural Affairs (DEFRA)
COD-UK-066	Food and Environment Protection Act (1985) Licence - Kentish Flats		2003	Department of Environment Food and Rural Affairs (DEFRA)
COD-UK-067	Food and Environment Protection Act (1985) Licence - Barrow		2003	Department of Environment Food and Rural Affairs (DEFRA)
COD-UK-068	Food and Environment Protection Act (1985) Licence - Burbo		2003	Department of Environment Food and Rural Affairs (DEFRA)
COD-UK-069	Food and Environment Protection Act (1985) Licence - Lynn		2003	Department of Environment Food and Rural Affairs (DEFRA)

Annex C: Information sheet on the COD environmental database

1 Introduction

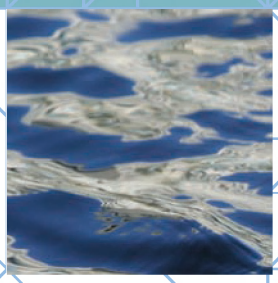
Offshore wind is a relatively new activity. Knowledge gaps on potential impacts on the marine environment and the significance of such impacts still exist. In order to fulfil the legal requirements for licensing, developers of offshore wind farms are obliged by national authorities to undertake project-related environmental baseline surveys and monitoring studies, and to undergo Environmental Impact Assessments (EIA). Furthermore, many countries involved in offshore wind developments have started generic environmental research projects at sea. To facilitate international exchange of information und thus support responsible deployment of offshore wind in Europe, one aim of COD is to collect the existing knowledge on environmental issues of offshore wind in the participating countries, and to make the gathered information accessible on the website. For this purpose a Microsoft Access database was developed by COD.

download database: http://www.offshorewindenergy.org/index_cod.php

2 Content of the database

The COD database covers a range of available reports/publications and information on ongoing research projects on offshore wind energy whose content refers to any of the following environmental aspects:

- subjects of the marine ecosystem:
  marine mammals, birds, bats, fish, zoo- and phytobenthos, soil/seabed, water/hydrology, visual landscape and men;
- potential influencing factors (which result from the construction and operation of wind farms and which can affect the environment):
  e.g. visual intrusion, noise/vibration, disturbing effects of facilities, collision risks, disturbing effects of construction/maintenance traffic, electromagnetism, sedimentation/turbidity;
- potential environmental impacts:
  e.g. collisions of birds/bats (mortality), changes in migration, damage of mammals' hearing ability, change of habitats, changes in species abundances, changes in hydrography and sediment structures, pollutions caused by ship collisions;
- investigation methods,
  e.g. guidelines or terms of reference on the performance of investigation methods for different components of the marine environment;



- instruments of spatial planning and risk assessment:

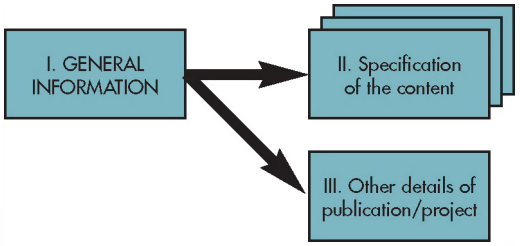
  e.g. guidelines and reports for the application of tools or development of methods for environmental planning, such as Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), Habitats Assessment, spatial planning, designation of protected areas.

3 Structure of the database

For each recorded report or ongoing project you will find three forms in the database:

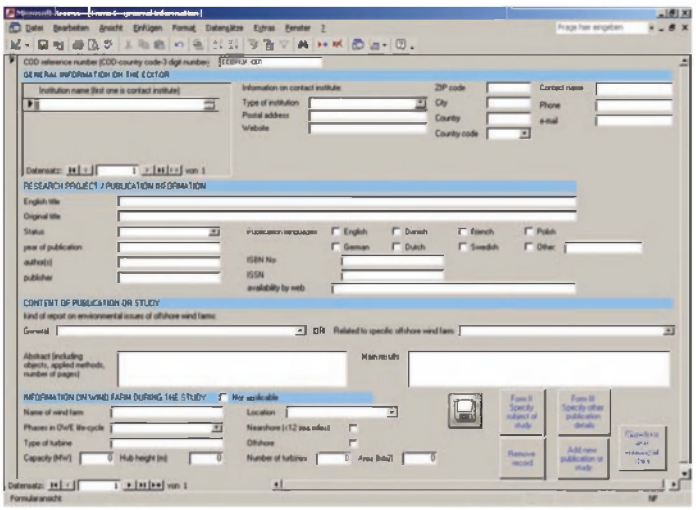
Form I: general information (one form per publication / research project)
Form II: specification of the content (one or more forms per publication / research project)
Form III: information on planning instruments / miscellaneous (one form per publication / project)

Per publication or project the structure of the database can be visualised as follows:

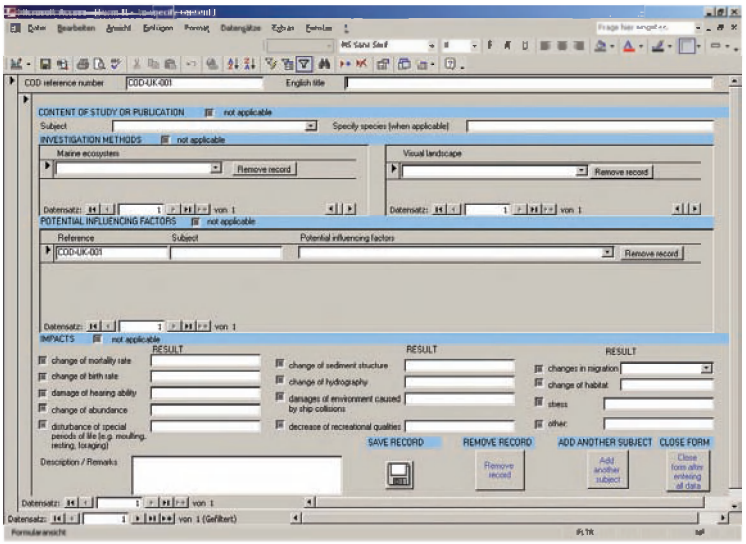


When opening the database you will immediately see Form I, showing the first data record. To see all fields, please maximise the window. To get to the other forms for this report/project, please press the buttons "Form II" or "Form III". To get back to Form I, press the button "Close form". To move to other data records (respectively reports/projects), please use the arrows for previous or next record at the bottom of Form I.

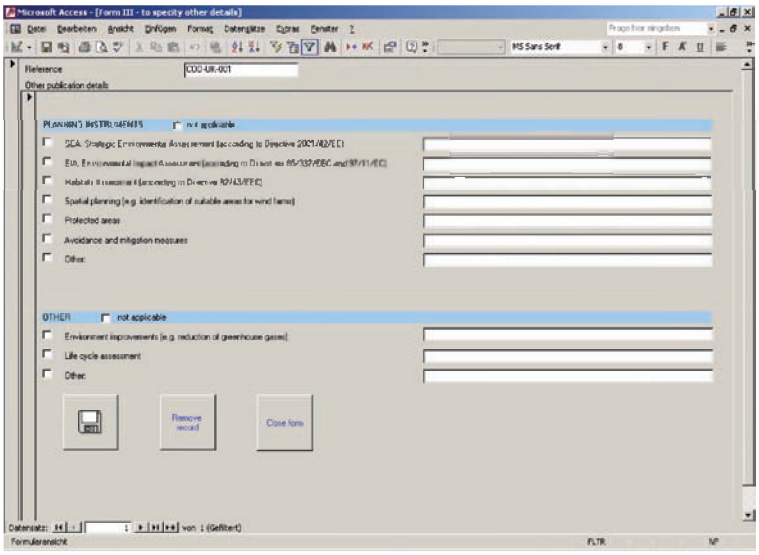
Form I – general information

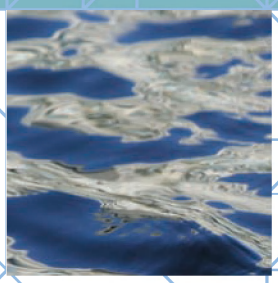


Form II – specification of the content



Form III – other details of publication/project
(information on instruments of spatial planning and risk assessment, miscellaneous)





Annex D: Glossary

Baseline information:
Description of existing (in this case) environmental conditions ('State 0') at and surrounding an action.

Baseline studies:
Studies of existing environmental conditions which are designed to establish the baseline conditions against which any future changes can be measured or predicted.

Cumulative effects:
Incremental effects of an action on the environment when the effects are combined with other past, existing or future actions ('combined effects').

Combined effects / combination effects:
caused by various components of the same action ('cumulative effects').

Competent Authority (CA):
Those which the member states designate as responsible for the consentig process / granting of licenses.

Cause-effect-relationship (syn: cause-and-effect-chain):
The connection between an action's disturbance (pressure) and its effect on the environment.

Developer:
The applicant for authorisation for a private project (e.g. offshore windfarm)

Development Consent:
Decision of the competent authority (/ies) which entitles the developer to proceed with the project.

Direct effect:
An effect in which the cause-effect-relationship has no intermediary effects.

Duration:
Period of time in which an effect on a valued ecosystem component (VEC) will exist or be detectable.

Effect:
Any change in the physical, natural or cultural environment brought about by a development project.

Environmental Components:
Fundamental elements of the natural environment: air, water, soils, terrain, vegetation, fauna (under the influence of the existing use patterns).

Environmental Impact Assessment (EIA):
A process by which information about the environmental impacts of a project are collected. It describes the procedure which fulfills the assessment requirements after the EIA-Directive respectively the correspondent national law. This procedure is in the hands of the competent authority.

Environmental Impact Statement (EIS):
In many EIA-regimes the environmental information is presented in the form of an Environmental Impact Statement (in UK often also abbreviated as 'ES'). This document sets out the assessment of the likely effects of the project on the environment. It has to be provided by the developer as part of the documents required to achieve a development consent.

Evaluation:
Make judgements on certain factual informations against the background of legal or other valuation standards. Evaluations involve making judgements as to the value of what is being affected and the risk that the effect will occur and be unacceptable. It comrises the determination of the significance/intensity of effects.

Evaluation level:
Level of evaluating the factual information or operating with the results of evaluations on factual information. On the evaluation level evaluation standards or thresholds are needed. This level should clearly be distinguished from the factual level.

Factual level:
Level of factual issues or factual information about any problem. The factual level is the basis for further evaluation (sse also evaluation level).

Impact:
Any change in the physical, natural or cultural environment brought about by a development project, which is evaluated as being negative (compared to a desirable state of environment).

Interaction:
An action or influence that results from the mutual relationship between two or more actions or an action and a VEC.

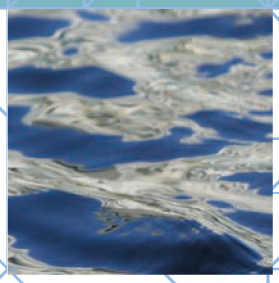
Indirect effect:
An effect in which the cause-effect-relationship has intermediary effects.

Indicators:
An indicator quantifies and simplifies phenomena and helps to understand complex realitie such as environmental systems. They help to describe the environmental quality an allow the measurement of changes/ progresses.

Non-trivial effects:
A high probability of occurrence or an unacceptable magnitude of an effect ('Trivial effects').

Likelihood:
Degree of certainty of an event occuring. Likelihood can be stated as a probability.

Magnitude:
A measure of how adverse or beneficial an effect may be.



Monitoring:
A continuing assessment of conditions at and surrounding the action. This deter-mines if effects occur as predicted or if operations remain within acceptable limits and if mitigation measures are as effective as predicted.

Pressure:
Project or activity of human origin, which exerts effects (e.g.disturbances) on the environment.

Project footprint:
The land or water area covered by a project. This includes direct physical coverage (e.g. foundation of piles) and direct effects (disturbances that dierectly emanate from the project, such as noise).

Receptor (sensitive R.):
A component of the natural or manmade environment that is potentially affected by an impact. Receptors differ in sensitivity.

Reclamation:
The alteration of landscape usually as mitigation for an action, to recreate conditions proir to the project.

Recovery:
The return of environmental conditions to the state they were prior to the action.

Residual effects:
Effects that remain after mitigation has been applied.

Threshold:
A) The point after which a component of the environment is clearly affected and degrades.
B) A limit of tolerance of a VEC to an effect, that if exceeded, results in an adverse response by that VEC.

Threshold values:
Generalised values / indicators which characterise the point of damage. Often threshold values cannot be scientifically measured, but are the result of a mutual agreement or consent shared by the concerned science community.

Trivial effect:
A low probability of occurrence or an acceptable magnitude of an effect ('Non-trivial effects')

VEC:
Valued ecosystem component (VEC).

Zone of influence:
A geographic area, extending from an action, in which an effect is non-trivial.

NOTICE TO THE READER

Extensive information on the European Union is available through the EUROPA service at internet website address http://europa.eu.int/

The overall objective of the European Union's energy policy is to help ensure a sustainable energy system for Europe's citizens and businesses, by supporting and promoting secure energy supplies of high service quality at competitive prices and in an environmentally compatible way. European Commission DGXVII initiates, coordinates and manages energy policy actions at transnational level in the fields of solid fuels, oil & gas, electricity, nuclear energy, renewable energy sources and the efficient use of energy. The most important actions concern maintaining and enhancing security of energy supply and international cooperation, strengthening the integrity of energy markets and promoting sustainable development in the energy field.

A central policy instrument is its support and promotion of energy research, technological development and demonstration (RTD), principally through the ENERGIE sub-programme (jointly managed with DGXII) within the theme "Energy, Environment & Sustainable Development" under the European Union's Fifth Framework Programme for RTD. This contributes to sustainable development by focusing on key activities crucial for social well-being and economic competitiveness in Europe.

Other DGXVII managed programmes such as SAVE, ALTENER and SYNERGY focus on accelerating the market uptake of cleaner and more efficient energy systems through legal, administrative, promotional and structural change measures on a trans-regional basis. As part of the wider Energy Framework Programme, they logically complement and reinforce the impacts of ENERGIE.

The internet website address for the Fifth Framework Programme is
http://www.cordis.lu/fp5/home.html

Further information on DGXVII activities is available at the internet website address
http://europa.eu.int/en/comm/dg17/dg17home.htm

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