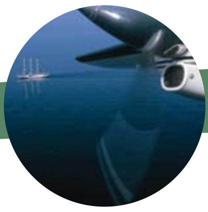
This environmental impact assessment for Kriegers flak is procuced by Sweden Offshore Wind AB. Sweden Offshore Wind AB is now incorporated in the Vattenfall Group.





Wind Farm – Kriegers Flak

ENVIRONMENTAL IMPACT ASSESSMENT

sweden offshore wind ab

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Contents

Preamble and reader notes

1. Preamble and reader notes

Sweden Offshore Wind AB (hereinafter Sweden Offshore) is developing a wind farm on Kriegers Flak, an area in the southern Baltic Sea outside of Swedish territorial waters, situated about 30 km south of Trelleborg.
The wind farm will consist of maximum 128 wind turbines with a total installed capacity of maximum 640 MW.
This document constitutes an Environmental Impact Assessment (EIA) in accordance with Chapter 6 of the Swedish Environmental Code (EC).
In accordance with the EC, Chapter 6, Section 7, an EIA shall contain the following information:

- A non-technical summary
- A description of the planned activity (location, design, scope etc.)
- A description of alternative locations and designs
- A description of the consequences of not implementing the planned activity
- A description of the impact on human health, the environment and the economising of land and water resources
- A description of actions to minimise impact

The purpose of an EIA is to identify and describe the direct and indirect effects that a planned activity or action may have on humans, animals, fauna, land, water, air, climate, landscape and cultural heritage, partly also on the economising of land, water and the physical environment in general and partly on the economising with raw material, energy and other materials.
Further, the purpose is to facilitate a collected view of these effects on human health and the environment.
This EIA primarily deals with the wind farm. However, it also deals with the cabling within the Swedish Economic Zone. Therefore, and as the cabling is a precondition for the realisation of the project, certain information about the cabling has been included in this document (Chapter 16).
The cabling within Swedish territorial water will be subject to a separate permitting process in due course.

Reader notes

In the document there are a number of fact boxes with blue background. These contain added information and are intended for those readers who wish to go deeper into a subject of particular interest. It is not necessary to read the fact boxes in order to follow and understand the general text.

The document sometimes refers to investigations carried out on behalf of the Group on the German side of Kriegers Flak. The reason for having carried out investigations there, is that Sweden Offshore's mother company is developing a wind farm also on this location ("Kriegers Flak I"). As conditions in most cases are the same at the two locations, the result of these investigations can often be used to describe the conditions on the Swedish side ("Kriegers Flak II"). The distance between the two planned wind farms is 2 km.

Chapter 2 contains a comprehensive summary of the document. To get a good overview, it is beneficial to read this chapter before the rest of the document.

In Chapter 3, Background, the Swedish energy policy is described as well as the advantages with wind power and the planned project. In this chapter, the company Sweden Offshore is presented as well as the participants that have contributed with the production of this document.

Chapter 4 contains a summary account of the consultative process.

Chapter 5 contains a description of the wind farm (number of turbines, their positioning, technique etc.), the different project phases (investigation, development, operation and dismantling) and the physical impact on the surroundings (for example noise and vibrations). The chapter does not investigate the consequences of the impact that will occur, but merely a factual description thereof (for consequences, see Chapter 12).

Chapter 6 contains preliminary cost calculations for the project.

Chapter 7 shows the time schedule that has been prepared for the various sub stages of the project.

Chapter 8 describes the alternative locations that have been investigated and explains why Kriegers Flak has been considered the best alternative.

Chapter 9 deals with the different design and scale alternatives that have been considered.

The "do nothing" alternative, i.e. the future development if the wind farm is not built, is described in Chapter 10.

Chapter 11 is an account of the general conditions at the chosen location.

Here, topics such as hydrography, seabed conditions, wind conditions, occurrence of animals, plants and shipwrecks/ancient remains are discussed. Also, the importance to fishing, navigation, recreation and exploitation of natural resources are discussed. Finally, a description of the landscape view is made.

Chapter 12 describes and assesses the environmental impact that may occur as a consequence of building the wind farm.
The chapter takes account of what has already been discussed (for example humans, animals and navigation) and thereafter describes the way in which the impact occurs (for example through noise and vibrations). Thereafter the scale of the impact is assessed. In order to make the assessments consequent and for the reader to easier comprehend the background of the assessments, the bases for the assessments that have been used are described.

As mentioned above, a further wind farm is being developed at Kriegers Flak within the German Economic Zone. As it is possible that both the German and the Swedish projects will receive full permitting, it is interesting to investigate which consequences, i.e. cumulative effects, the building of both these projects could have. An assessment of the cumulative effects is made in Chapter 13.

Comprehensive control programmes will be conducted in order to establish possible impact on fauna and animals living on the seabed, on fish, birds, hydrography (salt water impact) and sea traffic. The control programmes that have been devised are summarised in Chapter 14.

A collected assessment of the project is made in Chapter 15. The chapter has been divided into effects on a global, regional and local level. On a local level, the effects are divided into the development, operation and dismantling phases.

A short summary of the cabling, its design and environmental impact is presented in Chapter 16

The document ends with a reference section (Chapter 17), abbreviations and explanations (Chapter 18) and a register of appendices (Chapter 19).

The investigations and studies that are appended hereto have, as and when they were completed, been added to the main document in order to be able to read the EIA as an independent document. It is the opinion of Sweden Offshore that this EIA even without the appendices fulfil the requirements of Chapter 6 of the EC. The appendices can therefore be regarded as extra curricular but have been appended for the sake of completeness and to satisfy those readers that wish or may need to go deeper into special sections of the EIA. As the appendices that constitute visualisations may be regarded as of special interest, these are attached both as appendices and as separate documents at the end of this EIA.

Summary

2. Summary

Introduction

Sweden is in need of new electricity generating capacity and this shall, in accordance with Chapter 2, Section 5, of the EC, be based on renewable energy resources. According to the Government's planning target, Sweden shall produce 10 TWh of wind power in 2015. In order to achieve this target, it is important to build large, offshore-based wind farms.

Sweden Offshore Wind AB's business concept is to develop offshore-based wind farms. The company, which was founded in 2002, is Swedish and is owned by the two German companies WPD AG and Wind-Projekt GmbH that together have developed wind farms with a total installed capacity of over 800 MW. Within the Group, there is 13 years of wind power experience both on- and offshore.

Scope and location

The project that Sweden Offshore is planning is a wind farm consisting of maximum 128 turbines. The wind farm shall be capable of producing about 2 TWh, which is equivalent of 20 % of the planning target for wind power set by the parliament.

The chosen area is located on the north-eastern section of Kriegers Flak, a raised seabed/submarine bank in the southern Baltic Sea about 30 km south of Trelleborg. The area lies outside of Swedish territorial waters but inside of Sweden's Economic Zone, where it borders to Germany's and Denmark's economic zones. The area is located only 2 km away from where Sweden Offshore's mother company is developing a wind farm.

The water depth in the chosen area varies between 16 and 42 meters.

The distances between the WTG's and the rows have not yet been fixed, as they will depend on the wind

energy content and the park efficiency. In general, one can assume that the distances will be in the range of 500 – 900 meters.

Alternative locations

In a comparison between ten possible locations around the Swedish coastline for a large-scale, offshore-based wind farm, Sweden Offshore has found Kriegers Flak to be the most suitable area from a localisation point of view. The area lies on an adequate distance from shore and is relatively shallow. Sea lanes in the area are a sufficient distance away. The seabed is basically without vegetation. The structure is expected to benefit commercial fishing as feeding ground even if individual fishermen may be deprived. There are no special environmental interests in the area. Industrial impact already exists on the Danish side of Kriegers Flak through täktverksamhet. Similar impact is expected through the establishment of a wind farm on the German side. The development of the German wind farm has resulted in Sweden Offshore gaining significant knowledge of Kriegers Flak. The possibility to coordinate the establishment of the two wind farms will lead to lower relative cost, an advantage that will be even bigger if a planned transmission link between Sweden and Germany will become reality.

Technical description

The maximum height of the turbines is expected to be 170 meters. Thereof the tower will be about 100 meters high. The diameter of the tower will be about 7 meters.

The turbines will be marked in accordance with the rules of the Swedish Maritime Administration and the Swedish Civil Aviation Authority.

As both the water depth and the seabed material vary within the project area, it is envisaged that several different types of foundations will be used. Monopiles will probably be used down to 25 meters water depth. Tripods, a three-legged frame construction consisting of steel tubes, will probably be used for greater depths. The wind farm will be built in two phases divided into two seasons with an installation time of one to two days for each turbine.

The operational lifetime is estimated to be 30 years.

Investigations conducted

To gather as much information as possible about the chosen area, the following investigations have been carried out:

1. Investigations/studies carried out at Kriegers Flak

- presence of resting birds
- presence of migrating birds
- presence of fish
- presence of invertebrate aliens and macrophytes
- presence of sea living mammals
- presence of bats
- investigation of hydrography/currents
- investigation of visibility
- investigation of sediment structure
- investigation of seabed conditions
- drill tests

2. Other investigations/studies

- noise propagation
- shadow propagation
- visualisation
- risk analysis
- wind analyses

Area description

The wind conditions at the site are good. The average wind speed has been measured to be between 8,7 and 9,6 m/sek and the maximum wind speed 23,9 m/sek.

The seabed consists of clay, moraine and gravel with some sandy areas present. The fauna is very sparse and there are no endangered species. In respect of animals living on the seabed, only very few specimens of two red-listed species have been found. The area is regarded as having very little importance for seabed-living animals.

Occasional specimens of grey seal, harbour seal and arctic ringed seal are believed to sometimes pass the area but only a few mammals have so far been observed.

The area is not of importance for birds. This is due to the water depth.

Several flights of birds pass the area, amongst others cranes and geese.

However, there are no flights of bats in the area.

There are no shipwrecks within the designated area and also no exploitable natural resources (with the exception of wind energy).

26 different species of fish have been observed, the most common being herring and cod. Investigations are being carried out to determine if the designated area is a feeding-, spawning- and/or a raising ground for fish. To date, the results show no signs thereof.

The area is important and forms part of a larger area of national importance for the fishing industry. About 26 fishing vessels are net fishing for cod in the area and the catch is about 5 kg/ha.

The nearest sea-lanes are a good distance away from the planned wind farm.

Expected environ<mental impact

The wind farm may give cause to different environmental effects. These effects may occur during the building and operational phases as well as during the dismantling phase. Important effects are those that may occur due to noise and vibrations, electromagnetic fields as well as light, shadows and reflexes. Also, the risk of spill and contamination, changes in sedimentary conditions, birds colliding with the turbines and the risk of hydrographical effects, eventual ancient remains and effects on the landscape have all been studied. The area does not to any great extent contain any protected values or species. The effects of the nearby surroundings will therefore be limited.

An account of expected environmental effects during the building, operational and dismantling phases is made below.

The building phase

Noise and vibrations from working vessels and from foundation work may scare fish and mammals. As the building phase is limited in time, the impact is expected to be small.

Occurrence of mud and changed sedimentation may lead to fauna, animals living on the seabed, fish roe and fry being covered. This may lead to reduced growth or, in the worst case, death. Clouded water may lead to habitat changes for mobile species. The volume of sediment that will be stirred up during the construction work depends on the seabed conditions. The impact is limited in time. There are no protection-worthy species or biotopes to any great extent. Impact due to clouding and sedimentation is therefore judged to be small.

Operational phase

The wind farm will have an impact on the landscape picture but as the wind farm hardly will be visible from the shore during daylight, the disturbance onshore is judged to be small. Whether hazard lights on the turbines will be visible from the shore during the night is still not clear as the regulations regarding hazard lights currently are under review. From closer view, the turbines will dominate the landscape picture.

The risk of birds colliding with the turbines is regarded as small since studies have shown that birds make way for offshore-based wind turbines. This has also been confirmed through the studies on collision risks for birds that Sweden Offshore has commissioned.

The risk of ships colliding with wind turbines is also regarded as very small (0,0006/year or about 1 700 years between two collisions without increased safety measures and 0,00015/year or about 6 700 years between two collisions with increased safety measures being adopted). If an accident occurs, the negative consequences could be severe.

From the point of the knowledge base of today, the reaction of fish from underwater noise is judged, in the worst case, to be local. Noise could lead to fish avoiding the immediate neighbourhood. It will however in such case be possible for fish getting used to the noise.

If a security zone is established within the designated area, this could lead to very positive effects for the fish population. A restriction would result in short term negative effects for the fishing industry, but would have positive effects in the longer term (amongst others through a so called spill-over effect).

Finally, the impact on the salt water level is judged to be negligible.

The dismantling phase

The impact during this phase will be similar to that occurring during the building phase. There will be less noise, less vibrations and sedimentation as the part of the foundation that is below the seabed level will be left in the ground.

Grid connection

The grid connection will be carried out in two phases. During phase I, a 340 MW cable will be connected to the grid point Trelleborg Nord and during phase II, a 300 MW cable will be connected to the grid point Arrie. The grid connection will be made with 4 three-phase sea cables and 4 three-phase land cables, all AC. The cables will be trenched some 0.8 meters into the seabed. Onshore, land cables will be used. Two transformer stations will be built within the designated area for the wind farm.

As several countries will build grid connections to the Kriegers Flak area, there are good opportunities to make better use of the total investment by allowing transmission between the countries. A proposal is that this aspect should be considered in future deliberations and that the potential be analysed closely.

Background

3. Background

3.1 The need for new electricity production

According to forecasts by STEM, the demand for electricity on the Swedish market will continue to increase at the same pace as during the last 10 years.

If Sweden does not create the right conditions for new electricity production, the increase in demand will lead to the country being forced to continue as a net importer of electricity. According to forecasts made by Nordel, the import will mainly come from Denmark, Finland, Norway and Poland and to a great extent from fossil fuel based production.

The aim of the Swedish energy policy, both in the short and long term perspective, is to provide the supply of electricity and other forms of energy on a competitive basis with the rest of the world (Bill 2001/02:143). The energy policy shall furthermore create the right conditions for an efficient and sustainable use of energy and a cost effective supply with low negative impact on human health, the environment and the climate. Finally, it shall also facilitate the change to an ecologically sustainable society.

Increased demand for electricity together with the phase-out of nuclear energy production will lead to a demand for a more environmentally friendly energy production in order to fulfil the aims of the energy policy.

3.2 Why wind power

According to chapter 2, section 5 of the EC, new electricity production shall mainly be based on domestic and renewable energy sources.

Wind power is an infinite source of energy that is emission-free and that does not need any fuel transports. Wind power is reversible, meaning that it can easily be removed after it has served its use and the site can be restored to its original environment. When wind power is used as a source of energy, the 15 national environmental quality objectives are fulfilled either directly or indirectly. For example, limited climate impact, fresh air, only natural acidification, good built environment, a balanced marine environment and flourishing coastal areas and archipelagos.

Life cycle analyses show that the use of energy in manufacturing, transport, construction, operation and dismantling of wind turbines is about 1 % of the energy production during its useful life. This means that a modern wind turbine situated in a good wind location has produced as much energy already after 4 months of operation as it takes to manufacture the turbine (SOU 1999:75, p 246).

In Germany, Denmark and Holland, wind power production stands for a significant part of the overall energy production.

In Sweden, wind power production has increased since the late 1980-ies but despite of this, the production is only about 0,7 TWh per year (2003). Both the general public and the Government are positive towards an increase in wind power construction (opinion poll by SIFO in 2002 and statements by the Energy Minister Mona Sahlin and Prime Minister Göran Persson in 2004).

The parliament has set a target for wind power production of 10 TWh by 2015 (Bill 2001/02:143).

3.3 Why this project

Offshore-based wind power is a relatively new technical occurrence. In Sweden, the first offshore-based wind turbine was erected in 1997. Today, there are offshore installations on three locations; Yttre Stengrund, Bockstigen and Utgrunden.

The main advantage of building wind power offshore as opposed to onshore is the comparatively higher wind speed. Offshore-based wind turbines also

have less impact on the landscape picture as they are placed far away from buildings. A further advantage is that larger wind farms can be built offshore. A reason for this is that the transport of e.g. large rotor blades is easier by sea.

The disadvantage with offshore wind power is the higher capital cost compared to building onshore. Altogether, the advantages outweigh the one disadvantage.

The wind farm that Sweden Offshore plans to build at Kriegers Flak is situated in an area with very good wind resource and at a far distance from shore. There are no protection-worthy species on the site and there are no plans for alternative use of the area. In addition, the nearest shipping lanes are a good distance away.

The establishment of the wind farm would contribute to fulfilling the Swedish energy policy objectives. With 128 wind turbines with a capacity of 5 MW each, the production of electricity would be 2 TWh, equivalent to 20 % of the planning target of the parliament.

2 TWh is the equivalent annual electricity consumption for 420 000 houses and 40 % of the annual production of the Barsebäck II nuclear power plant.

3.4 Description of Sweden Offshore Wind AB

Sweden Offshore was founded in 2002 and is domiciled in Stockholm.

Sweden Offshore is owned by the two German companies WPD Wind Projekt Development AB (hereinafter WPD) and WIND-projekt GmbH (hereinafter WIND-projekt). Within the owning group there are several years of technical, financial and legal experience and over 13 years of wind power experience. In the Stockholm office, there is also five years experience from work on the Utgrunden offshore wind farm in Kalmarsund.

WPD

WPD is carrying out renewable energy projects (wind, hydro and geothermal) and the company has so far realised 65 wind farms with a total installed capacity of 620 MW.

WPD takes initiatives to and develops wind farms, it finds equity investors and other capital. Furthermore, the company develops legal structures for the special purpose vehicles that need to be incorporated for e.g. the management, operation and sale of electricity.

The company, with its 50 employees, is currently responsible for the operation of over 50 wind farms and is involved in the development of five offshore-based wind projects.

In October 2004, the company was awarded top ranking by the independent rating company EULER HERMES Ranking. A document on this can be viewed on the web page www.wpd.de. According to the rating company, WPD is better positioned than its competitors in the wind energy market.

During the period from 1997 to September 2004, WPD realised projects for a combined value of SEK 7,4 billion and is the market leader in placing private equity into wind power projects.

WIND-PROJECT

WIND-Projekt is an independent engineering firm that is working with planning, building and technical operation of wind turbines and other renewable energy sources. Since it was founded in 1994, WIND-Project has been responsible for the erection of 130 wind turbines with a total installed capacity of 170 MW.

Currently WIND-Project is developing a 2.3 MW offshore-based wind turbine in the harbour of Rostock, Germany, called "Breitling".

Together with Offshore Ostsee Wind AG, WPD and WIND-Projekt are developing an offshore site on the German part of Kriegers Flak ("Kriegers Flak I"). The wind farm will consist of 80 wind turbines with a total installed capacity of 320 MW. It is expected that planning permission will be forthcoming during April 2005.

Offshore Ostsee Wind AG is also developing an offshore-based wind farm consisting of 21 wind turbines 15 km from the German peninsula Darss. The project is called Baltic I.

In Sweden, Swedish engineers, biologists, lawyers, environmental consultants etc complement our skills. We also co-operate with German researchers who possess deep ecological knowledge and who use very advanced research methods. As the group already has made use of these German researchers during earlier projects, their knowledge is being used also in this project.

Sweden Offshore is independent from manufacturers, which makes it possible to choose the best technology for each individual case.

3.5 Description of the project administration

The Project group

Sweden Offshore Wind AB
WIND-Projekt
WPD

Collaborators

Maria Röske, Thomas Stalin
Carlo Schmidt, Andree Iffländer
Gernot Blanke, Achim Berge

Consultants	Area of responsibility
Deutcher Wetterdienst	visibility
Institutet för Naturvårdsbiologi	bats
Flygfältsbyrån AB	cable laying, grid connection
Germanischer Lloyd	risk analysis
Hydromod GmbH	studies on salt water mixing and currents
IfAÖ	environmental site research
Jan Pettersson	birds
Advokatfirman Lindahl	legal
University of Lund	bird studies, control programme
Marin Mätteknik AB	hydrographical survey, seabed investigation
Nautic Nord	hydrographical survey, seabed investigation
NVE HVDC Group	grid connection
SSPA	risk analysis
Stig Lundin	fish studies, test fishing
University of Uppsala	wind
Vermessungsbüro Weigt GmbH	hydrographical survey, seabed investigation

Consultation Report

4. Consultation Report

Early and extended consultation has been performed in accordance with the provisions of the EC and the views that have been expressed during these processes have been taken into account during the preparation of the EIS.

A comprehensive account of the consultation process can be found in Attachment 3.1 and 3.2. This chapter contains a brief summary of the consultation process.

4.1 Early consultation

During the period December 2002 up and to including April 2003, Sweden Offshore has carried out early consultation with the Skåne County Council, relevant authorities and communities and with the general public of those communities (Appendix 3.1). Early consultation has also been carried out with the commercial fishermen that use Kriegers Flak, with the Swedish Fishermen's Federation and with the Central Organisation for the West Coast Fishermen. Before the meetings with the authorities and the communities, the participants received written information about the company and the project (basis for early consultation).

Information exhibition at Vellinge Townhall

The communities that Sweden Offshore has met for early consultation are Trelleborg, Kävlinge, Vellinge and Skurup.

Before meeting the general public in these communities, information exhibitions were arranged in each community. During these three-week exhibitions, there was an information folder available summarising the project and letterboxes were put up for depositing questions and opinions. In order to answer questions, personnel from Sweden Offshore was present during pre-advised times. Both the information about the exhibitions and the early consultation process were announced in the papers several times well in advance.

During the exhibitions, representatives of the company answered questions from three persons. A few notes were left in the letterboxes. In conclusion, the interest from the general public was weak.

Early consultation was carried out with the following authorities: The Swedish National Board of Fisheries, the Swedish Maritime Administration and the Civil Aviation Authority. In November 2002, Sweden Offshore sent basic information to the National Board of Fisheries and the Maritime Administration. Both authorities provided written statements. The official meetings were then conducted at the end of March/early April. Following a proposal from the Civil Aviation Authority, a joint early consultation meeting was held together with the Maritime Administration and the Civil Aviation Authority.

Affected fishermen were informed about the project during December and later, a consultation meeting was held with this group. Representatives from the Fishermen's Federation and the West Coast Fishermen were also present during that meeting.

The contact with the professional fishermen was through Ms. Eva-Lena Olsson and Mr. Lennart Kindblom. The fishermen were informed about the early consultation by the aforementioned persons and through advertisements in Sydsvenska Dagbladet and the magazine Yrkesfiskaren.

The Defence Forces were contacted in November 2002 by telephone and, on a preliminary basis, there were no objections to the wind farm from their side.

A consultation report was sent to the Skåne County Council in May 2003 and in June, the company was informed that the wind farm would cause major environmental impact (Appendix 3.2).

4.2 Extended consultation

From November 2003 to November 2004 the extended consultation process was carried out (Appendix 3.2).

The consultation information packs, inclusive of Attachments, were sent to 60 different parties.

Consultation meetings were held with 17 parties and the remaining 43 were invited to send written comments and viewpoints to the company. 30 of those choose to participate in the written consultation process.

Accordingly, the 47 parties that participated in the process were

Swedish National Labour Market Administration
Baltic Cable
Baltic Gas Interconnector
Banverket (National Rail)
National Board of Housing
Union of Builders
Eurowind
National Fishermen's Federation
Swedish Defence Research Agency
Popular Movement Against Nuclear Power & Arms
Save the South Coast Society
Swedish Landscape Protection Society
Society of Swedish energy advisers
The Defence Forces
Greenpeace
Swedish Emergency Management Agency
Royal Academy of Engineering Sciences
The Coast Guard
LO – National Workers Union
Civil Aviation Authority
Skåne County Council
Swedish Society for Nature Conservation
Swedish Environmental Protection Agency
NUTEK
The National Heritage Board
Geological Survey of Sweden
Swedish Maritime Administration
Skurup Community
Swedish Metrological & Hydrological Institution
The National Board of Health and Welfare
The National Institute for Ecological Sustainability
Swedish Rescue Services Agency
Svenska Kraftnät (system operator)
Organisation of Swedish West Coast Fishermen, section 9, Halland County
Swedish Confederation of Professional Associations
Swedish Fishermen's Federation
Sydkraft AB including Sydkraft Nät (grid) and Sydkraft Gas
Swedish Confederation of Professional Employees
Trelleborg Harbour Authority
TT-line
Vellinge Community
Swedish Road Administration
Affected professional fishermen (represented by Mr. Nils Rinander, lawyer, and Mr. Lennart Kindblom, technical adviser)

Consultation meetings were furthermore held with the general public in the communities of Vellinge, Skurup and Trelleborg, who were informed about the meetings well in advance through several advertisements in different newspapers. Information material was made available in public places such as libraries and town halls. Summary information was also available in printed form in an information brochure. There was low interest level shown by the general public.

The commercial fishermen were informed about the consultation through specially designed advertisements in different newspapers, including the magazine Yrkesfiskaren. In addition, the information was also sent to the two individuals that represent fishermen in the Kriegers Flak area, namely Mr. Nils Rinander (lawyer) and Mr. Lennart Kindblom (technical adviser).

During the autumn of 2004, additional consultation material was sent to the parties. This was done in co-operation with the Skåne County Council following the advice given by the Council to the company in this matter. The supplementary material consisted of three pages of text and three visualisations showing that the wind farm could be built in other configurations than the one previously put forward in the consultation documentation. Foremost, it showed that the total height of the wind turbines probably could be slightly higher, the distance between the turbines could be longer and that the number of turbines could be reduced. The new configurations were judged not to result in any additional environmental impact, but would probably lead to better economics for the wind farm. 16 of the 60 consultation parties choose to respond to this supplementary consultation, with most stating that they had no objections to this change.

Through advertisements in different newspapers, the general public in the communities of Vellinge, Skurup and Trelleborg were also given the opportunity to give their viewpoints, but nobody choose to respond.

Within the context of the Esbo Convention, the National Environmental Protection Agency informed Denmark and Germany. The scope and the layout of the information material, was decided directly between the two countries and the Agency.

Description of the Wind Farm

5. Description of the wind farm

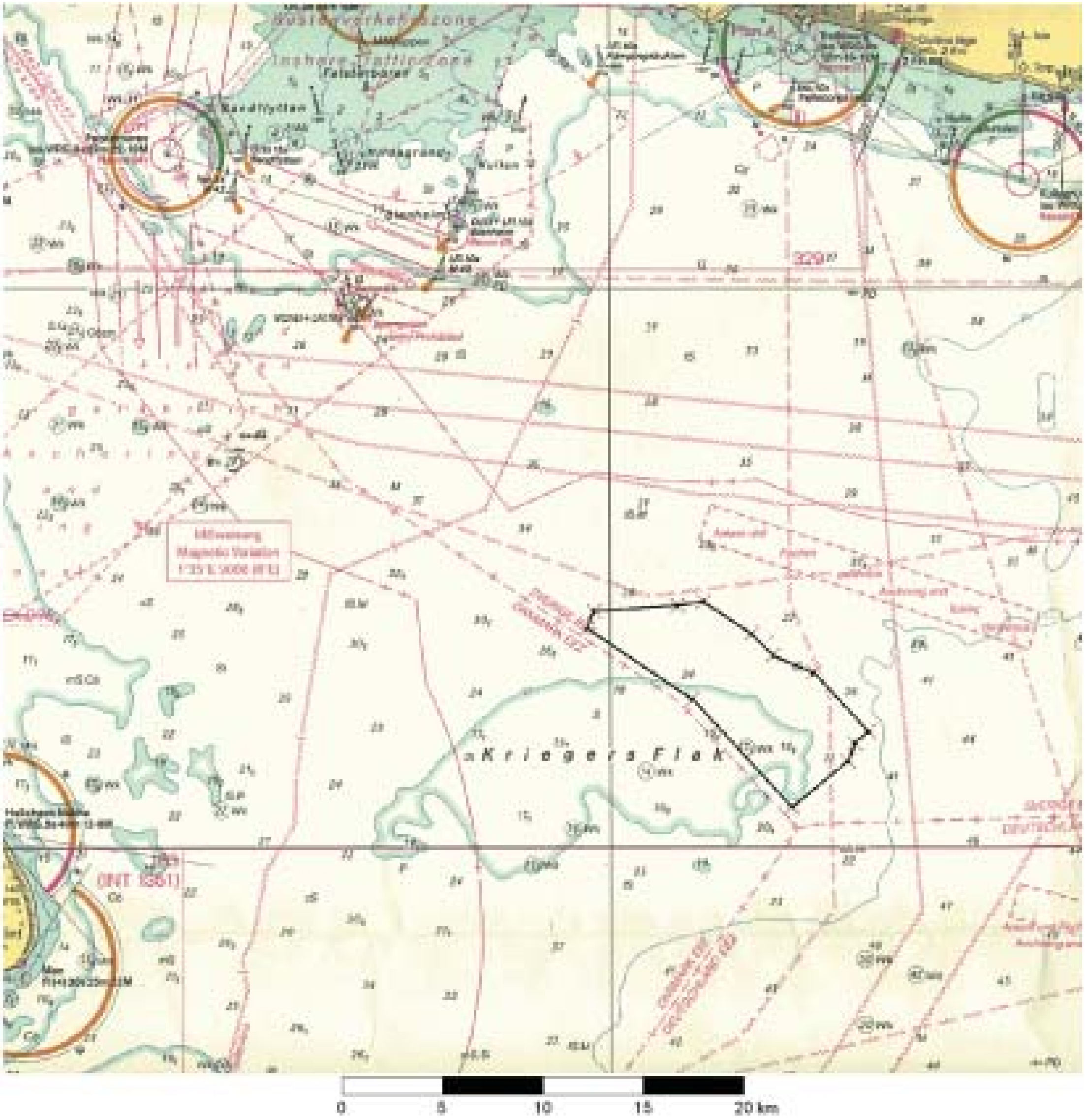
This chapter contains a description of the wind farm (number of turbines, positioning, technique etc.), the different phases (development, building, operation and dismantling) and the physical impact on the surroundings (for example noise and vibrations). The chapter does not investigate the consequences of the impact that will occur, but is merely a factual description of this impact. The consequences are described in Chapter 12.

5.1. Scope

Sweden Offshore plans to build a wind farm with maximum 128 wind turbines with a capacity of 5 MW each. The erection of the wind farm is planned to take place in two phases during two seasons. The number of turbines to be erected during each phase depends on the seabed conditions, the type of foundations chosen and the design of the cable routing.

5.2. Localisation

The designated area is situated on the northeastern part of Kriegers Flak in the southern part of the Baltic Sea. Kriegers Flak is a submarine bank occupying an area that is about 18 km (east – west) by 7 km (north – south). On the central parts of Kriegers Flak, the water depth is between 16 and 17 meters while on the outskirts of the area, the depth is 20 – 25 meters and thereafter it quickly increases to more than 40 meters. The main part of Kriegers Flak lies within the EEZ of



Denmark but it also stretches into the German and the Swedish EEZ.

The designated area for the wind farm lies outside of Swedish territorial waters but inside the EEZ where it borders to the German and Danish EEZ.

The nearest landmass in Sweden is Trelleborg (about 30 km), in Denmark Mön (about 34 km) and in Germany Rügen (about 40 km).

The total area of the wind farm will maximum be 6 km x 12.5 km. The coordinates and the corresponding reference points are described in appendix 2.1.

5.3. Placing of the turbines

The distance between the turbines will be determined during the detailed development work. Several different configurations have been discussed and the relevant distances between the turbines in a row/distances between rows, were at that time 575/900 metres and 800/900 metres respectively.

The turbines should, generally speaking, be erected where the lowest water depth is present on the site, as this is a condition for a cost effective placement of the turbines. The final micrositing will have to consider the so-called wind-shadow. The turbines should, therefore, not be placed too close as they would otherwise steal wind from each other.

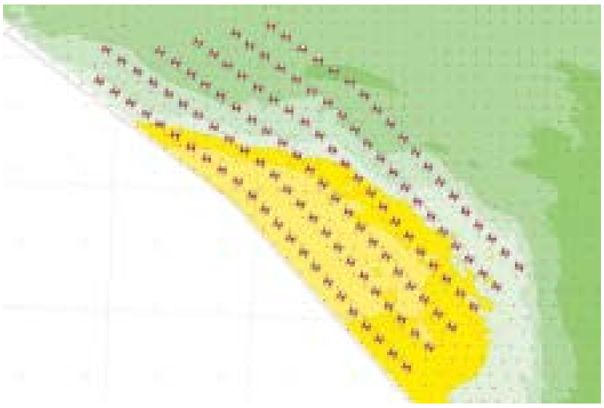
During the micrositing process, emphasis will also be on a configuration that will result in the lowest possible impact on the salt water seabed-current.

5.4. Layout

5.4.1 The wind Turbines

A wind turbine consists of a rotor, a nacelle and a tower.

The rotor has three blades of about 65 metres length each, which are mounted on a hub. When the wind passes the rotor, the kinetic energy of the air is converted to a torque along the main shaft. The electricity



Example of positioning of 128 wind turbines (the coloured areas mark 20, 25, 35, and > 40 metres depth)

production is regulated by changing the angle of the blades.

The nacelle is placed on top of the tower and it contains various components and systems, for example the rotor shaft, the generator and the gearbox.

The tower consists of two steel sections that are screwed together. The height of the tower will be about 100 metres and the diameter about 7 metres.

The maximum total height of the wind turbine (the tip of the highest rotor blade) will be 170 metres (height above mean water level).

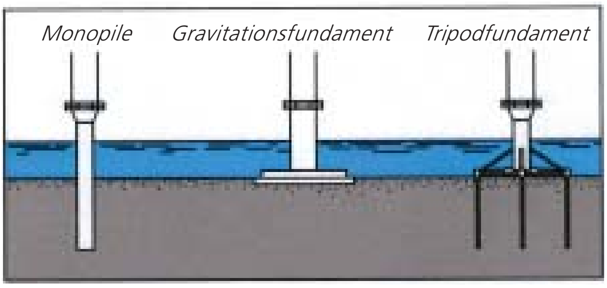
Lightning conductors will be attached to the rotor blades thus allowing the wind turbines to safely discharge any lightening down into the seabed without damage to the equipment or to humans.

The planned, rated capacity of the turbines is 5 MW each. There are currently three 5 MW prototypes in the market but serial production of any of these has not yet started. During the late autumn 2004, the turbine manufacturer RePower Systems erected a 5 MW prototype in Brunsbüttel, Germany. Enercon has installed a 4.5 MW turbine in Emden, Germany. Furthermore, Multibrid in Bremerhafen, Germany, has built a 5 MW prototype for offshore use. Discussions have been initiated with several manufacturers, amongst others with RePower, Vestas, Enercon, GE Wind Energy, Nordex and Bonus (Siemens).

As examples, the technique behind the RePower 5 MW turbine is presented in Attachment 2.2 and similar information on the Enercon 4.5 MW turbine is presented in Attachment 2.3.
At the time of procurement, the turbine that offers best economic and environmental conditions will be chosen.
Offshore-based wind turbines differ from onshore-based turbines in several ways. The main difference is that offshore-based turbines are subjected to much harder conditions due to stronger winds, greater difficulty in performing service and harsher climate (salt water, waves and ice).

5.4.2 The foundations

The foundations anchor the wind turbines to the seabed. For offshore turbines, there are several different types of foundations. The choice of foundation depends on the water depth, the seabed condition, the weight of the turbines and the cost. As the seabed condition and the depth vary on the site, different types of foundations will have to be used. Examples are monopiles, tripods and gravitation foundations.



MODIFICATIONS FOR OFFSHORE USE

- A service crane will be installed in the nacelle to reduce the cost for barge-mounted cranes.
- A container is mounted on the working deck, some 10 metres above sea level, containing all electronic equipment including the transformer (690V/20kV). It will be hermetically sealed to shield the equipment from the salty air. (Electronic equipment and transformers are mounted in the nacelle in most modern wind turbines).
- Ladders and a mounting system to allow for safe landing and boarding will be attached to the towers.
- A room for overnight stays in case of emergency, also for use by the service team, will be built inside the tower.
- Meticulous encapsulation of electronic equipment in the voltage centre will be made.
- Anti corrosion treatment is very important for prolonging the turbine life. During evaporation, the seawater forms a dangerous salt water mist in the higher air layers. All exterior surfaces will, in accordance with ISO 12944-2 (1998), be treated with class C5-M anti corrosion protection. Exterior surfaces that may come in direct contact with water will be treated with class 1m 2/high. Interior surfaces that are subjected to outdoor air will be protected with class C4 and surfaces that don’t with class C3 corrosion protection.
- Redundant support systems will be installed.
- Collecting containers for oil spill will be installed

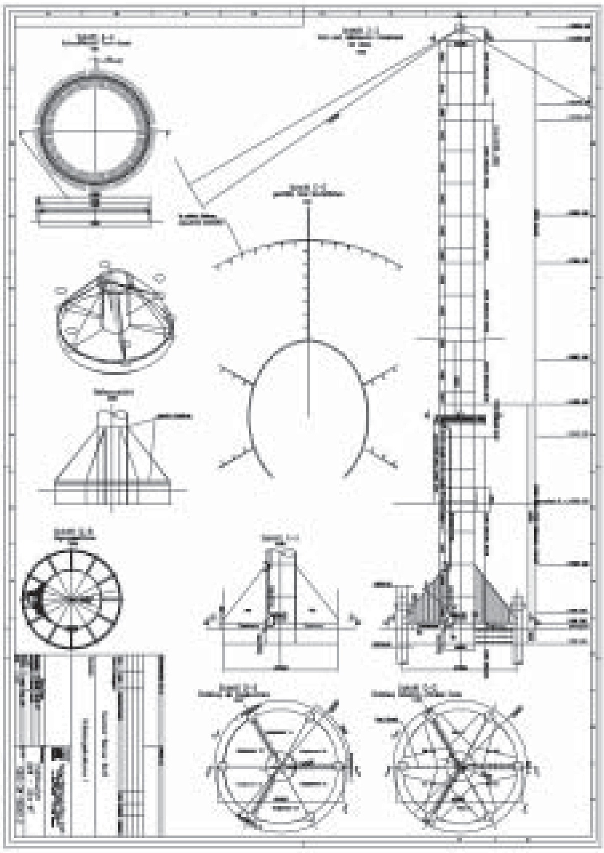
It is important that, irrespective of the foundation type used, the design of the foundations is such that they will withstand the special conditions that prevail on the site, especially the pressures that icy conditions may bring.

Offshore-based wind turbines have hitherto been built in fairly shallow waters, i.e. down to 15 – 20 metres maximum. Monopiles were used at Bockstigen, Yttre Stengrund and Utgrunden. In other countries, gravitation foundations have been used in shallow waters, for example at the Middelgrund wind farm outside Copenhagen.

At Kriegers Flak, the wind turbines will be placed in water depths of between 16 and 42 metres with the majority in depths between 20 and 40 metres. At this water depth, no wind turbines have yet been erected.

The group, together with Acker Warnow Warft/ OPD, Weserwind and Germanischer Lloyd, has conducted a comprehensive study of the possibilities to construct and manufacture foundations. The study shows that the monopole, simply described as a steel tube with a diameter of 7 metres, could be a good alternative down to 20 metres. At water depths of more than 20 – 25 metres, it could become too heavy and subject to unfavourable oscillation characteristics.

In water deeper than 30 metres, it is believed that jacket foundations, a kind of lattice construction, will be the optimum solution. This type of foundation has



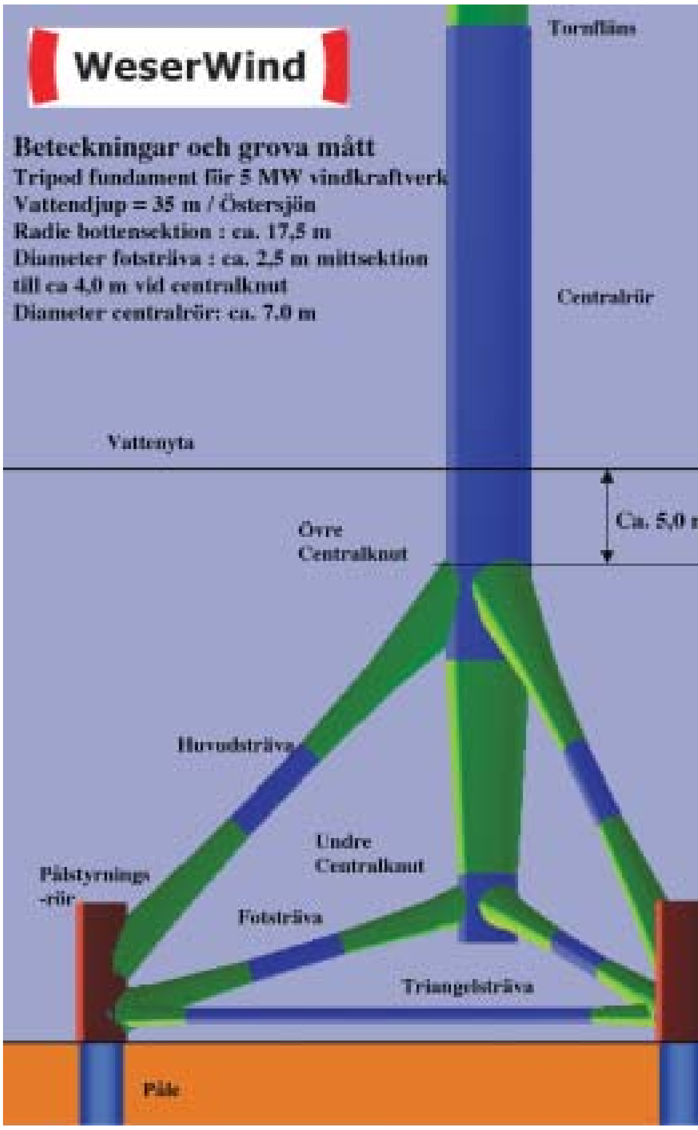


Figure. Drawings of the tripod foundation. Source: Sweden Offshore Wind AB, Weserwind.

not yet been tested by the wind power industry and the costs have also not yet been studied by the company.

Suction pile is a construction that works like an upside-down glass that is pushed some 6 – 10 metres into the seabed. Thereafter the remaining air is pumped out to create a vacuum pressure inside the foundation. The advantage with this type of construction is that the wind turbine can be mounted onto the foundation in the port and thereafter be floated to the site by tugs. The disadvantage lies in the cost and that it requires specific seabed conditions. For example, suction piles cannot be used where the seabed consists of marl clay, as is the case on parts of Kriegers Flak. Where the seabed only consists of sand, the use of suction piles may be a good alternative.

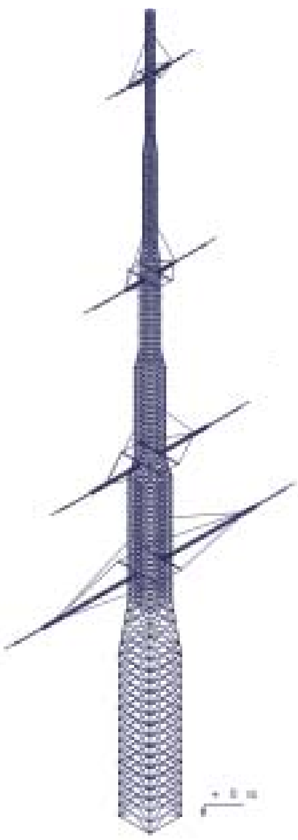
In view of the relatively deep water at Kriegers Flak, tripods will probably be used in a large-scale, offshore-based wind power project for the first time. The tripod foundation is a three-legged framework of steel tubes that was first used in the oil offshore industry to build light, three-legged platforms for smaller oilfields. A frame beneath the tower connects the pillar that spreads the pressure onto three steel tubes. The diameter of the steel tubes is about 3.5 metres. A variant of the tripod, the "Halbtaucher", is floated to the site where it is filled with water and placed on the seabed. This could turn out to be a good alternative and, therefore, the use of the Halbtaucher will be studied closely.

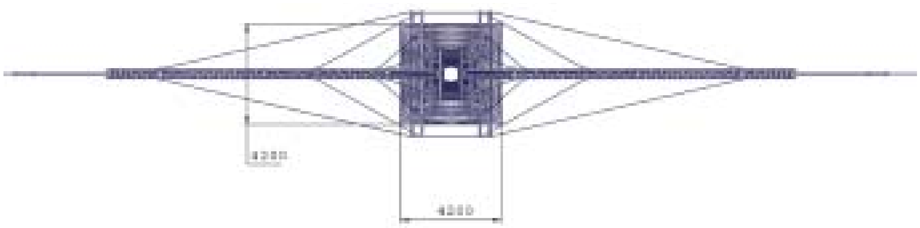
As indicated above, a lot of work will go into dimensioning and the right type of simulation models in order to decide which type of foundation will be best from a technical and economic view. It is therefore not yet possible to state which foundation type that will be used. It is however foreseen that monopiles will be used down to about 25 metres and tripods for greater depths.

5.4.3 Measuring masts

1 – 3 measuring masts will be erected on the site in order to verify the electricity production from the wind farm. The maximum height of the masts will be 110 metres and they will be about 5 metres wide at their widest section. A monopile or a tripod will probably be used as a foundation. Which of those that will be used depends on the water depth at the exact location. A further alternative, which will be studied in more detail, will be to mount the measuring masts on top of the transformer station.

The drawings below and on the left are examples of how a measuring mast may look.





Source: in Situ Instrument AB

5.5. Obstacle marking of the turbines

The Maritime Administration and the Civil Aviation Authority will decide the exact obstacle marking of the wind turbines.

During the construction phase, the area will, wherever necessary, be marked with light buoys.

According to the Maritime Administration, they will decide that during the construction phase, all wind turbines will be marked with luminous tape. The corners of the wind farm and the sides every two nautical miles will be marked with a yellow flashing hazard light, night-time lightening and numbers. The towers will be painted yellow up to 15 metres above the mean water level or, alternatively, with horizontal yellow/white tape with a minimum width of two metres. Lights, names and spotlights will be mounted 15 metres above the highest water level. To further protect against collisions, the Morse Code letter “U” will be flashing continuously. The maritime obstacle marking will be in accordance with international recommendations issued by IALA.

Currently, the rules and regulations surrounding hazard lights are being reviewed and are expected to be ready during the spring 2005. Proposals for hazard lighting are being made by individual countries and the final rules will thereafter be decided by ICAO, the International Civil Aviation Organisation.

As the height of the wind turbines is likely to exceed 150 metres, they will probably be equipped with flashing lights. According to the Swedish Civil Aviation Authority, the highest point of the turbine, i.e. the tip of each rotor blade, should be marked. In view of several important arguments against this marking, the Authority seems to have abandoned this idea. Instead, the thinking now is to place the flashing light on top of the nacelle.

The following working hypothesis for wind turbines higher than 150 metres is currently (November 2004) being used by the Authority:

The tower shall be equipped with a low-intensive red light at two locations.

The nacelle shall be equipped with one high-intensive light that flashes 60 times per minute.

The light will be directed so that it will not be visible on the ground within a distance of 5 km from the wind turbine.

As mentioned above, this is only a Swedish working hypothesis and it is currently not possible to have a firm view on future obstacle marking.

5.6. Description of the different project phases

5.6.1. The Development phase

During the period 2002 – 2004 several surveys have been carried out (see chapter 19.1). The most important of these are summarised below.

a) Geophysical and geotechnical surveys.

In order to gain information about the impact on seabed-based flora and fauna and to be able to work out foundation proposals, the seabed has been investigated using different geophysical methods. The seabed profile has been studied using sonar and the structure of the surface layer has been studied using sidescan

sonar. To gain information about sedimentary strata and the distance to solid rock formations, a seismic boomer was used. These investigations were carried out by the companies Weigt and Marin Mätteknik. In order to chose a suitable technique and to calculate the dimensions of the foundations, test drillings have been conducted on the German side of Kriegers Flak. Furthermore, an inventory of the available geotechnical and geophysical studies that have been carried out in Denmark and Sweden has been made by SGI.

b) Biological surveys
Extensive investigations to determine the occurrence of seabed living animals, fish, mammals and flora have been made in the area using aircrafts, ships and divers. The occurrence of migrating and resting birds as well as migration routes for bats in the area has been investigates. All of these studies have been supplemented by documentary studies.

c) Oceanographic surveys.
The IfAÖ has amongst others investigated salt and oxygen contents as well as water temperature.
Ice conditions have been studied by Germanische Lloyd and BSH.

SMHI has made a worst case scenario estimate of the mixing of salt water between upper and lower layers. An estimate of the cumulative impact of building both the German and Swedish wind farms at Kriegers Flak has also been carried out by SMHI. The hydrographical conditions of the area have been surveyed and summarised by Hydromod.

5.6.2. The construction phase

As previously stated, it has not yet been decided which type of foundation that will be used although it is likely that monopiles will be used in shallower (down to 25 metres) and tripods in deeper waters. The foundations will be piled or drilled some 30 metres into the seabed.

The aim, as far as possible, is to pile the foundations into the seabed. If this proves impossible, for example due to rocks and other solid ground, the foundations will be drilled into the seabed. In order to determine the right foundation dimension and decide whether to pile or drill, preparatory work will be carried out at each specific foundation location. This encompasses geophysical surveys, such as using sonar and sidescan sonar, seismic surveys and videotaping, as well as geotechnical surveys such as drilling, sounding, vibration testing and sampling of the seabed layers. Proposals regarding this preparatory work can be found in the SIG report (Attachment 4.3, chapter 6).

Drilling at the site will be carried out inside the steel tube casing that constitutes the foundation cylinder. The drill mud is sucked through a hose leading up to the drill ship. Onboard the ship, there are two ways to make use of the mud. Either the contents are fed back into the sea where the currents are strong as is the case at the site. The currents will result in quick spreading of the sediments. The second alternative is to dispose of the mud in a container onboard the ship. The mud will sink to the bottom of the container and the water will thereafter be let back into the sea. The remaining sediment will then be released back through the foundation casing. Thereafter the piling can continue down to the target depth.

To get rid of a solid obstacle, directional drilling can be applied from several angles with a smaller drill. The obstacle will be broken up and the piling can be continued.

The foundation surface will be treated with biodegradable corrosion protection.

The technology for assembling wind turbines is rapidly improving. It will quite soon be likely that turbines will be assembled in their entirety onshore and that large special purpose vessels will carry them to the site. As this is a cost saving and less time consuming technique it will, if possible, be used at Kriegers Flak.

If this latter alternative will not be possible at the time of building the wind farm, the assembly process will look as follows:

As far as possible, the assembly of the turbines will be carried out onshore. The following four components will then be assembled at the site:

- The lower part of the tower

- The upper part of the tower
- The nacelle
- The rotor and the rotor blades

The different parts will be transported to the site with special installation vessels that are equipped with cranes.

Depending on the weather, the installation of each wind turbine usually takes one to two days. As weather conditions usually are favourable, it will probably take place during the period April to September.

The installation is planned to be carried out in two phases during two calendar years. There are four reasons for this.

Firstly, one can monitor the environmental consequences during the first phase to determine if something unexpected has occurred.

Secondly, one can make use of the knowledge gained during installation to optimise the construction of the foundations.

Thirdly, it will be natural to divide the cable laying into two phases as just over 300 MW can be connected to each of the two transformer stations (read more about this in the report "Elektrisk integrering av Kriegers Flak II I det Sydsvenska elnätet", attachment 13.1).

Finally, only monopiles will be used during the first phase, resulting in a fairly simple installation process.

During the construction phase, the entire site including a 500 metre security zone will be suspended. A suspension notice will be sent to Ufs (Notices for seafarers) and the area will be laid out in navigational charts. Radio messages about the suspension will be relayed at several times.

5.6.3. The operational phase

The wind turbines will function automatically and will produce electricity at wind speeds between 3,5 and 30 m/s. At wind speeds above 30 m/s the pitch of the blades will adjust to a 0 degree angle causing the turbines to stop rotating until the wind speed again is lower that 30 m/s.

The wind turbines will be operated from an onshore-based operation centre. The inbuilt control systems will detect problems early and will send error messages to the op-centre. It will be possible to switch on or off turbines from the op-centre. Communication will be established through an opto cable that will be integrated with the main electrical cable. A satellite backup system will also be available should the opto cable fail.

All operational data will be registered in the op-centre. Personnel will man the op-centre around the clock. The following systems will be monitored:

- The wind turbines
- The infrastructure (cables and foundations)
- Nautical security systems
- Air security systems (bulbs on the wind turbines etc)

The transformer stations that register storms, fire etc., will, in addition, be monitored.

The monitoring system in the op-centre must be able to determine where a potential fault has occurred as well as the scale thereof.

Through this constant monitoring, faults and problems should be cured or limited before serious damage has occurred.

The wind turbine suppliers will, once or twice per year, carry out inspections and service on the turbines. During these visits, among other service tasks, a change of oil filters takes place. The oil in the gearbox is changed every 2 – 3 years.

To assist during emergencies, the turbines will each have a bedroom equipped with first aid kits, food, life buoys, lifelines, duvets, fire extinguishers and fire alarms. There will also be communication devices with direct links to rescue stations onshore. The room can also be used by service men that need to stay on the turbines to carry out extended repairs or maintenance work.

It will be possible to board each wind turbine by ship and there will be equipment installed to allow personnel to climb up onto the turbine by themselves from the water level.

Security and survival training relating to the special risks associated with work offshore will be given to all service personnel.

The wind turbines will be operated in accordance with current health, environment, rescue, electrical safety and work environment regulations.

5.6.4. The dismantling phase

The operational phase is expected to last for 30 years. Following the operational phase, the wind turbines as well as most of the infrastructure installations, will be dismantled. To avoid uncontrollable leakage, any environmentally hazardous fluids (such as oils) will be removed before the turbines are dismantled. The section of the foundation that is situated further than one metre into the seabed will be left after dismantling. A plan for recycling will be drawn up and all parts that can (e.g. steel and copper parts), will be recycled. The work will be quality guaranteed.

When the construction phase starts, to ensure that the dismantling actually will take place, the operator will put up a surety for the dismantling costs in the form of a bank guarantee.

5.7. Physical impact on the surroundings

Physical impact on the surroundings due to the wind farm may occur due to noise, vibrations, light, shadows and reflexes, sedimentation, emissions and contamination. The turbines could also become a barrier for migrating birds. The foundations could become artificial reefs and they could influence the salt water mixing. Finally, the physical presence of the wind farm will influence the landscape picture. Below, the expected impact is described for the respective phases.

5.7.1. The construction phase

5.7.1.1. Noise and vibrations

During the installation process, piling and/or drilling may give cause to significant noise. Most noise is caused by piling. Both processes give cause to blast waves in the sea.

The pile hammer will create sound levels of more than 205 dB (re I□Pa-m).

According to Dietz (2003), sound waves with levels of 220 dB were recorded during the installation (piling) of the Utgrunden wind farm in Kalmarsund. The frequency spectrum was between 1 Hz – 16 kHz. All included, the piling work lasted for about four hours with 1 320 hammer blows per foundation.

During drilling, it is not established which frequency spectra and initial sound levels will be caused. Richardson et al (1995), has recorded broadband emissions when drilling a tunnel casing with a diameter of 8 metres. There are however no exact records regarding the technology nor the geological structure and the water depth. Due to the drill speed, the main noise frequency surveyed was below 10 Hz. Due to resonance effects in the shallow water, noise levels in the range 30 to 100 Hz have also been established.

Due to different drill-bit sizes and technique, noise emissions from oil drilling work is not comparable.

One can assume that during piling, total noise emissions will reach a lower maximum level than during drilling.

Also, ships and vessels used for transportation to the site and installation work will emit noise.

The frequency spectrum and noise level caused by ships and vessels depends on their size and propulsion. The frequencies that will be emitted will probably reach from 20 Hz to 10 kHz and the sound levels at source will reach between 130 – >150 dB re IµPa at a distance of 1 metre from the sound source (Richardson et al 1995).

5.7.1.2. Sediment and sedimentation

Some sediment will be released during dredging, piling and drilling.

Most volumes will be released during dredging. Dredging will, however, only be necessary if gravitation foundations will be used. In the unlikely event that dredging will be performed, a study will be made of where existing deposits are located and the consequences of using the different deposit alternatives.

As mentioned above, the company will strive to use piling for laying the foundations. Whilst piling, only very small quantities of sediment are released. The seabed conditions will determine the exact quantity of sediment that will be released.

Where piling is not possible, e.g. when hitting large boulders, drilling will be used to lay the foundations. While drilling, sediment and mud will be released and sucked through a hose to the drill ship. Hardly any sediment will be spilled if containers are used onboard the drill ship. If mud is released back into the sea, it will quickly be spread (due to currents) and sediment a large area. Except for occurrences such as moving water and the density of water (salt level, presence or not of thermoclines or haloclines), the particle size will have an influence on sedimentation. Faster sedimentation generally occurs when particles are bigger/heavier rather than smaller.

5.7.1.3. Spills and pollution

Ships and vessels that install the wind turbines use different oils for propulsion and lubrication and these oils could theoretically leak into the sea. The work specifications will contain special terms and conditions that have to be followed by the different contractors. To make sure that these terms and conditions are adhered to, a traffic and security centre will be in operation during the construction phase.

5.7.2. The operational phase

5.7.2.1. Noise and vibrations

The wind turbines emit an aerodynamic (from the blades) as well as a mechanic (from the gearbox and generator) noise. The aerodynamic noise is a “swishing” noise whilst the mechanic noise is scorching, sometimes emitting hearable tones.

The computer program WindPRO, version 2.3.0.125, was used to calculate the noise level in the air. This calculation model was used during the environmental approval process for the Horns Rev and Rödsand wind farms.

The picture below shows the thresholds for 55, 50, 45, 40 and 35 dB. The 40 dB threshold, which is the value approved at a property border and that corresponds to the noise from a normal refrigerator, at maximum sound spread conditions lies some 1,5 km from the wind farm.

It is, however, questionable if this model is fair to use for offshore-based wind power. The program does not take into consideration that the sound spread differs as it is less reduced at sea compared to over land. In view of this, Sten Ljunggren at KTH has developed a calculation method for sound spreading from offshore-based wind turbines that is reproduced in the electronic version of Ljud från vindkraftverk, Report 6241, National Board of Housing, STEM and Swedish Environmental Protection Agency.

According to this method, a maximum of 29,4 dB(A) at the nearest point onshore (Trelleborg) is calculated. This is more than 10 dB(A) below the threshold. It should be noted that the model does not consider the background noise from ships, waves, etc. Furthermore, during calculations, a worst-case value for the

The inner rings around each wind turbine represents 55 dB(A). Thereafter the noise level reduces with 5 dB(A) for each line that that surrounds the wind farm.

NOISE DISTRIBUTION FOR OFFSHORE BASED WIND TURBINES

In view of the fact that water is a particularly hard surface from an acoustic point of view, noise emitted towards a water surface is very efficiently reflected. Noise distribution from offshore-based wind turbines will in principle, therefore, be different from onshore-based turbines. At tailwind, noise will be directed towards the water surface and reflected several times leading to a longer distribution radius compared to over land. A reduction of 3 dB as opposed to 6 dB onshore can be used to calculate noise for each doubling of the distance from the source. The temperature of water and air also influences noise distribution. During autumn, noise distribution is reduced when sound waves are directed upwards as cold air moves above a warm water surface. During spring and early summer, the opposite occurs resulting in increased noise distribution.

noise capacity level has been used. The reason is that there is currently only one 5 MW turbine prototype from which to gather information. Also, prototypes generally produce higher than normal values.

Wind turbines also cause noise in the water. This is partly due to vibrations in the tower and foundations being transmitted into the water and partly to the occurrence of pressure fluctuations when the blades pass the surface. As the blades are mounted high above water level, the pressure fluctuation has very limited impact.

Wind turbines do not emit ultrasounds (Degn 2000). Infrasound, on the other hand, is emitted within the frequency 0,02 to 20 Hz (Ehrich, 2000).

To show exactly how noise from wind turbines is distributed in water is not possible. Different levels of salt and temperature layers result in different distribution conditions. The seabed conditions also influences the distribution. A soft seabed with rich fauna will dampen the noise spread (Jonasson 2004).

The lack of studies is the main reason for not being able to account exactly for the noise distribution. Those that exist have been studying much smaller wind turbines than the turbines relevant in this case. For example, one such study commissioned by SEAS and made by Ødegaard & Danneskiold-Samsoe, has investigated sub-sea sound distribution from a 2 MW wind turbine. The investigation, which was carried out some 20 metres away from both steel and concrete foundations, found:

- Sub-sea sounds from offshore wind turbines is not higher than the background noise for frequencies above 1 kHz
- Sub-sea sounds from offshore wind turbines is higher than the background noise for frequencies below 1 kHz
- Concrete foundations emit more noise than steel foundations at frequencies lower than 50 Hz and less at frequencies between 50 and 500 Hz.

Noise is also emitted during service work.

5.7.2.2. Clouding and changed sedimentation

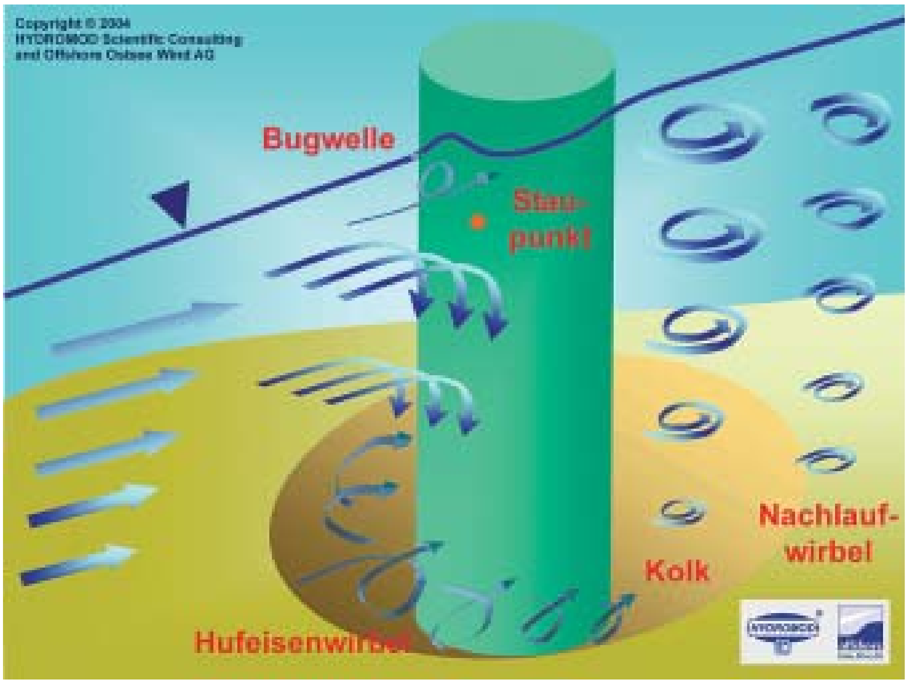
Changes in sedimentation conditions may occur as a result of current changes due to the foundations. Calculations made during the development of other offshore-based wind farms show very little impact on currents from the turbines.

Turbulence behind the foundations will, however, lead to slightly added spreading of sediments near to the foot of the turbine. The spreading will stop once balance has been reached between local and added particles. This sedimentation is therefore limited in time.

5.7.2.3 Spills and pollution

During normal operation, wind turbines do not cause any emissions.

The gearbox contains lubrication oil (about 300 – 400 litres) that is checked for quality and chemical composition on an annual basis. The oil is changed every 2 – 3 years by pumping it to and from the service vessel. The hydraulic system for the disc brakes also contains oil. The yaw system will most likely be elec-



Schematic figure showing the swirl that occurs behind the foundations.

trical and will therefore not contain any oil.

The gearbox and other parts that contain oil are completely sealed off. Therefore, in case of an internal leakage, oil cannot leak into the sea. If an accident occurs in the machinery causing an oil leakage, such oil will be gathered into a special trough. A detection device in the trough will register the leak and will, via the operation control, stop the wind turbine. In case of a hose breakage, pressure gauges will cause the wind turbine to stop if a sudden drop in oil pressure occurs.

Transformer oil will be present inside the transformer in the nacelle. The transformer will be equipped with a trough with a level gauge. It is however envisaged that dryformers without oil will be used.

The oils that will be used will be environmentally adapted.

Ships and vessels used during service work use different kind of oils for propulsion and lubrication. Theoretically, these oils may leak into the sea. Special handling instructions for hazardous materials, such as oil, will be issued.

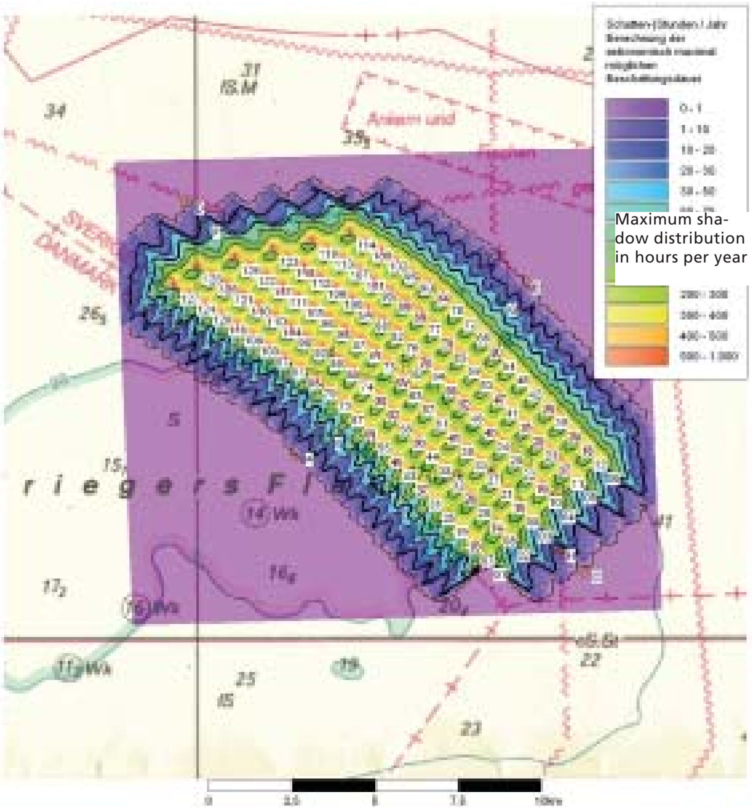
Routines for handling minor leakages on platforms and ships as well as an action plan for contacts with the Coast Guard in case of oil or chemical spills will be in place.

In case of a collision between vessels and larger ships, spills may be significant. These risks are discussed in Chapter 12.9.2.

5.7.2.4. Light, shadow and reflexes

The wind turbines will be illuminated (see Chapter 4.5). The Maritime Board in cooperation with the Civil Aviation Authority will determine the exact layout. As described in Chapter 4.5. above, the rules relating to hazard lights are currently under review.
The towers will give cause to permanent shadows.

Intermittent shadows and reflexes will occur when the blades passes or reflects the light arrays of a light source. During sunshine or artificial illumination, the rotor blades will give cause to frequent silhouettes and reflexes in the neighbourhood. The rotor blades may cause shadows up to 1 500 metres long. Depending on the height of the sun, the length of the shadow will vary. A computer program, WindPRO, has been used to calculate how many hours per year different areas will be subjected to shadow (see picture below). To prevent reflexes, the blades will be surface coated with an anti-reflective substance. Shadows can penetrate down to maximum 20 metre water depth. There is no light penetration below 20 metres in the Baltic Sea.



Shadow extension. Points A – D are 2 km away, point E is at the centre and the other points are 1 km away from the wind farm.

5.7.2.5 Barrier effect

Wind farms may constitute a barrier for migrating birds or for low flying birds between resting and feeding grounds. Whether a barrier effect will actually occur, depends on the distance between the turbines and the bird species. Some birds fly unhindered between wind turbines.

5.7.2.6 Reef effect

An artificial reef for fish and other marine organisms may be formed by the sub-sea parts, i.e. part of the tower and the foundation, of the wind turbine.

5.7.2.7 Protected area

If the area is closed, it can no longer be used for fishing and will thus become a protected area for fish.

5.7.2.8 Hydrographical impact

In theory, the foundations could cause changes in the currents that, in turn, could cause different salt water mixing in the Baltic Sea.

Calculations made by SMHI show that mixing of low and high salt water will increase by less than 1 % due to the presence of the wind farm, compared to the current salt water mixing (see Attachment 5.2).

A marginal reduction of wave height and change of wave character is expected in the immediate vicinity of the turbines (Attachment 5.1).

5.7.2.9 Occupied area

The total area occupied by the foundations will be about 4 270 m2. This constitutes about 0,008 % of the total wind farm area. 60 monopiles and 68 tripods were used in the calculations. The use of additional tripods will reduce the area occupied by the foundations.

5.7.2.10 Impact on the landscape picture

The physical presence of the wind farm will change the landscape. From being an open and free surface, the area will be dominated by the wind turbines.

5.7.3 The dismantling phase

5.7.3.1 Noise and vibrations

Noise will be created during the dismantling phase. The ships used during dismantling will also temporarily create added noise levels.

5.7.3.2 Clouding and sediment spreading

The amount of clouding and sediment spreading that will occur during this phase depends on the seabed conditions and the type of foundation that have been used.

5.7.3.3 Spills and pollution

Ships that are used during the dismantling phase use different types of oils for propulsion and lubrication and, in theory, these could leak into the sea.

Project economics

6. Project economics

It is a delicate task to make a precise cost calculation before the procurement process has been completed. In addition, there are uncertainties about future electricity and certificate prices. With this in mind, an estimation of the most important project key numbers is presented below.

Average electricity price	300 SEK/MWh
Average certificate price	300 SEK/Mwh
Total capacity installed	640 MW
Total investment cost	10 300 000 000 SEK
Investment cost per annual kWh	5,00 SEK
Investment cost per kW	16 000 SEK
Estimated total electricity production	50 250 000 MWh
IRR	10 %
Capacity factor	36 %
O & M cost per MWh	93SEK
O & M cost as percentage of revenue	15 %

- **The following remarks must be made:**

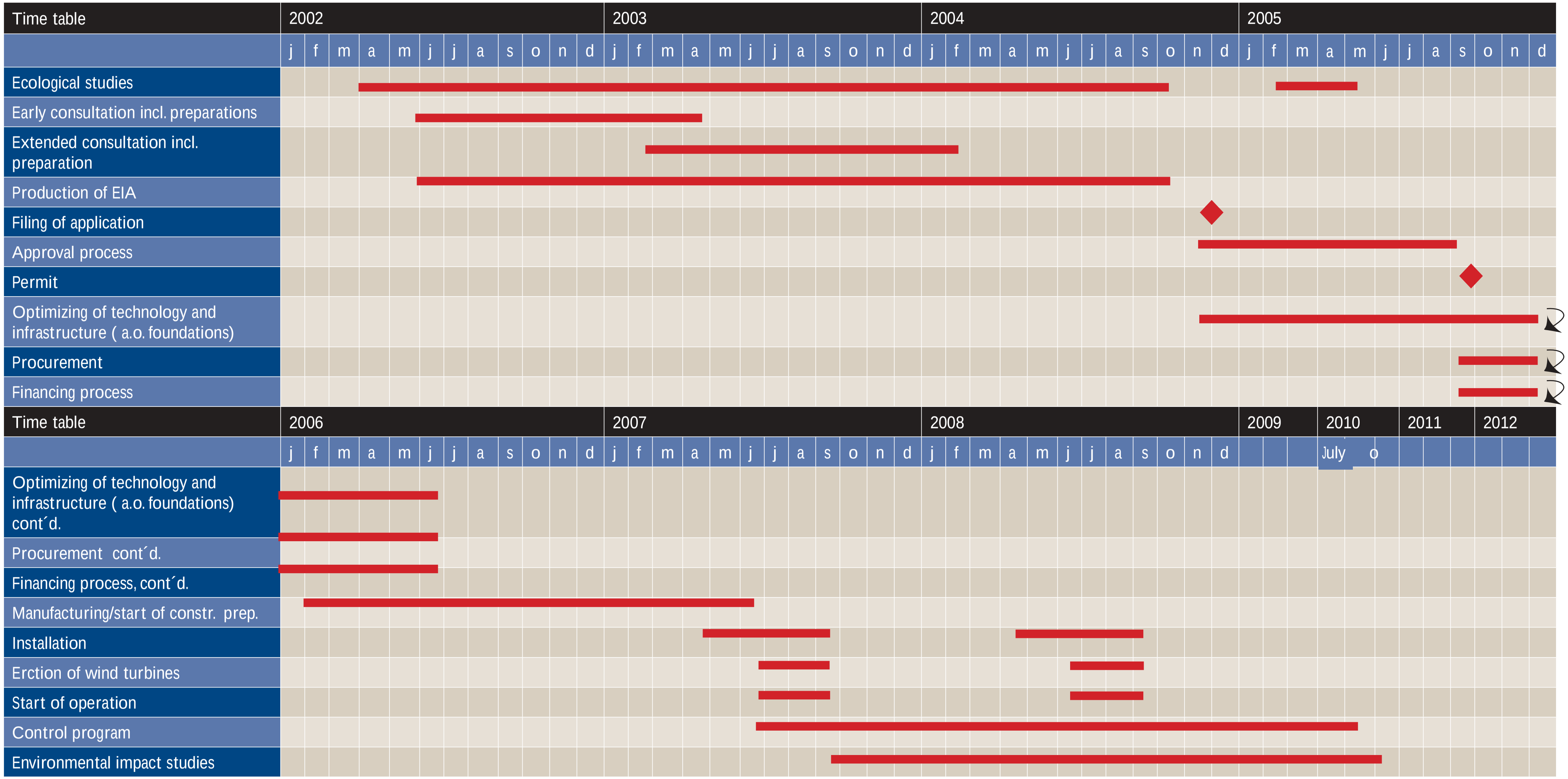
- In respect of investment costs, the numbers are based on a "worst case scenario", in the sence that, when in doubt, we have used a high number. More competition is soon expected for offshore wind turbines that will lead to lower prices.
- Also for the electricity price, a worst case scenario has been assumed. The number for the electricity production is taken from the worst of three wind studies.
- The electricity and certificate prices used here are much lower than estimates made by most experts.

In conclusion, even whith several worst case scenario numbers included in the economic projections, the project will become profitable.

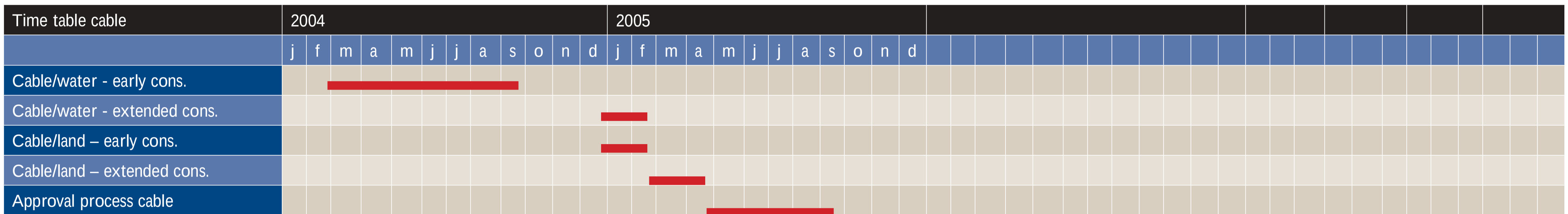
Time table

7. Time table

Wind Farm



Grid connection



Alternative locations

8. Alternative locations

The sea around Sweden's coast is sensitive and certain areas are particularly sensitive and extra worthy of protection. Due to this, the choice of location for offshore wind power plant is very difficult and a comparison with alternative locations is of great importance to be able to chose the location with the best advantages and that at the same time causes the least obstruction and inconvenience.

In the 6th chapter, § 7 of the EC, it states that an EIS should contain an "account of alternative locations, if these are possible, and alternative solutions together with the motivation of why a certain location has been chosen". Due to this a site study has been made and is presented below.

8.1 Important criteria for choice of location

The criteria that are important for choice of location are presented below.

a) Offshore-based

The area should be offshore. The advantage of building wind power offshore is primarily that there is more wind in comparison to onshore, the wind energy per square meter can be up to 40 % higher than onshore. Offshore wind power is also less intrusive on the landscape as turbines are placed far from the closest buildings. Offshore wind farms also allow the advantage of having larger farms built. This is due to the fact that larger areas can be claimed and that the transport of large components, such as rotor blades, is easier at sea.

b) Within Sweden's borders

As the energy being delivered is going to Sweden it is required that the area is within the territorial border or within Sweden's economic zone.

c) Scope

The area should be large enough to allow a large number of wind turbines for the project to be financially profitable. The number of wind turbines needed for financial profitability depends among other things on the cost of the plant at the location, which in turn depends on water depth, seabed conditions etc. A very important factor is the cost of the grid connection that will be very high if the area is far from the shore. For a normal wind power project the cost for grid connection seldom exceeds 7-10% of the total cost of the project but for a project based far out at sea, such as Kriegers Flak, the cost is 13-15%. This is due to the fact that 1 km of sea cable is approximately five million SEK. In other words, when building offshore wind power you need to build a relatively large amount of turbines and thereby claim a large area in order to finance the grid connection.

d) Water depth

Offshore wind farms should be built at a depth between 10 and 40 meters. If built deeper than 40 meters there are technical and economic limitations. If built shallower than 10 meters there is a greater conflict with the surrounding eco system as the sunlight penetrates the water causing a more abundant flora and fauna. The latter problem occured when planning the German project Adlergrund, where the rich flora and fauna was especially important, as the area was protection worthy for resting birds.

e) Distance to the coast
The wind farm should be placed at a distance that limits the effects on the landscape picture and reduces the disturbance of the visual experience. At the same time the wind farm should be placed at a distance that does not incur costs that are too high when connecting to the electrical grid (as mentioned above the costs for 1km sea cable is approximately five million SEK). Sweden Offshore is of the opinion that the optimal distance is between 20 and 40 km.

f) Seabed conditions
The selected area should be good for grounding the foundations, such as sand and moraine. Loose sand deposits can however be inappropriate if they are subjected to transport and movement through currents and waves. The seabed substratum is also of importance. Rocky and uneven seabeds makes the grounding of the foundation harder. In most cases the seabed conditions do not cause a hazard to the establishment of wind farms but can influence the method of grounding which in turn has an effect on the economy.

g) Local wind conditions
The wind energy is proportionate to the cube of the wind speed. This means that if the wind speed is doubled the wind energy is increased eightfold. The local wind condition is for this reason of high importance. Offshore wind resources generally increase in proportion to the distance from the coast. According to STEM, the main criteria for suggesting an area of national interest for wind power is that the wind energy content should be at least 3 800 kWh/m2/year at the height of 80 m above ground/sea (Wind power: Distribution of the national planning target and criteria for areas of national interest, STEM, ER 16:2003). This corresponds to an average wind speed of approximately 7,2m/s per year.

h) Conditions for grid connection
Connection points with available capacity must be located within reasonable distance from the coast. In the report “Overall conditions for large-scale wind power development offshore and in mountain regions”, The Swedish Transmission System Operator, Svenska Kraftnät, on appointment from the government, showed the effects of large-scale wind power development offshore and in mountain regions. In this report Svenska Kraftnät stated that the conditions for connection are most favourable in locations where there has previously been electricity production but that now are redundant. The table below shows the production sources that are redundant and where connection of wind power production was considered relatively easy. Out of these four locations Barsebäck is the only remaining redundant production site included in the report. The other sites are back in production and can produce electricity when needed. The probable development, according to Svenska Kraftnät, is that wind farms with installed capacity of about one hundred MW primarily get connected to the regional grid and that these then need to be reinforced. The reasons are that it is generally cheaper to connect to a lower voltage grid, and that the regional grids are closer to the coast than the transmission grid, which reduces distance, and thereby the connection costs, between the wind farm and the grid. Larger wind farms may need to be connected directly to the transmission grid when the regional grid is incapable of accepting the capacity.

Power plant	Capacity [MW]
Barsebäck	600
Stenungsund	820
Marviken	200
Bråvalla	240

i) Environmental restrictions
When choosing alternative locations, the local environment is important. The wind farm should not influence or encroach areas that are officially protected or ecologically sensitive.

j) Commercial fishing and navigation

When considering if an area is appropriate, the fishing industry and shipping/navigation is taken into account. The development should not hinder important fishing and it should not be in the vicinity of busy shipping lanes as this can create a safety risk.

k) Miscellaneous

There can also be other factors that are important to consider. These are accounted for under Miscellaneous.

8.2 Studied locations, description and assessment

There are only really ten locations that can be of interest to investigate for large scale offshore wind power projects taking the above mentioned criteria into account. These are Fladen, Lilla Middelgrund, Stora Middelgrund, Norra Midsjöbanken, Södra Midsjöbanken, Hoburgs bank, Finngrunden, Persgrunden Kriegers Flak as well as an area in Stockholm that we will call ABI. Most other locations are disregarded as they are too close to shore (e.g. Smygehamn – Abbekås) or are too small to hold a larger project. All locations clearly meet the first two criteria, namely that they are offshore and within the borders of Sweden. Assessment of the other criteria is presented below.

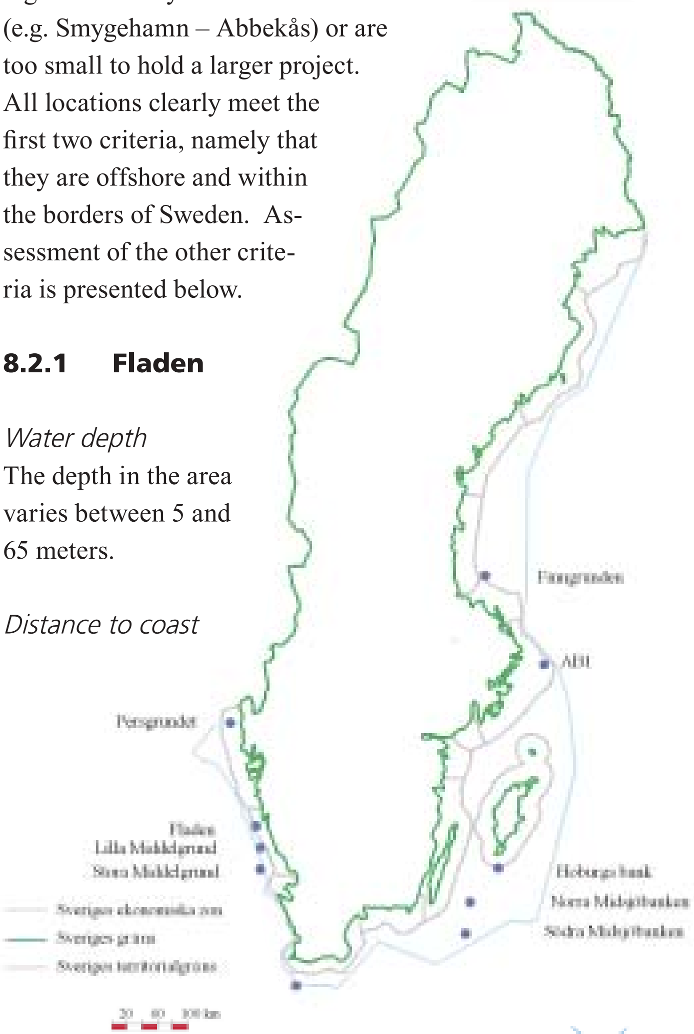
8.2.1 Fladen

Water depth

The depth in the area varies between 5 and 65 meters.

Distance to coast

The distance to the coast is approximately 25 km. This means that the visual effect on the landscape by a project is very limited and the cost for grid connection acceptable.



Scope

Sufficient, details about exact surface missing.

Seabed conditions

The seabed substrate is primarily hard. The area has a high topographical variation and contains mainly rocks and blocks of stone. The surface sediment contains mostly sand and gravel with smaller areas of mud/moraine (SGU, 1994)

Local wind conditions

According to SMHI, the average wind speed at the height of 100 meters is 9,5m/sec. These values are calculated by 20 year long measurements from stations at Nidingen, Vinga and Måseskär.

Conditions for grid connection

A theoretical possibility for connection to an existing power grid system is at the Värö peninsula.

Environmental restrictions

Fladen is an important feeding ground for grey seal and harbour seal.

There are many various kinds of algae. Within the area there are species that are not found at the coasts of Skagerack and Kattegatt. Fladen is one of 13 Swedish areas that HELCOM has branded as an internationally important marine protection area. The area is also classified as a national area of interest and is a Natura 2000-area. Both the National Board of Housing and The Swedish Environmental Protection Agency are of the opinion that the area should remain untouched.

Fishing and navigation

National interest for recreational fishing. Probably spawn and breeding area for fish (National Fisherman's Federation, background material for investigation of the possibility of prohibiting fishing in a protected marine area). Distance to the closest channel is approximately 5 km.

Miscellaneous
An application for the development of a wind farm containing a maximum of 60 wind turbines was rejected in October 2004 by the Government.

8.2.2 Lilla Middelgrund

Water depth
Between 6 and 40 meters.

Distance to coast
Approximately 20 km. The visual effects on the landscape are therefore minimal/acceptable and the cost of grid connection acceptable.

Scope
Sufficient, exact details missing.

Seabed conditions
Lilla Middelgrund is a diverse bank with large topographical variation. Cobblestone fields and blocks of stone dominate the area with rock piles and ridges.

Local weather conditions
According to SMHI the average wind speed at the height of 100 meters is 9,5 m/sec. These values are calculated by 20 year long measurements from stations at Nidingen, Vinga and Måseskär.

Conditions for grid connection
In the area, there is only the 400 kV transmission grid to connect to. It is probably possible to connect to the nearby station Breared but this is a worse alternative due to the vicinity of Ringhals. It would burden the limited west coast line further and investments in the station will be needed. The area has a relatively well-developed regional grid of 130 kV, which may be a better alternative.

Environmental restrictions
Lilla Middelgrund is probably one of the most important spawning areas for herring within Kattegatt and one of the most important hibernation areas for water fowl within the Baltic Sea and Kattegatt (Marine fishing banks – knowledge overview and biological assessment). For the Razorbill species, the area is thought to be the most important hibernation area in the world (Karlsson 1998). Furthermore 14 red algae and three brown algae species have been encountered in the area (Karlsson 1998).

Further, the area is one of 13 Swedish areas that the (Helsinki commission) HELCOM has classified as an internationally important marine protection area.

Lilla Middelgrund is a Natura 2000-area. Both the National Board of Housing and The Swedish Environmental Protection Agency are of the opinion that the area should remain untouched. STEM has also crossed the area off its list of suitable locations for wind power.

Fishing and navigation
Lilla Middelgrund is part of an area of national interest for recreational fishing. Recreational fishing in the area is extensive. National interest for navigation is west of the area.

8.2.3 Stora Middelgrund

Water depth
9-15 meters.

Distance to coast
Approximately 35 km. The large distance means that the visual effects on the landscape are virtually non-existent. However it means high costs for grid connection.

Scope
Stora Middelgrund is largely within the Danish economic zone and the area within the Swedish economic zone is probably not large enough to accommodate a financially viable wind farm.

Seabed conditions
Information missing, but the seabed conditions are thought to be good.

Local wind conditions
According to SMHI, the average wind speed at a height of 100 meters is 9,5 m/sec. These values are calculated from approximately 20 year long measurements from the stations at Nidingen, Vinga and Måseskär.

Conditions for grid connection
The area only contains a 400 kV transmission line to

connect to. Possible connection could take place at the close by station Breared but this is a worse alternative due to the closeness to Ringhals and that it would burden the limited west coast line further. Investments in the station will be needed. There is a relatively well-developed regional grid of 130 kV, which may be a better alternative.

Environmental restrictions
Stora Middelgrund is classified as a national interest area for commercial fishing and nature preservation.
Fishing and navigation

National interest for recreational fishing. National interest for navigation is west of the area. The area has relatively heavy sea traffic and the Maritime Administration is of the opinion that wind power on Stora Middelgrund should not be developed until a security analysis for navigation has been made.

8.2.4 Norra Midsjöbanken

Water depth
Between 8 and 20 meters.

Distance to coast
Approximately 40 km. This means that the visual effects on the landscape are virtually non-existent and high cost for grid connection.

Scope
Sufficient, exact data missing.

Seabed conditions
The bank consists of a moraine wall with hard seabed substrate surrounded by sandy areas.

Local wind conditions
According to SMHI, the wind speed is approximately 9,0 m/sec at a height of 80 meters. The values are based on data measured in 2003.

Conditions for grid connection
The area only contains a 400 kV transmission line to connect to. Possible connection could take place at the 400 kV station at Hemsö in Blekinge. This would entail a relatively long sea distance but, according to Svenska Kraftnät, this is the best alternative from a transmission grid viewpoint. Investments in the station will be needed.

Environmental restrictions
Norra Midsjöbanken is an important hibernation area for birds. The area is thought to be an important spawning and breeding ground for Turbot and probably other species as well (National Board of Fisheries). The Swedish Environmental Protection Agency has suggested the area becomes a Natura 2000-area. The area is one of 13 Swedish areas that HELCOM has classified as an internationally important marine protection area. Both the National Board of Housing and The Swedish Environmental Protection Agency are of the opinion that the area should remain untouched. STEM crossed the area off its list of suitable locations for wind power in October 2004.

Fishing and navigation
National interest for navigation is north-west of the bank.

Miscellaneous
The Swedish Defence Forces are opposed to the development of wind power in the area due to it being of high importance for the defence systems.

8.2.5 Södra Midsjöbanken

Water depth
Approximately 11-27 meters.

Distance to coast
Approximately 80 km. No visual effects on the landscape but the costs for grid connection will be unacceptable.

Scope
Sufficient, exact data missing.

Seabed conditions
Information missing but the seabed conditions are thought to be good.

Local wind conditions
According to SMHI, the wind speed is approximately 9,1 m/sec at a height of 80 meters. The values are

based on data measured in 2003.

Conditions for grid connection
The area only contains a 400 kV transmission line to connect to. Possible connection could take place at the 400 kV station at Hemsö in Blekinge. This would entail a relatively long sea distance but according to Svenska Kraftnät this is the best alternative from a transmission grid viewpoint. Investments in the station will be needed.

Environmental restrictions
According to the report "Marine fishing banks – knowledge overview and biological assessment", the bank has a high concentration of water fowl during the winter. The area is one of 13 Swedish areas that HELCOM has classified as an internationally important marine protection area.

Fishing and navigation
The area is probably important for fishing cod and herring.

Miscellaneous
The Swedish Defence Forces are opposed to the development of wind power in the area due to it being of importance for the defence systems.

8.2.6 Hoburgs bank

Water depth
The main part of the bank is 20-35 meters deep. There are however also areas that are approximately 15 meters deep.

Distance to coast
Approximately 20 km. The visual effect on the landscape is therefore small/acceptable and the cost of grid connection acceptable.

Scope
Sufficient, exact data missing.

Seabed conditions
The seabed contains ridges of coarse blocks of stone and gravel with surrounding rock areas.

Local wind conditions
According to SMHI, the wind speed is approximately 9,1 m/sec at a height of 80 meters. Values are based on data measured in 2003.

Conditions for grid connection
The area only contains a 400 kV transmission line to connect to. Possible connection could take place at the 400 kV station at Hemsö in Blekinge. This would entail a relatively long sea distance but according to Svenska Kraftnät this is the best alternative from a transmission grid viewpoint. Investments in the station will be needed.

Environmental restrictions
Hoburgs bank is one of the ten most important bird areas within The Baltic and Kattegatt and the area is of global importance as a hibernation area for long-tailed duck. 25% of Europe's long-tailed duck population is thought to hibernate on Hoburgs bank (The Swedish Environmental Protection Agency, Species and nature type guidelines). The bank is an important spawning and breeding area for many kinds of fish (Greenpeace, protect the oceans of Sweden). Grey seal frequent the area and the bank probably serves as a refuge for both plants and animals (Fishermen's Federation). Hoburgs bank is furthermore one of 13 Swedish areas that HELCOM has classified as an internationally important marine protection area. Hoburgs bank is a Natura 2000-area. The National Board of Housing and The Swedish Environmental Protection Agency are of the opinion that the area should remain untouched.
Fishing and navigation
National interest for navigation is north-west of the bank.

Miscellaneous
The Swedish Defence Forces are opposed to the development of wind power in the area due to it being of importance for the defence systems.

8.2.7 Persgrunden

Water depth
Approximately 4-15 meters.

Distance to coast

Approximately 18 km to Ramsö and 20 km to the mainland. The visual effects on the landscape are therefore small/acceptable and the cost of grid connection acceptable.

Scope
Sufficient, approximately 10,8 km2.

Seabed conditions
Persgrunden contains many shoals. The area looks like a mountainous landscape under the surface. The rocks/cliffs consists of massive granite and between them the seabed is sand, gravel and mud.

Local wind conditions
According to SMHI the average wind speed at a height of 100 meters is approximately 9,5 m/sec. These values are calculated from approximately 20 year long measurements from the stations at Nidingen, Vinga and Måseskär.

Conditions for grid connection
The area only contains a 400 kV transmission line to connect to. Possible connection could take place at the nearby station Skogssäter. Investments in the station will be needed. There is a well-developed regional grid of 130 kV in the area, which may be a better alternative.

Environmental restrictions
Persgrunden is situated in the coastal and archipelago area between Norway and Brofjorden and according to the EC, chapter 4, §3, large-scale wind power may not be established in this area.

Fishing and navigation
There is intense commercial fishing in the area, especially for crayfish and lobster. The Maritime Administration judges Persgrunden to be an inappropriate location due to the safety risks. Outside the area there is heavy sea traffic and the channel is so deep that there is no possibility to anchor a drifting ship.

Miscellaneous
The currents in the area are very strong. Persgrunden has by STEM been selected as a national interest area for wind power.

8.2.8 AB 1

Water depth
The Maritime Administration has looked at the area due to STEM's work on promoting a national interest for wind power, and according to the Maritime Administration, the seabed is very unstable with varying degrees of depth, such as 55 m and 77 m depth, between small shoals which are only between 7 m and 20 m deep.

Distance to coast
Approximately 45 km to Kappelskär. This means that there is no visual effect on the landscape when seen from the main land. A number of islands are however relatively close by and from these the visual effects would be great. The cost of grid connection would be high.

Scope
Sufficient, the shoal is 58,5 km2.

Seabed conditions
Specific information on the seabed conditions do not exist. As the larger part of the Stockholm archipelago consists of rocky seabed, a conclusion is that this is also the case here. The above-described "valleys" probably consist of mud.

Local wind conditions
According to SMHI the average wind speed is 8,8 m/sec at a height of 80 meters.
Conditions for grid connection
It is probably hard to get large cables through the Stockholm archipelago. This is due to consideration for the traffic and the large amount of islands. No suitable connection points have been found on the mainland.

Environmental restrictions
In the Norrtälje overview plan, the area is included in a large unspoilt area of the outer archipelago, which, according to chapter 3, §2, of the EC should be as protected as possible against measures that may influence the character of the area. The entire area of the archipelago is, according to chapter 4, §§ 2 and 4 of the EC, of national interest for the nature and cultural

heritage, meaning that any exploitation and other interference in the area can only be made if it, according to §1, takes place in a way that does not harm the area's nature and cultural heritage. The outer archipelago is the part, which from a nature and leisure point of view is most unique from a national as well as an international perspective. Due to this, large parts of the outer archipelago have been suggested for the UNESCO world heritage list. The area can be become a future marine reservation area. The Swedish Environmental Protection Agency has pointed out four protection-worthy areas in the county of Stockholm, which are also on the HELCOM's BSPA (Baltic Sea Protected Areas) list of areas which are to be considered as marine reservations with Svenska Björn and the surrounding area being one of these.

Fishing and navigation

A navigational lane of national interest touches the area in the northeast. This is where the heavy traffic to and from Åland navigates. Furthermore, some coastal shipping runs through the eastern part of the area. No significant commercial fishing occurs in the area.

Miscellaneous

The area is important from a nature and recreational viewpoint.

8.2.9 Finngrunden

Water depth

Between 4 and 30 meters.

Distance to coast

Between 25 and 50 km. The closest point to land from the west bank is about 25 km and the closest from the east bank is about 50 km. This means a minimal visual effect on the landscape but also very high costs for grid connection.

Scope

Sufficient. Finngrunden is one of the largest shoal areas in the country and has a theoretical potential for development corresponding to the entire 10 TWh goal set by the government.

Seabed conditions

The bank consists of a limestone plate with glacial deposits. Sand and gravel is the most common sediment but deeper depths are dominated by sand and mud. In some places the seabed is rocky. In the south-western part of the eastern bank there is a small area of sand. Moraine materials such as sand, gravel and rocks are in constant motion across the bank due to waves and drifting ice.

Local wind conditions

According to SMHI the average wind speed is approximately 9 m/sec at a height of 80 meters. The values are based on data measured in 2003. The energy potential in the area is 6500 kWh/m2/year according to the county council of Uppsala (Basis for STEM's delimitation of national interest within sea and coastal areas within Uppsala county).

Conditions for grid connection

A wind farm should be connectable to the transmission grid south of the critical border for transmission of electricity between the north and south of Sweden. A possible connection point could be Forsmark. However, according to Forsmark, they can only take approximately 270 MW.

Environmental restrictions

None.

Fishing and navigation

The amount of active fishing boats has increased in the past years and the fishing is primarily focused on herring. There are both Swedish and Finnish fishermen in the area.

Miscellaneous

Finngrunden is valuable from an archaeological viewpoint as it contains at least 14 known wrecks older than 100 years. Extractable resources of sand and gravel are found in the area. These deposits should not have such an impact as to hinder the development of a wind farm. The area is also valuable in terms of recreation. Finngrunden is hard hit by drifting ice. Data from 1980-2004 show that the ice often reaches a thickness of 50 cm. The drifting ice varies a lot but the northern and eastern winds pack the ice into mountains or valleys that in harsh conditions reach several meters in thickness and get stuck on the shoals forming ice towers (information from Jan-Eric Lundqvist, SMHI). Finngrundens west bank has been pointed out as an area of national interest for wind power by STEM.

8.2.10 Kriegers Flak

Water depth

16-42 meters (in the specified area).

Distance to coast

Approximately 30 km. The visual effects on the landscape are therefore very small and the costs for grid connection acceptable.

Scope

Sufficient, the specified area is 5400 hectare.

Seabed conditions

Kriegers Flak is a formation of moraine mud, layered with up to four layers of stones and blocks that have formed from the inland ice over various periods. In some places lenses of older mud deposited before the last ice age are very compact and hard. The underlying sedimentary bedrock is flat and relatively even and is probably made of limestone. On the site itself, the moraine mud is mostly found at the surface and these areas are often covered with stones and boulders. Within this area there are ridges with four to five meters height within a distance of 100 meters. Selected areas also have a thin layer of gravel and sand that in some places reach two meters in thickness.

Local wind conditions

The results from the wind studies that have been conducted vary between 8,7 and 9,6 m/sec. at 100 m height.

Conditions for grid connection

The possibility to connect to the electrical grid exists at numerous points in Skåne. The most interesting are Trelleborg Nord, Arrie, Sege and Barsebäck.

Environmental restrictions

There are no environmental restrictions in the area.

Fishing and navigation

National interest for commercial fishing.

8.3 Comparative discussion

Fladen has been rejected due to the conflict with the nature and environmental interests. As the Government has rejected the application for wind power development in this are,a this also means that Fladen is an unrealistic alternative.

Lilla Middelgrund is also an inappropriate location taking into account the big environmental interests.

A wind farm on Stora Middelgrund would probably mean risks to shipping and navigation. Furthermore the area within Sweden's economic zone is not big enough for a large wind farm development to be profitable.

Hoburgs bank, Norra Midsjöbanken and Södra Midsjöbanken have been rejected due to the conflict with the nature and environmental interests. A disadvantage for Södra Midsjöbanken is also the large distance to shore and a disadvantage for Norra Midsjöbanken and Hoburgs bank is the fact that the national defence forces are against wind power development in these areas.

Against development of Persgrunden is the intensive commercial fishing activity, the safety risks for shipping and navigation and the fact that according to chapter 4, §3 of the EC, there is not supposed to be any wind power development in the area. Furthermore, the seabed conditions are problematic.

A disadvantage for the area above-called AB1, is the large distance to shore and the fact that the area is in the unique, outer archipelago. For a wind farm to be financially profitable a lot of turbines with large capacity are needed, which means a large total height. Such a development would probably change the areas unique character in a very distinct way. The problems of getting the cables through the archipelago are also a disadvantage.

Finngrunden is the alternative location that Sweden Offshore finds most interesting. The area has no environmental protection-worthiness and is at an acceptable distance from shore. There are also no shipping lanes running through the area, the water depth is optimal and the surface with appropriate water depth is big enough for a large development. Furthermore, the councils of Gävleborg and Uppsala are positive towards a wind farm development in the area (verbal information at a meeting in the autumn of 2003). The area does, however, have several disadvantages. Finngrunden is hard hit by drifting ice and the sedimentary seabed is mobile due to ice movement and waves. This makes a wind power development very problematic. Sweden Offshore have investigated how a foundation construction could look which could take the power of the ice, but an economic and technically optimal solution has not been found. Finngrunden is also valuable from an archaeological viewpoint as it contains at least 14 known wrecks over 100 years old. The area also has recreational value.

Kriegers Flak is at a suitable distance from shore and has a water depth suitable for wind power development. Shipping lanes run just north and east of the bank at a safe distance. The seabed is primarily without vegetation and the area is in this respect not protection-worthy. There are also no classified environmental interests in the area. The area is however important for commercial fishing (national interest).

8.4 Choice of Kriegers Flak

STEM has devised a criteria template that is designed to indicate if an area is suitable for wind power development. Here, we use it to help determine if development should take place at Kriegers Flak. The results are summarised with the template criteria in the table below. In terms of “water depth for offshore location”, the original template was no longer valid as the technical development has brought new possibilities. Monopiles and other simpler types of foundations can today be used down to a depth of 25 meters. More advanced types of foundations make wind power possible at depths down to 40 meters. From the chart it is possible to see that Kriegers Flak gets a high score throughout, and for most of the criteria even the highest score. The score for the criteria “Industrial impact” is motivated by the fact that on the Danish side of Kriegers Flak there is gravel pit and quarry activities and there is a wind farm development going on in the German economic zone. Moreover, it cannot be ruled out that a wind farm will be built on the Danish side in the future. Put together, it demonstrates that Kriegers Flak meets the requirements of STEM criteria for a good wind power development very well, at the same time as a development there would entail a lesser burden on the environment than most of the other alternatives.

The National Board of Housing has on top of this singled out Kriegers Flak as one of the two most interesting locations in Sweden for large-scale wind power development (Conditions for large-scale development

Criteria	Categories of suitability					Suitability of Kriegers Flak
	-2	-1	0	+1	+2	
Wind energy content at 80 m height	<1500 kWh/m^2 *year *3	1500-2500 kWh/m^2 *year *3	<2500-3500 kWh/m^2 *year *3	<3500-4000 kWh/m^2 *year *3	>4000 kWh/m^2 *year *3	+2
Cost for grid connection	<2500 SEK/kW	2000-2500 SEK/kW	1500-2000 SEK/kW	1000-1500 SEK/kW	<1000 SEK/kW	0
Water depht	>40 m	>30 m	>25 m	10–25 m	<10 m	Total 0
Max. installed capacity	<1 MW	1–3 MW	3–5 MW	5–10 MW	<10 MW	+2
Impact on areas of national interest	2 areas of nat. interest		1 area of nat. interest		No areas of nat. interest	+2
Degree of industrial exploitation	No industry		Area partly industialized		Industrial area, port	+1
Distance from the coastt	3 km	5 km	8 km	12 km	>17 km	+2

of wind power offshore, Vänern and in the mountains). The second area that was singled out in the report as particularly interesting was Finngrunden.
Another important argument for the chosen area is that Sweden Offshore has great knowledge of Kriegers Flak due to the planned wind farm by the group on the German side. This, together with the possibility to co-ordinate the development of both farms, brings down the cost of establishing the wind farm. During June 2005, there will, for example, be a measuring and research station installed on the German side of Kriegers Flak – a large cost that does not burden the budget of Sweden Offshore.

With regard to the criteria "cost of grid connection", the following can be stated: In the case that a transmission connection between Sweden and Germany becomes a reality, the economy will be positively influenced for the three projects that would be involved (Kriegers Flak I and II and Baltic I). In the case of "transmission cable" (se Chapter 15.5), the degree of suitability +2 would be more correct.

The many advantages of Kriegers Flak (large area, no protection-worthy interests, hardly any influence on navigation and the landscape) as well as the enormous potential (the transmission cable and the co-ordination of developing three farms, possibly four with the Danish side) makes Kriegers Flak the most outstanding area for large-scale development of offshore wind power in Sweden.

Alternative layout/scope

9. Alternative layout/scope

According to the EC, the developer should also present those alternative ideas that have been studied with regards to layout and scope. The alternatives that have been discussed are the establishment of more turbines, fewer turbines, smaller turbines and larger turbines.

9.1 More turbines in a larger area

The advantages of building a larger wind farm are primarily financial. A lot of costs are fixed and the project will therefore be more profitable if more turbines are built. There are, however, many practical factors that make it hard to build more turbines at Kriegers Flak.

- The area is limited to the south and west by the borders to the German and Danish economic zones.
- The sea lanes that are close by limit further development to the north and east. A risk study shows that further development to the north would make the risk of collision significantly higher.
- A further development to the north would also mean that the farm would come closer to shore, which would mean an increased visual effect on the landscape.
- Regardless in which direction you increase the area (within Sweden's economic zone) you will automatically hit deeper water. As our studies show that there is a risk that the installation of turbines at a depth over 35 meters may influence the salt-water exchange in the Baltic negatively (see Attachment 5.2), there is a strong argument for not claiming a larger area.
- The depth of the water is also a limitation from a technical viewpoint as there is no current technique to build at deeper depths than 40 meters.
- As it is impossible to know exactly what impact an offshore farm of this size would have, this too is an argument against a larger farm.
- Finally, the capacity of the electrical grid needs to be considered. Our studies have shown that it would be hard to feed more electricity into the existing grid in Trelleborg and Arrie than what is currently planned for.

9.2 More turbines in the same area

One way to build more turbines within the area is to place the turbines closer together. The closer they are to each other, the worse the electricity production per turbine due to the wind shadow caused by the other turbines. As the distances that are currently planned (575 x 900 and 800 x 900 m respectively) are the shortest possible with regard to the wind shadow, it would be uneconomical to place the turbines closer together.

9.3 Fewer turbines

The main reason for not building a farm with fewer turbines is that the fixed costs (studies, laying down cables etc) remain the same making a farm with fewer turbines difficult to become profitable.

A situation may arise, however, where a configuration with fewer turbines with a lower total capacity is more economical, namely, if this would mean that only one connection point was required. In other words, if the connection point at the transformer station Trelleborg Nord could accept the entire capacity of the farm, a further cable to Arrie would become unneces-

sary. An example that has been studied and presented at the extended consultation, is the building of 86 turbines with a capacity of 5 MW, i.e. a total capacity of 430 MW.

9.4 Smaller turbines (less capacity)

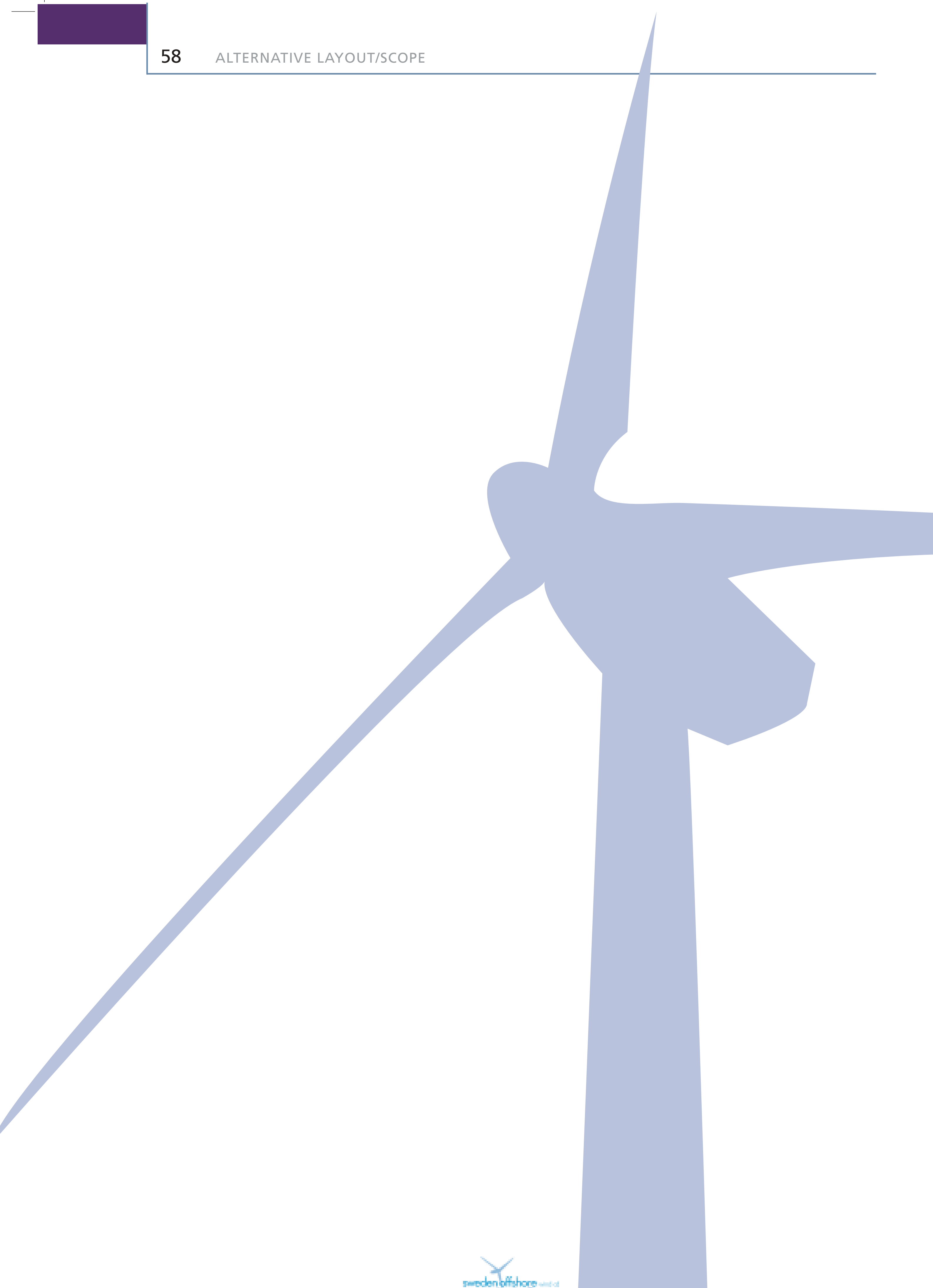
If smaller turbines are used, a larger area must be utilised or, otherwise, the same amount of energy cannot be produced.

As described above, it is difficult to increase the area used, but if one choses instead to produce less energy within the same area, then the financial profitability will be a limiting factor. As also described above, a configuration resulting in less energy production can be more economical if only one connection point is required. An example that has been studied and presented at the extended consultation is the building of 88 turbines with a capacity of 3.6 MW, i.e. a total capacity of 316.8 MW.

A further reason for using turbines with a lower capacity would be that 5 MW turbines are not yet in serial production.

9.5 Larger turbines (higher capacity)

Sweden Offshore plans to use the turbine model with the highest capacity available on the market at the time that procurement commences. This is assuming that the technology has been proven and tested. The construction is planned for 2007 and 2008 and it is currently not likely that a turbine with higher capacity than 5 MW will exist and/or be proven and tested. However, if this should be the case, Sweden Offshore is open to using a turbine with a higher capacity than 5 MW.



The Zero Alternative

10. The Zero Alternative

The zero alternative will describe how the situation will develop over time if the project is not realized (EC chapter 6, §7).

10.1 National energy supply

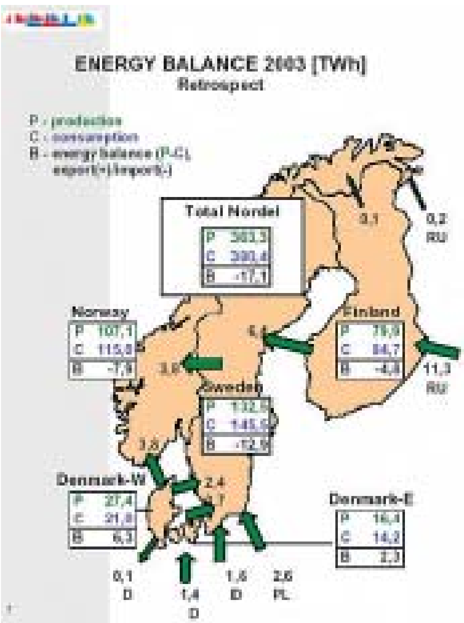
According to forecasts from STEM, the demand for electricity on the Swedish market will continue to rise at the same pace it has for the past ten years. This will lead to that Sweden will continue to be a net importer of electricity as the current Swedish production capacity will not be enough.

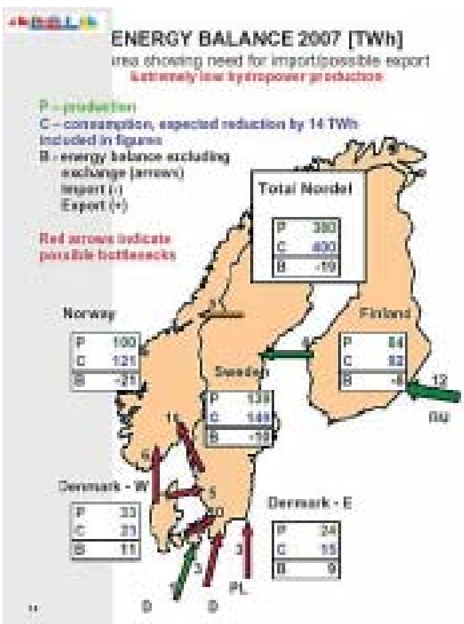
The pictures below show the import for 2003 and the expected level of import for 2007 (Nordel 2004). The pictures show that the imported electricity primarily comes from Poland and Germany. The zero alternative therefore results in that the marginal electricity produced from fossil and bio fuels will increase.

10.2 Environmental impact

10.2.1 Fossil fuels

If the wind farm is not built and the electricity instead is produced from fossil fuels, the following burden will be put on the environment:





Energy balance according to Nordel for 2003 and 2007, Nordel 2004.

- The mining of approximately 840 000 tons of coal/year
- Carbon dioxide emission of approximately 2 100 000 tons/year
- Sulphur dioxide emission of approximately 2 520 tons/year
- Nitrogen dioxide emission of approximately 2 100 tons/year

(Source: SOU 1999:75)

10.2.2 Wind power in a different location

Kriegers Flak meets almost half of the Government's goals for production from renewable energy sources, which is 10 TWh of additional electricity in 2010.
If the farm is not built and the electricity instead is produced by wind power at different locations, it will probably have greater visual impact on the landscape than the Sweden Offshore planned project at Kriegers Flak, as most of the other locations are closer to the coast or onshore. For Skåne, Kriegers Flak is the only area that far away from the coast.

10.3 The Kriegers Flak area

The zero alternative means that the marine environment and the seabed at Kriegers Flak are kept in the condition they are today. The zero alternative also means that the risk of over-fishing in the area remains. Finally, the zero alternative means that the free horizon remains as well as the fact that the collision risk disappears.

10.4 Alternative I to the zero alternative

A comparison has been made above with a case where no farm is built in the appointed area. It can, however, be questioned if this comparison is relevant. Kriegers Flak is one of the best locations for large-scale wind power development in Sweden and it is therefore likely that wind power will be developed at the location. Another company, Eurowind, already have plans for a farm consisting of 180-220 turbines. Compared to these plans, the alternative that Sweden Offshore presents in this document, means less of an environmental impact at the location but also that less energy will be produced.

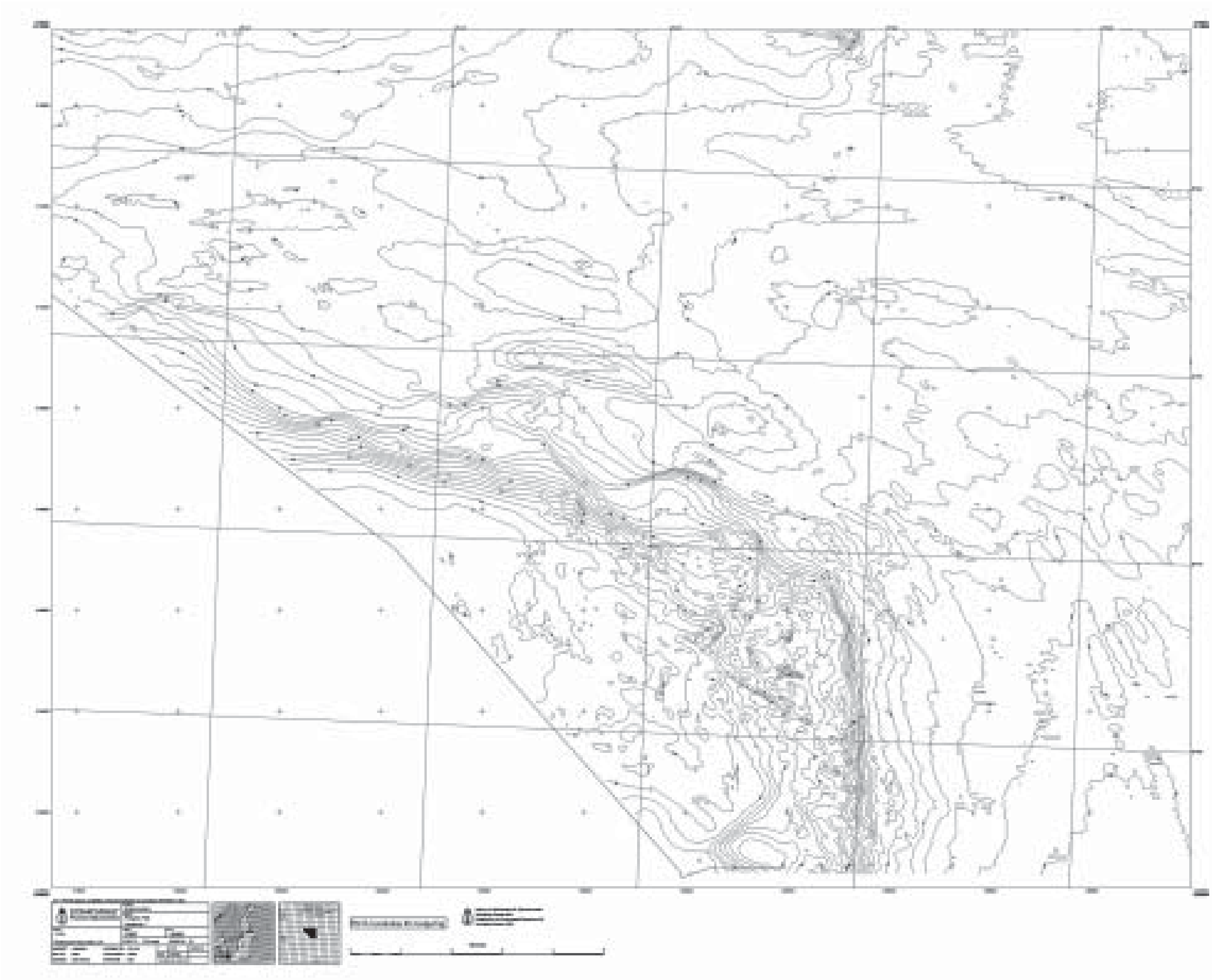
10.5 Alternative II to the zero alternative

As the permit for a wind farm within the German economic zone is expected early 2005, the scenario of this farm should be brought up as an alternative to the zero alternative. The only differences this brings is that the visual impact on the landscape remains, even if the impact in that case is a lot less, as well as the fact that the collision risk remains (se Attachment 12.2 chapter II).

Presentation of the area

11. Presentation of the area

In the following chapter we will describe the conditions of the selected area. We will deal with subjects like the seabed, wind, water and ice conditions, the presence of animals and plants as well as the cultural environment and the landscape picture. Also, the importance of the area for recreation, fishing, shipping, defence and extraction of natural resources are dealt with below.



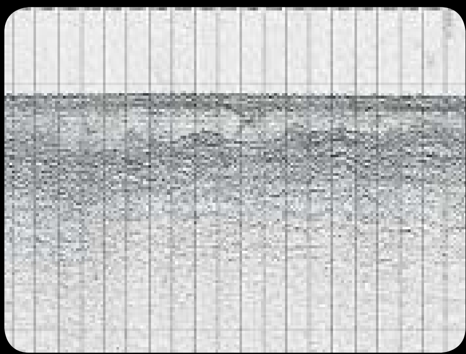
11.1 Geotechnology & geology

The sediments in the selected area was, on behalf of the Group, studied by Weigt during the autumn of 2003, with multidirectional echo sounding, side scanning sonar and reflected seismic methods. Wiegt has also researched the geological structure of the sediments south east of Kriegers Flak (German territory) with sonar reflected seismic methods. This was carried out during spring 2002 and autumn 2003.

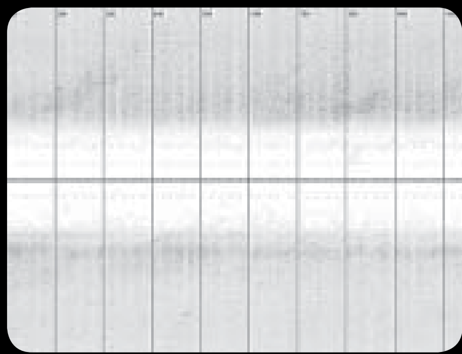
During the autumn 2004, on behalf of Sweden Offshore, Marin Mätteknik carried out an additional study between the transectional areas previously studied by Weigt. These examinations were also carried out with multidirectional echo sounding, side scanning sonar and seismic reflection methods.

In addition, SGI has, on behalf of the Company, made a geological compilation of officially available research work in the area.

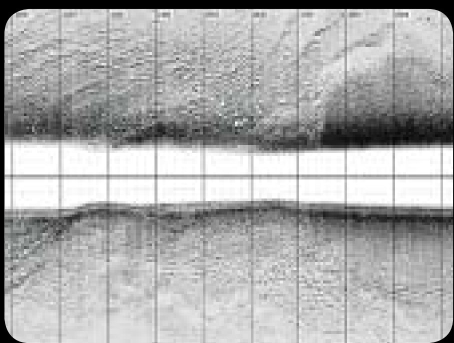
Examples of the research work is presented below in Attachments 4.1 and 4.2



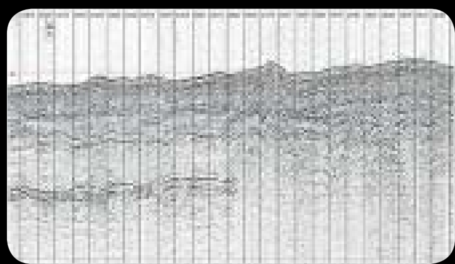
Example mixed sediment



Exampl sandy seabed



Example clay ridges side scan sonar



Example clay ridges seismic survey

11.1.1 General information about Kriegers Flak

Kriegers Flak is a raised seabed/submarine bank in the southern Baltic Sea. Water depth within central parts of the area is 16-17 metres, increasing to 20-25 metres at the borders. Outside the area the depth increases sharply to 40 metres or more. The seabed is made up of sediments from the last ice age on top of sediments from the cretaceous period.

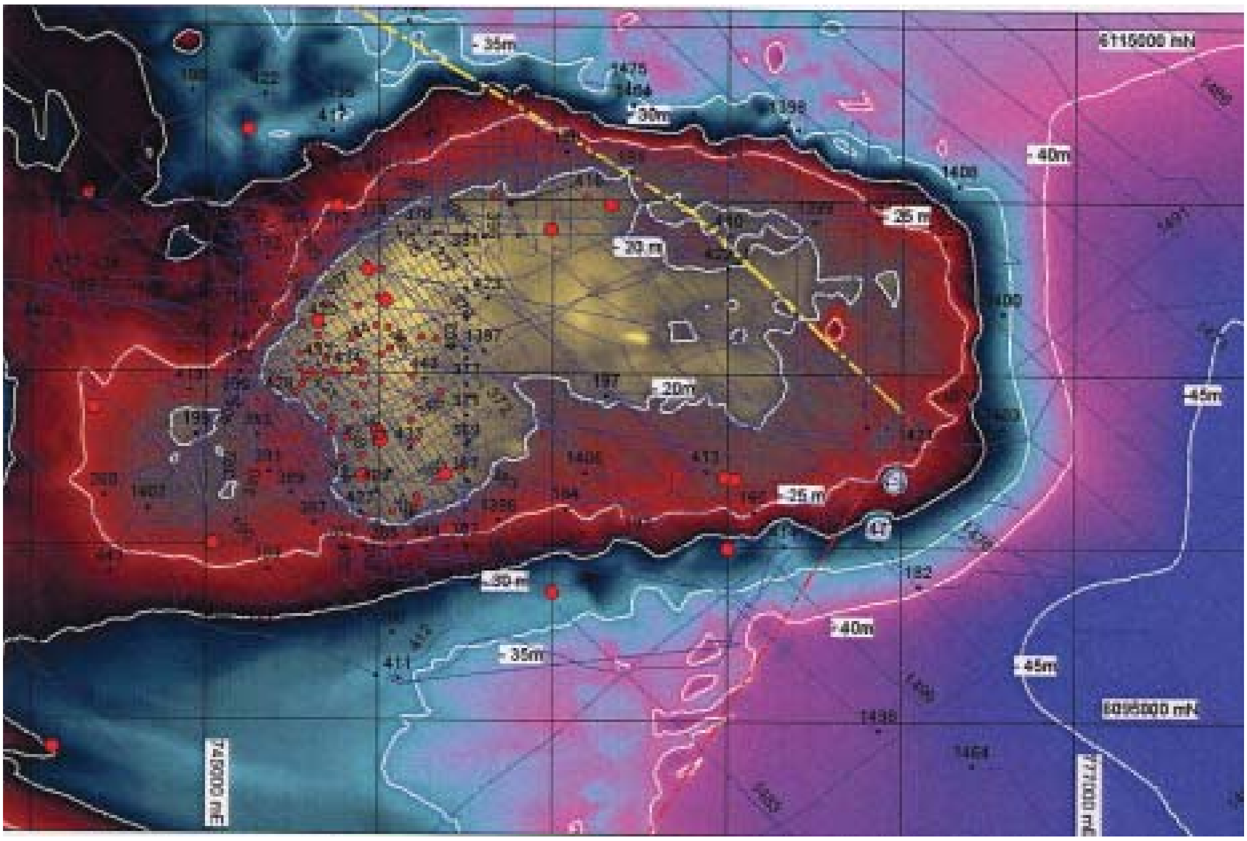
The border between the top of the sedimentary bedrock and the quaternary deposits is located within the actual area at a depth of between 50 and 60 metres.

The upper part of the layer, deposited before the quaternary period, consists of limestone, comparable to glacially deformed lime at nearby Møns Klint in Denmark. The nearest core drilling to great depth is at Smygehuk between the Danish and the Swedish economic zones, and marked Smygehuk I (Lat.N55° 18' 16.22", Long. E13° 03' 02.25").

There, the top 350 metres of the sedimentary bedrock consist of white, soft limestone with a rich occurrence of flint (up to 30%) in the upper part, but declining with depth and only sporadically occurring on greater depths than 150 metres. The changeover between quaternary sediment and the sedimentary bedrock was found to be at a depth of 42 metres below the surface, which indicates that the top level of the pre-quaternary deposits are likely to show small variations in depth and therefore assumed to be horizontal within the present area. Characteristics and quality for the upper layer of the bedrock is in line with the evaluations of the drillings Smygehuk I.

The composition and powerfulness of the removed sediment layers from the last ice age depend partly on the water depth and partly on local water conditions (currents, speed of water etc). In shallow waters, i.e. the central area of Kriegers Flak, quaternary sediments are found with powerfulness of generally less than 20 meters, while the sediment powerfulness south of Krieger Flak (Arcona basin) is more than 40 meters.

Overview of Kriegers Flak with isochrones showing the water depth. The yellow line indicates the border between the Swedish and the Danish economic zones (GEUS Report 2004/97).



Generally, the quaternary sediments consist of deposits from ice and glaciers, which, in their turn, have been superposed by sea and marine sediments.

The glacial landscape is in the north-eastern and south-western parts of Krieger Flak dominated by moraine ridges with a height of a few meters and spreading in north-westerly to south-easterly direction. The moraine ridges have probably been the source of pre-quartine erosions and movements of sand and gravel to other parts of the area.

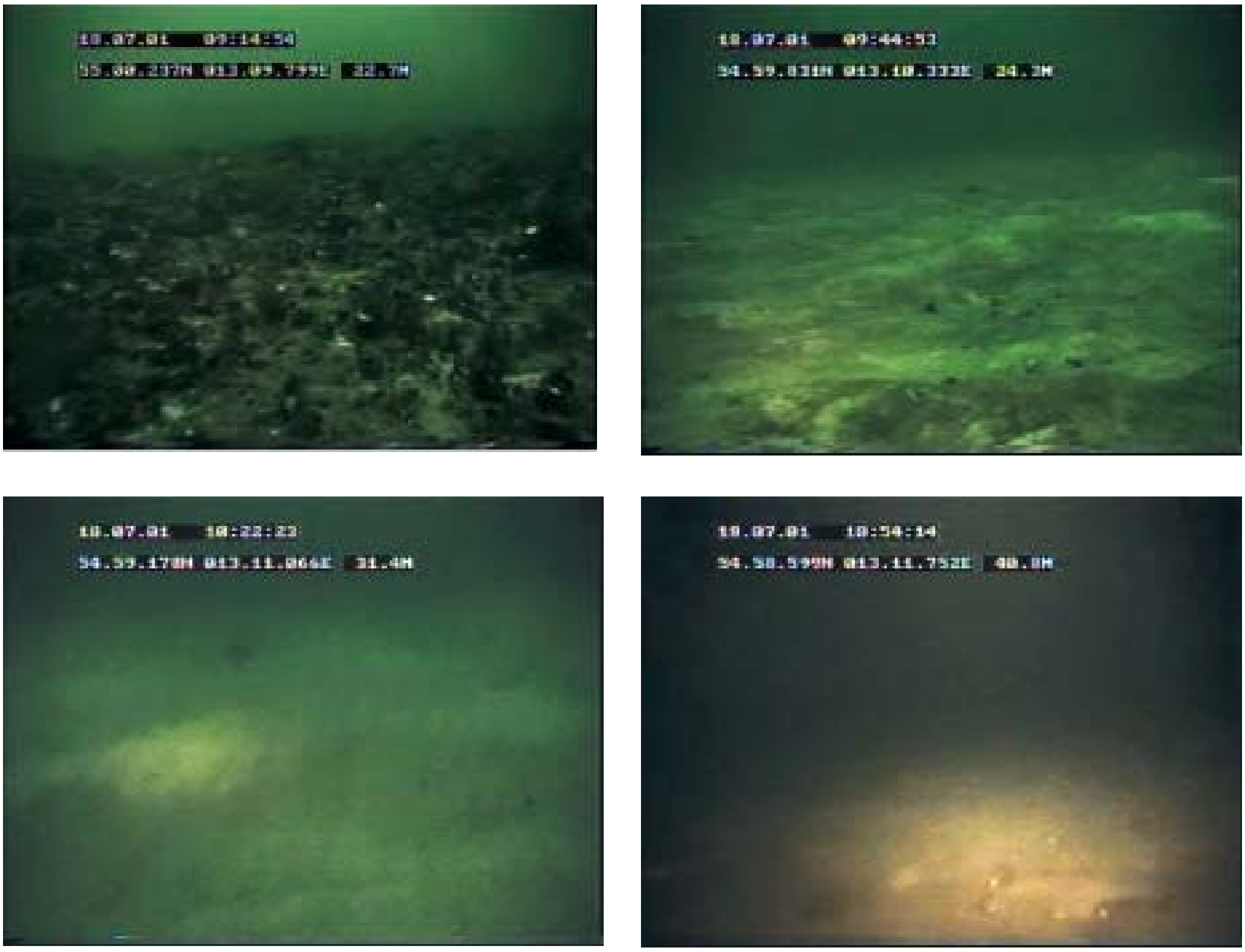
The moraine deposits are the oldest deposits on the seabed. Two of these deposits can be identified in the area. An early deposit of seabed moraine can be related to the ice movements and thereby creating deformations and deposits, and a later deposit in the shape of surface moraine. Further erosion and movement of sediments from the moraine areas are likely. Kriegers Flak was gradually covered by the Baltic ice-locked lake, which made coastal deposits along the peripheral areas possible. The main parts of the sand and gravel deposits dates back to the Littorina time and are deposited on the leeward side of the moraine ridges. Processes from later dates indicate erosions and deposits of sediments in connection with storms. An analysis of deposited material indicates that sediments with large content of gravel, stones and blocks are likely to have been deposited in direct connection with the shore deposits. These two moraine deposits are found at different depths, separated by layers of courser material, such as stones and rocks.

Fine and course sand deposits containing gravel and stones characterizes the central, shallower parts of Kriegers Flak.

Clay, deposited late during the last ice age and covering the moraine deposits, can be observed at depths of around 26 metres. A thin layer of sand usually covers the clay deposits.

11.1.2 Specifics for the selected area

The main part of the water depth in the selected area



Video footage from the seabed at Kriegers Flak varies between 16 and 25 metres, increasing towards north east. Along the outskirts of the shallow area, the depth quickly increases towards 40 metres.

In principle, all fine-grained sediments have already eroded from the top of Kriegers Flak, and the seabed therefore mainly consists of clay moraine, which probably, according to seismic and sonar research, is covered by courser sediments such as stones and rocks. Locally, the clay moraine is covered by thin sand lines even within the shallow area.

As the water depth increases towards northwest and gradually towards east/northeast, the seabed is influenced to a lesser extent by currents and movements of water, why finer coursed sediments can be found. In the outskirts of the shallow area at a water depth of around 40 metres, fluvial sediments can be found with a powerfulness of between 5 and 10 metres. The fluvial sediments are heterogeneous in their composition with grain sizes varying from mainly silt and clay soils, and locally with elements of organic material, passing from clay to mud-like soil. The fluvial sediments on top of the clay moraine, are usually covered by a layer of sand with powerfulness of a couple of metres. The seabed outside the peripherals generally stretches horizontally, showing only small variations in depth within the area studied. Locally, a limited number of cavities can be noted. In these cavities an increased powerfulness can be noted on both the fluvial sediments and covering sand layer. The sediments may also contain courser material such as gravel, stone and rock.

As mentioned previously, moraine ridges along the seabed can be observed in the north-eastern part of Kriegers Flak. The ridges show a height of around 5 metres.

The peripherals of the bank are in the north-eastern part covered by gravel, stone and rock.

For a more detailed description of the specific geotechnical conditions, see Attachment 4.3.

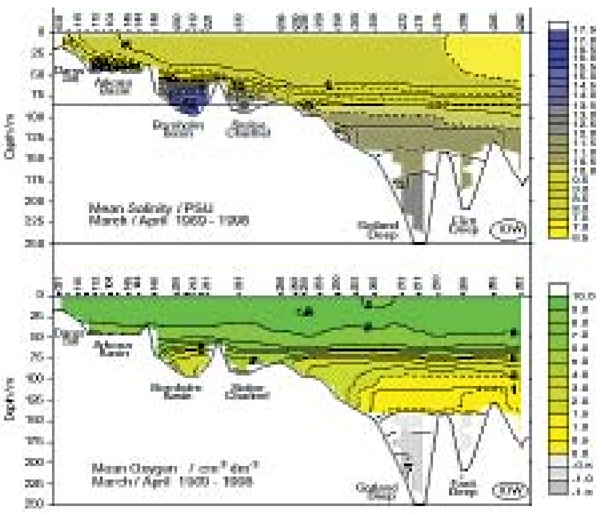
11.2 Hydrography

11.2.1 Current conditions/flow of salt water in the Baltic Sea

Kriegers Flak is situated in the south-eastern part of the Baltic Sea on the western edge of the Arcona basin, which is the most westerly of a number of cascade shaped basins in the southern Baltic. The deepest basin is the Gotland basin at 460 metres.

The Kriegers Flak bank is an area with around 20 metres depth surrounded by a seabed with a depth of 35-40 metres. The water depth east of Kriegers Flak in the central parts of the Arcona basin is around 45 metres.

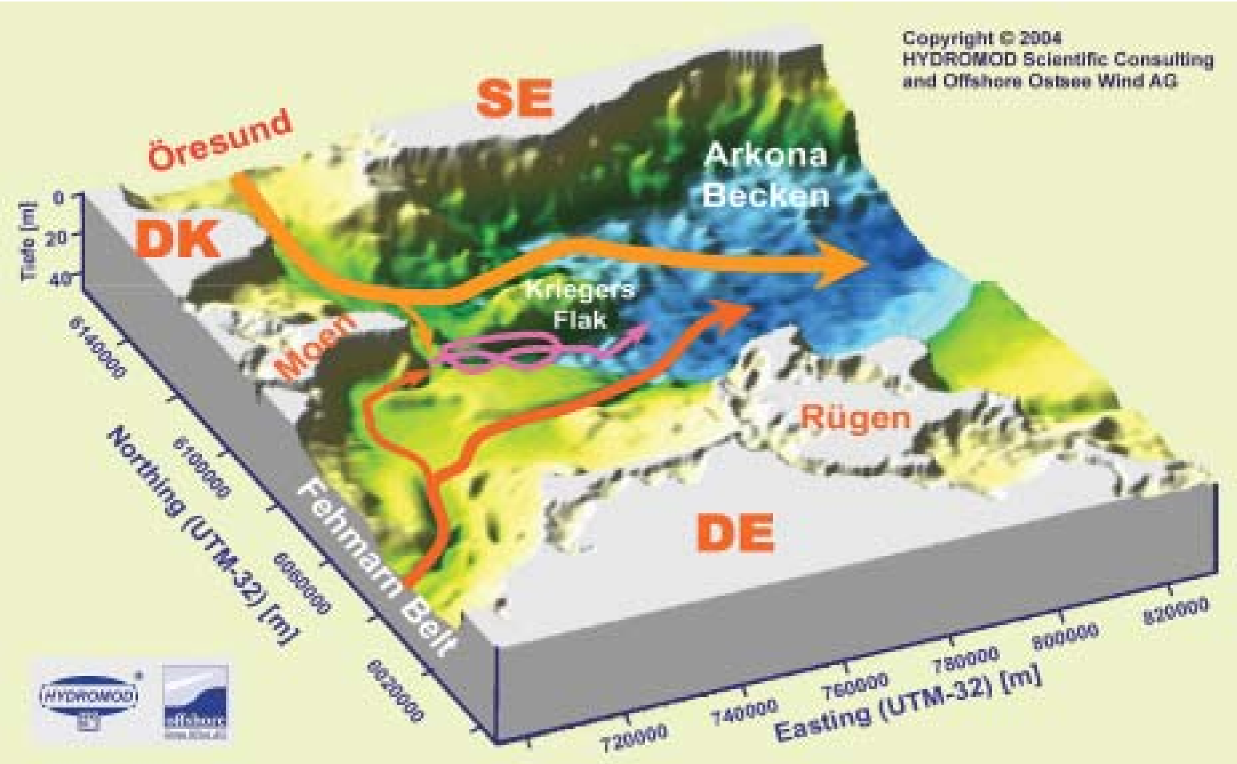
The Baltic is generally completely surrounded by land masses and the only connection with the North Sea is via Store and Lille Bælt and the strait of Öresund. The cross-section of these straits is small in comparison with the total area of the Baltic, obstructing the natural flow of water. The flow is further restricted by two thresholds at 18 and 8 metres depth respectively (Darss and Drogden). On its way through the Belts, salty water mixes partly with out flowing bracken water, and has by the time it reaches the threshold received the salinity and oxygen needed for the forma-



Salt and oxygen levels, the sea of Arcona

PATHWAYS OF CURRENTS IN THE BALTIC

Salty seabed water enters through Öresund and passes the Drogden threshold and then moves between Mön and Kriegers Flak down towards the Darss threshold, where it falls in under the Darss current. These two currents continue anti-clockwise from the south-western corner of the Arcona basin and follow along the southern line towards Cape Arcona where they intermingle/mix. Thereafter the salty water moves down to the deep parts of the Arcona basin or continues northeast along the narrow inlets of Bornholm. A part of the Drogden current divides northeast of Kriegers Flak and moves clockwise to join up with the westerly Drogden current in the south-eastern corner of the Arcona basin. Via the narrow inlet of Bornholm, the salty seabed water in the Arcona basin moves further east, ending up in the Gotland basin. Reference: On the pathways and mixing of salt-water Plumes in the Arcona Sea, 2003, H.U. Lass, IOW, Warnemünde.



Inflow of salt-rich deep layer water into the Baltic, Hydromod

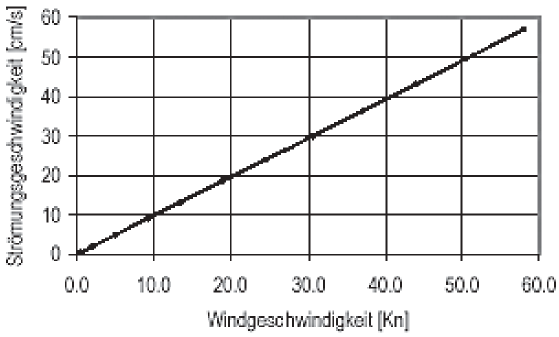
tion and exchange of the deep water of the Baltic.

The figure above illustrates the salt and oxygen content of the different Baltic basins.

The water balance of the Baltic Sea is characterized by a yearly surplus of 470 km³ fresh water. This allows a flow of bracken water with a salinity of eight PSU from the Baltic into the Skagerak (water in the upper layer). The surrounding waters of Skagerak have a very much higher salinity, 33 PSU, and are hence considerably heavier. This water plume with heavier water is the source of a pressure gradient creating a flow of heavier and saltier water from the Skagerak into the Baltic (the water at the seabed). This is described as inland sea circulation and is occurring during the summer half of the year.

The current condition in the Baltic is very variable and driven mainly by the wind, horizontal density gradients and differences in the water level (Fennel

1995). During normal winter storms the water level in Kattegat increases and, in comparison to the southern Baltic, there will be a height difference of ca 1 metre. This increased water level generates a greater inflow of salt water from Kattegat via Öresund, increasing the



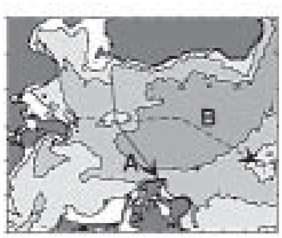
Samband mellan vindhastighet och strömningshastighet
Correlation between wind speed and current flow speed

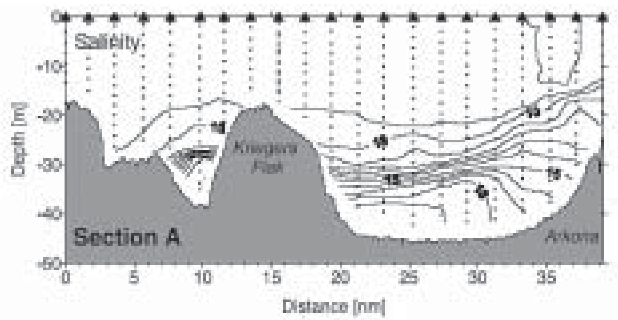
salination level in the Baltic. Periods of five to ten days of storm will also increase saltwater currents through the Bælts for the same reason.

With a frequency of three years or more, large additions of salty water occur caused by prolonged winter storms preceded by periods of high pressure, forcing water from the Baltic, thus lowering the water level considerably. This prolonged inflow means that the Belt sea front, where the bracken water mixes with the salty sea water, is shifted forward to the Darss threshold. This makes it possible for a mixed water plume with a salinity of at least 17 PSU to move into the Arcona basin and later fill up the other basins with heavy and oxygen rich water. These large additions of salty water are less frequent, resulting in a shortage of oxygen in the deep basins of theBaltic.

11.2.2 Salinity, temperature and oxygen content

The area at and around Kriegers Flak is hydrologically well documented. SMHI has since 1958 a measuring station in the Arcona basin east of Kriegers Flak measuring temperature, salination and oxygen content once





or twice a month at each five metre interval from the surface down to a depth of 45 m (BY2). This measuring series can be downloaded from www.smhi.se.

IOW in Rostock is working on a model for the salt level balance of the entire Baltic, taking into account the cumulative effects of establishing a number of offshore wind farms. Results should be known during 2005.

On behalf of the Group, the water conditions around Kriegers Flak have been researched continuously by IfAÖ during 2002-2003. This was carried out simultaneously with other water related environmental

Hydrographical data (median values +/- SD) during the three fishing campaigns in the test area in 2003

	Salt content [PSU]		Water temperature [C°]		Oxygen content [mg/l]		[% fullness]	
	Surface	Seabed	Surface	Seabed	Surface	Seabed	Surface	Seabed
Spring 2002								
Median values	7,6	7,9	15,6	13,9	9,1	8,6	91,5	83,1
Standard deviation	0,2	0,6	0,3	1,3	0,2	0,2	1,9	1,9
Differens surface/seabed Measurements: n=10	-0,3		1,7		0,5		8,3	

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	Salt content [PSU]		Water temperature [C°]		Oxygen content [mg/l]		[% fullness]	
	Surface	Seabed	Surface	Seabed	Surface	Seabed	Surface	Seabed
Summer 2002								
Median values	7,5	7,4	19,5	16,4	8,1	8,0	88,6	86,7
Standard deviation	0,1	0,3	0,2	1,3	0,4	0,3	3,5	2,9
Differens surface/seabed Measurements: n=11	0,0		3,1		0,2		1,9	
Autumn 2002								
Median values	7,9	16,6	11,2	10,5	10,4	7,8	94,0	70,0
Standard deviation	0,0	4,6	0,2	0,4	0,2	0,7	1,3	6,9
Differens surface/seabed Measurements: n=11	-8,6		0,7		2,6		24,0	

research. Similar investigations on the German side of Kriegers Flak gave the following results regarding salinity, oxygen level and water temperature:

During the month of May 2003, the surface temperature varied between 9.5 and 13.0°C and at the seabed between 7.7 and 10.5°C.

During month of July 2003 the surface temperature measured, showed variations of between 9,5 and 13,0°C and between 7,7 and 10,5°C at seabed level.

During July 2003, the surface temperature within the research area was between 17.2 and 18.8°C. At seabed level sharp variations were noted in temperatures between 5.9 and 12.3°C. In September 2003 the surface temperature only varied with 0.8°C between 14.3 and 15.1°C, whilst the seabed temperature measured between 13.0 and 14.8°C.

The temperature of the surface water during 2003 is relatively uniform within the researched area. As during 2002, the temperature at the seabed locally varies with an amplitude of 6.4°C (summer 2003). The difference in temperature values at surface and seabed was greater during the summer and reached at various measuring stations values of 11°C. During spring, differences were between 0 and 4.6°C. In the autumn only small differences were measured of between 0 and 1°C.

During the 2003 period of research the salinity level showed surface values between 7.2 and 8.6 PSU and at

Hydrographical data (median values +/- SD) during the three fishing campaigns in the test area in 2003

	Salt content [PSU]		Water temperature [C°]		Oxygen content [mg/l]		[% fullness]	
	Surface	Seabed	Surface	Seabed	Surface	Seabed	Surface	Seabed
Spring 2003								
Median values	7,6	15,5	10,9	8,6	11,2	10,4	101,2	90,0
Standard deviation	0,2	2,2	0,8	0,7	0,3	0,4	0,7	4,4
Differens surface/ seabed	-7,9		2,3		0,8		11,2	
Measurements:	n=20		n=20		n=6			
Summer 2003								
Median values	7,6	15,4	18,1	10,1	9,3	3,3	99,8	34,8
Standard deviation	0,2	3,0	0,5	2,0	0,4	2,1	5,2	21,9
Differens surface/ seabed	-7,8		8,0		6,0		65,0	
Measurements:	n=20		n=20		n=20			

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	Salt content [PSU]		Water temperature [C°]		Oxygen content [mg/l]		Oxygen content [% fullness]	
	Surface	Seabed	Surface	Seabed	Surface	Seabed	Surface	Seabed
Autumn 2003								
Median values	7,8	15,1	14,7	14,3	9,4	5,2	96,8	52,3
Standard deviation	0,1	2,2	0,2	0,4	0,2	2,0	1,8	20,1
Differens surface/ seabed	-7,3		0,4		4,2		44,5	
Measurements:	n=19		n=19		n=19			

the seabed, greater variations, depending on position, from 8.6 and up to 18.9 PSU.

The median value of salinity close to the seabed, varied very little through the seasons, and during the three periods it measured between 15.1 and 15.5 PSU.

The tests show that during year 2003 the oxygen level at the surface was between 8.8 and 11.4 mg/l, which in percentage terms is between 93 % and full saturation.

At the seabed, large variations were measured, and only during spring the values were high and comparable with the surface values of between 9.7 and 10.9 mg/l (saturation of 83-96%).

During the summer, on the other hand, a pronounced lack of oxygen at seabed level in these areas was noted ($\geq$ 40m), with minimum values for O2 of only 1.1, whereas in areas above the 40 metre line, oxygen levels were 7,4 to 8,1 mg/l.

The autumn tests carried out during 2003, showed in average a slight improvement of the oxygen level (5.2 mg/l). The areas near the seabed still showed very low values of 1.6 – 7.7 mg/l O^2.

The median values of temperature, salinity and oxygen vary largely between surface and seabed.

11.2.3 Depth visibility

During the investigations in 2003, described above, also the depth visibility was researched. During spring of 2003 this was measured to 6.0 m and during the summer and autumn to an average of 4.8 metres.

11.2.4 Ice Conditions

Ice is sometimes formed around Kriegers Flak. The risk of ice formation depends on the wind direction, salinity of the water, (lesser salt the greater risk of ice), currents and depth.

Westerly winds bring in mild air from the Atlantic into the Baltic area and hence no ice formation with winds from that direction. If the wind, however, comes in from east, the Baltic is cooled down, which could lead to ice formations. During very severe winters the ice will cover the whole of the Baltic east of Bornholm. However, this has only occurred three times during the twentieth century.

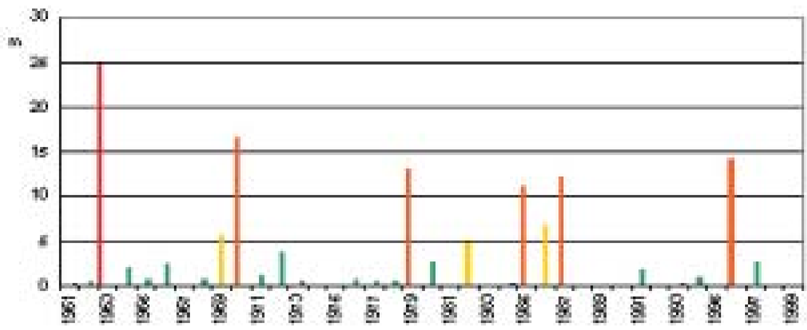
On behalf of be the Group, Germanischer Lloyd has compiled information, collected during 30 years, of ice conditions around Kriegers Flak. The result is shown in the table below:

According to observations made by the ice depart-

Number winters		Average number of days with ice per year			
Observed	Ice free	Mild and normal winters		Cold and extremly cold winters	
		<70 %	70–100 %	<70 %	70–100 %
30	19	0	0	20	16

The percentage indicates to which degree the water surface is covered by ice ment of the German BSH during a span of 40 years, the water freezes west of Bornholm about 10-15% of all winters. During these years drifting ice (classified as thick ice, 30-40 cm, to very thick ice, 50-70 cm) may, depending on wind direction, in a few days move between the German, Swedish and Danish coasts. The ice periods last between January and the middle of March. The maximum thickness of ice around Kriegers Flak has been estimated by BSH to 60 cm.

Formations of very thick drifting ice can occur in the Baltic Sea. This is however very rare. At Kriegers Flak, the German BSH estimates the thickness of this drifting ice walls to more than one metre.



Ice-winter classification, Mecklenburg-Vorpommern 1961 – 99, BSH

11.2.5 Wave size

Rough seas will depend on the strength of wind, direction, duration and possible swells.

Swells play a lesser role at Kriegers Flak and will occur relatively seldom, around 4% of time.

The highest wave height were the wind farm is planned is between 6 and 7 metres. This wave height will only occur during late autumn and winter storms.

High waves of 3,5 to 4,5 metres seldom occur but can be found all year around.

Rough seas with waves of 2 to 3metres is common during autumn and winter and are observed mainly during November and December.

Moderate sea with 1 to 1.5 metre waves occur during one third of the time.

Calm sea, 0-0.5 m waves, are characteristic from May until August.

Ice along the shore line will reduce the height of waves as wind blowing distance is reduced.

11.2.6. Sea level

Variations of the sea level largely depend on the winds in the Baltic. In this connection it is the large scale winds, as opposed to the local winds, which are of importance.

wave height/heavy sea	very high ≥ 5 m	high 3,5-4,5 m	rough 2–3 m	moderate 1–1,5 m	calm 0–0,5 m
January	0,2	1,4	22	43	33
February	0,2	1,0	21	43	36
March	0,2	1,0	17	44	38
April	0	0,4	10	38	50
May	-	0	6	35	57
June	-	0	8	36	54
July	0	0,1	13	40	47
August	0	0,2	13	40	46
September	0	0,3	19	42	37
October	0,2	0,5	20	43	35
November	0,2	0,6	21	44	33
December	0,3	1,0	24	44	29
Årssnitt	0,1	0,5	16,2	41,0	41,2

Source: BSH (1996) *percentage of time*

The wind forces the water against the shores. When the wind drops, the water flows back creating a rotation, rather like in a bathtub, when it reaches the opposite shore.

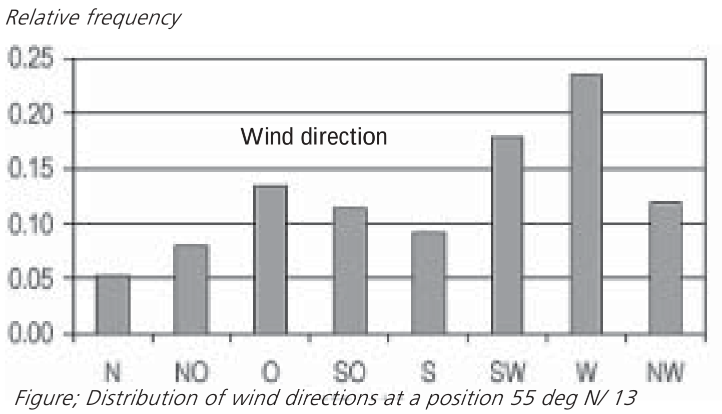
The greatest variations of the sea level in the Baltic occur at south-westerly and north-easterly storms.

Observations of the sea level in the area between Flensburg and Klaipeda, between the years 1901 and 1940, showed that only 15 % of the year high and year low respectively, exceeded +/-125 cm. In 50 % of cases the sea level variations were within +/-25 cm.

11.3 Wind conditions

The winds at Kriegers Flak are during summer time predominantly westerly, whilst during winter, easterly winds are quite common. The wind direction is between southwest and northwest just over 50 % of time.

Three different surveys of the wind resource Kriegers Flak have been carried out at.



Figure; Distribution of wind directions at a position 55 deg N/ 13 deg 18 min E of Kriegers Flak

The first survey made is accounted for in earlier consultation material, i.e. measurements from a buoy with a ten metre high measuring mast from the German meteorological station "Darsser Schwelle". Based on this survey, the average wind speed was calculated to 9.6m/s at 100 metres hub height. Since these measuring data were relatively uncertain (measuring height was only 10 metres), two new surveys have been carried out. One according to the WASP model and one according to the MIUU model.

Based on wind data from SMHI during 1980-89 from the high mast at Maglarp, the average wind speed has, with the help of the WASP method, been calculated to 8.7 m/s at 100 metres hub height. The main wind direction was 240 – 300 degrees.

The meteorological institution at Uppsala University has through the use of its MIUU method calculated the average wind speed in the area to 9.1 m/s.

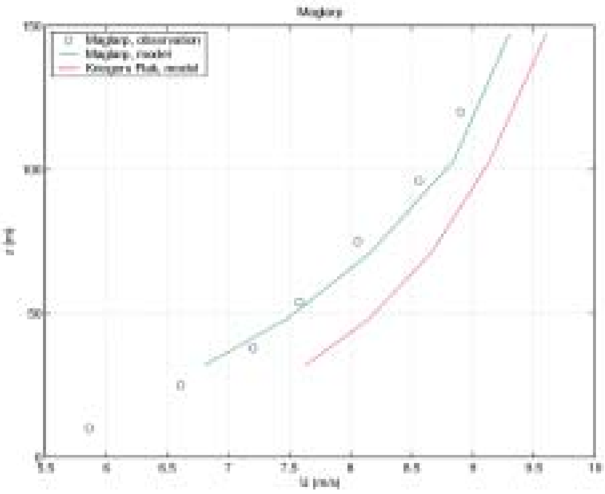
A comparison between measurements from Maglarp and the MIUU model for Kriegers Flak can be seen in the diagram on the right. In the diagram a MIUU simulation of the wind climate for Maglarp is also shown. When comparing the measured readings from Maglarp with the simulated wind climate, it shows that the MIUU model correlates well with measured series.

Since the MIUU model not yet is verified for measurements at sea, Sweden Offshore will use to the lower wind speed of 8.7 m/s.

The figure 8.7 m/s can be compared with the main criteria of the Swedish Energy Agency to recommend an area as being of national interest for wind power i.e. the wind energy should be calculated to at least 3 800kWh/m² per year at a height of 80 metres. This corresponds to an annual average wind speed of around 7.2 m/s.

Sweden Offshore is planning to erect up to three 100 metre tall measuring masts to verify the performance of the farm.

Germany is further more preparing the building of the meteorological research station FINO II at Kriegers Flak, which very accurately will establish the wind resource in the area.



Wind speed measured from the measuring mast at Maglarp in the period 1980 – 89. Simulated wind speed according to the MIUU model for Kriegers Flak and Maglarp

11.4 Visibility Conditions

The German Meteorological Office has on behalf of the Group carried out a study regarding visibility conditions and the visibility of the wind farm. The description below is based on that report, which can be found in Attachment 11.2.

Regarding visibility from Falsterbo out over the Baltic Sea, the following statistics have been compiled:

The statistics show that visibility above 40 km is rare. On average this is the case in only 8.3% of the hours in a year. Best visibility is in May and September. Similar statistics from Rügen show that visibility out over the Baltic Sea is only 30 km., i.e. the same distance as from Trelleborg towards the nearest wind turbine during less than 10% of the hours in a year.

Month	Hour of the day								
	0–2	3–5	6–8	9–11	12–14	15–17	18–20	21–23	alla
Jan	3,6	3,6	3,2	4,0	4,7	3,6	2,2	3,2	3,5
Feb	1,4	1,6	1,2	2,2	3,6	3,6	2,4	1,8	2,2
Mrs	3,6	2,9	2,7	3,8	8,1	8,1	5,1	3,5	4,7
Apr	4,7	3,9	5,1	6,7	8,5	8,8	9,7	6,6	6,8
May	11,2	7,2	10,1	14,1	17,0	19,6	22,9	15,0	14,6
Jun	4,9	3,9	5,4	9,9	15,1	17,4	16,6	9,2	10,3
Jul	7,9	3,6	7,3	11,0	16,9	17,8	17,9	11,4	11,7
Aug	6,5	3,4	6,3	9,7	16,0	13,2	14,3	8,0	9,7
Sep	12,2	10,6	10,6	12,8	20,4	18,3	13,8	13,0	14,0
Oct	9,2	9,1	7,3	9,4	14,1	14,9	9,0	9,9	10,4
Nov	7,1	7,7	5,2	6,9	9,9	10,3	6,7	7,0	7,6
Dec	3,4	4,8	4,0	4,5	5,4	4,7	3,1	2,4	4,0
Annual average	6,3	5,2	5,7	7,9	11,7	11,7	10,3	7,6	8,3

Percentage of time when the visibility is over 40km

Month	Time	Per month
	Hours	km
Jan	7–15	13,4
Feb	6–16	20,6
Mrs	5–17	38,8
Apr	4–18	55,4
May	3–19	140,6
Jun	2–20	153,6
Jul	3–20	167,9
Aug	4–19	121,7
Sep	5–18	87,9
Oct	6–16	40,6
Nov	7–15	26,3
Dec	7–15	18,8
Total per year		875,1

Visibility of the German wind farm at > 30 km distance, Deutsche Wetterdienst

11.5 Flora

Flora within the chosen area at Kriegers Flak, on the German and partly on the Danish side, has on behalf of the group been researched by IfAÖ (Institute for Applied Ecology Ltd) with the aid of a video camera and samples of the seabed. The full study can be found in Appendix 6.1.

The research shows that the area has a heterogeneous biotope structure. Especially the shallower parts of the proposed construction area, offer stone and rock provide naturally hard substrata. Towards northeast, fine and medium-fine sand is usually found.

During the preliminary surveys, thin existence of small samples of red algae on stones and mussels were observed. The level of cover was very low. Below 25 metres, only a few algae were found. Due to methods of survey and the small size of the samples, no exact definition of species on the Swedish side has been carried out.

At investigations in the outskirts of the German economic zone, different species of algae on small stones have been discovered at depth down to 25 metres. The red algae Rhodomela confervoides was well represented. Four additional species of algae were sporadically discovered in the bentos tests: Sphacelaria pluigera, Coccotylus (Phyllophora) truncata, Plysiphonia fucoides and P. fibrillosa.

Diving tests carried out during the summer 2002 discovered only one further species of red algae, namely Ceramium virgatum (formerly C.nodulosum).

Drifting algae was noted sparsely within the entire Swedish test area. Occasionally, Laminaria saccharina, was detected in the under-water pictures. It has not been established whether these algae have drifted in or if they are of an autochthonic population.

At tests carried out at the outer parts of the German economic zone, rich occurrence of drifting plants and parts thereof have been established. At test stations at a depth of between 25 and 35 metres during e.g. spring 2002, odd samples of Fucus vesiculosus, Laminaria

Photo of sugar wrack Laminaria saccharina from the test area

saccharina and fragments of Zostera marina were discovered. These species do not grow below the depth of 24 metres in the Baltic Sea. Also the green algae Blidingia minima has probably drifted in.

In summary, it can be established the flora within the area is typical for similar environments in the Baltic Sea and no red listed plants have been discovered.

11.6 Animal life

11.6.1. Invertebrate benthic fauna

In September 2003 IfAÖ, on behalf of Sweden Offshore, made an inventory of the selected area at Kriegers Flak. With the aid of a video camera the conditions of the seabed were studied in five transections, see illustration below. Seabed trawling was not possible due to large areas of stones and rocks. The area was researched by side viewing sonar and by multidirectional echo sounder.

Register of species for macrophytes at Kriegers Flak (d: only drifting specimens)

Classs	Taxon	Occurance at Kriegers Flak
Chlorophyceae	Blidingia minima	d
Phaeophyceae	Fucus vesiculosus	d
	Laminaria saccharina	d
	Sphacelaria plumigera	- 20m
Rhodophyceae	Ceramium nodulosum	- 25m
	Phyllophora truncata	- 25m
	Polysiphonia fucoides	- 25m
	Polysiphonia fibrillosa	- 25m
	Rhodomela confervoides	- 25m (30m)
Spermatophyta	Zostera marina	d

INVERTEBRATE BENTHIC FAUNA

The composition of species of benthic fauna in the Baltic is mainly dependant on the salinity of the water. The higher the salinity, the more marine species are present. In the area around the Arcona basin there are for that reason many species in comparison with the central and eastern parts of the Baltic. But in comparison with number species in the Sea of Bælt in the west, from the Mecklenburger Bay to Kattegat, there are on the other hand smaller numbers present. The benthic fauna in the western Baltic consists mainly of species immigrated from the North Sea and who's tolerance for the lower salinity varies from species to species. In the western Baltic, 240 different invertebrate benthic fauna species have been discovered, of which the majority are found in waters with a higher salinity. Of the invertebrate benthic species in the Baltic, the ringed worm Anelida with subspecies polycheat, Polychaeta and earth worm, Oligocheata, are the most common. Apart from these there are further species of molluscs Mollusca (mussels and shells) and crustaceans, Crustacea.

The table on next page shows the composition of species at Kriegers Flak.

In the Arcona basin there are only about 50 different species of invertebrate benthic fauna. The number varies within the basin depending on the hydrographical and sedimentation conditions.

In the Arcona basin the composition of benthic fauna is decided by both depth of water (above and below the halocline) and by the substrate (for instance mud, sand and stone).

The composition of macrozoobentos in the Arcona basin shows that few species exist. For over a hundred years the quantitative composition in the area has been documented. Up to 1950 there were only 7 different species. During the last century the number of species in the Arcona basin increased in several different spells. In the 1920's for instance, the polycheat, Nephtys ciliata immigrated, in the 1950's the iceland mussel, Arctica islandica and in the 1960's the polycheat species, Phyllodoce mucosa and Trochochaeta multisetosa.

In the 1960's there were 12-18 different species in the area and after the large supply of salt water in the 1980's as many as 24 species (HELCOM 1991a and b). Hardly any of the species in the Arcona basin stay permanently in the area.

The Baltic flat mussel Macoma baltica is the species which stays in the area on a more continuos basis. Only during years of a prolonged lack of oxygen it will abscond from the area. In the outer areas of the Arcona basin the, number of species for macrozoobentos is increasing. In a survey east of Rügen at a depth of 20-40 metres, 30 different species were found (Gosselck 1985). In the area of Rønnenbank 15 species were discovered in 1991 (Miljøministeriet Skov-og Naturstyrelsen 1994). In the beginning of the 1990's Kube (1996) registered 25 different species in the Adlergrund trench. Most species were however discovered in the 1950's under the auspices of Löwe (1963), when 40 different species were discovered. Of particular interest were the findings of different species of crustaceans which do not normally exist the south-eastern parts of the Baltic, for example Pontoporeia affinis and Saduria antomon.

Species and taxonomic index of macrozoobentos at Kriegers Flak
(Surveys made by AfAÖ 2002 and 2003).

Cnidaria
- Cordylophora caspia
- Gonothyraea loveni
- Hydrozoa, Athecata
- Hydrozoa, Thecata

Plathelminthes
- Turbellaria, indet.

Nemertini
- Nemertini, indet.

Priapulida
- Halicryptus spinulosus
- Priapulus caudatus

Polychaeta
- Ampharete acutifrons
- Ampharete baltica
- Arenicola marina
- Aricidea suecica
- Bylgides sarsi
- Capitella capitata
- Eteone longa
- Eumida sanguinea
- Fabricia stellaris
- Hediste diversicolor
- Heteromastus filiformis
- Lagis koreni
- Marenzelleria viridis
- Neanthes succinea
- Neoamphitrite figulus
- Nephtys caeca
- Nicolea zostericola
- Ophelia limacina
- Pholoe inornata
- Phyllodoce mucosa
- Polydora ciliata

Polychaeta forts.
- Polydora cornuta
- Polydora quadrilobata
- Pygospio elegans
- Scoloplos armiger
- Sphaerodoropsis baltica
- Streblospio shrubsoli
- Streptosyllis websteri
- Syllides longocirrata
- Terebellides stroemi
- Travisia forbesii

Oligochaeta
- Clitellio arenarius
- Enchytraeidae
- Phallodrilus sp.
- Tubifex costatus
- Tubificidae
- Tubificoides benedeni

Mollusca
- Arctica islandica
- Astarte borealis
- Astarte elliptica
- Cerastoderma lamarcki
- Cingula striata
- Corbula gibba
- Hydrobia ulvae
- Macoma balthica
- Mya arenaria
- Mytilus edulis
- Nudibranchia, indet.
- Retusa truncatula
- Theodoxus fluviatilis
- Zippora membranacea

Chelicerata
- Nymphon brevirostre

Crustacea
- Balanus crenatus
- Balanus improvisus
- Bathyporeia pelagica
- Bathyporeia pilosa
- Carcinus maenas
- Corophium crassicorne
- Corophium volutator
- Crangon crangon
- Diastylis rathkei
- Gammarus oceanicus
- Gammarus salinus
- Gammarus zaddachi
- Gastrosaccus spinifer
- Idotea balthica
- Jaera albifrons
- Microdeutopus gryllotalpa
- Monoporeia affinis
- Mysis mixta
- Neomysis integer
- Palaemon elegans
- Palaemonetes varians
- Pontoporeia femorata
- Praunus flexuosus
- Praunus inermis
- Saduria entomon

Insecta
- Chironomidae-Larven

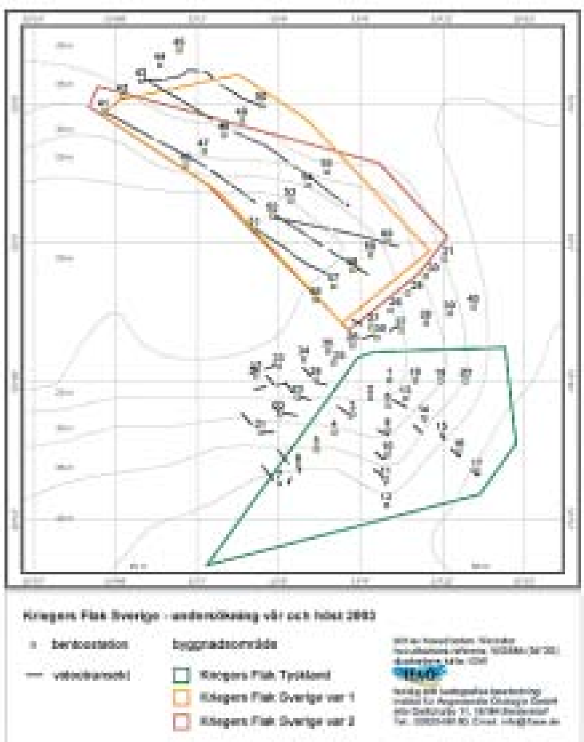
Bryozoa
- Alcyonidium gelatinosum
- Callopora lineata
- Electra crustulenta
- Walkeria uva

90 arter och högre taxa

Research was carried out as a compliment to the very extensive examination of the invertebrate benthic fauna, commissioned by the Group and carried out over the entire Kriegers Flak area during 2002 and 2003. These examinations were carried out in accordance with German norms for inventory of sea areas for wind power construction.

The selected area at Kriegers Flak has a heterogeneous biotopical composition. During tests of makrozoobentos a total of 90 species proved to be of a superior nature. The richest in species were polychaeters, crustaceans and molluscs.

The epifauna in the area was sparse of species and completely dominated by blue mussels, Mytilusedulis, Other species present were sand prawn, Crangon crangon and shore crab, Carcinus maenas.



Seabed examination with side viewing sonar at Kriegers Flak

Characteristically for the infauna was a high degree of small, short-lived species. The most common were polychaeters and molluscs. The biomass was dominated by different species of mussels. Three different habitations were detected. The decisive criterion is the water depth (which influebces the parameters salt and oxygen content). The parameters from the analyses of the sediments (grain size) seemed to influence the composition of the fauna, but a direct connection with the certified fauna habitations could not be established with available data.

Two of the species found within this area, the two mussel species Astarte borealis and Astarte ellipicta, are entered in the list of endangered species in Sweden (category ”v. vulnerable”, Gärdenfors 2000). The presence of the species was, however, low.

A. borealis is an arctic boreal species. Populations in the Baltic are practically isolated remains. The move to increased water depth which can be observed in the Baltic does not derive, as with other species, from salinity but from the temperature of the water. (Jagnow & Gosselck 1987). In accordance therewith, this species can be found first at a depth of 35m. This species can reach an age of maximum ten years and belongs therefore to the long-living mussels in the Baltic.

The species Astarte elliptica exists in a nearly sympatric relationship (development of species happens between populations without a physical barrier that keeps them apart) with the closely related A. borealis. This species has been found within the survey area in the same habitat, but less frequently.

In conclusion, it can be established that the area is characterized by a great variety of and small proportion of threatened species.

A difference was observed depending on weather the survey stations with seabed catchers were situated above or below the halocline). The area has therefore been divided into three communities with reference to the benthic fauna, ”A”, ”B1”, and ”B2”.

Station group A contained all stations above the halocline. These areas were characterized by the great variety of the seabed (sand, gravel and stone). In accordance with this, only two species with high ecological potency were present at all stations, namely the polychaet Pygospio elegans and the common Baltic mussel Macoma baltica. Also the polychaet Hediste diversicolor, the sand mussel Mya arenaria, the blue mussel Mytilus edulis and the water snail Hydrobia ulvae were present at nearly all stations. Occurrence of both the polychaet Travisia forbesii and the amphipods Bathporeia pilosa were plentiful, (a precence of >50%). Both are typical sand seabed inhabitants within the eufotic zone. A further 28 species were registered only irregularly or sporadically within this group of stations.

Below the halocline the stations were divided in two groups, ”B1” and ”B2”.

The first group mainly contained sand seabed (station group B1). The stations within this group were mainly placed between 28-38 metres depth although some were at 40 metres depth. Common for all these stations was low organic content, the humus content was mainly less that 1 % of dry matter.

The structural element in this group was the blue mussel M. edulis, which occurred at all stations in high density. Also the Baltic mussel M. baltica, the polychaet P. elegans and the crustacean Diastylis rathkei were observed at all stations.

Nine further species were detected at more than half of the stations, for instance Saduria entomon, Monoporeia affinis and Halicryptus spinulosus. Also these species are species that usually are limited to the cold and salt-rich waters below the halocline. The number of species in this type of biotope was very high. In total, 62 different species and higher taxon were registered.

A high degree of salinity, low water temperatures and sporadic incidents of oxygen shortage characterized those under water stations below a depth of 40 m which mainly constituted the group B2. In addition, organic substance in the form of mud in hollow areas was accumulated, the humus content was measured to an average 3% and reached a maximum value of 10 % of dry matter.

Five species could be observed at all stations in group B2: D. rathkei, H. spinulosus, M. balthica, S. armiger and the polychaet Terebellides stroemi. Also the mussel A. borealis, the polychaets P. elegans and Bylgides sarsi and also the Pontoporeia femorata and the Priapulus caudatus were widespread (presence of >75%). At more than half of the stations, the two species of polychaets, Aricidea suecia and Ampharete baltica, and the blue mussel M. eduli were found.

11.6.2. Fish

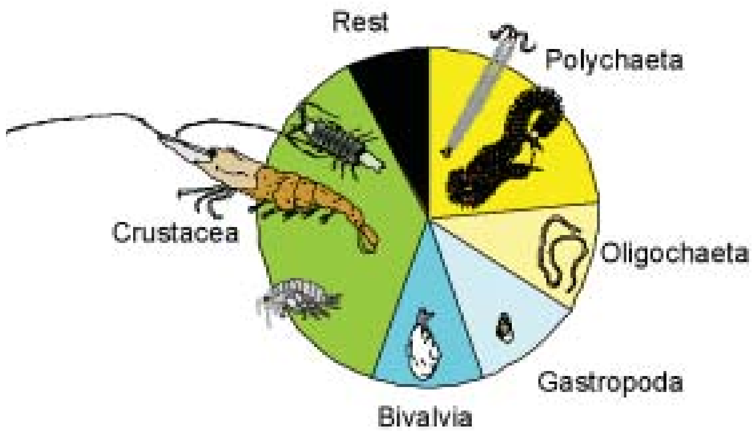
There are around 144 species of fish in the Baltic of which 97 species are salt water and 40 species are fresh water fish with 7 species alternating between salt and fresh water (Thiel et al. 1996).

A survey carried out by IfAÖ on behalf of the Group on the German side of Kriegers Flak identified the following 27 species in the area:

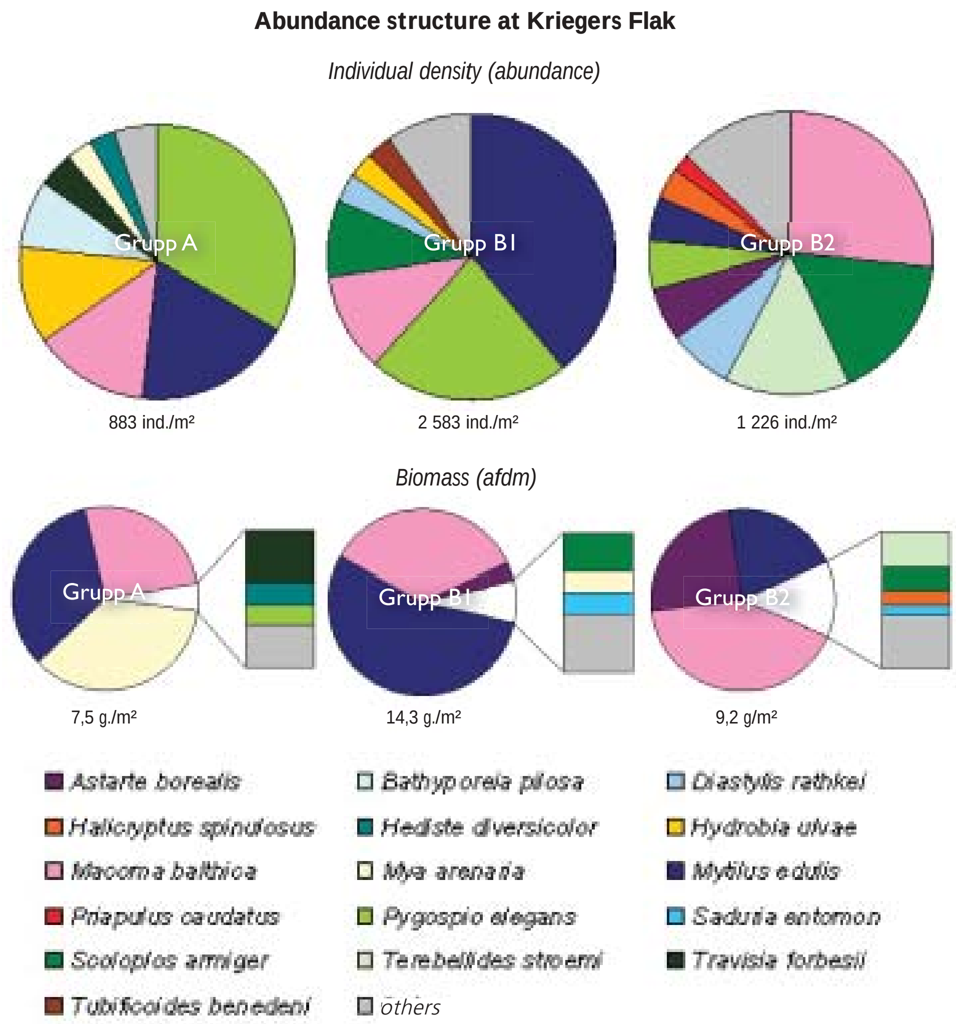
Cod, whiting, haddock, plaice, common dab, flounder, herring lumpsucker, eel, grey mullet, saithe, turbot, sculpi, snakeblenny, spratt, viviparous blenny, lumpsucker, blackgoby, rockgunnel, goldsinny-wrasse, shortspined and sea scorpio. (For latin names and family belongings, see Appendix 7.6.).

None of these are listed as endangered speices in the Swedish register.

The surveys were carried out during 2002 and 2003



Overview over distribution of macrozoobentos in the south-western Baltic



Abundance structure within the three observed symbioses (above: abundance and below: biomass)

and involved three rounds of test fishing/trawling per year (June, August and October) with between 10 and 20 catches per round (90 catches in all). In order to catch small fish, a special trawl was used. Where seabed conditions made it impossible to fish, divers were used. As the seabed conditions are similar within the Swedish and German selected areas (there is only 1 km between them), it can be assumed that the above mentioned 27 species are present also in the Swedish zone.

The presence of the most common species of fish measured as a percentage of the total number of individuals caught by seabed trawling on the German side of Kriegers Flak, was during the 2002 survey divided as follows;

Cod 53 %, plaice 15 %, Flounder 15 %, whiting 8 %, herring 5 %, common dab 2 %, sprat 1 % and others 1 %. See figures next page. The readings for pelagic species, such as herring and sprat, are however not representative as these mainly do not live on the seabed.

During 2002 the average occurrence of fish was 172 individuals /hectare. The occurrence of cod was 54-114 individuals /hectare during 2002, and 26-37 individuals/hectare in 2003.

The occurrence of the most common species of fish counted as a percentage of the weight of the total catch was during the survey of 2002 as follows;

Cod 62 %, plaice 17 %, flounder 13.5 %, whiting 5 %, common dab 1 % and others 1.5 %.

The average fish biomass was 45.6 kg/hectare for the year 2002 and 17.4 kg/hectare for 2003, see figure below.

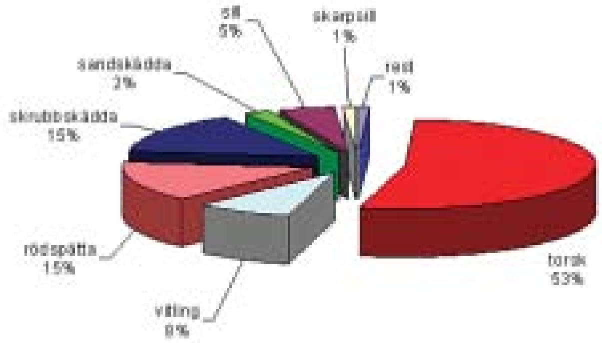
The reduction of fish measured both in the number of individuals per hectare, and in kg/hectare during 2002, very likely depends on the lack of oxygen measured in 2003.

The cod population at Kriegers Flak measured by the length of the cod, show a remarkable reduction of cod longer than 38-40 cm, which is the minimum size for catching. During 2002 only 13 % of the cod caught were above the minimum measurement and during 2003 the corresponding value was 16 %. These figures show a great fishing pressure for cod. The large distance to the coast from Kriegers Flak makes the area at times highly exposed to waves and wind. These circumstances, in combination with the hard and stony seabeds present in the area, means that the area theoretically has the necessary qualities for the fish to feed and grow.

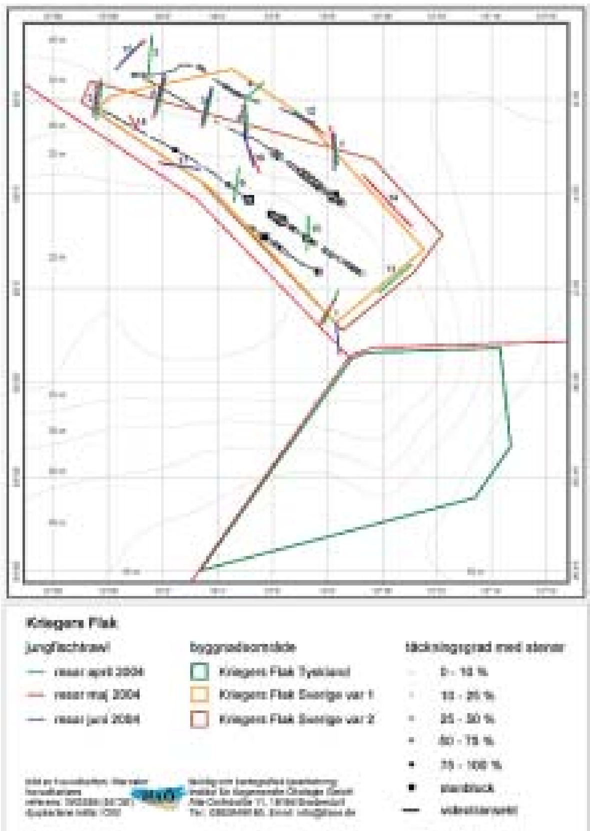
During the spring of 2004, a first round of test fishing was carried out on the Swedish side in order to study whether the projected area is a feed, spawn and/or a growth area for fish. The test fishing, carried out by IfAÖ, is a complement to the tests carried out on the German side and the concept of the survey has been worked out in cooperation with The National Board of Fishing.

Three rounds of fishing tests were carried out during April, May and June during a total of 28 days. The methods, such as bottom trawling, were used as well as echo sounding.

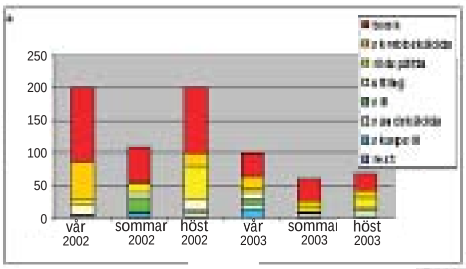
During these tests, 13 species of fish were found.



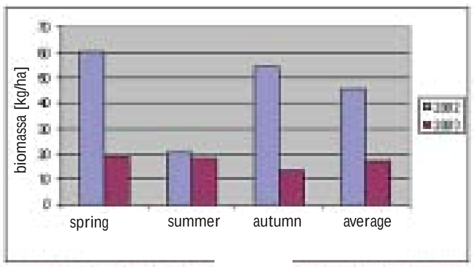
Occurrence of the most common fish species at Kriegers Flak in 2002



Transections for test fishing



Biomass caught at Kriegers Flak in 2002 – 2003 divided into different fish species in kg/ha



Biomass caught at Kriegers Flak in 2002–2003 during different seasons

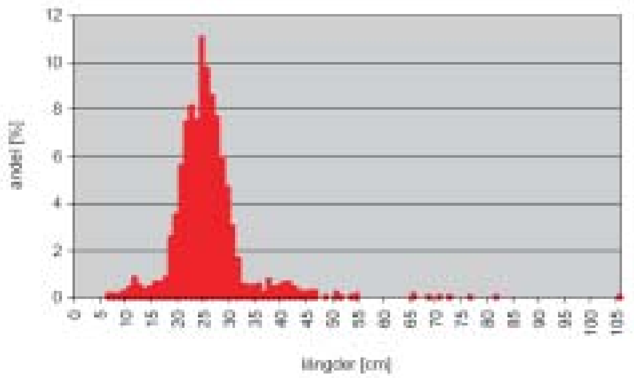
The average occurrence of fish was measured to 122 individuals/hectare and 13.8kg/hectare.

The test fishing of cod has mainly resulted in detection of a stock of between 18 and 23 cm, see figure below. Juvenile cod under 15 cm was sparse, only 3.5 % of the catch. Spawn mature cod above the minimum size of 38 cm only accounted for 4.7 % of the catch.

The result of these tests in other words indicated that the area does not constitute a spawn or growth area for cod.

The survey methods from the test fishing in the spring of 2004 have been assessed and suggestions for further test fishing in the autumn of 2004 and spring of 2005 have been worked out. The result of these complimentary tests will be presented in March 2005.

Size distribution for cod, spring 2004



FISH IN THE BALTIC

The fish fauna in theBaltic can be divided into two categories, namely those who prefer to live in pelagic areas and those who prefer benthic conditions (i.e. species living close to the seabed). Examples of pelagic species are herring, Clupea harengus, spratt, Sprattus sprattus, salmon, Salmo salar, brown trout, Salmo trutta, transparent goby, Aphia salar and mackerel, Scomber scombrus.

Those who prefer the seabed are cod, Gadus morthua and whitling, Merlangius merlangus. These species hunt either directly on the seabed or just above it. The cod prefers to stay at mussel banks, areas covered in growth and stony areas.

Smaller fish belonging to the goby species live on sandy seabeds, for instance grey gunard, Ammodytidae, Eutrigla gurnardus, and young flat fish (flounder, Platichthys flesus, dab, Limanda limanda, plaice, Pleuronectes platessa and turbot, Psetta maxima).

Rock and stone areas and mussel banks seem to be favoured by tadpole fish, Raniceps raninus, black goby, Gobius niger, rock gunnel, Pholis gunnellus, Goldsinny-wrasse, Ctenolabrus rupestris, lumpsucker, Cyclopterus lumpus, eel, Anguilla anguilla, Viviparous blenny, Zoarces viviparous, lemon sole, Myxocephalus scorpius, Fourhorn sculpin, Myxocephalus quadricornis and longspined bullhead, Taurulus bubalis.

In shallow waters between the stone fields, there are areas covered with sea grass and algae. In the sea grass one finds broad-nosed pipefish (Syngnathus typhle), greater and smaller pipefish and two-spotted goby (Gobiusculus flavescens). As these areas are full of hiding places, they are like playing rooms for many fish species.

As the water is relatively deep at Kriegers Flak, there are only very few individuals of red algae fastened to stones or in aggregate with blue mussels.

On soft seabeds one finds Lumpenus lampretaeformis, Rhinonemus cimbrius, Agonus cataphractus and different kinds of flat fish.

Different species live at different depths. There are species that move between different depths dependent on the season.

Fourbeard rockling and Snakeblenny live at more than 20 metres depth.

Sea stickleback (Spinachia spinachia) live at less than 10 metres depth and is not influenced by that planned project.

Great sandeel lives in coastal waters during the summer months and retreats to deeper waters during the winter

11.6.3 Birds

11.6.3.1 Staging birds

On behalf of the Group, extensive surveys at and around Kriegers Flak have been carried out by IfAÖ both on the Swedish and German sides of the area. The surveys were carried out between April 2002 and March 2004.

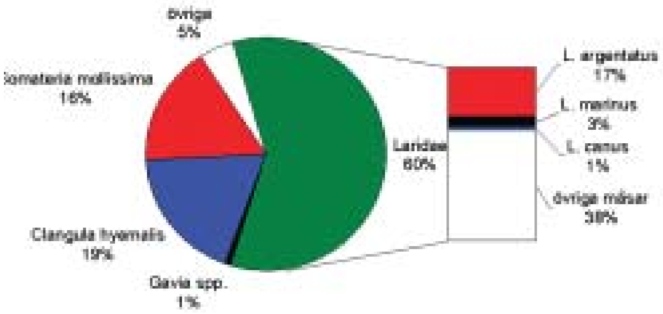
An area of 508 km² has been researched from ships at 35 different occasions with a distance of 4 km between the transections.

Observations have also been made 16 times from aeroplanes in a 840 km² area with 2 km between the transections.

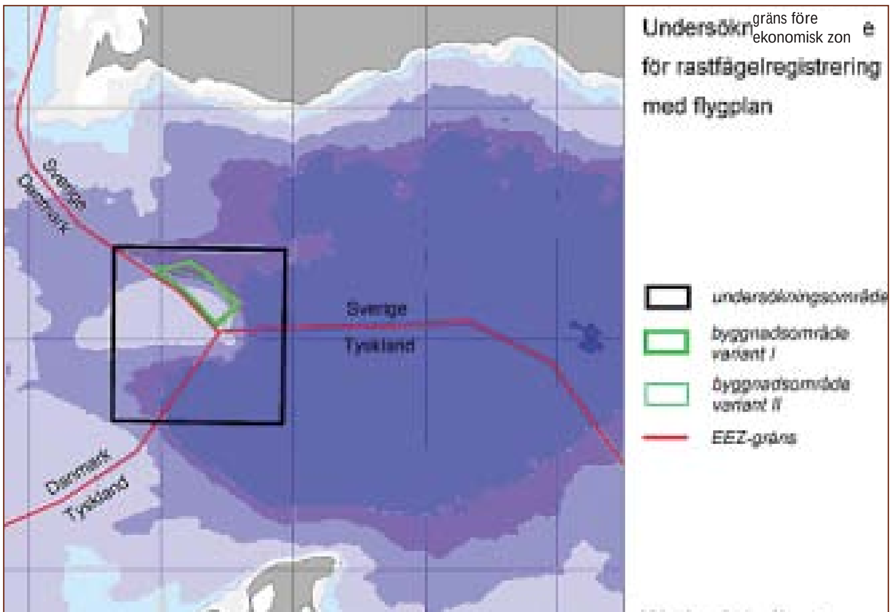
In total, 24 different bird species were observed. The distribution between different species that were observed from ships is shown in the graph below.

Sea gulls dominate the bird population to 60 %. Most common are herring gull, Larus argentatus, and great black-backed gull, Larus marinus, mainly living of fish remains from fishing boats, see figure below. The herring gull was the only species, which was observed at all test occasions and during the winter 2003 the population consisted of about 3200 individuals.

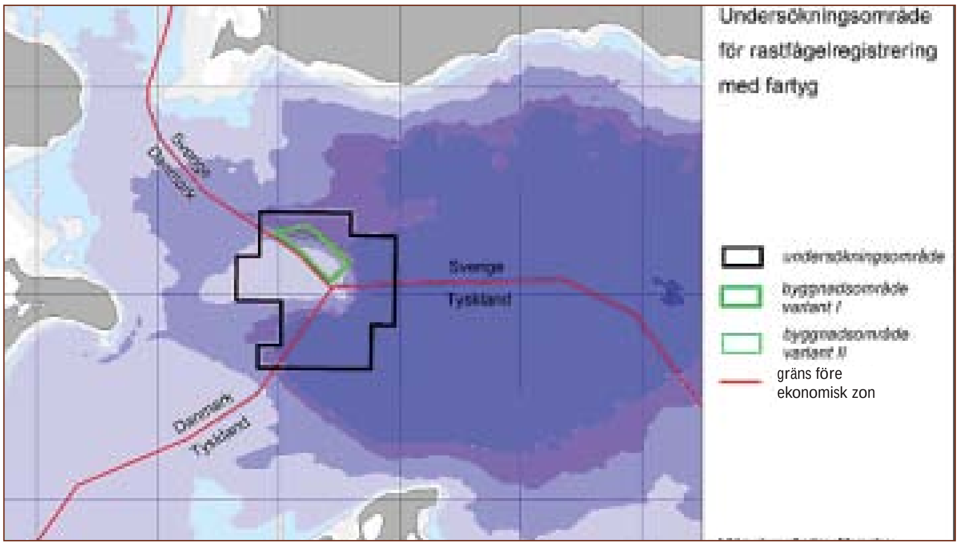
Spread over the area, the habitation of herring gull was registered to between 0.11- 5.17 individuals/km², great black-backed gull to 0.02-1.32 individuals per km², lesser black-backed gull, Laurus fuscus, to 0.01-0.23 individuals/km², common gull, Larus canus, to 0.1-0.77 individuals/km². Little gull, Larus minutus, and black headed gull, Laru ridibundus, only rarely migrate through the area and exist in densities up to 0.1



Distribution between different species



Survey area – aeroplane transects



Survey area – ship transects

individual/km². Single species of fish eating loons and razorbills can be found during the winter months on the shallow parts of Kriegers Flak. These birds avoid areas with heavy shipping. A maximum of 160 loons have been registered.

The density of loon, Gavia spec, has been measured to between 0.1-0.37 individuals/km², razorbills, Alce torda, to 0.11-0.81 individuals/km², common murre, Uria aalge, 0.02-0.18 individuals per km² and black guillemot, Cepphus grylle as 0.02-0.22 individuals/km².

With the exception of long tailed duck, Clangula hyemalis, there are no mussel eating sea ducks spending the winter at Kriegers Flak. During the months between November to May, long tailed duck reside in areas where the water depth is less than 30 m. The maximum number of staging long tailed ducks, counted during the winter months by ships, amounted to 5 000. During autumn and spring migration the numbers could reach 10 000 individuals. During the winter, during the ship counts, the population of long tailed ducks has been registered to between 5.46-8.16 individuals/km². During the migration season the duck has had a maximum density of 16.5 individuals/km². The water is probably too deep to be an ideal feeding place for other sea ducks, that usually during the winter only stay in waters < 20 metres deep.

During spring and autumn migration only a few sea ducks stage in the area. Eider ducks are seen only sporadically, for example during periods of calm weather, with 1.68-2.63 individuals/km2.

During spring migration, Melanitta nigra has been registred to 0.07-1.05 individuals/km2. Melanitta fusca has on exceptional occasions registered to 0.03-0.06 individuals/km2.

To summarize, one can establish that Kriegers Flak does not have any particular value for water fowl. Amongst others, this has to do with the great depth and the long distance to shore.

The size of populations in the surveyed area were small, with the exception of gulls. The fact that loons and sea ducks were not present in larger numbers was probably due to ship traffic. The occasional large occurrence of gulls was due to the fishing activities.

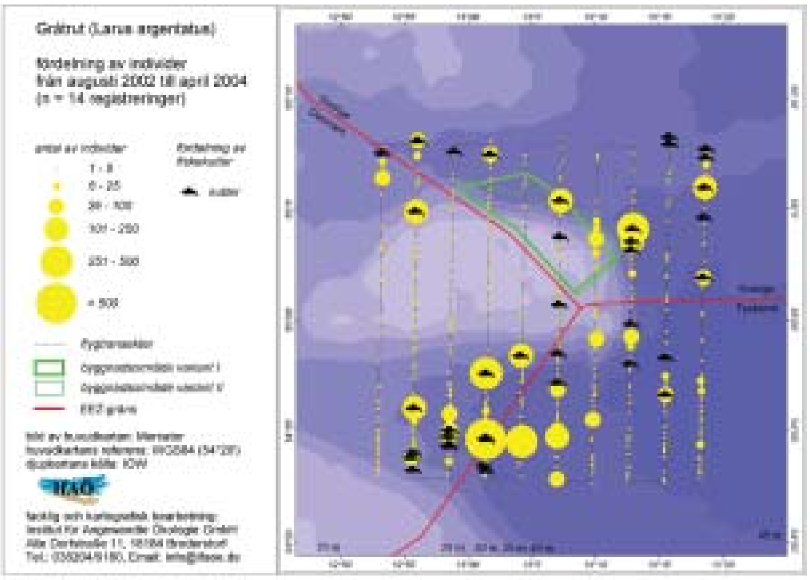
The great variety and peculiarity of the bird community is high considering 11 species of water fowl are present on a regular basis.

11.6.3.2 Migrating Birds

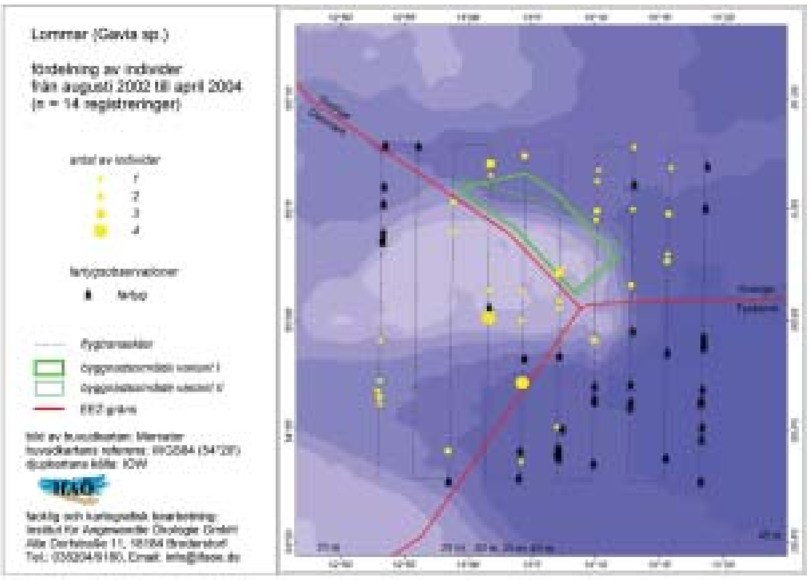
On behalf of the Group, IfAÖ has carried out extensive visual observations and radar studies of migrating birds. The surveys were carried out on both the Swedish and German side of Kriegers Flak.

The visual observations were made in order to decide the species of migrating birds during day as well as night. During night, observations were made by registration of calls.

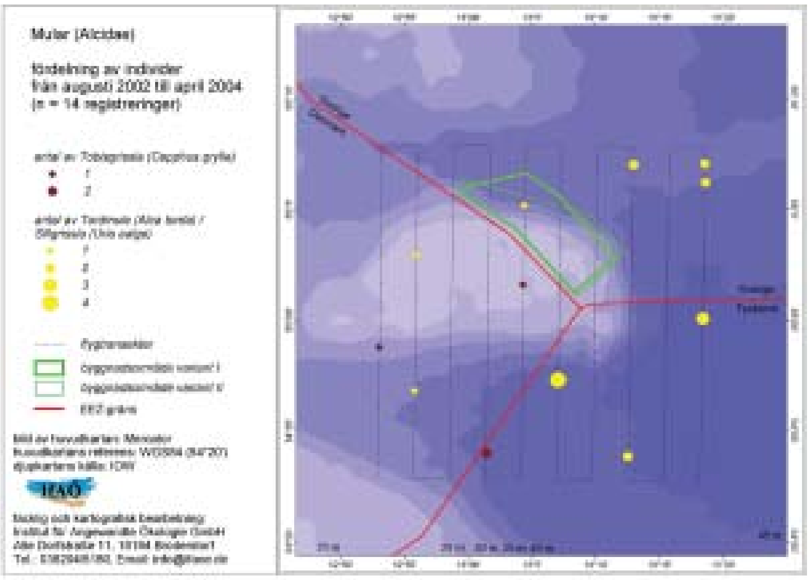
The purpose of the radar observations were mainly



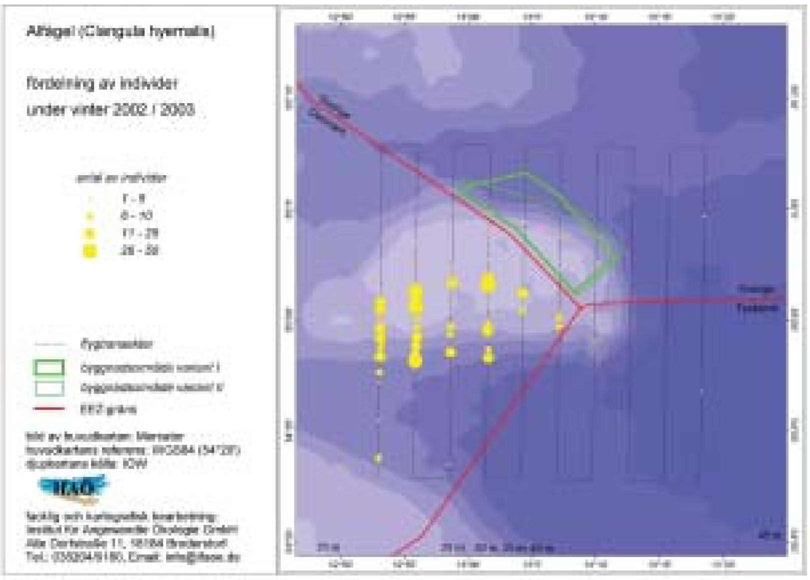
Distribution of all observed Herring Gulls, indifferent Gulls and fishing boats counted from aircraft at Kriegers Flak.

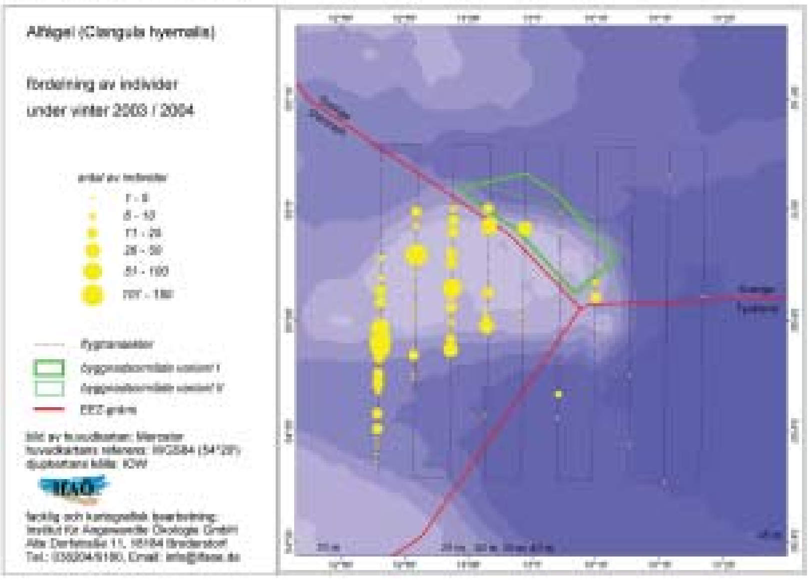


Distribution of all observed Divers and ships counted from aircraft at Kriegers Flak.

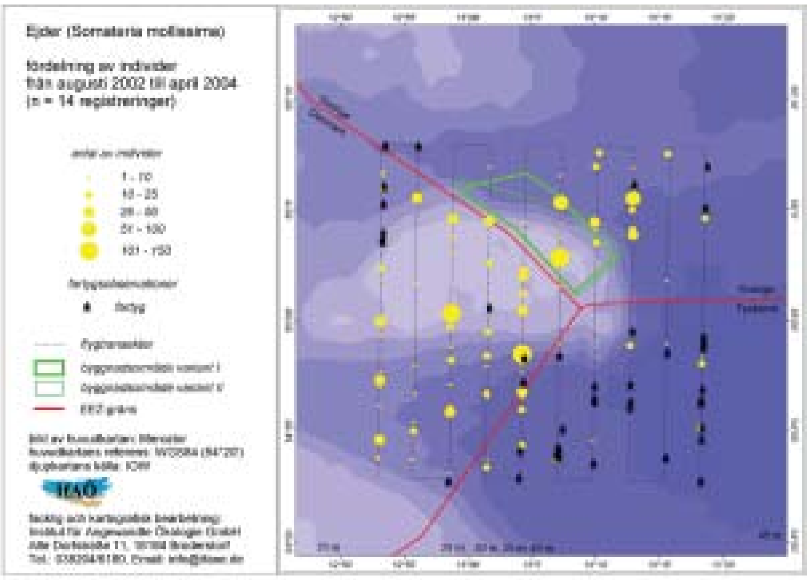


Distribution of all observed bills counted from aircraft at Kriegers Flak





Distribution of all observed Longtailed Ducks counted from aircraft at Kriegers Flak.



Distribution of all observed Eider counted from aircraft at Kriegers Flak.

to acquire knowledge of the nocturnal migration and height distribution during day as well as night.

Since radar lack coverage in the lowest interval, visual studies were needed to register the migrations below 10 m height. Visual and radar studies were therefore carried out in parallel in order to detect at which height each individual species is migrating at.

During the two test years, a total of 139 species of birds have been observed migrating through the area, see tables below. A complete list of the species is found in Appendix 8.2.

There are very few studies of birds carried out at sea. Earlier studies have been conducted from the coast to a distance of about 5 km. The study carried by the company could therefore be regarded as pioneer work. Those documented studies of migrating birds across the southern Baltic and its vicinity, have on behalf of the company been collated by IfAÖ in a literary study (see below).

It is difficult to summarise all the results from the above mentioned surveys. Only matters relevant for the planned project are dealt with here.

	Year 1 April 2002–March 2003	Year 2 April 2003–March 2004
Days of observation	65	58
Number of species	117	110
Number of individuals, total	19.002	43.618
Individuals of definite species	17.090	42.084
Number of water fowl	14.966	40.005
Number of land birds	2.124	2.079
Individuals with no definite species	1.912	1.534
Most frequent species	Eider (6.501) Barnacle goose (4.675) Wigeon (1.329) Brent goose (868) Common scooter (796) Crane (474) Siskin (270) Chaffinch (249) Meadow pipit (239) Skylark (145)	Eider (30.662) Barnacle goose (4.773) Brent goose (1.418) Common scooter (1.371) Crane (905) Wigeon (350) Greylag goose (221) Cormorant (210) Meadow pipit (185) Barn swallow (133)
Species with highest continuity	Cormorant (35) Common scooter (31) Eider (25) Pied wagtail (23) Barn swallow (22) Black-throated diver (20) Skylark (20) Chaffinch (20) Meadow pipit (19) Wigeon/Dwarf gul (17)	Eider (41) Common scooter (33) Cormorant (31) Barn swallow (26) Graylag goose (22) Common swift (21) Lesser black-backed gull (17) Meadow pipit (17) Pied wagtail /Skylark/Black-headed gull / Dwarf gull (16)

Summary survey of migrating birds 2002 – 2004

a) Literature Study

The migrating routes in the south-eastern Baltic are in comparison well researched by the University of Lund. The migrating periods for individual species are extensively described thanks to direct monitoring (for instance at the bird station at Falsterbo) and records at the catching stations (Ottenby, Bornholm and Greifswalder Oie). Also the connection between migration and weather has been carefully studied.

Through the literature, it is clear that mainly long distance migrating birds fly at night and those birds who move a short to middle distance do so during daytime.

Scandinavian land birds migrate above the Arcona Basin and also two migrating streaks for arctic waterfowl pass above the area.

North of Bornholm, from the Kalmar Strait towards Kriegers Flak, loon, eider, brent goose and barnacle goose pass by.

South of Bornholm, in the direction of Cape Arcona/the Cadet trench, the common scoter, Melanitta nigra, has its flight path. Most of the others migrate mainly along the coast line.

Songbirds and pigeons (>>100 000 000), birds of prey (>>10 000) and cranes (around

70 000), move south directly from southern Sweden (Alerstam 1975, 1976). Cranes and birds of prey move during daytime and through the narrow straits of the Baltic Sea.

Different species of songbirds mainly migrate at night and fly in a broad formation across the southern part of the Baltic. There are however songbirds migrating at night, for instance finches.

Bird migration does not occur evenly but is concentrated to certain days/nights with favourable conditions for the birds (Ahlerstam & Ulftrand 1972).

b) Composition of species

The chosen area of Kriegers Flak was investigated during 123 days, between April 2002 and March 2004.

A total of 62 620 birds were observed migrating through the area and of these 54 971 were water fowl (loon, cormorant, porchards, seagulls, terns and razorbills) and 4 203 land birds (songbirds and birds of prey). For 3 446 birds, it was not possible to identify which type of species they belonged to.

139 species have been observed and of those only 10 species with more than 100 individuals /year.

Occurrence measured in percentage of the investigative days.

The 5 species recorded during most number of days during the first year of research were cormorant at 35 %, common scoter 31 %, eider 25 %, white wagtail 23 % and barn swallow 22 %.

During the second year, eider had an appearance of 41 % of the days surveyed, scoter 33 %, cormorant 31 %, barn swallow 26 % and greylag goose 22 %.

Further information of the most frequently observed species can be found in the table on previous page.

Most occurring species measured in number of individuals.

Those species most occurring during the entire survey period were eider, Smateria mollissima, with 371 163 observed individuals, barnacle goose, Branta leucopsis, 9 448 individuals, brent goose, Branta leucopsis, 2 214 individuals, common scoter, Melanittra nigra, 2 214, common crane, Grus grus, 1 379 individuals and eurasian wigeon, Anas, penelope, 1 329 individuals,

Presence of day migrating land birds

Of the migrating land birds the most common in numbers were eurasian siskin, Carduelis spinus, with 270 observed individuals-year, common chaffinch, Fringilla coelebs, meadow with 249, pipit, Anthus pratensis, with 239, eurasian skylark, Alauda arvensis, with 145, barn swallow, Hirunda rustica, with 133, white wagtail, Motacilla alba, with 133 and dunlin, Calidris alpina, 104 individuals/year.

Of these, chaffinch, skylark, barn swallow and white wagtail appeared during less than 20 % of the days. Siskin appeared 7.7 % of the days, dunlin 9 % and meadow pipit 18.5 % of the days.

Endangered and Red listed species

Of the 139 registered species of migrating birds, 21 are listed in the EU bird protection directive.

These 21 protected species are red-throated loon, black-throated loon, whooper swan, barnacle goose, European honey buzzard, western marsh harrier, hen harrier, osprey, merlin, peregrine falcon, pied avocet, European golden plower, ruff, bat-tailed godwit, Caspian tern, sandwich tern, common tern, Artic tern and black tern.

With the exception of loons, barnacle goose and crane, only a few of these species were registered.

Of the 139 registered bird species, 26 are also registered on the Swedish red-list of endangered species (Gärdenfors 2000).

The corn bunting is listed in the highest category; “Critically Endangered”.

The black-legged kittywake, caspian tern, and lesser black-backed gull are listed as “Endangered”. The lesser black-backed gulls having been observed at Kriegers Flak, are likely to belong to the sub-species intermedius, which has no vulnerable status, and probably habitat the island of Saltholm.

In the subsequent vulnerability category “Vulnerable”, there are 12 species; greater scaup, European honey buzzard, hen harrier, peregrine falcon, dunlin, black-tailed godwit, bar-tailed godwit, sandwich tern, little tern, black tern, black guillemot, and twite.

There are nine species in the group with least vulnerability, “Near Threatened”; red throated loon, bean goose, northern pintail, northern shoveler, velvet scoter, pied avocet, eurasian curlew, ruddy turnstone and yellow wagtail.

Cranes and birds of prey using thermals (rising hot air/up winds).

Annually, around 40 000 cranes migrate from southern Sweden to Rügen in Germany and back.

During the spring migration the cranes mainly pass east of Kriegers Flak on their way to southern Sweden. As they are sensitive for side winds, easterly winds could cause a slight deviation and in those cases they could be flying across Kriegers Flak.

The majority of the day migrating birds of prey, move along a line from Falsterbo across the Baltic. Certain birds of prey, for instance the rough-legged buzzard, however move in a straight north/south direction across the Baltic and could therefore cross a wind farm at Kriegers Flak.

The visual observations have confirmed that few termite-flying birds cross Kriegers Flak. The following species and numbers (first/second year) were registered; European honey buzzard (2/-), western marsh harrier (3/3), hen harrier (-/1) and common buzzard (1/2) Others mainly none termite flying birds of prey being observed were (first/second year); northern goshawk (7/-), sparrow hawk (15/34), osprey (6/3), common kestrel (3/4), merlin (1/0), Eurasian hobby (-/3) and peregrine falcon ((1/5).

c) Visual observations

Water fowl

The water fowl migration is concentrated to March/April and September/October, see figure 1.

That flights do not follow an even pattern and are focused to single days/nights with favourable conditions, as stated in literature (Ahlerstam & Ulfstand 1972), was confirmed by these observations.

The most common species of water fowl observed during this time was eider duck, barnacle goose, brent goose and common scoter.

Figure 1: Flight of migrating water fowl at Kriegers Flak April 2002 to March 2004, based on individuals per hour.

Land birds

Land birds usually fly during the same times as water fowl. Occasionally they also move during August. See figure 2.

A number of cranes were spotted at Kriegers Flak during a few days during autumn of 2002 and spring 2004. Figure 3, illustrates the intensity of flights for different species of land birds.

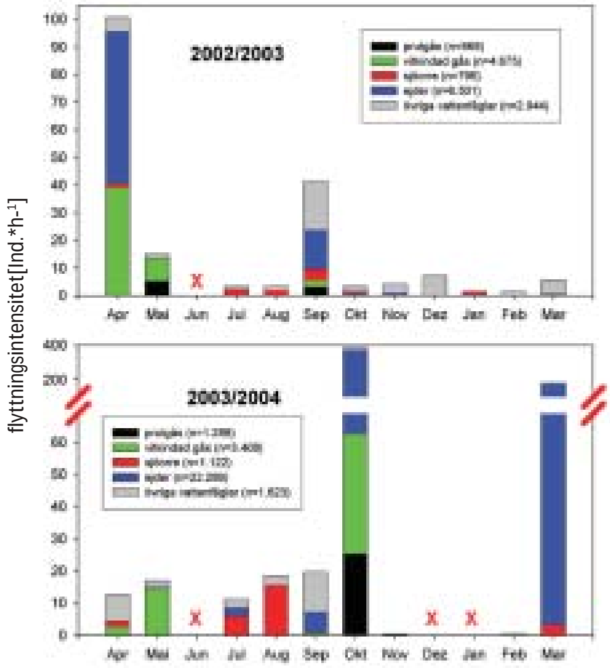
Table 2: Flight of day moving land birds and cranes at Kriegers Flak, April 2002 to March 2004, based on individuals per hour.

Table 3. Flight of land birds divided into the most common species based on individuals per hour.

Birds identified at night

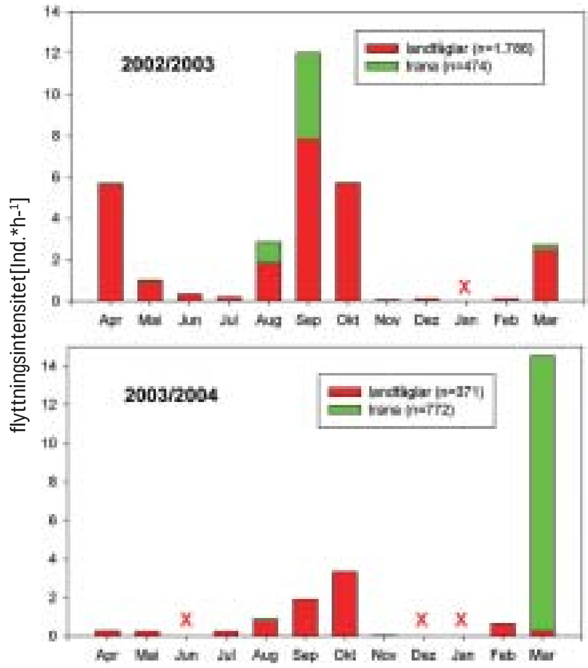
By recording birdcalls at night, 43 different species were identified from April 2002 until March 2004. Most recordings were made during nights of intense movements. Only eight species were present at more than two half-hour intervals per month, see table below. Of these species, tawny pipit, blackbird, European robin and redwing were the most numerous.

Figur 1



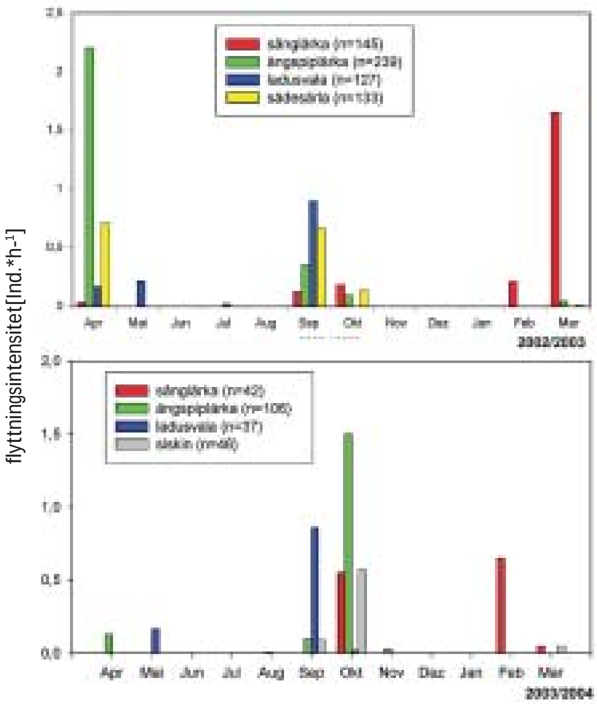
Water fowl

Figur 2



Land birds

Figur 3



Most common species of land birds

Bird species	04/ 02	05/ 02	09/ 02	11/ 02	03/ 03	05/ 03	09/ 03	10/ 03	11/ 03	03/ 04	Summa
Grey heron *Ardea cinerea*		1								1	2
Kestrel *Falco tinnunculus*		1									1
Oystercatcher *Haematopus ostralegus*	1										1
Avocet *Recurvirostra avosetta*		2									2
Dunlin *Calidris alpina*		2									2
Curlew *Numenius arquata*		1									1
Greenshank *Tringa nebularia*		1									1
Green sandpiper *Tringa ochropus*		1									1
Common sandpiper *Actitis hypoleucos*		1									1
Long-eared owl *Asio otus*	1				1						2
Ringed dove *Columba palumbus*										2	2
Skylark *Alauda arvensis*					9			1	2	4	16
Barn swallow *Hirundo rustica*		1									1
House martin *Delichon urbica*		1									1
Meadow pipit *Anthus pratensis*								2		1	3
Yellow wagtail *Motacilla flava*		2					1				3
Pied wagtail *Motacilla alba*		1					1	1	1		4
Wren *Troglodytes troglodytes*					3			1		1	5
Dunnock *Prunella modularis*	2	2									4
Robin *Erithacus rubecula*	8	1	2	1	2	6	1	10		7	38
Thrush nightingale *Luscinia luscinia*		1									1
Black redstart *Phoenicurus ochruros*			1			2		1			4
Redstart *Ph. Phoenicurus*		2									2
Blackbird *Turdus merula*		1			12			7	2	4	26
Fieldfare *Turdus pilaris*	1	1			2						2
Song thrush *Turdus philomelos*	5	1						6	1	10	23
Redwing *Turdus iliacus*	12	1			8			7	3	4	35
Mistle thrush *Turdus viscivorus*										2	2
Lesser whitethroat *Sylvia curruca*			1								1
Whitethroat *Sylvia communis*		1									1
Blackcap *Sylvia atricapilla*		1									1
Marsh warbler *Acrocephalus palustris*						1					1
Chiffchaff *Phylloscopus collybita*			2					1		1	4
Willow warbler *Phylloscopus trochilus*	1										1
Jackdaw *Corvus monedula*								1			1
Goldcrest *Regulus regulus*									1	2	3
Pied flycatcher *Ficedula hypoleuca*		1				1					2

Cont.

Cont´d

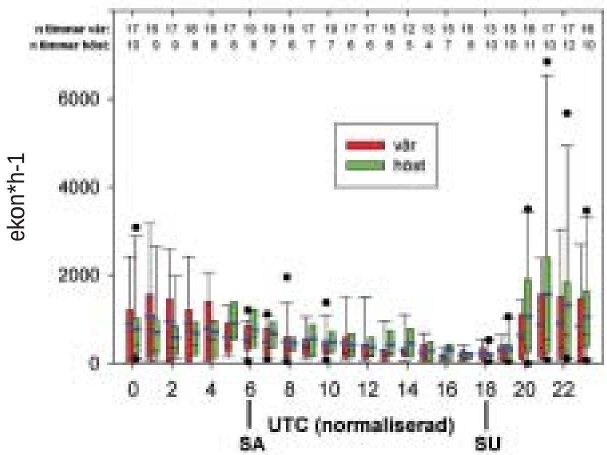
Bird species	04/ 02	05/ 02	09/ 02	11/ 02	03/ 03	05/ 03	09/ 03	10/ 03	11/ 03	03/ 04	Summa
Starling *Sturnus vulgaris*					3			1		3	7
Chaffinch *Fringilla coelebs*	1										1
Linnet *Carduelis cannabina*								1			1
Twite *Carduelis flavirostris*								1			1
Redpoll *Carduelis flammea*								1			1
Snow bunting *Plectrophenax nivalis*										3	3
Corn bunting *Milaria calandra*		1									1
Reed bunting *Emberiza schoeniclus*		1									1

Occurrence of night flying bird species that have been identified by registering calls, half hourly intervals per month

Night and Day Variations

Both land and water fowl showed maximum flight intensity during morning hours. During afternoons and evenings hardly any flying was recorded.

The peak at noon in March 2004 was represented mainly by cranes. The exact timing of this maximum during the morning hours was linked to the time of sunrise.



The hourly distribution of the flights for land birds (and cranes) during the months of April 2003, September 2003 and March 2004 (n = 1.658)

Month	N	NO	O	SO	S	SV	V	NV	n
April 2002	1	40	59	0	0	0	0	0	8.763
May 2002	1	98	0	0	0	1	0	0	1.588
March 2003	39	26	17	3	3	3	3	6	198
April 2003	7	46	23	5	5	7	6	1	271
May 2003	0	42	48	0	0	8	1	0	2.714
March 2004	29	32	35	2	0	0	1	1	9.228
September 2002	4	2	6	1	6	14	67	0	5.319
July 2003	1	1	4	1	8	44	16	26	1.201
August 2003	6	0	0	1	4	8	77	3	667
September 2003	0	9	2	3	14	59	9	5	417
October 2003	0	0	0	0	1	4	95	1	25.502

Direction of flights for water fowl during individual months of the main flight

Month	N	NE	E	SE	S	SW	W	NW	n
April 2002	51	6	19	10	3	0	8	4	455
March 2003	25	8	2	13	17	13	2	20	179
April 2003	36	52	4	4	0	0	0	4	143
May 2003	54	0	4	2	7	7	13	14	56
March 2004	46	50	1	1	0	0	0	2	924
August 2002	0	0	0	5	77	5	9	5	22
September 2002	35	0	3	0	25	5	33	1	610
October 2002	0	0	0	0	96	0	5	0	119
July 2003	1	1	3	20	15	37	17	6	231
August 2003	1	2	0	2	15	36	46	0	131
September 2003	0	1	6	4	70	12	6	0	159
October 2003	3	0	2	4	3	9	68	11	376

Direction of flights for land birds during individual months of the main flight

Direction and height distribution

During spring migration the preferred flight direction was from north to east. The direction of flights for land and water fowl is presented in the tables below and on the previous page.

During the visual observations nearly half of the birds flew below 10 meters height (figure on the right).

Generally, water fowl were flying at the lowest heights. Differences for both season and species were noted (figure on the right).

Birds were flying at a higher levels during spring than during autumn. Geese, wigeons and cranes flew higher than 50 metres. Gulls, apart from little gulls, flew at a level of 10-50 metres. Loons and pochards, particularly eider ducks and scoters flew below 10 metres.

The flight of cranes on 27 March 2004 took place at between 100 and 200 metres height. This differs from the flight of cranes between 12 and 13 September 2002, where the average flight height, with the aid of radar, was recorded to 242 metres.

Species/Group of species	< 10 m	10–50 m	> 50 m	n groups
Divers *Gavia spec.*	50/29	25/57	25/14	16/14
Cormorant *Phalacrocorax carbo*	37/46	50/42	13/12	30/41
Barnacle goose *Branta leucopsis*	75/35	8/8	17/57	12/40
Geese *Anser spec., Branta spec.*	13/51	27/26	60/23	15/74
Wigeon *Anas penelope*	35/47	21/47	45/6	29/19
Eider *Somateria mollissima*	64/53	25/45	12/2	52/617
Common scooter *Melanitta nigra*	47/70	37/28	17/2	60/74
Long-tailed duck *Clangula hyemalis*	93/100	8/0	0/0	14/12
Sparrow hawk *Accipiter nisus*	30/65	40/35	30/0	10/26
Crane *Grus grus*	5/0	11/8	84/92	19/12
Herring gull *Larus argentatus*	12/33	82/50	6/17	138/12
Lesser black-backed gull *Larus fuscus*	21/41	79/59	0/0	19/22
Common gull *Larus canus*	30/22	70/78	0/0	10/18
Common gull *Larus minutus*	67/77	33/23	0/0	18/57
Barn swallow *Hirundo rustica*	65/60	29/38	6/2	17/52
Pied wagtail *Motacilla alba*	57/77	38/23	4/0	47/13
Meadow pipit *Anthus pratensis*	26/83	62/12	13/5	47/41
Chaffinch *Fringilla coelebs*	31/60	54/40	15/0	13/10

Percentage distribution of flight heights for migrating birds at Kriegers Flak according to visual observations during the first and second year of survey (n = number of groups).

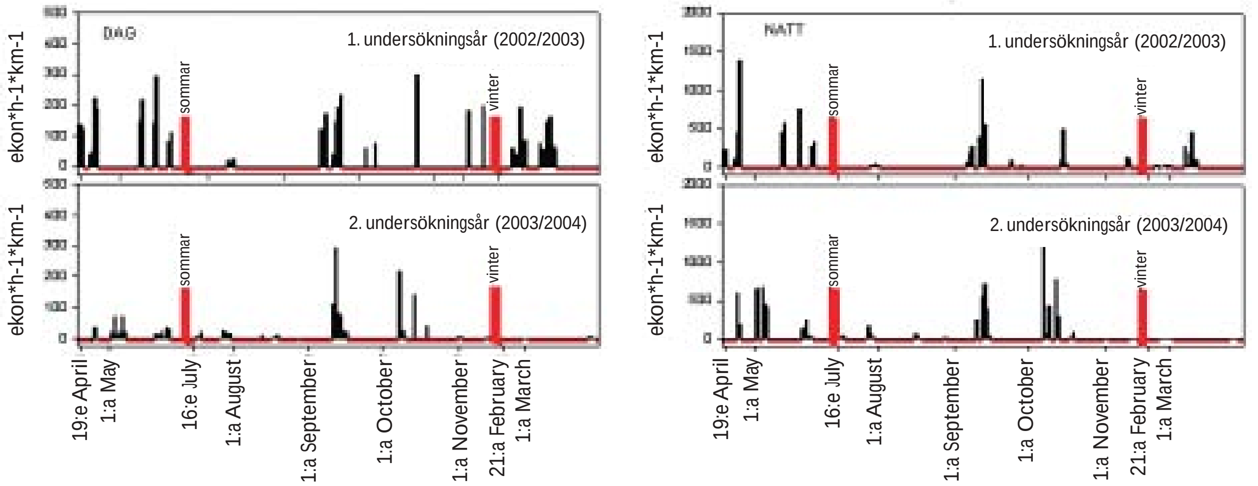
d) Survey by radar

Radar observations from a surveying ship at Krieger Flak were carried out during 88 nights and days between April 2002 and March 2004. The survey was carried out with ship radar directed vertically towards the sky with a reach of 1 500 metres.

Generally, the highest intensity of the night flight occurred during the months of April/May and September/October.

Those flights recorded by radar, were concentrated to a few days and nights where the flight intensity was greater at nighttimes. Half of the spring flights were recorded during four days and half of the autumn flights during two days. During the summer months of July/August and during March, hardly any flights took place at night, se table below.

The average number of birds migrating at night was considerably higher than during daytime. The maximum number of recorded echoes was for the night flight 2 967 echoes per hour and km, and for the day flight, 1 355 echoes per hour and km.



Distribution between day and night flights in the period between April 2002 and March 2004

A comparison of the maximum migration intensity at Kriegers Flak with that recorded at Falsterbo shows that the highest migration intensity is 0.3 – 0.4 times

Year of research	Year 2		Year 1	
	Night	Day	Night	Day
Average +/- SA (ekon*h-1 *km-1)	147±330	25±76	241±357	117±132
Median (ekon*h-1 *km-1)	12	3	89	73
Min./max. (ekon*h-1 *km-1)	0/2.967	0/804	0/2.131	0/1.355
n original echos	17.229	4.334	15.024	13.869
n corrected echos	144.240	36.549	181.491	137.399
number of nights/days	48	49	37	39

*The characteristic values of the flight intensity (echoes *h-1 *km-1) according to radar data; comparison of day and night flights (SA = standard deviation)* the intensity measured at Falsterbo. If one instead relates to the average migration intensity, Kriegers Flak has a factor of 0.22 and 0.14 respectively related to that at Falsterbo.

Day and night variations

The variations between day and night flight intensity are clearly shown when looking at the hours individually.

Two hours after sunset, the number of flights increases considerably and reaches a peak about three hours after sunset.

During the night the flight remains at relatively high and steady level.

During daytime fewer flights occur with a minimum in the late afternoon. The distribution of day flight between different hours showed a much smaller difference in comparison with the night flight.

In the autumn the number of flying birds after sunset is higher than during the spring flights.

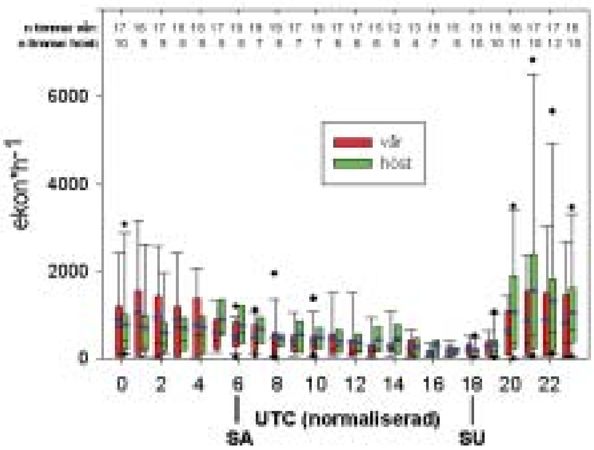
The flight in the autumn shows a second peak during the hour before sunrise, which is not the case for the spring flight.

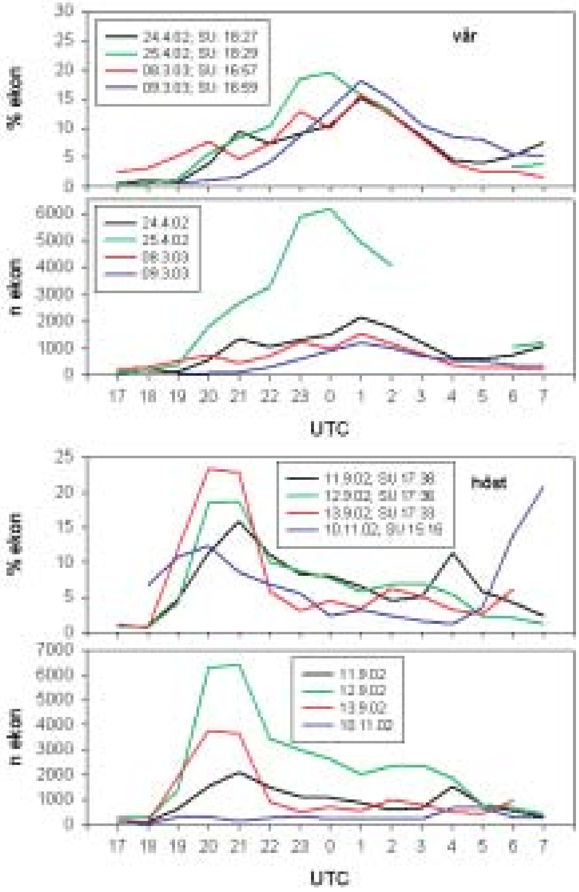
The day flight does not show corresponding differences between spring and autumn.

Height distribution

During the two spring flights a considerably higher number of birds flying below 100 metres were recorded in comparison with the autumn flight; 35 % against 22 % for the first year of surveying.

Day and night variations of the intensity of the migration flight during spring and autumn respectively.





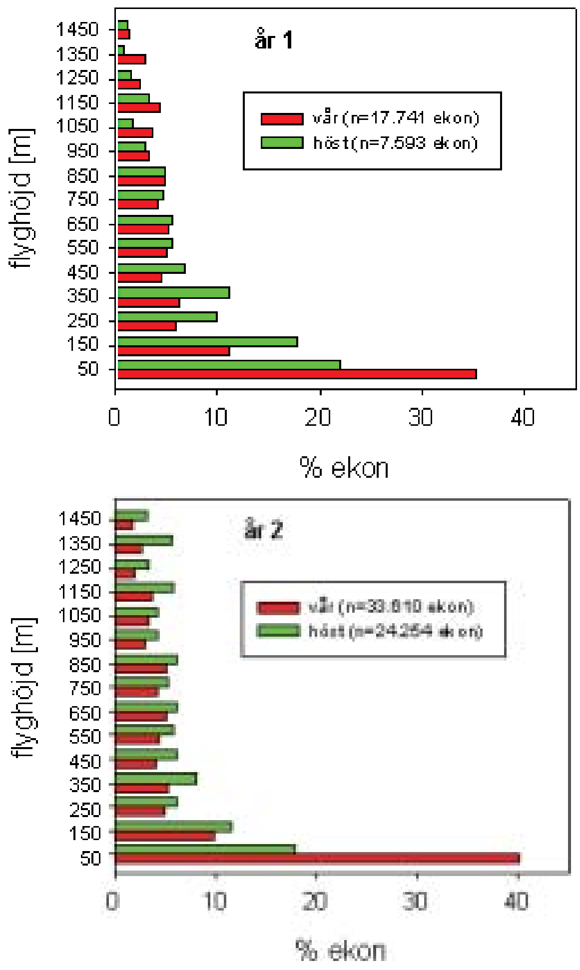
Example of flight intensity, spring and autumn flight

During the autumn the flight shifts upwards, during 2002 to a height between 201 and 400 metres and during 2003 more evenly distributed. The big season related variation, depends largely on the presence of gulls, which in turn is explained by the intensity of commercial fishing in the area.

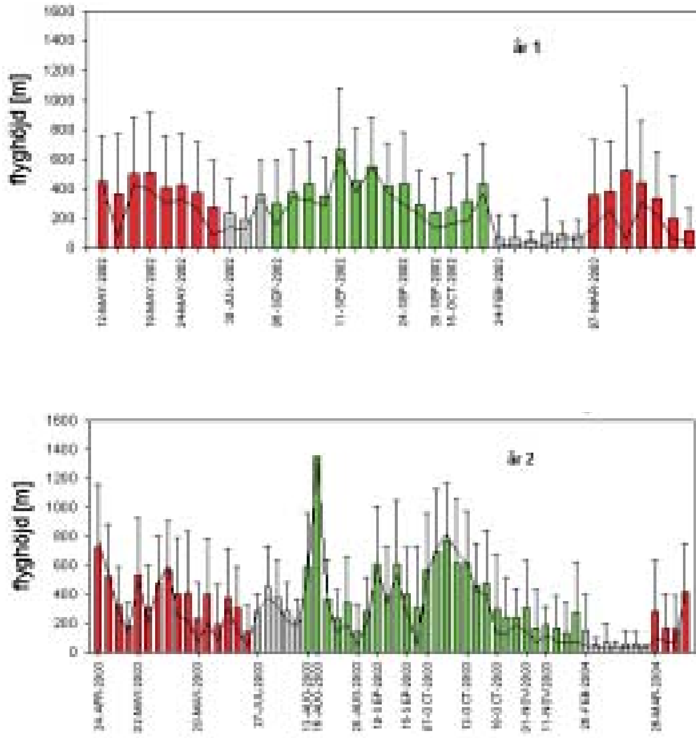
Also during spring and autumn flights there are big season related differences.

During daytime most echoes were recorded below 200 metres, 63.9 % compared to 38.7 % during night time during the first year of investigation.

At night most echoes were recorded above 400 metres. There is also a variation during the 24 hour cycle.



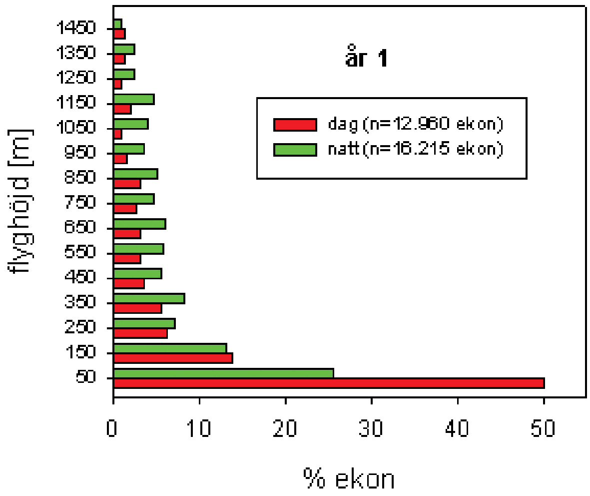
Distribution of flying altitude between spring and autumn flights

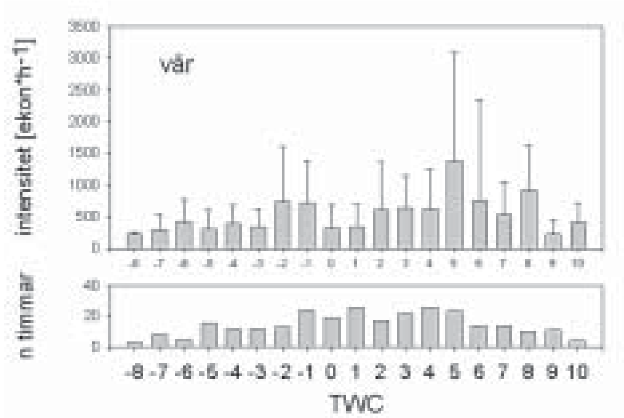


Distribution of flying altitude according to season

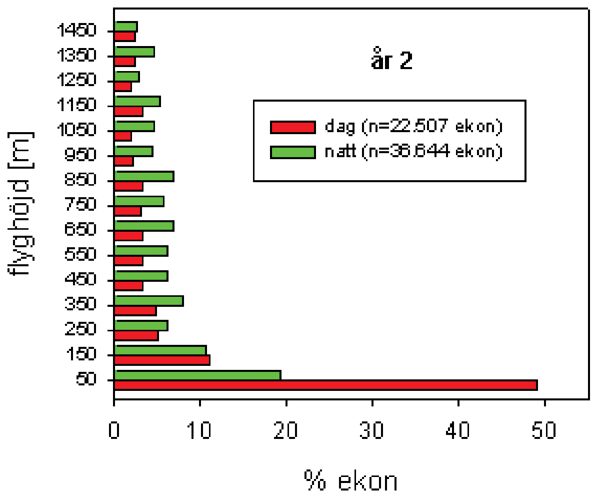
Influence of weather on the flights intensity and height.

The weather conditions have a strong influence on the migrating pattern, partly the overall weather conditions and partly the conditions at the break-up area of the birds. There is correlation between flying intensity and different weather parameters, but these change

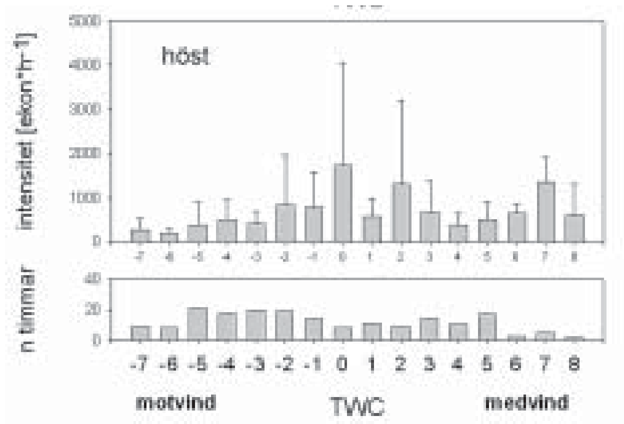




Detail of flight on October 15 2002



Height distribution in special circumstances

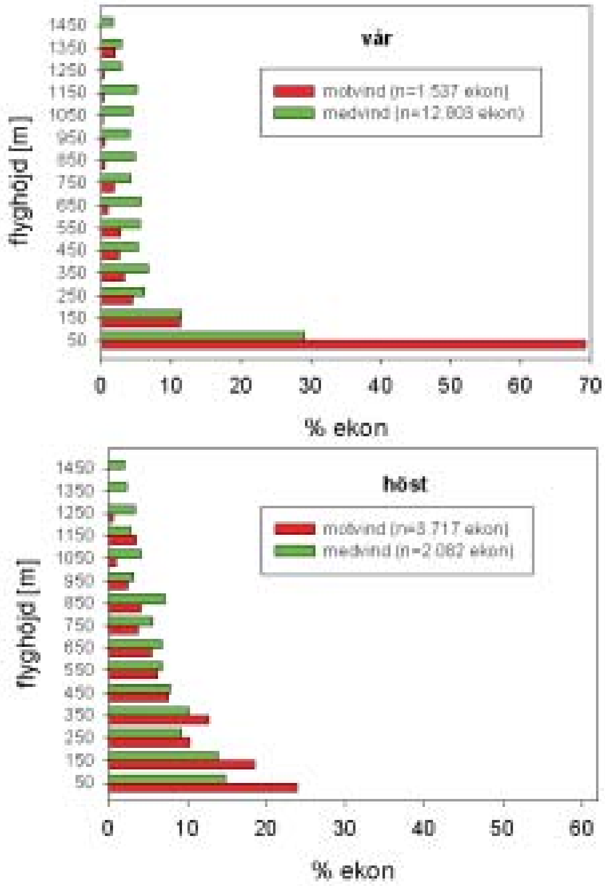


The intensity of flights depending on tailwind or headwind

between the years surveyed. The connections are complex and it is yet too early to draw any conclusions. The survey show that the bird flights predominantly take place during tail wind, i.e. westerly winds in spring and easterly winds in the autumn. During the autumn tail winds are relatively spars and some flights will therefore take place under different wind conditions.

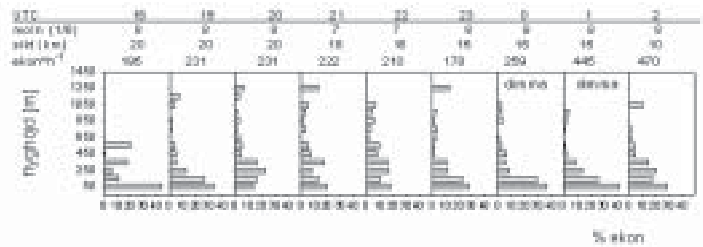
The wind direction also influences the choice of flying height. During the spring flight the birds will fly at a much higher height than at headwind when almost the entire flight takes place at below 100 metres. During the autumn the flight pass is lowered at headwind, but flights take place higher up in headwinds than during the spring flight.

Individual weather conditions will influence flight height. On October 25, 2002 it was raining during daytime but cleared up at around 6 pm at the coast of Skåne. An intensive flight of songbirds set off. Two to three hours later the flight was observed at Kriegers Flak, relatively heigh, up to 1 250 metres. At midnight,



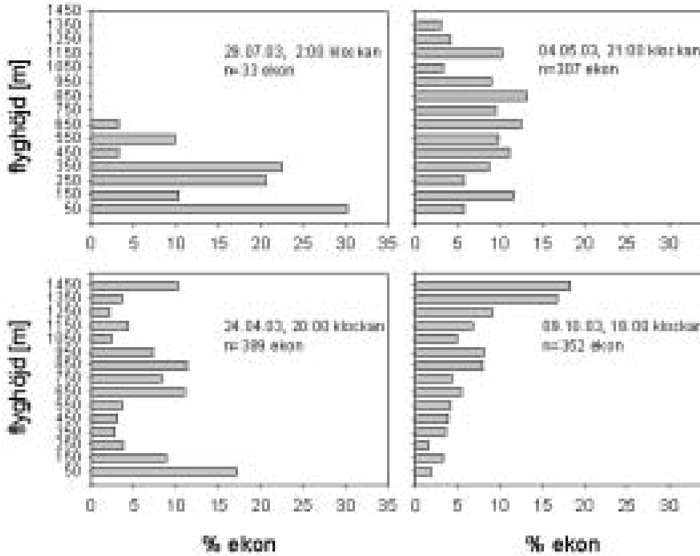
The altitude distribution of flights depending on tailwind or headwind

heavy fog was formed causing the flight to dropp to below 200 metres.



Detail of flight on October 15 2002

Other special weather conditions that cause deviations from the general pattern are shown in the table below:



The altitude distribution in special circumstances

11.6.4. Bats

11.6.4.1 Staging Bats

The presence of bats in the projected area at Kriegers Flak has not been investigated by Swedish Offshore since the long distance from shore makes it unlikely that bats reside permanently in the area.

11.6.4.2 Migrating Bats

Of the 18 Swedish species of bats at least five species migrate in the direction south to west between summer and winter retreat. Field studies at the Swedish coast has shown that during the autumn an out-flight takes place from certain points at Gotland, Öland, Blekinge and Skåne and that during spring an in-flight from the south takes place at more wide spread areas along the Swedish coast (Ahlén 1997, 2002). At the out-flight points there are occasional amassment of bats waiting for improved weather conditions.

At the south coast of Skåne many bats track out of from Falsterbo and there are migrating species along the entire coast.

The existence of migrating bats in the chosen area has, on behalf of Sweden Offshore, been researched by Mr Ingmar Ahlén. With the planned geographical position of the wind farm in mind and the flight directions of the bats, the bat expert Ingmar Ahlén, in conjunction with other bat experts along the south coast of Skåne, is of the opinion that only the conditions at Smygehuk and its surroundings would be of interest to study closer in order to find out whether flights take place or not.

At these investigations, see Appendix 9.1, nothing was discovered indicating flights from Smygehuk and therefore no significant flights are considered to cross the planned area.

There are no surveys indicating from where in-flights originate, but according to Ingmar Ahlén, it is likely that the bats fly across from Rügen and Mön. It is not known whether these flights pass Kriegers Flak.

11.6.5 Marine Mammals

Three species of seals and one of whale regularly occur in the Baltic.

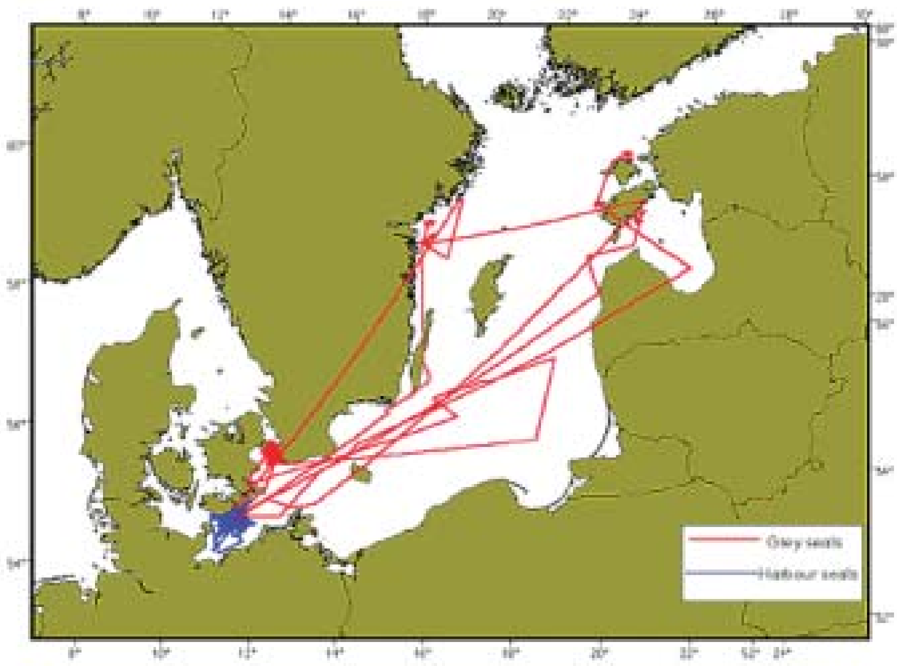
The three species of seal occurring in the Baltic are grey seal, Halichoerus grypus, ringed seal, Phoca hispida and harbour seal, Phoca vitulina. The ringed seal only occurs in the eastern part of the Baltic and is therefore of no interest to study for the planned wind farm.

The only species of whale living in the Baltic is the porpoise, Phocoena phosoena.

The numbers of grey seal, ringed seal and porpoise are mainly threatened by pollution and of getting caught in fishing nets.

The number of seals in the southwest Baltic is well surveyed, see picture below.

Extensive surveys have been carried out by IfAÖ on behalf of the Group on seals and porpoises in connec-



Satellite tracking of Grey seal (red marking) and Harbour seal (blue marking) tion with studies of staging birds at Kriegers Flak.

These investigations ran for two years between April 2002 and March 2004. An area of 505km² was surveyed from ships at 35 occasions with a distance of four km between the transections. Mammals have also been surveyed by aeroplanes 21 times within an area of 560 km2, with a distance of two km between transactions.

In order to register possible existence of porpoises, click-detectors of the type T-POD were at 15 occasions positioned between one to three days from an anchored ship during a total of 36 days.

During the whole period only three porpoises and three grey seals were observed at Kriegers Flak. No harbour seals were observed during the two year long survey.

An extensive literature study of grey seal, harbour seal and porpoises has been made in connection with the above study by IfAÖ and the result thereof, together with the investigations, are presented below.

11.6.5.1 Grey Seal

The grey seal is the biggest of the Swedish seal species. It can reach three metres and weigh 300 kg. Females are smaller than the males and can reach a length of 2 metres and weigh up to 200 kg. The grey seal gives a grey impression with a lighter belly. The profile of the head is the most distinct feature in comparison with other seals, with a straight line from head to nose, which is quite long. The grey seal reaches an age of 25-35 years in wild conditions and up to 40 years in captivity.

The natural habitat of the grey seal is concentrated to the north-eastern Baltic and at the beginning of the 20th century there were about 100 000 in the area.

Since the grey seal competes with the fishermen for fish, it was pursued early on and the numbers declined rapidly. In the middle of the 1980s' the total number was estimated to 1 500 individuals. The population thereafter increased largely and was 7500 individuals in 1999 (Sundberg & Söderman 1999). The population along the Swedish south coast, Skåne, Småland and Gotland, is estimated to 200 individuals (Helander & Häkönen). At Falsterbo, there is a population of grey seals, which was counted from land in 1996 and estimated to 50 animals (Tielman & Heide-Jörgensen 2001).

In Danish waters 12 grey seals were observed during 2000 at Rödsand (Tielman & Heide-Jörgensen 2001). During the autumn 2000, also grey seal cubs were identified. It is unclear if they stem from Rödsand or Falsterbo.

In 1990 grey seals had a resting place at Saltholm in Öresund but when counting from the air in 2000, no seals could be detected (Tielman & Heide-Jörgensen 2001).

Along the German Baltic coast there are no colonies or resting places of grey seal as the grey seal was extinguished in Germany during the 1920's.

By monitoring grey seals with an implanted satellite transmitter, it has been possible to confirm that 95 % of grey seals move within an area with a radius of 36–196 km from the resting place at the western tip of Rödsand, see red markings in the figure on page 101. The grey seal wanders in the Baltic were it regularly crosses the Arcona Basin and is therefore assumed to move in the waters at Kriegers Flak. The three observed grey seals at Kriegers Flak probably belong to the population based at Falsterbo since this is closer to Kriegers Flak than Rödsand.

Grey seal uses areas close to the cost as well as areas further out at sea for locating food. Kriegers Flak could potentially be a food retrieving area for seals from Falsterbo but as so few seals have been spotted there, it is not very likely. The reason for this is probably the intense traffic in the area around Kriegers Flak (60 000 ships a year, fishing and leisure boats not included).

11.6.5.2 Harbour Seal

Harbour seal is an Atlantic seal species and its habitat is sharply restricted to the western parts of the Baltic. The area border is made out of the islands of Falster and Mön and the south coast of Skåne. The harbour seal resembles the grey seal but is smaller and has a smaller head. The forehead is noticeable and the nose

slightly upturned. The colour is grey speckled. Adult harbour seals measure 1.5-2 metres and weigh 50-130 kg.

An isolated population is to be found at Kalmarsund. The nearest territory/resting place of the harbour seal, as seen from Kriegers Flak, is Rödsand/Lolland, the island of Saltholm in Öresund (Denmark) and Falsterbo. By monitoring grey seals with in-planted satellite transmitters from Rödsand, it has been established that 95 % of the harbour seal moves within an area with a radius of 15 km from the resting place at the west tip of Rödsand, see blue marking in the picture to the left.

During counting from the air of the Danish population in 2000, 326 individuals were spotted at Falster, Mön, southern Lolland and Öresund. The total population was estimated at 750 animals.

Due to the harbour seal epidemic in 2002, which killed around 30 % of the European population of harbour seal. this information is now out of date. The experience gained from the seal epidemic in 1988 shows that the harbour seal recovered quickly with an average growth of 10 % per annum between 1988 and 2000.

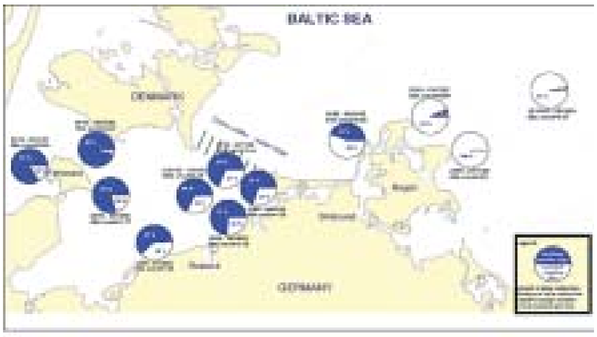
Along the German Baltic coast there are no colonies of harbour seals and only the odd harbour seal of the western population was spotted sporadically.

During two years of investigations no harbour seal has been spotted at Kriegers Flak, which, bearing in mind the fact that this area is well outside the radius of 15 km from the permanent resting place, was not expected.

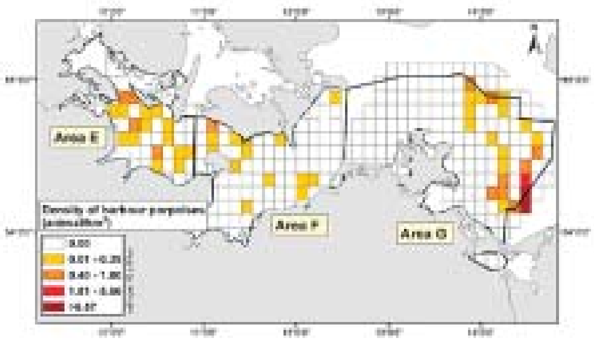
11.6.5.3 Porpoise

Apart from a few occasional visits by other whale species, the porpoise, Phocoena phocoena, is the only type of whale present in the Baltic. In the border areas of the North Sea and the Baltic, there are today about 36 000 porpoises. The porpoise is one of the smallest of the toothed whales. It can be 1.5 metres long and weigh around 50 kg. The porpoise can reach an age of 15 years.

In the bay of Kiel, an inventory was carried out in1994 where 588 animals were recorded (SCANS 1994). In connection with the environmental study for building of the wind farm at Nystedt, porpoises in the area south and east of the islands Falster and Lolland were surveyed during 1999 and 2000. It was discovered during these surveys that during the months of August and November, a total of 34 porpoises were spotted during 23 observation opportunities. In the area east of Falster, only one porpoise was detected. East of the Dars threshold to Cape Arcona, porpoises are very rare. During surveys carried out from the air during the summer of 2002 of the German Baltic coast, within the MINOS project, a concentration of porpoises at the Oder bank in connection with the mating and calfing period, was noted. When the same area was surveyed in August, September and December of 2002, no porpoises were spotted. The survey shows that the area east and north-east of Rügen is more attractive during May and June than the bays of Kiel and Mecklenburg, see figure below.



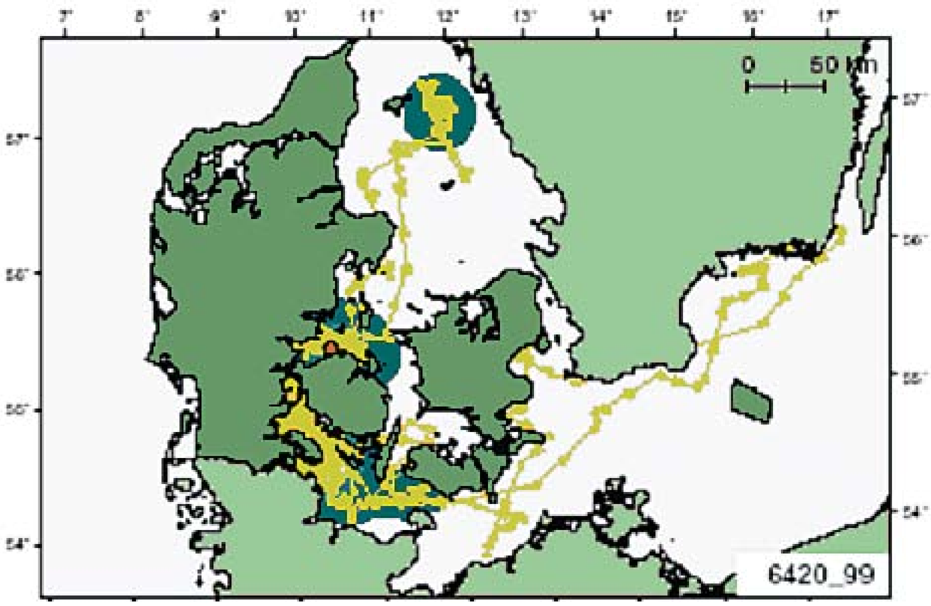
Percentage of days when porpoises were registered by fixed T-POD detectors; Kilian et al 2003



Distribution of porpoises using arial observations, May to August 2002; Scheidat et al 2004

Within the MINOS project, a number of fixed click detectors of the T-POD type have been used to detect porpoises. The main registrations were concentrated to the area west of the Dars threshold, see figure below.

During the period from August 2002 to August 2003, the German Museum for Marine Studies and Fisheries in Straslsund carried out a survey of porpoises with T-POD detectors. At station 21 at Kriegers Flak, porpoises were detected during 16 of a total of 241 days of surveying. The results of Danish telemetry investigations of porpoises show that the porpoises mainly exist at the Darss and Drogden thresholds, but



Telemetric survey of one porpoise 1999/2000; Teil-mann et al 2004 occasionally move eastwards and then pass the areas near to Kriegers Flak, see figure below.

The Porpoise population east of Rügen is by many scientists regarded as a separate population of porpoises. Genetic population studies indicate the existence of two different populations, one along Kattegat and in the inner parts of the Baltic (Wang & Berggren, 1997). The knowledge of this easterly population is limited, the number of individuals is few and the population is regarded as threatened (ASCOBANS, 2002).

During two years of investigations at Kriegers Flak, a total of three porpoises have been spotted. This was at two occasions during the summer of 2003.

In conclusion, there are large populations of porpoises west of the Darss threshold and. During the calving and mating season, also east of Rügen. The area at Kriegers Flak is probably not utilized by porpoises. The three observed porpoises are probably part of the western population in Denmark

11.7 Cultural environment

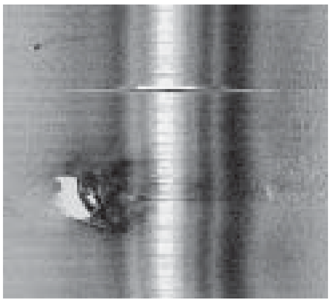
Kriegers Flak was once above water level and it is therefore possible that archaeological remains exist in the area.

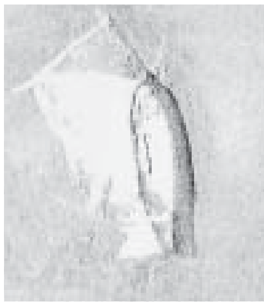
On the Danish side of Kriegers Flak, the area has been searched without finding any. Possibly, any findings have been eroded as the sediments at Kriegers Flak are greatly eroded.

During 2003 Sweden Offshore investigated the whole area along the six proposed rows in a northwesterly direction up to an area of 100 metres of each side of the respective row. At these surveys, no archaeological remains were found, nor any wrecks or other objects.

In connection with the extended consultation process, The National Maritime Museums of Sweden informed that in the Swedish Marine Archaeological Archive, SMA, the are two listings of wrecks or other archaeological remains at Kriegers Flak

In view thereof, Sweden Offshore commissioned Marin Mätteknik to survey the areas with a side scan. Despite an extensive survey nothing was found in one of the two areas identified in the archive. Not even after discussions with and hints from the National Maritime Board regarding the exact location, no wreck could be found. The information for the other area was however correct. Here a ship was discovered which, according to the National Maritime Museums of Sweden, probably is a two-masted ship from the beginning of the 19th century. The wreck appears to be in good condition, see picture below.





The nearest turbine will be erected approximately 1 850 metres south of the wreck and thereby the wreck is a comfortable distance away. More information about the wreck in Appendix 4.4.

11.8 Seascape picture/landscape picture

The concept of landscape picture (or seascape picture which in this case may be a more accurate word) can be said to be a combination of the appearance of the landscape and emotional aspects (SOU 1999:75).

The appearance of the landscape

The shape of the landscape at sea is flat/horizontal and the texture is made up by the waves. A distinction of the sea is also that the colours are few and that it is an open, large scale landscape with few variations.

Emotional aspects

Different people will experience the landscape in different ways depending on their background, knowledge, interests and expectations of their surroundings.

Many coastal people greatly value the unbroken horizon, which was clearly noted during the consultation process.

11.9 Natural resources

The Danish part of Kriegers Flak is today used as a sandpit. The preconditions for a wind farm in the Danish economic zone has been investigated by the Danish Environmental Protection Agency who have come to the conclusion that there are other areas in Denmark better suited for offshore based wind power.

On the German side, a wind farm of around 80 turbines is being planned.

Since there are no major sandy areas within the planned area on the Swedish side, there are no claims for a sandpit.

11.10 Shipping

The information below is based on the reports of GL and SSPA, (Appendices 12.1 and 12.2).

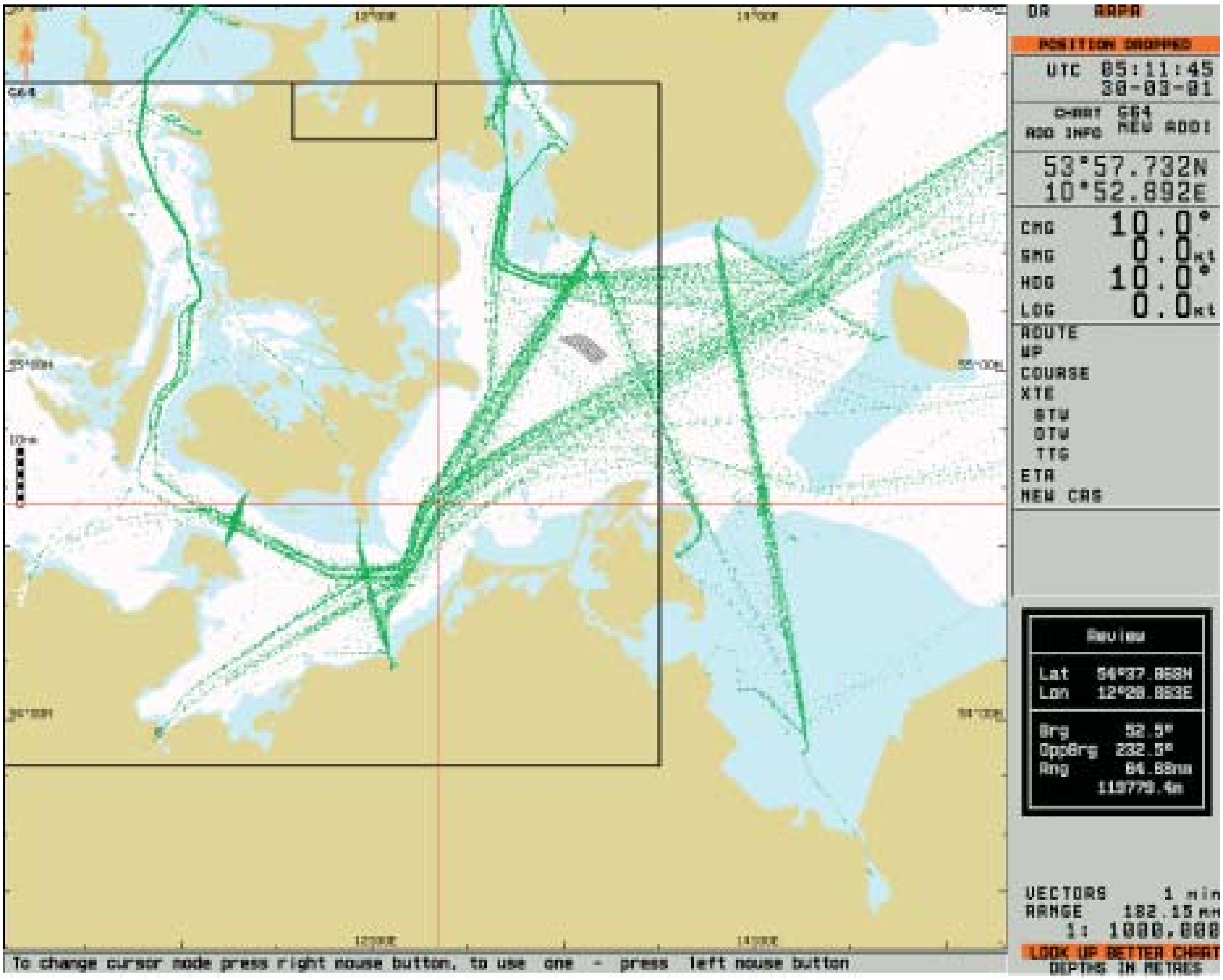
11.10.1 Traffic flow in south Baltic

The GL reports contain a substantial survey of the maritime traffic in the southern Baltic. Estimated traffic is based on available statistics from 2002.

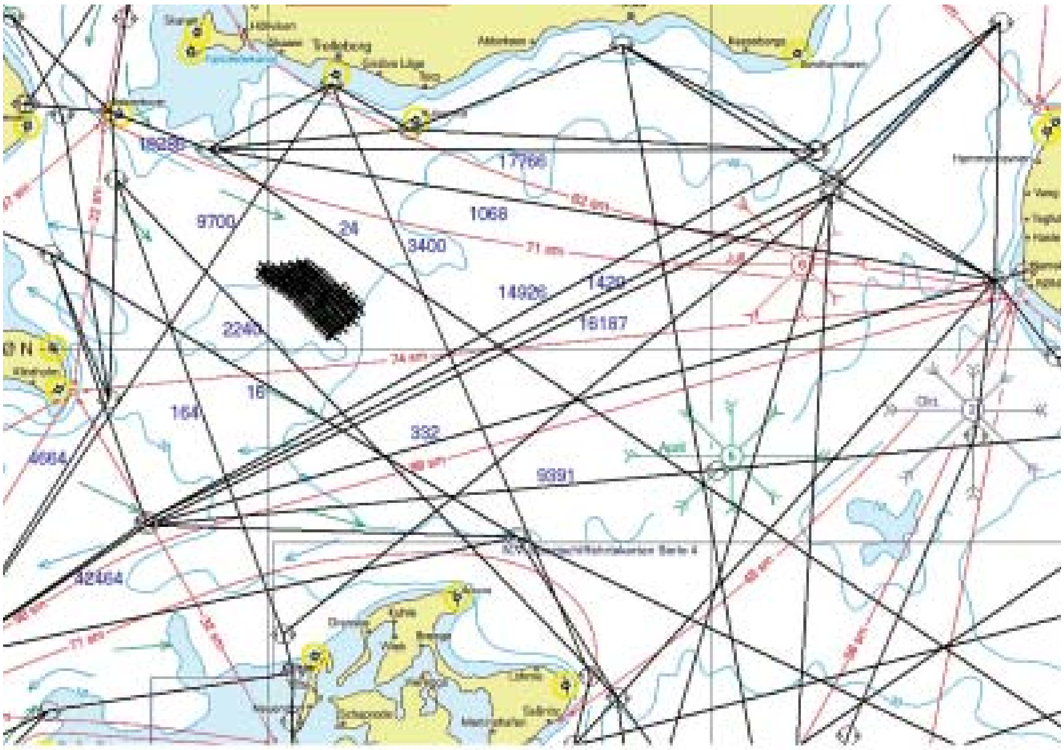
From 2004 (April), there are also direct observations based on AIS. As the Swedish authorities do not have access to the special programs necessary to save all AIS data, Sweden Offshore obtained authorization from the Armed Forces to install this program at the Sjöinfokompaniet in Malmö. Here, all AIS information as from April 2004, was registered and saved and this material formed the base in for an extensive picture of the traffic.

AIS has been obligatory for passenger ships and tankers as from 1 July 2003. Even if AIS will be made mandatory for all other vessels as from January 2005, it is likely that most ships trafficking the southern Baltic already use the system. The diagrams already accounted for from AIS, are therefore likely to present a relatively true account of the traffic, particularly since it is dominated by passenger ships and tankers.

The correlation between the AIS diagrams and the traffic flows based on earlier statistics is good.



AIS observations of traffic around Kriegers Flak, GL



Shipping routes developed by GL based on AIS statistics

11.10.2 Traffic flow at Kriegers Flak

The shipping around the wind farm KF II could be described as five main shipping lanes with a total frequency of around 65 000 ship passages.

The main flow of traffic through the southern Baltic has two distinct shipping lanes. One directed towards the Belts and German ports west of Rügen and another directed towards Öresund. The lane towards the Belts passes south of Kriegers Flak and the planned German wind farm whilst the lane towards Öresund passing the Swedish south coast.

Apart from these two lanes, there are three others mainly used by ferries between Trelleborg and Travemünde/Rostock, Trelleborg and Sassnitz/Swinoujscie and Öresund and Sassnitz/Swinoujscie.

11.11 The Fishing Industry

Commercial fishing at Kriegers Flak is mainly carried out by Swedes but also by Danish and German professional fishermen. The largest catches are caught in the area just north of the planned wind farm. With statistics from the National Board of Fisheries as a base, the average yield within the proposed area of Kriegers Flak is estimated to about five kg/ha/year. The low yield, partly depends on that trawling is very difficult due to an often rocky seabed.

11.11.1 General about the professional fishermen of Skåne

The fishing fleet on the south coast (Blekinge and Skåne) amounted to 472 vessels in 2002. Of these, 418 or 89 % were below 12 metres in length. The small-scale coastal fishing is clearly dominating, looking at the number of ships of the south coast fleet. The bigger tonnage in concentrated to Simrishamn, Sölvesborg and Karlskrona. During the 1990's the gross tonnage of the fleet diminished with just over 40 %. The bigger tonnage on the south coast diminished from 20 % to 12 % during the same time. The typical south coast fishing boat is a 20 year old net-fishing boat with a length of less than 12 metres.

The fishing companies in Skåne are, since the beginning of the 90's, more and more dependant on cod fishing, which, for six out of ten businesses, represents 85 % of their income. For the south coast fishermen, the average value per catch was about SEK 288 000 (2001). A large part of this is used to cover capital and running costs. According to information from a report by the National Board of Fisheries regarding household income of the local fishing community (1997), the av-

THE DEVELOPMENT OF FISHING ON THE SOUTH COAST AT THE END OF THE 20TH CENTURY

Due to international regulations, the base of Swedish fishing has shifted to the Baltic. A development towards larger and more effective tonnage that largely fish for herring and spratt to produce fish meal has taken place simultaneously.

In later years, the population of the very important cod has diminished and despite of price increases, the profitability has gone down.

The increased importance of the Baltic has not helped the south coast based fishing that mainly takes place near the coast in smaller vessels.

For long, the resources of the sea were regarded as unlimited. During the later part of the 1990's, however, it became clear that the capacity of the fishing fleet had become too large, so that, without regulations, the entire fish population became threatened.

Large catches of cod characterised the 1980's. The fast technical development and modernisation increased the catch sizes. Winches meant that also smaller vessels could fish in deeper waters.

The extensive cod fishing cod fishing during the 80-ies, eventually led to a reduced population and the long period of profitable fishing in the Baltic ended in the 90-ies.

The Swedish EU membership in 1995 led to that Sweden became part of EU fishing politics. One of the demands was that the Swedish fishing boat fleet should be reduced. Bonuses were offered to those fishermen that either scrapped their vessels or just took them out of operation. Simultaneously, a mandatory fishing license and fishing boat permit was introduced in order to regulate the fleet.

In spite of the reduced catches during the 90-ies, profitability has been kept due to higher prices.

The reduced profitability for the south coast fishing during the 90-ies has led to a near halving of the fleet. The average age of the fishermen is about 49 years (2001).

Today, fishing in the Baltic is regulated by agreements within the Baltic Fishery Commission (IBSFC). Each year, the highest allowable catch (TAC Total Allowable Catch) is decided, based on population estimates and catch recommendations issued by biologists of the International Council Exploration of the Sea (ICES). The total volume is then, in negotiations, divided between the countries. The commission also decides on any equipment limitations, minimum measurements etc.

Swedish fishing is part of the common fishery policy of the EU (CFP). The main principle of the CFP, is that fishing in EU waters is common for the member states. Within the coastal zones (12 nautical miles from the base line), fishing is, however, reserved for the national fishermen. Regulations over and above those issued by the EU can be issued by individual countries, but they can only be a toughening of the EU rules or may only be applicable for the national fishermen. In Sweden, regulations are issued by the Parliament, the Government, the County Councils and the National Fishery Board. The cast guard control fishing at sea and in the landing ports

erage income derived from small-scale coastal fishing (vessels <12m) was SEK 57 600 per household.

The true statistics for catches is difficult to retrieve. Up to the year 2000 the statistics were based on the catch receivers' postal address. Since January 2001, the hauls are now registered to belong to a certain coastal stretch in the local county of the port of landing.

By studying the fishermen's logbooks, a more accurate assessment of the catches can be made. These, on the other hand, only cover the catches of the licensed fishermen. Since 1990, the County Council of Skåne collate the over-all information of the logbooks. The cod fishing on the south coast, according to this information, amounted to 13 726 tons with a value of SEK 213 033 000. Of this, only 4 322 tons could be related to fishermen on the south coast. Apart from cod, it is herring together with spratt that is creating the income.

There is a steady decline in the number of fishermen and the average age in Skåne in 2001 was 48.7 years. In the age group up to 30 years there were only 39 fishermen registered, which indicate, low recruitment within this trade

11.11.2 Fishing in the affected area

At Kriegers Flak, small-scale coastal cod fishing, i.e. fishing with duration of less than 24 hours according to the National Board of Fisheries, is taking place.

The fishing is almost entirely yarn fishing on the seabed that are placed in a links of about

1 000 metres (10 nets/100m) length. Each boat uses 6-15 links simultaneously

The shallow area, (18-20 m) including the relatively steep sloping areas out to a depth of 35-40 metres, mainly consists of rock, blocks and stones, which makes it impossible for seabed trawling. The extent of surface trawl fishing of herring and spratt within the area is little known but is likely to be small. The reason is that net fishing can be carried out without disturbances. The most intense fishing is carried out on the eastern steep at a depth of between 25 and 40 metres. Large parts of this area will lie outside of the projected wind farm.

Statistics on catches derived from the logbooks of the fishermen show that nearly 95 % of net catches are made up of cod (1996-2003), see table below. Species making up more than 1 % of the total catch are, by size, flounder, whiting and plaice. Other species together constitute less than 1 % of the catch.

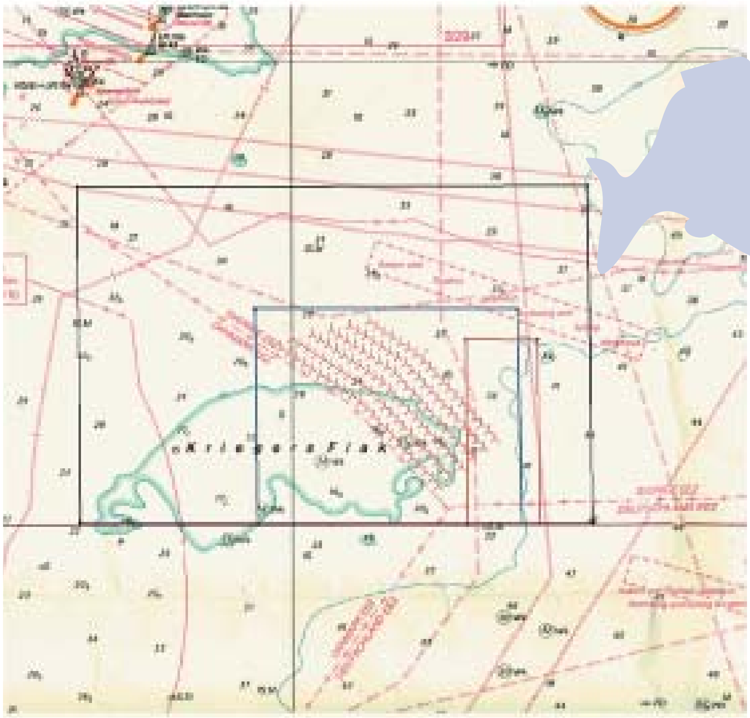
The return by number of kg fish/ha varies in relation

Species caught with yarn	1996	1997	1998	1999	2000	2001	2002	2003	Total
Perch				8					8
Saithe			13			188	558	6	765
Wolf-fish, family						8			8
Salmon	36		8			3	105	20	172
Mackerel		5				1			6
Unknown catches				5		150			155
Turbot	143	401	397	90	34	40	61	25	1 190
Rainbow trout						2			2
Plaice	867	2 571	670	1 381	1 200	728	750	2 295	10 462
Dab	28	9							37
Herring	25 000			0					25 000
Lumpsucker	13			2				18	33
Flounder	3 800	10 813	10 396	6 029	6 065	5 013	7 742	5 732	55 590
Cod	321 810	310 468	142 989	178 005	195 223	258 994	209 236	196 981	1 813 705
Whiting	1 781	1 443	1 409	3 021	5 098	4 302	4 706	1 098	22 858
Sole			73			2			74
Trout		223		22	1	11	12		269

Fish caught with yarn during spring 1996 – 2003 by weight in kg for different species. The statistics are from area no 1 but conditions in areas 2 and 3 are similar.

to the size of area chosen for collecting statistics. The three areas that we have chosen to investigate and analyse statistics from, are shown in the picture below.

In the tables below, one can see the catch statistics for cod with different types of equipment in the three different squares.



Area no 1 is marked with a black line, area 2 with a blue line and area 3 with a red line

Equipment	1999	2000	2001	2002	2003	Total
Yarn	178 005	195 223	258 994	209 236	196 981	1 813 705
Trawl	16 605	64 091	33 708	32 919	56 514	567 125
Other			1 200			13 389

Area 1. Catch of cod in kilos with different equipment during the period 1999–2003

Equipment	1999	2000	2001	2002	2003	Total
Yarn	96 028	95 818	125 781	140 508	153 874	966 625
Trawl	6 930	4 551	4 480	3 540	8 006	89 180
Other			1 200			9 639

Area 2. Catch of cod in kilos with different equipment during the period 1999–2003

Equipment	1999	2000	2001	2002	2003	Total
Yarn	85 748	80 080	72 446	114 168	126 290	736 373
Trawl	5 140	10 154	2 226	6 986	9 927	105 796
Other						0

Area 3. Catch of cod in kilos with different equipment during the period 1999–2003

These statistics show that the extent of trawling in all squares is small.

The areas of these squares are 109 414, 36 014 and 8 232 hectares respectively.

If we only compare catches of cod, as this is the most caught fish, squares 1 and 2 show similar yields, i.e. 2.27 and 3.56 kg/ha/year respectively.

The smallest square (no 3), on the other hand, shows a higher yield, 12.47 kg/ha/year. According to information it is this area (square 3) which is most frequently used by the Swedish fishermen and as mentioned earlier the main part of this area will be outside the planned wind farm.

This fishing around Kriegers Flak is concentrated to two periods per annum, see tables below. Fishing is evenly spread from January to May, as fishing lately has been banned during the summer months of June, July and August. The second period with a more intense fishing takes place during the month of September. During the above two periods nearly 90 % of the annual catch is caught.

The number of fishing boats active at Kriegers Flak amount to 25. Their home ports are spread from Lomma in the north to Ystad in the east. According

Weight of cod [kilos] caught with yarn	1999	2000	2001	2002	2003	Total
Jan	9 808	35 040	18 015	33 235	15 935	112 033
Feb	20 675	18 109	33 575	14 823	41 141	128 323
Mar	38 677	23 719	68 345	28 691	50 143	209 575
Apr	14 958	33 360	42 980	48 759	32 327	172 384
May	35 440	24 478	36 307	41 836	25 339	163 400
Jun	4 505	3 247	8 752		2 223	18 727
Jul	20	25	157		1 972	2 174
Aug	2 085	10 401	2 116	1 321	359	16 282
Sep	41 972	28 002	17 722	34 341	19 196	141 233
Oct	4 670	8 370	10 943	5 930	4 233	34 146
Nov	4 795	6 202	7 939	300	1 423	20 659
Dec	400	4 270	12 143		2 690	19 503
Total	178 005	195 223	258 994	209 236	196 981	1 038 439

Area 1, monthly catch of cod by yarn in kg, 1999 – 2003

Weight of cod [kilos] caught with yarn	1999	2000	2001	2002	2003	Total
Jan	1 842	8 140	5 100	32 535	11 070	58 687
Feb	9 599	5 819	17 330	6 930	40 791	80 469
Mar	18 492	6 489	28 685	15 910	43 335	112 911
Apr	13 228	19 005	31 038	36 997	25 607	125 875
May	27 730	16 995	15 895	31 313	18 229	110 162
Jun	3 955	108	760		2 030	6 853
Jul	20	25			1 912	1 957
Aug	1 865	4 050	350		359	6 624
Sep	13 602	17 545	2 180	14 613	3 972	51 912
Oct	900	7 970	6 710	1 910	2 845	20 335
Nov	4 795	5 402	5 730	300	1 084	17 311
Dec		4 270	12 003		2 640	18 913
Total	96 028	95 818	125 781	140 508	153 874	612 009

Area 2, monthly catch of cod by yarn in kg, 1999 – 2003

Weight of cod [kilos] caught with yarn	1999	2000	2001	2002	2003	Total
Jan	1 842	4 335		32 035	11 377	49 589
Feb	5 289	4 220	6 120	6 330	38 161	60 120
Mar	13 942	6 150	2 360	16 410	37 835	76 697
Apr	13 228	13 735	19 253	29 465	18 838	94 519
May	28 015	16 995	17 320	26 863	5 930	95 123
Jun	2 695	50	760		2 030	5 535
Jul	5				1 500	1 505
Aug	1 885	4 050	50		100	6 085
Sep	13 152	14 395	2 180	2 615	3 950	36 292
Oct	900	7 970	6 670	150	2 845	18 535
Nov	4 795	3 910	5 730	300	1 084	15 819
Dec		4 270	12 003		2 640	18 913
Total	85 748	80 080	72 446	114 168	126 290	478 732

Area 3, monthly catch of cod by yarn in kg, 1999 – 2003 to present legislation these fishermen are not entitled to any compensation, but Swedish Offshore plans to compensate the fishermen for the potential economic damage caused by the farm. Negotiation regarding economic compensation is in progress.

11.12 Leisure fishing

Kriegers Flak was earlier known to house large cod. Within the area, anglers were using rods and regular fishing trips were organised. These trips were offered during three months a year (when the large cod assembled) and during this period a maximum of two to three trips a week were organised.

As the large cod in the area has declined in numbers, leisure fishing has more or less come to an end. Nowadays only sporadic anglers/organised fishing trips occur during the months of May and June.

11.13 Recreation

The area is during the summer months passed by leisure boats. None of these stay for any length of time in the area.

11.14 The Interests of the Armed Forces

In the area south of the Swedish south cost, the Forces are engaged in reconnaissance and intelligence activities. This is mainly done by monitoring using radar and communication intelligence equipment.

11.15 Cables

A telecommunication cable named GS2 crosses the area. The cable is however not in use.

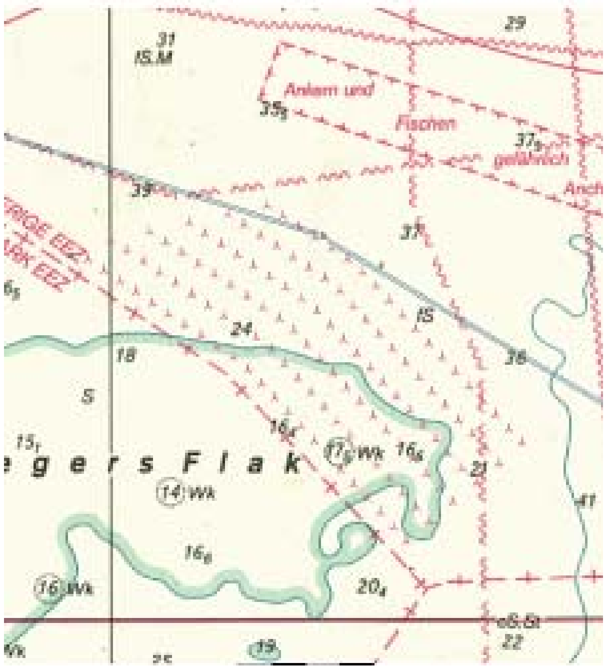
Another cable has been identified but since it is situated in the outskirts of the area, it will not have to be crossed.

Marin Mätteknik has during their investigations discovered traces of something which is either a cable or a trawling track. If it is a cable, it is likely to be the above mentioned GS2 cable. The coordinates do not entirely match the information about the GS2, but it is usual that this type of information has a certain margin of error.

For further information about these cables, see Appendix 4.5.

Two different cables that are no longer in use cross the area.

The DONG company has plans to lay a gas pipeline across the Baltic. Two different alternative routes have been suggested and one of these could have an impact on the north-eastern parts of the farm (see picture below).



Alternative routes for gas pipeline, DONG

Consequences of the wind farm

12. Consequences of the wind farm

This chapter describes assesses the environmental consequences that may arise due to the wind farm. The chapter looks at what is being affected (for example humans, animals and shipping) and then describes in which way it impacts (for example through noise and vibrations). Following this description, the degree of impact is assessed. The degree of impact has been established in cooperation with IfAÖ. To make the assessments consequent and for the reader to better understand how the assessments have come about, the grounds for assessment that have been used are also described.

12.1 Human health

12.1.1 Impact

Impact on humans from the wind farm could arise due to noise, shadows and accidents.

a) Noise

A question that often arose during the consultation with the population, was whether noise from the wind farm would be hearable from the shore.

The work during the construction and dismantling phases will give rise to noise and vibrations. The noise will mainly come from below the water surface and will not be hearable onshore. Noise from above the water line will not give cause to any serious disturbance. This is due to the long distance to shore and the background noise from e.g. waves.

Increased noise from work ships in the area will probably not cause any disturbances onshore.

In the direct vicinity, however, increased noise levels will occur due to increased traffic during construction and dismantling work. As the work is limited in time and humans normally don't frequent the area, the negative impact on humans will be negligible.

During the operational phase, the wind turbines will emit noise but it is not expected to cause any negative impact as the distance to the nearest houses is big.

According to calculations made with the WindPRO computer program, the threshold of 40 dB, that is the marker used to assess outdoor noise from wind turbines, will reach about 1,5 km from the perimeter of the wind farm (see Chapter 5.7.2.1).

According to the model devised by Mr. Sten Ljunggren (see Chapter 5.7.2.1), noise from the wind farm will reach a maximum value of 29,4 dB(A) at the nearest point onshore. In reality, considering the background noise, noise from the wind farm will never be hearable from shore (verbal information from Mr. Sten Ljunggren).

In most cases, noise from the wind turbines will not be distinguishable at closer distances as the background noise from waves and the wind is high when the turbines operate.

Transports by helicopter and ships that are necessary for service and repairs of the turbines, will not significantly increase the disturbance level as the area is subjected to traffic already.

b) Shadows

The shadows that will arise due to the wind farm will reach maximum 2 000 metres from the turbines (see Chapter 5.7.2.4) and will thus not have an impact on humans onshore. Due to the temporary character of the shadows, impact on humans in passing boats will be small.

c) Accidents/oil spill

There are reports of blades/part of blades having come loose, of fire and of towers collapsing but these are very rare. Experience from operating turbines show that it is mainly flaws in steering and control that may cause accidents.

The risk of ice covering should not be underestimated. When a turbine is started after standstill, the ice cover is normally shaken off and the ice falls down along the tower. As an exception, sheets of ice can be thrown from the blades.

The risk of turbines collapsing, that parts of the turbine comes lose or that ice is thrown off is very small. As the farm is 30 km away from the nearest house, there is no risk for humans that are ashore. There is, however, a risk for humans that are inside the farm area, but as humans normally don't frequent the area or the vicinity thereof, the third party risk is minimal. Those affected, may be service personnel and fishermen.

Oils and chemicals in the turbines are sealed off and secondary containers will prevent leakage into the sea in case of an accident.

Boat traffic to and from the area will be intensive during the construction and dismantling phases. During this time, there is a risk of oil and material spill, especially when laying the foundations. Small spills of this kind will not have an impact on human health.
If a ship collision would occur, this could lead to big oil or chemical spills that, in turn, could have a negative impact on human health.

The risk of accidents that cause oil spills, has been calculated by SSPA to 0,0006 per year, or about 1 700 years between collisions (to be compared to the number that has been calculated for the wind farm in the German economic zone, namely 580 years).
The average oil spill has been estimated to 3 400 tons. With security increasing measures, such as tugboats on standby, the risk decreases to 0,00015 collisions per year or about 6 700 years between collisions (see Attachment 12.2).

SSPA has also calculated the risk of humans being injured due to ships colliding with the wind farm. In this case, the risk of accidents has been estimated to 0,000002 per year, or, provided no security increasing measures are taken, one every 500 000 years. A comparison with the European ferry traffic shows that the collision risk between ferries and wind turbines is much smaller. With security increasing measures such as AIS and traffic control, the risk is reduced to 0,0000005 personal accident cases per year, or one every 2 000 000 years.

Summary of impact on humans.

The wind farm is situated far from shore resulting in no shadows reaching the shore. Also, no noise from the turbines will be hearable onshore.

The risk of humans being injured due to falling ice or from parts of a turbine are minimal.

If an accident occurs, for example a ship colliding with a turbine, oil from the turbine and the ship could leak out and cause large negative effects. The risk thereof is, however, very small. The risk of personal injury at such an accident is also considered as minimal.

12.1.2 Mitigating measures

A security zone will be created around the wind farm and the turbines will be marked so as to be seen from passing ships.

To avoid leakage, the oils and chemicals in the turbines are hermetically sealed and a secondary container will prevent any leakage from reaching the sea. In case of oil still leaking out, there will be specially prepared routines to handle smaller leakages from platforms and boats as well as an action plan for contact with the Coast Guard in case of an oil or chemical spill into the sea.

To assist in cases of emergency, the turbines will be equipped with first-aid kits, life buoys, duvets, fire extinguishers and fire alarms. There will also be communication equipment on the turbines for direct communication with onshore rescue stations.

There will be equipment making it possible for humans to climb out of the water. Each turbine will be equipped with an overnight room equipped with a bed and foodstuffs.

Service personnel will be educated in the special risks that are associated with offshore equipment. Service work onboard the turbines will follow special routines. In connection with the construction phase, security routines for work on the turbines as well as for transport to and from the service station in Trelleborg will be devised. All service personnel and other casual visitors will have to undergo survival training in order to be allowed to board a turbine in the wind farm. The same rules as being used onshore, will be used for high current work on the turbines.

In conjunction with affected authorities and rescue organisations, a contingency plan will be devised. The Coast Guard and not the coastal communities of Skåne will be responsible for concerted actions.

Rescue exercises will be held during the construction phase.

Sweden Offshore will propose the security increasing measures recommended by SSPA and decisions in this matter will be made in consultation with the affected authorities.

12.1.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)
- The structure will cause threshold values for environmental quality in- and outdoors, not to be fulfilled.
- The structure will cause very big noise deterioration.

High impact (high value – reasonable impact/reasonable value – high impact)
- The structure will cause threshold values for environmental quality in- and outdoors, not to be fulfilled.
- The structure will cause big noise deterioration.

Medium impact (medium value – medium impact)
- The structure will cause threshold values for environmental quality indoors to be fulfilled and outdoors not to be fulfilled.
- The structure will cause reasonable noise deterioration.

Small impact (reasonable value – no impact/small value – reasonable impact)
- The structure will cause all thresholds for environmental quality being fulfilled and will only cause minor noise deterioration.

Minor/no impact (small value – minor impact)
- The structure will cause all thresholds for environmental quality being fulfilled and will only cause marginal noise deterioration.

Conclusion

No thresholds for environmental quality will be exceeded and no noticeable deterioration of current noise levels will occur. In view of the very low accident risk, it is, in summary, concluded that the wind farm will cause very little negative impact for human health.

12.2 Hydrography

The hydrography in the area is described in Chapter 11.2

12.2.1 Impact

Saltwater flows from the Kattegatt along the seabed past the area where the wind farm is planned and further into the Baltic Sea via the Arkona and the Bornholm basin. During the inflow, the incoming water is gradually mixed with water of less density from above. For this reason, the salt level and density of the inflowing water is reduced before it reaches the real Baltic Sea.

If the wind turbines are built in the path of the inflowing water, the mixing will increase slightly, which in turn will cause water will slightly less salt content and density to reach its destination.

SMHI has made a simple calculation of what the maximum size of the mixing may be, i.e. calculated an upper threshold of the impact that the wind farm may get (Attachment 5.2). The calculation has been made so that a high safety margin has been obtained regarding the volume of mixed water. The result shows that the salt water mixing will increase by much less than 1 % compared to the current average mixing. From this, SMHI concludes that the wind farm will not have a negative impact on the saltwater mixing in the Baltic Sea.

On behalf of the group, the company Hydromod has also investigated whether a wind farm on the German side of Kriegers Flak may influence the saltwater mixing and they have concluded that the impact will be negligible (Attachment 5.1).

Within the area of the wind farm, a marginal lowering of the wave height and wave character is expected. This will not have any environmental impact.

Summary

The salt water mixing will increase much less than 1 % compared to the current average mixing.

12.2.2 Mitigating measures

While planning the wind farm, Sweden Offshore has considered the results that have been forthcoming in the investigations and the turbines will be placed where the least possible impact is caused on the flow of water.

12.2.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)

- The structure will cause permanent disturbance/deterioration of the water quality/salt balance that will destroy the eco system and threaten red listed species.

High impact (high value – reasonable impact/reasonable value – high impact)

- The structure will cause permanent disturbance/deterioration of the water quality/salt balance that will destroy the eco system or threaten red listed species.

Reasonable impact (reasonable value – reasonable impact)

- The structure will cause permanent disturbance/deterioration of the water quality/salt balance that will have a permanent impact on the eco system or a temporary impact on red listed species.

Small impact (reasonable value – small impact/small value – small impact)

- The structure will cause occasional disturbance/deterioration of the water quality and quantity that will cause occasional impact on the eco system.

Minor impact (small value – minor impact)

- The structure will have no impact on the water quality/salt balance that has an impact on the eco system.

Conclusion

The impact on the hydrography will be minor/negligible.

12.3 Flora

The occurrence of flora is described in Chapter 11.5

12.3.1 Impact

There could be negative impact on the flora due to the seabed area occupied by the turbines, the changed sedimentation and due to spills and pollution.

a) **Seabed occupied by the turbines/secondary hard structure**

The foundations of the wind turbines occupy about 0,008 % of the total wind farm area and this area does, therefore, disappear as an area for flora. In addition, the area occupied by transformer stations and a temporary disturbance when laying the cables on the site are also taken, but the seabed area in question is negligible. The direct loss of seabed due to permanent installations will, with all probability, not have an influence on the flora in the area.

Each foundation will also form secondary, new hard structure with an area of between 400 and 900 m2, which is a ten to twenty times bigger area than the lost hard seabed, albeit with a different depth structure. The secondary hard structures will, most likely, compensate for the loss of the hard seabed.

In areas with soft seabeds, positive effects will occur through a new type of flora, namely hard seabed flora (verbal information from Mr. Hans Kautsky, University of Stockholm).

b) Clouding and changed sedimentation

During the construction phase, the marine seabed flora will be subjected to a direct increase in sedimentation through over layering of sediment. This could result in reduced growth, reduced survival or death.

During the operational phase, changed flow patterns could theoretically lead to different sedimentation, which in turn could lead to local changes in the composition of the flora. The studies made by Hydromod do, however, not show that any traceable changes in the flow patterns will occur.

c) Spills and pollution

Smaller leakages would not cause any important negative impact on the benthic fauna, but large volumes of oil or other environmentally hazardous substances could cause great damage. The risk of spills and leakage is considered to be small (see Chapter 5.7.2.3). Also, the risk of collisions causing oil spills is considered to be very low (see Chapter 12.8.2).

Summary of impact

Impact on the seabed flora will primarily occur during the construction phase flora in the direct vicinity may become covered by loose sediments. This impact is limited in time.

12.3.2 Mitigating measures

The spreading of sediments during the construction phase will be minimised by the use of a hose that sucks up loose sediment.

To prevent oil spill, special containers will be present on the turbines (see 5.7.2.3) and the collision avoiding measures recommended by SSPA will be proposed by Sweden Offshore. Decisions in this matter will be taken in consultation with affected authorities.

12.3.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)

- The structure extinguishes (causes permanent damage) an identified value that motivates the natural values of the area, an area of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure causes big impact (temporary damage, long time – up to a generation) on an identified value that motivates the natural values of the area, an area of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).
- The structure extinguishes (permanent damage) an identified value that motivates the natural values of the object, for example a protection worthy species or biotope according to the species and habitat directive (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)

- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).
- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)

- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion

The flora in the area is limited to a few species of red algae that are present in the outskirts of their vertical presence at depths of between 16 – 20 metres. The new establishment areas that the turbine foundations offer, will possibly compensate more than enough for the hard seabed areas taken up by the structure. No red listed species have been observed in the area. The impact on the flora is, in summary, regarded as minor.

12.4 Fauna

The occurrence of invertebrate benthic fauna is described in Chapter 11.6.1.

12.4.1 Invertebrate benthic fauna

12.4.1.1 Impact

The wind farm may cause negative impact on the benthic fauna as part of the seabed is occupied by the turbines, due to changed sedimentation and due to spills and pollution.

a) Occupied seabed/secondary hard structure

The foundations of the turbines occupy about 0,008 % of the total area of the wind farm and this space will disappear for the benthic fauna. In addition, the area occupied by the transformer stations and the temporary disturbance when laying the cables in the wind farm area is also taken, but the occupied area is a negligible part of the total area. The direct loss of seabed due to permanent installations will, with high probability therefore, not be of importance for the macrozoobentos present in the area.

Each foundation will also form a secondary, new hard structure with an area of between 400 and 900 m2, which is ten to twenty times larger than the lost hard seabed, albeit with a different spread of depth. The secondary hard surfaces will probably compensate for the loss of hard seabed.

b) Clouding and changed sedimentation

Due to work with the foundations, clouding and temporary increased sedimentation may occur during the construction and dismantling phases, and due to changed flowing conditions the same may occur during the operational phase. The worst problems are estimated to occur during the construction and dismantling phases.

The marine seabed fauna can, within a limited area, be subjected to increased sedimentation through over layering of sediments. This could result in reduced growth, reduced survival or direct death. Certain species can penetrate up to 90 cm thick layers of sand whilst other species cannot even survive an over layering of a few centimetres.

Indirect consequences may also occur due to reduced occurrence of food due to reduced survival of marine algae.

Adhesive fauna are dependent on water transport for nourishment and for these animals, an increase of sediment in the water may have a negative impact as in and outflow openings may become blocked.

Mobile fauna may also be subjected to clouding. Stationary or semi stationary species (for example sedentary polycheats) are more sensitive than those that can move (nekton, for example crayfish).

During the operational phase, changed water flowing patterns in the areas immediately behind the wind turbines, may lead to locally changed sedimentation conditions, which possibly may lead to changes in the local habitat.

c) Spills and pollution

Minor leakages should not cause any important negative impact on benthic fauna, but large volumes of oil or other hazardous substances could cause great damage. The risk of spills and leakage is considered as very low (see Chapter 5.7.2.3). Also, the risk of collisions causing oil spill has been deemed as very low (see Chapter 12.8.2).

Summary of impact on benthic fauna.

In summary it may be noted that sediment and sedimentation may cause negative impact for benthic fauna in the immediate vicinity when the foundations are laid/dismantled. This impact is limited in time. Larger spills and pollution would cause great damage but the risk thereof is considered small.

12.4.1.2 Mitigating measures

Areas with a high concentration of macrozoobentos should, if possible, be avoided.

By using a hose to suck-up free sediments during the construction phase, sediment spreading will be minimised.

Special containers will be present on the wind turbines to prevent oil spills (see 5.7.2.3) and the collision avoiding measures recommended by SSPA will be proposed by Sweden Offshore. Decision in this matter will be made in consultation with affected authorities.

12.4.1.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)
- The structure extinguishes (causes permanent damage) an identified value that motivates the natural values of the area, an area of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)
- The structure causes big impact (temporary damage, long time – up to a generation) on an identified value that motivates the natural values of the area, an area of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).
- The structure extinguishes (permanent damage) an identified value that motivates the natural values of the object, for example a protection worthy species or biotope according to the species and habitat directive (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)
- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)
- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).
- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)
- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion

Only two red-listed species and only a few individuals have been observed in the area. The marine benthic fauna in the area does not constitute any special protection worthy nature protection object and the wind farm will not have any impact on the biological diversity. The wind farm will, therefore, have minor impact on the benthic fauna.

12.4.2 Fish

12.4.2.1 Impact

Fish may be subjected to negative impact due to the following: noise and vibrations, light, shadows and reflexes as well as deteriorated water quality due to clouding and changed sedimentation or oil. If the wind farm would cause negative impact on the fish feed, it could lead to negative consequences for fish in the area.

If a security zone is established that makes commercial fishing impossible and through artificial reefs, a positive impact for the fish population is possible. The occurrence of fish in the area is described in Chapter 11.6.2.

> **HEARING OF FISH**
>
> The hearing of fish is good at low frequencies and many fish can hear sounds with lower frequency than 20 Hz.
>
> Generally, fish can be divided into three groups in respect of their ability to hear sounds. The first group consists of species that lack a swim bladder (for example mackerel and flat fish) and they can hear frequencies up to just over 250 Hz. The second group are species with a swim bladder (most species, for example cod, eel and salmon) that can hear frequencies up to about 500 Hz. The third group consists of species with a special connection between the swim bladder and the OTOLITEN (for example common carp and herring) and they can hear sounds with frequencies up to 2 000 Hz. (Source: Wahlberg/Westerberg, 2004)

a) Noise and vibrations

Noise distribution in water is very effective, which causes organisms living below the surface to constantly be subjected to noise.

There are three ways that the noise from wind turbines may have an impact on fish; make communication more difficult, frighten the fish and cause temporary or permanent hearing damage (Wahlberg/Westerberg, 2004). In addition, noise from wind turbines could cause fish to become permanently stressed. The expected impact due to noise is described below.

The construction phase

Possible piling or drilling during construction could cause severe noise disturbance and this could cause fish to completely avoid the area during the construction phase.

In connection with the piling work at Utgrunden I, noise measurements were carried out on behalf of Enron Wind/SEAS both above and below sea level. During the evaluation that followed, it was concluded that the effect of low frequency noise during piling could cause certain avoiding reactions from certain less hearing species, such as those with a swim bladder, for example cod, eel and salmon. The reaction is only expected to occur at about ten metres from the noise source. For hearing specialists with a relatively low hearing threshold within frequencies of 100 to 3 000 Hz, for example various herrings, avoiding reactions may be accentuated. The hearing capability of fish could also be damaged due to piling work. It has, however, been shown that the hearing capability will be recreated.

The operational phase

Sub surface noise from operating wind turbines is generated to a relatively broad extent, amongst others within the area that fish can hear, i.e. low frequency noise (for more information on noise generated by wind turbines, see Chapter 5.7.2.1). There is, however, always background noise in the sea from waves and shipping, and it is therefore difficult to know how much hearable noise there is from wind turbines. Westerberg has measured noise from wind turbines at Nogersund, and these measurements show an increased, total noise level, amongst others within the infra sound spectrum (Westerberg, 1997).

According to Wahlberg and Westerberg (2004), fish can probably register wind turbines at distances between 0,4 and 25 km at wind speeds equivalent to between 8 and 13 m/s.

This is, however, only valid for fish with a swim bladder. For fish without a swim bladder that have impaired hearing, the distances mentioned above are shorter.

Exactly from where fish can hear noise from a wind turbine depends on the type of turbine, the number of turbines, the hearing capability of the fish, the background noise, the wind speed, the water depth and the seabed conditions (Wahlberg and Westerberg, 2004).

Theoretically, the noise from wind turbines could frighten fish, but only within a distance of maximum 4 metres and only at high wind speeds, 13 m/s (Wahlberg and Westerberg, 2004).

Studies show that fish learn to associate certain noise with a certain occurrence. This could result in that fish associate noise from wind turbines with a non-dangerous structure that does not frighten them.

Noise measurements from the wind farm at Utgrunden show that the noise emitted by the turbines not even frightens the fish away at a distance of 1 metre from the turbines. This could indicate that fish associate the noise from wind turbines with something that is not dangerous.

It may further be assumed that the continuity of noise is a determining factor for the reactions of fish. Westerbergs investigations of fish behaviour near bridges with car and train traffic showed that fish did not to any great extent react to the more or less continuous traffic, but that shoal of fish could make vertical movement changes at sudden noise emissions, such as when a train passed the bridge. This would indicate that the continuous noise from wind turbines will not have a significant impact on fish. However, no certain conclusions can be drawn as the study was limited in scope.

For many fish, noise signals are important in order to localise each other during spawning and signal readiness for mating. Noise and vibrations could therefore influence the suitability of an area for spawning. Studies show that noise from wind turbines may influence signalling of fish at a distance of several kilometres but the degree of importance of such influence is not known (Wahlberg and Westerberg, 2004).

Studies have shown that if fish continuously are subjected to high noise levels, damage to the inner ear can follow (Hastings et al., 1996, McCauley et al., 2003). There is, however, nothing that indicates that noise from wind turbines may, temporarily or permanently, damage the hearing of fish (Wahlberg and Westerberg, 2003).

The studies that have been made on the impact of noise on fish have generally been conducted on single turbines and smaller structures. The results cannot, therefore, easily be transferred to large wind farms. It should also be noted that the knowledge of the impact on roe and juvenile fish is very small. Following a review of the studies, Wahlberg and Westerberg (2004) conclude that juvenile fish are at least as sensitive as grown species while roe is considered less sensitive.

A careful judgement would however be that noise from wind turbines does not have any important negative impact on fish. The fact that large numbers of fish have been registered at Horns Rev (Hvidt et al., 2004) supports this theory.

The effect of noise and vibrations on fish will be studied closely during a control programme following the construction of the wind farm. The control programme is described in Attachment 19.10.1.

The dismantling phase

Noise during the dismantling phase may temporarily frighten the fish away. Noise that causes damage to the hearing of fish is not very likely, but cannot be excluded.

b) Light, shadows and reflexes

During the operational phase, light is generated from the floodlights on the turbines. Light is known to attract fish but apart from a possible collision risk, fixed light points are not considered to cause any negative impact.

During the operational phase, the towers and the blades cause shadows that could have an impact. During the construction and dismantling phases, the shadows are temporary and during these periods, the impact is limited.

Fixed shadows, such as behind the towers, attracts fish and is not considered to have a negative impact.

Fast movements that are mirrored on the water surface, could on the other hand cause unrest. The blades, sweeping over a large area, cause a fluctuating shadow on the water surface. Many organisms react by escaping or by carefulness in similar situations. Among anglers and scientists, it is considered common knowledge that fish react by escaping or seeking protection when a shadow passes over them. The reason is probably a protective measure so as not to become feed for praying birds. Whether the fish can get used to these intermittent shadows has not yet been studied, but it is regarded as likely that fish get accustomed to it.

It should be noted that the light penetration in the Baltic Sea stops at a depth of 20 – 25 metres, and it is therefore assumed that shadows from the wind turbines do not affect fish at greater depths. During day time, most fish go deeper down for protection and move upwards during night time to feed. This further reduces the impact on fish.

c) Clouding and changed sedimentation

Due to work at seabed level, clouding will most likely occur during the construction and dismantling phases.

Changed sedimentation conditions may occur during the operational phase as a consequence of changed currents due to the foundations. This impact is, however, marginal and is not expected to cause any noteworthy effects. Due to the swirl forming behind the foundations, increased sedimentation is likely to occur. This impact is limited in time as an equilibrium quickly will occur (see Chapter 5.7.2.2).

Due to the suspended particles, the light penetration will be reduced in cloudy water.

Fish use their eyesight during their activities and a lesser light penetration could, therefore, cause more difficult conditions when e.g. seeking food.

For fish that eat mobile feed, it is likely that both the feed and the predator avoids areas with high particle concentration. Therefore, these fish will probably not be as affected as fish that predominantly feed on flora and fauna plankton, as plankton follows the currents and lack the ability to escape.

Spawn have a limited possibility to escape from an area as they have limited swimming capability. As spawn lack significant energy reserves, this could cause acute starvation.

Many fish in the Baltic Sea spawn on the seabed or on vegetation. Here, changed sedimentation can have an impact. A hard seabed that changes to a soft seabed, over layered vegetation and reduced light penetration may cause the vegetation to die, which in turn may lead to worsened spawning conditions for several species.

If already laid roe would be over layered, it would probably lead to the roe dying.

Clouding may also lead to the fish avoiding the area. A pool experiment conducted by Westerberg et al., (1996), showed that cod and Baltic herring avoid areas with a particle concentration of more than three mg/l. Other studies show that a much higher particle concentration is needed for fish to avoid the area. In a study by Hansson (1995), 100 mg/l is mentioned as a critical number.

Clouded water can cause temperature variations. The clouding cause the light energy to be concentrated to the surface, which in turn causes a faster warming of that layer compared to deeper layers. This could also lead to fish migrating.

The electrolytic balance and the solubility of oxygen in water may be affected by sediment suspension depending on composition of matter and volume. The two latter effects are often minor compared to those that arise due to reduced light penetration.

d) spills and pollution

Minor leakages should not cause any important negative impact on fish but large volumes of oil or other hazardous substances could cause great damage. The risk of spill and leakage is regarded as very small (see Chapter 5.7.2.3). The risk of collisions that cause oil spills is also regarded as very low (see Chapter 12.8.2).

e) Artificial reefs

During the operational phase, a so called reef effect occurs.

The foundations of the wind turbines will become artificial reefs and it is well documented that fish is attracted by such structures. The production of algae and small creatures are made possible on artificial reefs and this causes the volume of feed to increase. Preliminary results of a study at Utgrunden show that particularly brown algae, red algae, Common Mussels and Sea Tulips grow near the wind turbines. It has been observed that this draws smaller fish to the area.

There are divided opinions on whether artificial reefs only causes existing fish to concentrate to the structures, or, if they lead to an increased population.

f) Security zone/protected area

If a security zone is introduced, hindering commercial fishing in the area, this will constitute a protected area where fish may spawn and grow in peace. This could have very positive effects for the fish population in the Baltic Sea.

A new WWF report (Benefits Beyond Boundaries: The Fishery Effects of Marine Reserves) that has analysed data from 60 different marine reserves, amongst others show the following positive effects:

- The production of offspring increases, which could rebuild over exploited stock. This is amongst others due to that fish will live longer, become bigger and thus produce more roe. Also the stock density will increase. Many eggs and larvae drift away outside the boundaries of the protected areas and help rebuild stock that is being caught.
- Both fish ready to spawn and younger fish spill over to areas outside the reserve. This is due to stock inside the protected area becoming so dense that fish start to migrate.
- Protected areas offer a sanctuary for especially sensitive species where they can get a chance to survive.

Summary of impact on fish

During the construction and dismantling phases, fish could be frightened by noise and vibrations.

The construction and dismantling work could also cause clouding. The impact of clouding and changed sedimentation varies with sediment volume, water movement, tendencies of particle clustering and factors connected to the exposed organism. The reactions are species specific and roe and spawn are generally more sensitive to clouded water than grown fish. Over layering of roe may lead to direct death. High particle concentration may led to fish migrating from the area.

During the operational phase, noise and shadows from the wind turbines could frighten the fish away from the area, but it is also possible that fish get used to it and that the consequences of shadows and noise do not appear. A potential frightening effect is only expected within a few metres from the wind turbines. Noise could, however, influence the signalling of fish.

The changed or increased sedimentation expected during the operational phase is negligible and is not expected to cause any negative impact on fish.

Larger spills of oil or chemicals could have big negative consequences for fish. The risk of spills is, however, considered as very small.

If the commercial fishing is impaired in the wind farm area due to the introduction of a security zone, this could have positive effects on the fish stock as the fish through this get a protected area. This is, however, dependent on that fish are not negatively affected by noise from the turbines.

The artificial reefs that are created due to the foundations may also have positive effects on fish, for example through an increase of the availability of food and through in an increase in the number of species.

12.4.2.2 Mitigating measures

To lower the negative impact for fish in the area, the construction work will be concentrated to periods when the different species spawn at Kriegers Flak.

The construction will be limited to a limited area at a time. By not constructing in several areas at the same time, the so called techno effect is avoided.

If possible, the foundations and the towers will be constructed in such a way as to minimise the occurrence of infra sounds.

Special containers on the wind turbines will prevent oil spill (see Chapter 5.7.2.3) and the collision preventing measures that SSPA has recommended will be proposed by Sweden Offshore. Decisions in this matter will be made in consultation with affected authorities.

12.4.2.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)
- The structure extinguishes (causes permanent damage) an identified value that motivates the natural values of the area, an area of national or international interest (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)
- The structure causes big impact (temporary damage, long time – up to a generation) on an identified value that motivates the natural values of the area, an area of national or international interest (high value – high impact).
- The structure extinguishes (permanent damage) an identified value that motivates the natural values of the object (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)
- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)
- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).
- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)
- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion
The studies conducted so far do not indicate that the area currently constitutes an important spawning and growing area for fish. Final information about this will be gathered during the review of the studies that will be made during 2005.

The wind farm will not cause damage to the biological diversity or extinguish any protection worthy species.

The wind farm may in the worst case frighten fish away from the area, which the latest studies at e.g. Utgrunden oppose, and cause over layering of spawn during the construction phase. The negative impact for fish is considered to be low.

If a security zone is introduced, the collected positive effects for the fish stock would, instead, be large. This is due to that a protection area will shield the area from commercial fishing.

If an accident would occur that would cause leakage/spill of oil or chemicals, fish would be negatively effected. The risk thereof is, however, considered as very small.

12.4.3 Birds

The occurrence of birds is described in Chapter 11.6.3.

12.4.3.1 Impact

The wind farm may give cause to the following impact on birds:

a) Risk of collisions
b) Disturbance of staging and foraging water fowl
c) Barrier for migrating birds
d) Loss of habitat

a) Risk of collisions

In theory, all birds flying below 200 metres are subject to the risk of collision. Looking at the radar measurements carried out by the company, between 60 and 64 % of birds registered during day time, belong to this category. For birds registered during night time, the number was 30 to 39 %.

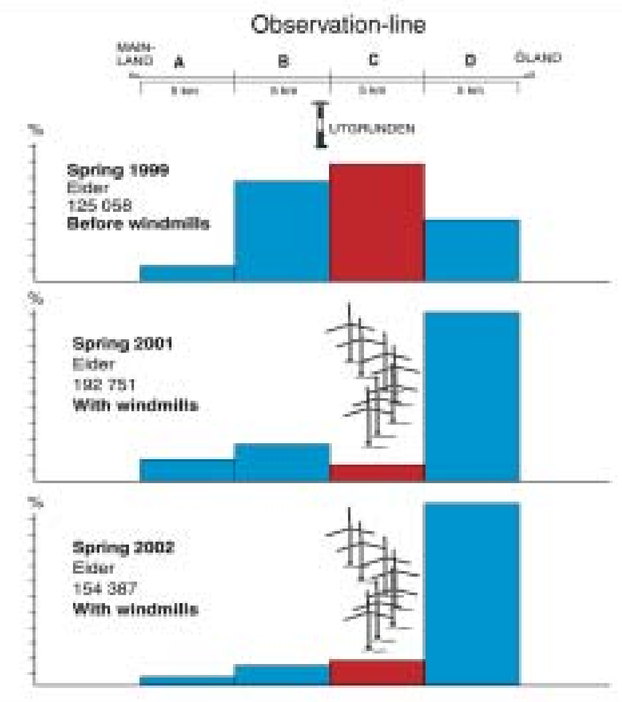
Birds migrating during day time will be less affected as they can see the hazards earlier and fly around them.

As the wind turbines will be floodlit, it will in general also be possible to see them during night time. Critical situations with added collision risk will primarily occur during the night with sudden fog/rain or strong winds occurring.

Studies of collisions between birds and wind turbines constitutes a lot of the material that deals with the impact of wind turbines. European studies show that the impact of wind turbines on birds through collisions are minimal in the areas that have been studied and in the habitats that are of interest for establishing wind farms. These studies have been criticised for having been made in areas with single turbines and often burdened by some sort of methodical problem, making the results difficult to interpret.

A recent study of the risk of collision at Utgrunden and Yttre Stengrund (Jan Pettersson and Thomas Stalin) however shows that even in the case with a greater number of turbines (seven and five respectively), the collision risk is minimal.

Before the seven wind turbines at Utgrunden were installed, about 40 % of flights of a total of 125 058 eider ducks, flew in the area where the turbines later were installed. When the wind farm had been installed only 6 % of 192 751 (spring of 2001) and 7 % of 211 239 eider ducks (spring of 2000) flew through the area.



Observations at Utgrunden wind farm

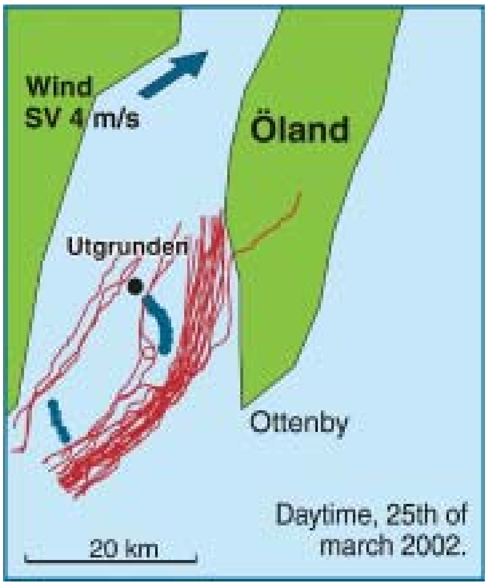
Investigations at Yttre Stengrund showed the same pattern. During the autumn of 2000, before the installation of the wind turbines, 32 % of eider ducks under flight flew through the area where the turbines later were erected. During the autumn 2001, when the turbines had been erected, only 2 % flew through the area.

Radar investigations were carried out during night time and showed that the birds identify the turbines in the dark and that they avoid them in the same way as during day time.

Investigations at Utgrunden and Yttre Stengrund showed that the birds, both during day and night time, seemed to detect the turbines at a distance of 2 km. The birds chose to pass at a relatively big distance of 500 to 1 000 metres from the turbines. Which side of the wind farm that the birds chose depends on the wind direction. It is very rare that the birds chose to fly above the wind turbines. During the whole time of investigation, not a single collision was observed (see picture on next page).

No collisions were observed during visual observations during day time at the Danish wind farms Horns Rev and Nysted.

The radar investigations carried out at Horns Rev showed that only between 14 and 22 % of the birds chose to fly through the wind farm. At Nysted, the corresponding figure was 9 %.



The investigations at both wind farms showed that the birds make way for the turbines well in advance. At Horns Rev, a change in flight path was registered at a distance of between 400 and 1 000 metres. At Nysted, the flight path changed already at a distance of 3 000 metres during day time and 1 000 metres during night time. The differences between the wind farms is probably explained by the different species registered. The investigations were conducted during one year, albeit not during days with bad visibility (fog/rain). Further, only larger water fowl and day migrating birds could be registered. The results from the investigations should, therefore, be treated with caution.

The collision risk depends on several different factors. As mentioned above, the weather has a great impact but the risk is also due to the species. An investigation of 190 bird species that have collided with a Danish lighthouse, show that five species made up for 75 % of the casualties (Hansen, 1954). These were Eurasian skylark, song thrush, redwing, dipper and European robin. About 90 % came from 14 different species, all of which were night flyers. Of all birds observed, very few were day flyers and only three were thermal flyers.

IfAÖ has in its report estimated annual collisions to 1 000. The risk of water fowl, such as ducks, geese, eider ducks, seagulls, terns and loons, would collide with wind turbines is considered as low. As thermal flyers normally fly at much higher heights and as their eyesight is well developed, the risk for collision is low. In addition, flights over open sea by thermal flyers occurs seldom. Most collision victims will most likely be middle distance flyers with very large breeding stocks in Scandinavia, for example Eurasian skylarks, thrushes and dippers. In relation to breeding stocks of Scandinavian night flyers (500 – 600 million), the annual maximum mortality quota is estimated to 0,002%. The IfAÖ considers that this quota will not have any negative impact on migrating birds (page 117, stocks decrease).

Jan Pettersson has, on behalf of Sweden Offshore, estimated the annual collision (Attachment 8.4). Jan Pettersson has estimated the number of annual collisions to 48, a much lower number than that of the IfAÖ.

b) Disturbance of staging and foraging water fowl

Wind turbines may also frighten breeding, staging and foraging birds. The effect varies for different species. Seagulls and terns are regularly observed at Horns Rev. During the construction phase, the frightening effect may become big due to transports and construction work. There are currently no studies made on the impact of noise and vibrations on birds.

c) Barrier effect

Here, barrier effect means that migrating birds to avoid the wind farm make a detour in their flight. As the planned wind farm will occupy such a large area, it is conceivable that migrating birds will act similarly to the wind farm as to islands, namely to fly over the area at several hundred metres height. This type of behaviour has been registered at onshore objects with, for example common scoter, loons and long-tailed duck (Bergman & Donner, 1964, Berndt & Busche, 1993). The above studies at Horns Rev, Nysted and Utgrunden have shown that large scale wind farms do have barrier effects even if there are species specific differences. For common scoters and loons, wind farm are examples of barriers whilst eider ducks fly through, although if mainly around them. Wind farms are no barriers for seagulls, terns and most thermal flyers, as the latter often fly higher than the wind turbines.

The important question regarding barrier effects, is whether the detour gives rise to any relevant increase in energy consumption. Considering the high, natural variations of flights and their total distance, IfAÖ estimates the extra load for the affected species as minor.

Jan Pettersson does also not consider that the extra energy consumption has any important negative impact on the individual (see Attachment 8.4).

d) Loss of abitat

As mentioned above (11.6.3.1), not many birds reside permanently in the area.

The few that reside in the area will probably not be affected as the distance between the wind turbines is big and the actual rotor is situated very high up.

The installation of wind turbines in shallow waters may cause a risk of damage to feeding places (for example of mussels). Access to such places may be important links in the life cycle for many species. As the water depth is between 16 and 42 metres at the site, the problem is, in this case, small.

e) Spills and pollution

The risk of spills and pollution is considered as very small (see Chapter 5.7.2.3). Also, the risk of collisions that cause oil spills has been considered as very low (see Chapter 12.8.2). If spills would occur, the negative impact for water fowl would be very big.

Summary of impact on birds

The impact on birds from the planned wind farm will foremost occur during the operational phase in the form of collision risk. Collisions will predominantly take place during night time, especially during bad visibility (rain/fog/strong wind). Studies show that the collision risk is very small. Birds detect wind turbines at distances of several thousand metres and the fly at the side of the farm. Jan Pettersson has estimated annual collisions to 48 and judges that this will not cause any important negative impact on migrating birds. IfAÖ does also not judge that the wind farm will have any important negative impact.

If an oil spill would occur, great negative impact would result. The risk thereof is, however, very small.

12.4.3.2 Mitigating measures

During the construction phase, all noise and light emissions will be kept at the lowest possible level. During bad weather conditions with strong winds, when installation activities probably are stopped, to minimise the risk of a bird collision, only the most necessary emergency lights will be used on working platforms and anchored ships.

The use of adapted colouring and lighting is a crucial measure to minimise the risk of birds colliding with wind turbines. The most important colouring and lighting aspects from an ornithological viewpoint are:

- Strikingly coloured marking of towers and rotors (This can be achieved with colours that are invisible for humans, as the ultraviolet band can be seen by birds but not by humans. For example, the rotor could be marked in a pattern that reflects ultraviolet light.)
- Reduction of the necessary lightning to an absolute minimum
- Only indirect lighting of towers from above (avoiding direct rays against the sky)
- Avoidance of far reaching blinding lights
- Air hazard lighting on the nacelle with white stroboscopic light

Whether it will be possible to adopt the colouring and lighting in this way will be decided by the affected authorities.

A further mitigating measure will be to shut the wind farm off hourly during nights with increased flights. It would, in this case, be some 10 – 20 important nights when more than 75 % of all night flyers fly. As such stops would be very costly and the expected collisions to expected to impact on the stocks, it will be unlikely that this method will be used.

Special containers on the wind turbines will prevent oil spill (see Chapter 5.7.2.3) and the collision preventing measures that SSPA has recommended will be proposed by Sweden Offshore. Decisions in this matter will be made in consultation with affected authorities.

12.4.3.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)
- The structure extinguishes (causes permanent damage) a nature value of national or international interest, for example a protection worthy species according to the species and habitat directive (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)
- The structure causes big impact (temporary damage, long time – up to a generation) on a nature value of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).
- The structure extinguishes (permanent damage) a natural value, for example a protection worthy species or biotope according to the species and habitat directive (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)
- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)
- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).
- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)
- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion
Few birds reside permanently in the area and no important negative impact is expected for these birds.

The risk of a collision for migrating birds is small and the estimated collisions will not have an impact on the biological diversity. The wind farm will also not have a negative impact on birds that cause any major impact on the stock. The impact on birds is, therefore regarded as minor.

12.4.4 Bats

The occurrence of bats in the area is described in Chapter 11.6.4.

12.4.4.1 Impact

a) Collision risk

It is only during the last few years that it has become known that bats may collide with onshore wind turbines. The most common cause for collision is that bats fly close to the turbines to hunt insects. Hypotheses also exist that bats interpret turbines for being trees to which they fly in order to rest. Studies in the US point to that only certain species, foremost migrating species of the Lasiurus family, are prone to collide.

Collisions between bats and wind turbines are especially serious as bats have a long life expectancy and are slow to reproduce.

There are no bats residing at the site and no flights from Sweden are assumed to fly through the area. Regarding the flights from Germany and Denmark, one can, according to Ahlén, assume that the spread of flights will be large (see Attachment 9.1). With this knowledge, one can assume that the risk of a collision is very low.

12.4.4.2 Mitigating measures

No mitigating measures are proposed.

12.4.4.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)

- The structure extinguishes (causes permanent damage) a nature value of national or international interest, for example a protection worthy species according to the species and habitat directive (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure causes big impact (temporary damage, long time – up to a generation) on a nature value of national or international interest, for example a protection worthy species or biotope according to the species and habitat directive (high value – high impact).
- The structure extinguishes (permanent damage) a natural value, for example a protection worthy species or biotope according to the species and habitat directive (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)

- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).
- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)

- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion
As mentioned above, no bats reside in the area of the planned wind farm.

It is also not conceivable that any significant flights will pass the area. The risk of negative impact on the relevant species are therefore regarded as negligible.

12.4.5 Sea living mammals

The occurrence of sea living mammals in the area is described in Chapter 11.6.5.

12.4.5.1 Impact

Negative impact may be caused on mammals due to noise and vibrations from the wind turbines and from the work carried out during the construction and operational phases. Shadows, as well as spills and pollution could also have a negative impact on sea living mammals.

a) Noise and vibrations
During the construction phase, possible piling or drilling may cause considerable noise disturbance and this may disturb mammals in the area. Of the sea living mammals that may exist in the area (porpoise, grey seal and harbour seal), loud noise may especially affect the porpoise. The noise may cause the navigation capability to be reduced and make the foraging more difficult. Frightening effects may lead to habitat changes. Very severe noise may lead to loss of hearing.

It has recently been established that marine mammals may react to noise from wind turbines at a distance of a couple of hundred metres (Koschinski et al., 2003).

Of marine mammals, seals have predominantly been studied regarding noise reactions from wind turbines.

The hearing of seals is very good within high frequency bands from 2 000 Hz and up, but they hardly hear frequencies below 1 000 Hz. Still, seals are not considered to be prone to noise disturbances. For example, a large seal colony in the sea outside a big airport on Greenland seem not to be bothered by the noise from aircraft. Experience from Danish offshore structures also show that no impact on seals is caused by the wind turbines. Studies close to the Bockstigen wind farm offshore south-western Gotland, also showed no noteworthy impact from wind turbines on seals.

Disturbances for seals only seem to matter in their spawning areas and areas important for feeding. However, seals seek their feed over large areas. They are extra sensitive whilst loosing hair/fur and whilst raising their cubs.

Seals can feel vibrations from long distances. According to Denhardt et al., (2001), seals use their whiskers to feel vibrations in the sea and they use the whiskers for hydrodynamic estimation of distance. Vibrations may potentially lead to that seals get frightened or get problems with distance estimations.

Vibrations may also have an indirect impact on seals, if fish avoid the area. For fish eating mammals, the quality of the habitat will be reduced.

Porpoises can hear in the frequency band 1 000 to 150 000 Hz. Investigations have shown that whales have left coastal areas and shipping lanes completely due to occurring noise (19.7.1). The exact impact of a wind farm as planned is currently not known.

Dr. Mats Amundin (PhD), the Kolmården expert on marine mammals, has, with regard to the Lillgrund wind farm, held that noise from the wind farm will neither disturb porpoise nor seals. The eco sounders of Porpoises have a frequency of 130 – 140 kHz, which is a different frequency than what a wind turbine can generate and there is, therefore, no conflict in this case.

The communication between seals occurs at lower frequencies, from one hundred Hz to a few kHz, but it is unlikely that the noise from the wind turbines has any importance as this noise has a much too low frequency.

Amundin further says that porpoises communicate at very high frequencies, which does not conflict with the noise generated by wind turbines.

According to the Danish Environmental Research (DMU), The Nysted wind farm, built at the most important staging area for harbour seals in the south-western Baltic Sea, does not cause any negative impact on the seal stock.

The DMU has followed the seals during the installation through monthly aerial photographs and video coverage.

Jonas Teilmann, researcher at the DMU, has in an interview (TT-Ritzau) explained that there were worries that the availability of food for seals would be changed and that it, over time, would harm the seals. So far, however, no negative impact has been observed.

b) shadows

No negative impact due to shadows on marine mammals is known.

c) spills and pollution

Spills and pollution could cause negative consequences for marine mammals. The risk of spills and pollution is, however, considered as very small (see Chapter 5.7.2.3) and the risk of collisions causing oil spills is also regarded as very small (see Chapter 12.8.2).

Summary

In summary, one can conclude that the work during the construction and dismantling phases could cause impact on nearby marine mammals. Seals get used to fixed structures such as bridges and lighthouses. During the operational phase, hardly any negative impact is expected for marine mammals.

12.4.5.2 Mitigating measures

The risk of mammals being hurt or damaged will be monitored during piling or drilling work. The mammals that are present at the site before the installation work, will be (frightened away) by the use of a signal in a frequency band that the mammals regard as unpleasant. Another technique that may be adopted is to shield off the noise by using so called noise barriers.

During the piling work, the plan is to start with less powerful blows and then gradually increase the power so that the animals have time to move away from the area.

Special containers on the wind turbines will prevent oil spill (see Chapter 5.7.2.3) and the collision preventing measures that SSPA has recommended will be proposed by Sweden Offshore. Decisions in this matter will be made in consultation with affected authorities.

12.4.5.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)

- The structure extinguishes (causes permanent damage) a nature value of national or international interest, for example a protection worthy species according to the species and habitat directive (high value – high impact).

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure causes big impact (temporary damage, long time – up to a generation) on a nature value of national or international interest, for example a protection worthy species according to the species and habitat directive (high value – high impact).
- The structure extinguishes (permanent damage) a natural value, for example a protection worthy species according to the species and habitat directive (high value but lesser extent – reasonable impact – high impact).
- The structure extinguishes (permanent damage) a nature protection object of regional interest with high values (high value but lesser extent – reasonable value – high impact)

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on (temporary damage, short time < 5 years) major nature protection values of national or international interest.
- The structure causes impact on a protection worthy regional object, where only part of the nature value of the object is extinguished (permanent damage, limited extent)
- The structure causes reasonable impact on the biological diversity of an object of national or international interest.

Small impact (reasonable value – minor impact/minor value – reasonable impact)

- The structure causes a small but measurable impact on the biological diversity of an object classified as of "highest nature value".
- The structure causes impact on a nature protection object (temporary damage, short time < 5 years) of regional interest (minor impact – minor value).

ASSESSMENT CRITERIA CONT´D

- The structure causes major impact on a nature protection object of local value (reasonable impact – minor value)

Minor/no impact (minor value – minor impact)

- The structure interferes with a local nature protection object or causes impact on an object of higher value. The values can quickly be restored following the operational phase of the structure.
- The structure causes no risk for measurable impact on the biological diversity of an object of national interest.

Conclusion

No marine mammals reside permanently in the area, there are no layover places in the vicinity and grey seal, harbour seal and porpoises are only sporadically assumed to cross the area. The area is therefore considered to be of less importance for marine mammals.

Limited negative impact will occur during the construction and dismantling phases by emitting, what the mammals consider, an unpleasant signal. This is done to stop mammals from residing at the site during the construction and dismantling phases. No mammals are expected to be hurt or damaged during the operation of the structure.

This, together with the fact that only few individuals sporadically are in the area, results in small negative impact on marine mammals.

12.5 Cultural environment

12.5.1 Impact

In connection with the dredging work at Kriegers Flak, there is a risk that ancient remains/wrecks could be destroyed.

The studies that have been made show that no ancient remains or wrecks have been found in the area of the planned wind farm.The only wreck that has been found lies at a safe distance about 1 850 metres north of the area.

12.5.2 Mitigating measures

Careful investigations have been made in order to establish whether ancient remains or wrecks are present in the area (see Chapter 11.7).

If a wreck/ancient remains still would be found during the construction phase, Sweden Offshore commits not to touch or dig in the ancient remains/wreck, to stop all work if an ancient remain/wreck is found and report the find to the county council.

12.5.3 Assessment

ASSESSMENT CRITERIA

Very high impact (high value – high impact)

- The structure extinguishes some of the values that identifies and motivates the area as of national or international interest for the cultural environment (for example a world heritage site).

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure causes big impact on some of the values that identifies and motivates the area as of national or international interest for the cultural environment (for example a world heritage site).
- The structure extinguishes some of the values that identifies and motivates the area as of national or international interest for the cultural environment (for example a world heritage site).
- The structure extinguishes a cultural environment value of regional interest with high values.

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on a cultural environment object of national or international interest.
- The wind turbine causes impact on a regional cultural environment object, where only part of the object is extinguished.
- The structure extinguishes a cultural environment object of local value.

ASSESSMENT CRITERIA CONT´D

Small impact (reasonable value – minor impact/ minor value – reasonable impact)

- The structure causes a small but measurable impact on main values of national or international value.
- The structure causes limited impact on a locally protection worthy cultural environment object or very small impact on a higher value object.

Minor/no impact (minor value – minor impact)

- The structure causes a small but not measurable impact on cultural environment values within a national or international interest.
- The structure does not extinguish any cultural environment values.

Conclusion

The wreck that has been identified lies at a safe distance from the wind farm.

No consequences are deemed to arise on cultural environment values.

12.6 Landscape picture/seascape picture

12.6.1 Impact

a) Daytime

During certain circumstances, the wind farm will be visible from the shore. What determines the visibility is:

- The distance between the wind turbines and the point of observation
- The height above sea level of the point of observation
- The visibility: mist, clouds, light/direct light and water and heat mirroring
- The colour of the wind turbines/the contrast against the background
- Lighting and light marking

The impact on the landscape picture will reduce with increased distance from the shore. In the study "Wind power in Sweden", guideline values for how well offshore wind turbines are visible from shore are given. According to the study, the turbines fade at a distance of 8 – 10 km and at a distance of 15 – 20 km, the turbines are hardly visible. The study does not mention the impact at distances over 20 km, the reason probably being that the impact at these distances are regarded as negligible.

According to a study made by Deutsche Wetterdienst on behalf of the group, the planned wind farm on the German side will only be visible for 875,1 hours per annum from a distance of 30 km (See Chapter 11.4). This corresponds to 10 % of annual hours. According to the same study, at a distance of 40 km, the wind farm will only be visible for 309,1 hours, i.e. for about 3,5 % of the time. At a distance of 30 km, the wind farm will predominantely be visible during July, and in May and September at a 40 km distance. Irrespective of distance, during January the wind farm will be least visible.

The site on the Swedish side of Kriegers Flak is located about 30 km from the coast and will therefore probably not be visible during more than 10 % of the annual hours. It is likely that the wind farm will be visible for less hours as direct light often occurs in the direction of the wind farm (the direction of sight is from the north to south seen from the Swedish coast).

At a distance of 30 km, 48 meters of the towers are hidden due to the curve of the earth beyond the horizon. The equivalent number is 70 metres at a distance of 35 km from shore (source: Lantmäteriet).

The following simulations are made by the lantmäteri authority and shows how the wind farm would be seen from Trelleborg during days with optimal sight conditions.

Lantmäteriet has also made a schematic account of the wind turbines to show the consequences of looking at the wind farm from different angles/places.

Visualisation from Trelleborg

Sight angle Trelleborg

Sight angle Falsterbo

Sight angle Beddingestrand

It is also important to describe how the structure will be experienced from close distance, from people in passing boats. 10 000 ferries annually pass west and east of Kriegers Flak. The passengers on these ships will be able to see the wind farm after a journey of 20 – 25 km from Trelleborg at a distance of 5 – 10 km. A vertical element in an open landscape dominated by horizontal lines will create a big contrast. From close distance, the wind turbines will, therefore, be dominant (see picture in Chapter 12.8.1). It is, however, probably difficult to estimate the height of the turbines as there is nothing else to relate to. It is likely that the turbines will be interpreted as lower than they are. Whether passengers will find the wind farm as interesting or disturbing in relation to the open sea and other objects, for example boats, is subject to individual judgement.

b) Night time

Deutsche Wetterdienst also investigated whether different strengths of light will be visible at distances of 30 and 40 km. The result was that neither the strengths 1 500, 1 600 or 2 000 cd was visible at these distances.

The regulations surrounding hazard lighting are currently under review on an international basis and no knowledge of the strengths of light to be used in the future are therefore currently known. It is therefore not currently possible to visualise how and if the wind farm will be experienced from shore.

The working ships that will be used in the area during the construction and dismantling phases will not be visible from shore.

Summary

During day time, the wind farm will very seldom be visible from shore. When it is visible, it will be seen as a long line of small, weak, white pins at the horizon.

Whether the wind farm will be visible from shore during night time, is currently not possible to say.

Seen from the sea, i.e. from a closer distance, the wind farm will dominate the landscape. How this is apprehended depends on the viewer.

All visualisations made are gathered at the end of this document and in Attachment 11.1.

12.6.2 Mitigating measures

To the extent possible, the colour on the wind turbines will be the one least visible.

12.6.3 Assessment

ASSESSMENT CRITERIA

Very big impact

- *The structure dominates greatly and is in big contrast to the surrounding landscape – permanent change, > a generation.*
- *The structure causes big physical change that greatly influences the ability to orientate, views, landmarks etc. – permanent change, > a generation*

Big impact

- *The structure dominates heavily or is in big contrast to the surrounding landscape – temporary, < a generation*
- *The structure causes big physical change that greatly influences the ability to orientate, views, landmarks etc. – temporary, < a generation.*

Reasonable impact

- *The structure has a certain dominance over or is in contrast to the surrounding landscape – temporary, less than a decade*
- *The structure causes physical changes that impact the ability to orientate, usual fare ways, landmarks etc. to a lesser extent – temporary, less than a decade*

Small impact

- *The structure has a subordinated impact on the surrounding landscape and/or the contrast effect of the structure is small*
- *The structure causes physical change that, to a lesser extent, impact the ability to orientate, usual fare ways, boundaries, landmarks etc.*

Minor/no impact

- *The structure harmonises with the surrounding landscape*
- *The structure cause no physical changes*

Conclusion

During day time, the structure will very seldom be visible from shore and the impact on the landscape is deemed to be low.

From closer distance, the wind farm will dominate the landscape and the impact from here is deemed to be high.

The impact during night time, can currently not be investigated.

12.7 Natural resources

12.7.1 Impact

The installation of the wind farm will limit the possibilities to use the Swedish part of the area for excavation of, for example, sand or other mineral resources. There is, however, not enough sand in the area to make it interesting and no mineral resources are currently known to exist in the area.

The erection of a wind farm means that the wind energy at the site is being used.

12.7.2 Mitigating measures

No mitigating measures are proposed.

12.7.3 Assessment

Conclusion

As no natural resources other than wind energy have been identified, it is not expected that there will be any impact on natural resources.

12.8 Shipping

Shipping in the area is described in Chapter 11.10.

12.8.1 Impact

The traffic with work boats and vessels to and from the area will be intense during the construction and dismantling phases. This will, however, due to the size of the area and the time limitation of the phases, cause very little impact on other traffic.

During the consultation process with TT-line, it has been found that the high speed vessel Delphin, that operates the Trelleborg – Rostock route, may possibly have to lower its speed from about 36 knots to 20 knots to avoid the formation of big waves, which is something that the TT-line thinks could disturb the construction work. A potential lowering of the speed would cause delays to the ship.

The big shipping lanes between Sweden and Germany pas to the east, south and west of Kriegers Flak, i.e. at a safe distance from the area of the wind farm. No impact will therefore be caused on the shipping lanes.

For the crews on passing ships, the landscape

ASSESSMENT CRITERIA

Very big impact (high value – high impact)

- *The structure makes it impossible to exploit natural resources as such as gravel or sand*

Big impact (high value – reasonable impact/reasonable value- high impact)

- *The structure greatly limits the possibilities to exploit natural resources such as gravel or sand*

Reasonable impact (reasonable value – reasonable impact)

- *The structure causes reasonable limitations to the possibilities to exploit natural resources such as gravel or sand*

Small impact (reasonable value – small impact/small value – reasonable impact)

- *The structure causes small limitations to the possibilities to exploit natural resources such as gravel or sand*

Negligible/no impact (negligible value – negligible impact)

- *The structure causes no limitations to exploit natural resources such as gravel or sand* picture will be greatly changed. A vertical element in an open landscape dominated by horizontal lines will cause a big contrast. Therefore, the wind turbines will dominate from a close view. It will, however, be difficult to estimate the height of the turbines as there is nothing else to relate to. The turbines will probably be viewed as smaller than they are.

The visualisations below show how the wind turbines will be viewed from an height corresponding to that of a bridge, at 1,8 and 3,6 km distance (see pictures at the bottom of the page).

It has not been decided whether traffic will be allowed in the wind farm area during the operational phase. According to the law on the Swedish Economic Zone, it follows that the Government, or the authority appointed by the Government, (the National Maritime Board), may issue regulations for a protective zone of 500 metres around each wind turbine. In practice, such a protective zone would mean that the whole wind farm plus 500 meters around it would be sealed off.

12.8.2 Collision risk

Big shipping lanes pass to the east, south and west of Kriegers Flak at a safe distance from the wind farm (see pictures in Chapter 11.10). Single ships may, however, always navigate outside of the shipping lanes and thereby pass Kriegers Flak at a closer distance. Collisions between ships and wind turbines may be caused by bad navigations, engine failure or faulty/damaged navigational equipment.

A collision may cause the turbines and the ships to spill oil and ships may also spill chemical cargoes. Oil spills can cause impact over larger areas and drift away with the wind. 18 % of all goods transported in the Baltic Sea is regarded as dangerous. A collision could, therefore, cause great consequences for the marine environment.

There are, however, a number of international rules that have arisen to prevent large spills. Since 1996, all new tankers with a capacity of more than 5 000 tdw, must have a double hull and ships with single hull will only be allowed until 2015 in the EU countries. Modern tankers nowadays use several compartments that are separated, instead of only one large compartment. This is a measure to prevent large spills.

The risk of a collision between ships and the wind farm

On behalf of Sweden Offshore, two studies have been carried out regarding the risks of a collision between a ship and the planned wind farm and the consequences of such a collision.

The first risk analysis was conducted by Germanischer Lloyd (GL), one of the leading European com-

panies on marine safety analyses. GL has calculated a so called basic collision risk, i.e. the risk of a ship colliding with the wind farm without regard for safety increasing measures. In this scenario, all collisions are considered, including those where a ship only touches a wind turbine without causing damage. The basic collision risk has been calculated to 0,004 collisions per annum, corresponding to a statistical interval of 251 years. If safety increasing measures are taken into consideration, the statistical interval between two accidents increases to over 1 000 years. These numbers are considerably lower than for other wind projects. For more information on the GL analysis, see Attachment 12.1.

The second risk analysis was carried out by SSPA. The analysis of GL mentioned above and the analysis that GL has made for the wind farm planned in the German economic zone, has been used as important basis for the SSPA study. SSPA has focused on what probably interests the public most, namely the risk of an accident that causes danger to nature or humans, for example through an oil spill. The risk of a collision that causes an oil spill has been calculated to 0,0006 per annum by the SSPA, or about 1 700 years between collisions (to be compared to the number calculated for the planned wind farm in the German economic zone, namely 580 years).

The average oil spill has been estimated to be 3 400 tons. With safety increasing measures, such as standby tugs, the risk is reduced to 0,00015 collisions per annum or about 6 700 years between collisions (see Attachment 12.2).

The risk of humans being hurt because the ship that they are on collides with the wind farm has been estimated to 0,000002 per annum, or one in every 500 000 years, provided that no safety increasing measures are taken. A comparison with European ferry traffic shows that the collision risk between a ferry and the wind farm is considerably lower. With safety increasing measures, such as AIS and traffic control, the risk for human accidents reduces to 0,0000005 per annum, or one every 2 000 000 years.

More details can be found in Attachment 12.2.

12.8.3 Mitigating measures

The safety increasing measures recommended by the SSPA will be proposed by Sweden Offshore and decisions in this matter will be taken in consultation with affected authorities.

12.8.4 Assessment

ASSESSMENT CRITERIA

Very big impact (high value – high impact)

- The structure is a permanent hazard to international shipping, i.e. existing shipping lanes have to be moved (permanent hazard, > one generation).

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure is a temporary hazard to international shipping, i.e. existing shipping lanes have to be moved (< one generation).
- The structure is a permanent hazard for other shipping, i.e. ships moving outside of shipping lanes (> one generation).

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on international shipping, i.e. disturbs the traffic compared with today.
- The structure is a temporary hazard for other shipping, i.e. ships moving outside shipping lanes.

Small impact (reasonable risk – minor impact/minor risk – reasonable impact).

- The structure has little impact on international shipping, i.e. disturbs traffic a little compared with today.
- The structure causes impact on other shipping, i.e. ships that move outside of shipping lanes.

Minor/no impact (minor value – minor impact)

- The structure has minor or no impact on shipping in the area.

Conclusion

As shipping lanes are at a safe distance, the wind farm will cause little impact for international shipping. The wind farm will be a temporary hazard for traffic outside the shipping lanes. This is however dependent on that traffic will be forbidden within the wind farm area.

12.9 Commercial fishing

12.9.1 Impact

The wind farm will probably not cause negative impact on the fish stock in the area (see Chapter 12.4.2). The fish resources will probably not be smaller within the wind farm area after it has been built. The reef effect of the foundations will cause the fish to be drawn towards the foundations to feed. If this means an increase of the bio mass or just a concentration of existing fish is, however, unclear.

During the construction phase, the work area will be sealed off and no commercial fishing will be possible during this phase. The same applies to the dismantling phase.

It has not been decided whether fishing boats will be allowed inside the wind farm area during the operational phase. According to the law on the Swedish Economic Zone, it follows that the Government, or the authority appointed by the Government, (the National Maritime Board), may issue regulations for a protective zone of 500 metres around each wind turbine. In practice, such a protective zone would mean that the whole wind farm plus 500 meters around it would be sealed off.

If the area is sealed off it can no longer function as a fishing area, resulting in that the income from the catch disappears. The size of the annual loss of income is estimated to be about 388 000 kronor (5 400 ha x 5 kg/ha x 14,40 kr/kg where 5 400 is the area covered by 128 wind turbines, 5 kg/ha is the estimated, average catch in the area (estimated by the company) based on statistics supplied by the Fishery Board, and 14,40 kr/kg is the average price for landed cod on the east coast over the last five years). See table at the bottom of the page.

On the other hand, a protective zone may cause positive, indirect effects. If commercial fishing is disallowed, the large area covered by the wind farm will become a protected area where fish can live without disturbance. This could benefit nearby areas by fish "spilling over" to such areas. However, this reasoning assumes that noise, vibrations or shadows cause a negative impact on the fish.

If no protective zone is established, fishing within the wind farm area should theoretically be possible, at least during beneficial wind and current conditions. Fishing would, however, not be possible to the same extent as before.

Summary

During the construction and dismantling phases, no commercial fishing will be possible in the area.

If the wind farm is closed for fishing during the operational phase, it will result in a reduction of income for commercial fishermen in the area.

A protective zone can, however, cause positive impact on the commercial fishing that takes place in the vicinity of the area.

If no protective zone is established, the physical presence of the wind farm may cause negative impact on fishing due to a limitation of fishing methods.

12.9.2 Mitigating measures

Appropriate distances between the wind turbines and the direction of the rows has been discussed with the professional fishermen. The distances preferred by the fishermen was, however, so big as to make the whole project loss making. Also, the preferred direction by the fishermen (north-south/east-west), could not be considered by Sweden Offshore as it would cause a loss of wind energy through the turbines.

According to current legislation, the affected fishermen are not entitled to compensation, but Sweden Offshore still plans to compensate them for the loss that the wind farm causes. An agreement for economic compensation is currently being discussed.

Cod landed on the east coast	1999	2000	2001	2002	2003	Snittpris
Annual average price in SEK per kilo	13,49	13,77	15,57	15,60	13,42	14,37

12.9.3 Assessment

ASSESSMENT CRITERIA

Very big impact (high value – high impact)
- The structure will lead to that commercial fishing no longer can be pursued in an area of national or international interest for fishing

Big impact (high value – reasonable impact/ reasonable value – high impact)
- The structure will cause big impact on fishing in an area of national or international interest for fishing.

Reasonable impact (reasonable value – reasonable impact)
- The structure leads to that only reduced fishing in an area of national or international interest or in other areas of importance for fishing.

Small impact (reasonable risk – minor impact/minor risk – reasonable impact).
- The structure leads to that only less fishing to a lesser extent can be pursued within an area of less importance for fishing.

Minor/no impact (minor value – minor impact)
- The structure has no impact on the ability to fish.

Conclusions

It is uncertain what impact the wind farm will have on commercial fishing. This is mainly due to that it is not yet decided whether traffic and commercial fishing will be allowed within the wind farm area.

If a protective zone is established, it will cause big, direct impact for affected fishermen. As the wind farm area only constitutes 1,5 % of the area designated to be of national interest for commercial fishing, this cannot be considered to make commercial fishing more difficult within the area of national interest. Negotiations for compensation are ongoing in order to pay the fishermen for potential loss of income.

In the longer run, commercial fishing as an industry, may benefit from a security zone through higher reproduction in combination with a so called “spill over effect”.

In summary, the maximum impact caused by the wind farm, may be considered as reasonable.

12.10 Recreation and outdoor life

12.10.1 Impact

As the area is very far from the coast, it has little impact on recreation.

Leisure boats seldom follow the shipping lanes and the wind farm, primarily, is a navigational hazard for this type of traffic. The freely available sea surface will be reduced, the character of “wilderness” in the area will be lost and will, instead, be dominated by technical structures. For some, this will be regarded as disturbing and by others as interesting. In a study made in the Torsås community in 2001, 400 persons were asked about what impact the Utgrunden wind farm had on the landscape picture. 37 % thought the wind farm had a positive impact and only 6 % thought that wind farm had a negative impact. 39 % thought that no impact was caused and 18 % had no view on the subject.

Whether a potential protective zone will be applicable also for leisure fishing has currently not been decided.

Intensive traffic of work ships and vessels to and from the area during the construction and dismantling phases will cause a certain disturbance for leisure boats.

12.10.2 Mitigating measures

There are no mitigating measures proposed.

12.10.3 Assessment

ASSESSMENT CRITERIA

Very big impact (high value – high impact)

- The structure will extinguish some of the values that form the basis for the recreational and outdoor life values in the area of national and international interest.

Big impact (high value – reasonable impact/reasonable value – high impact)

- The structure will cause big impact on some of the values that identifies and motivates the recreational and outdoor life values in the area of national and international interest.
- The structure will extinguish some of the values that identify and motivates the recreational and outdoor life values of the object of national and international interest.
- The structure will obliterate recreational and outdoor life values of very high regional interest

Reasonable impact (reasonable value – reasonable impact)

- The structure has an impact on the recreational and outdoor life values of national or international interest.
- The wind turbine will influence a regional protection worthy recreational and outdoor life value, where only parts of the value of the object is extinguished.
- The structure extinguishes a recreational and outdoor value of local interest.

Small impact (reasonable risk – minor impact/minor risk – reasonable impact).

- The structure causes a small but measurable impact on main recreational and outdoor life values of national or international interest.
- The structure causes a limited influence on a local protection worthy recreational and outdoor life value or a very small impact on an object of higher value.

Minor/no impact (minor value – minor impact)

- The structure will not extinguish any recreational and outdoor life values within an area of national or international interest.
- The structure causes a small but immeasurable impact on recreational and outdoor life values.

Conclusion

As the opinions on the impact caused by the wind farm will vary from person to person, it is difficult to make a general assessment. As the area does not constitute an area of national or international interest for recreational and outdoor life, the wind farm may maximum cause small consequences for recreation and outdoor life.

12.11 Air traffic

Aeroplanes normally do not fly at this low altitude and the wind farm will, therefore not cause any negative impact for air traffic.

The Civil Aviation Authority has announced that they have no objection to the planned structure as long as international regulations on hazard marking are followed.

12.12 Interest of the defence force

Information about the interests of the defence forces can be found in Chapter 11.14.

12.12.1 Impact

a) Disturbance of communication intelligence

The defence forces have informed Sweden Offshore that, currently, the Swedish communication intelligence system, is not equipped to handle disturbances from wind turbines. The planned wind farm will therefore cause impact on communication intelligence in the vicinity of the wind farm.

The problem could be fixed through a modification of the existing stations and the addition of one more station. It is estimated that the cost therefore would be about 40 million kronor at 2004 cost level.

It should be noted that the planned wind farm on the German side of Kriegers Flak will cause a similar impact on the Swedish communication intelligence. Full approval for that wind farm is expected in April 2005.

b) Disturbance of radar surveillance

The wind farm will also have an impact on radar surveillance. To paint the wind turbines with a paint that absorbs the radar signals (currently being developed by SAAB in Linköping), so that disturbing reflexes are avoided, is not an acceptable solution as it will make it possible to hide behind the wind turbines.

The defence forces are currently not planning any measures to rectify this problem.

12.12.2 Mitigating measures

The disturbance caused on the communication intelligence can be avoided through modification of and additions to existing stations. To finance and pay for such measures, is according to Sweden Offshore, the task of the state and not of the developer.

12.12.3 Assessment of impact

The wind farm will have a negative impact on radar surveillance. Following discussions with defence personnel, the impact of the disturbance is regarded as reasonable.

If no modification or addition is done, the communication intelligence activity in the southern Baltic Sea will become almost impossible. This would cause very big impact for the defence forces.

12.13 Summary of environmental impact due to the wind farm

It has been shown above that no protected species or biotope will be damaged by the wind farm to any great extent. The project will also not cause any damage on human health, no measurable impact on the important salt water mixing or impact on wrecks/ancient remains.

The biggest impact will be caused on the changed landscape picture that will be noted from close distance from passing ships. The impact caused on the communication intelligence of the defence forces, will in any case be caused by the wind farm in the German economic zone. This damage can be rectified through modification of and addition to existing systems. Further, in the judgement of Sweden offshore is, that the planned activity will benefit the fish stock within the area. This is especially so if the proposed condition regarding a protective zone is implemented, as this would cause the area to be protected from commercial fishing. Commercial fishing as an industry, will of course also benefit by increased reproduction, even if individual fishermen today will be banned from current fishing areas.

As the wind farm only occupies 1.5 % of the area laid out as of National Interest for commercial fishing, this cannot be deemed to cause a considerable impact on commercial fishing in the area of National Interest.

In conclusion, the wind farm will only cause limited negative impact for private and common interests.

Cumulative effects

13. Cumulative effects

13.1 Why cumulative effects?

Directly south of the wind farm described in this document, in the German economic zone, another farm is planned, consisting of 80 turbines, whereof 53 3,6 MW turbines and 27 5 MW turbines. The towers of the 3,6 MW turbines will be approximately 80 meters high and the distances are planned at 450 x 750 m. The towers of the 5 MW turbines are expected to be approximately 95 meters high and the distances are planned to be 600 x 900 m. The permit application for this development has already been submitted and a permit is expected early 2005. Offshore Ostee Wind AG, who is in the same group of companies as Sweden Offshore, runs the project.

As it is not unlikely that both developments will be granted permits, it is of interest to study the consequences that the development of both sites would have.

At the consultation meetings, an account of the cumulative effects for birds, salt-water mix as well as the landscape picture has been requested, and the studies have therefore been limited to these three effects.

Furthermore, the cumulative effect regarding shipping/navigation and risks has been dealt within short by the SSPA in the risk analysis that the company has made (Attachment 12.2).

Any impact of importance on other ”objects” (e.g. mammals, vegetation and seabed creatures) due to cumulative effects are not expected.

13.2 Birds

According to the study by Jan Pettersson, it is estimated that 10 water fowl will collide with the Swedish turbines at Kriegers Flak during the spring migration and 38 during the autumn migration. Corresponding numbers for the German turbines at Kriegers Flak are 5 and 18 respectively. This is assuming that the behaviour of the water fowl when encountering the turbines is the same as in Kalmarsund and that the night track and the track at low visibility is at the same low level as in Kalmarsund.

At the already built offshore turbines (Utgrunden I, Yttre Stengrund, Horns Rev and Nysted), this estimate would mean that approximately 45 water fowl would collide and die annually. If we also include the seven farms being planned (Klasården, Kriegers Flak I and II, Utgrunden 2, Lillgrund, Kårehamn and Rödsand syd), then, according to these estimates, further approximately 98 water fowl will be killed, which would mean a total of 0,007% of the Eider ducks in the Baltic Sea population. There are, however, at least 3-4 million water fowl who annually migrate over this part of the south-western Baltic and the estimate has been made under the assumption that the birds killed are Eider ducks, which therefore also is the worst-case scenario. The above-calculated risk of collision is very low in terms of population levels and the impact on the development of the population should therefore be seen as small and insignificant.

The results from the study at Kalmarsund (Pettersson 2004) show that the flocks of water fowl mainly fly at the side of the turbines, which means that they fly 1,2 km further, which constitutes 0,2-0,4 % of the total

Number of migrating birds and risk of collision				Spring			Autumn		
Existing wind farms	Country	Number of turbines	Km:s with turbines	Total migrating waterfowl	Birds/km windpark	Number of accidents	Total migrating waterfowl	Birds/km windpark	Number of accidents
Utgrunden1	SV	7	3	500 000	40 000	4	800 000	13 300	0,1
Yttre Stengrund	SV	5	1	50 000	8 000	0,1	650 000	100 000	10
Horns Rev	DK	80	7	40 000	4 000	1	75 000	8 000	6
Nysted	DK	72	6	250 000	25 000	5	300 000	30 000	18
Total existing farms		164	17			10			34
Planned wind farms	Country	Number of turbines	Km:s with turbines	Total migrating waterfowl	Birds/km windpark	Number of accidents	Total migrating waterfowl	Birds/km windpark	Number of accidents
Klasgården	SV	16	2,5	7 000	2 000	0,2	11 000	1 500	0,4
Utgrunden 2	SV	24	5	500 000	10 000	2	800 000	9 000	0,1
Lillgrung	SV	48	6,5	100 000	10 000	2	130 000	11 000	7
Kriegers Flak SV	SV	128	15	1 200 000	20 000	10	1 500 000	25 000	38
Kriegers Flak TY	TY	80	7	1 200 000	20 000	5	1 500 000	25 000	18
Kårehamn	SV	21	7	15 000	2 000	0,5	30 000	1 500	1
Rödsand syd	DK	40	10	250 000	10 000	3,5	300 000	10 000	10
Total planned farms		357	53			23			75

flight stretch from their winter quarters in Denmark to the average hatching areas in the Stockholm archipelago. For a flock of birds that is forced to fly around the Swedish farm at Kriegers Flak, the distance could be five or even seven kilometres longer than if they were to fly straight, which could be up to 0,9 % farther. A flock of water fowl that is affected by three of four different, future, offshore wind farms, may have their flight distance increased by up to 30 km, which could be as much as a 3,8% flight increase. Even this does probably not have a very big impact on the individual bird, as most water fowl have a reserve of at least 10-20 % for longer flying distances to their average hatching or hibernation areas. This increase in energy cost for some individuals may over time have a large impact if a number of farms, especially large farms, are built in the water fowl migration tracks. The full cumulative study can be found in Attachment 8.4.

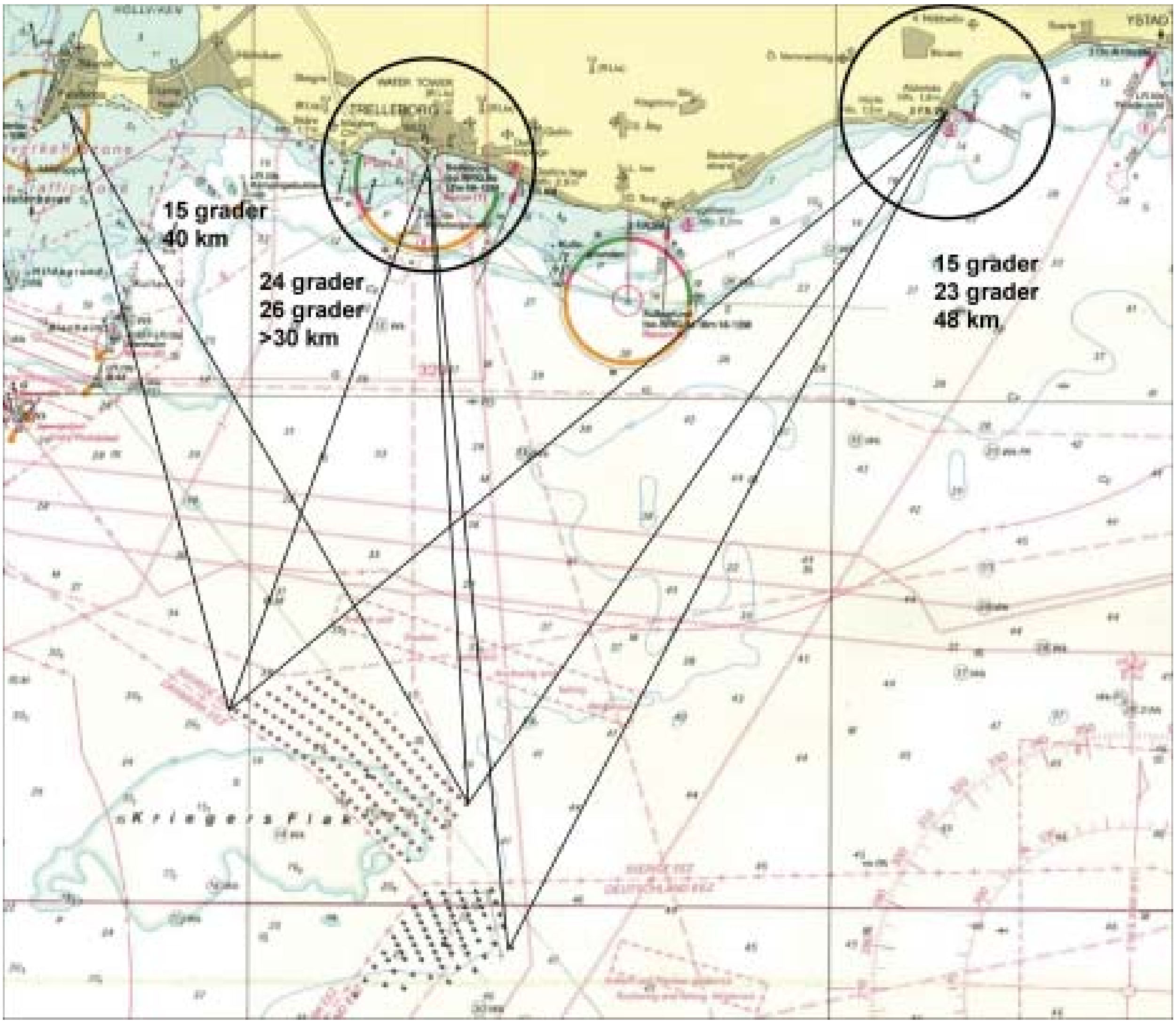
13.3 Current conditions/ saltwater mix

SMHI has estimated the total effect on the saltwater mix both farms would have (Attachment 21.5.3). According to this, the farms give a total increase in dilution of less than 175 m3/s. This is about 2% of the average dilution. According to SMHI's assessment, this increase will not be traceable.

13.4 Landscape picture

The planned farm in the German economic zone will not be visible from the coast of Sweden. There are two reasons for this. Firstly, the German farm, seen from a large part of the south coast, is behind the farm planned by Sweden Offshore.

Secondly, it is located at such a distance from the Swedish coast that from places where it is not hidden



by the Swedish farm, it is not visible due to the great distance. See picture above.

13.5 Risk

SSPA is of the opinion that the establishment of other wind farms directly next to the farm planned by Sweden Offshore would bring an increased security for the latter farm, as the other farms will act as safety barriers (see Attachment 12.2)

Control program

14. Control program

Comprehensive control programs will be conducted to be able to determine the possible impact on plants and benthic fauna (epifauna, infauna and macrophytes) fish, birds, hydro graphics (saltwater mixing) and shipping. The suggestions for control programs that have been made to date are not finalised yet as comments and viewpoints will be taken into consideration.

14.1 Flora and benthic fauna

The University of Lund has developed a suggested control program for epifauna, infauna and macrophytes. The proposal is mainly based on preliminary investigations with analysis of the protection value made by IfAÖ. It is found that a small or medium protection value is the basis for the criteria "rare or endangered species", "Regional/cross-regional importance" and, in terms of the macrophytes flora, "multiplicity and individuality". A high protection value is only applicable in terms of macrozoobentos "multiplicity and individuality".

Based on the preliminary findings, the proposed control program is divided into different depth areas that focus on slightly varying organisms. It is then further divided into time-based sub-programs that are suggested to include: preliminary investigations and the establishment of stations, investigations connected to the construction phase, and investigations during the operational phase. For the dismantling phase, it is suggested that a control program is established later, when the method of dismantling and the results from the operational phase are known.

A number of measuring stations where biological testing and video documentation is carried out, are placed at various depths. The video documentation should be conducted so that different measuring occasions may be compared.

Stations at a depth between 28-38 meters will partly investigate the biomass and specimen density of the sea mussel, and partly the infauna in terms of species structure and specimen density. Stations at a water depth of more than 40 meters will study the infauna in terms of species structure and specimen density. During the development phase, the influence of possible sedimentation is studied and during the operational phase, new stations are established to study the establishment of organisms on the foundations. Vegetation and possible spread of drifting algae is studied using the video documentation.

For the entire control program proposal for epifauna, infauna and macrophytes, please see Attachment 6.2.

14.2 Fish

The wind farm's possible impact on fish and fishing will be watched continuously. On the German side of Kriegers Flak, the group already conducts comprehensive baseline investigations, showing what the situation is today.

During November and December of 2004, after consultation with the Fishermen's Federation, a pilot study was made of test fishing with fyke nets and nets with various mesh sizes. These fishing tests were carried out both in the area planned for the farm as well as a reference area further west on Kriegers Flak. As the draughts in the fyke nets were small, the programs will focus on fishing with normal nets. It is probably too deep to fish with fyke nets.

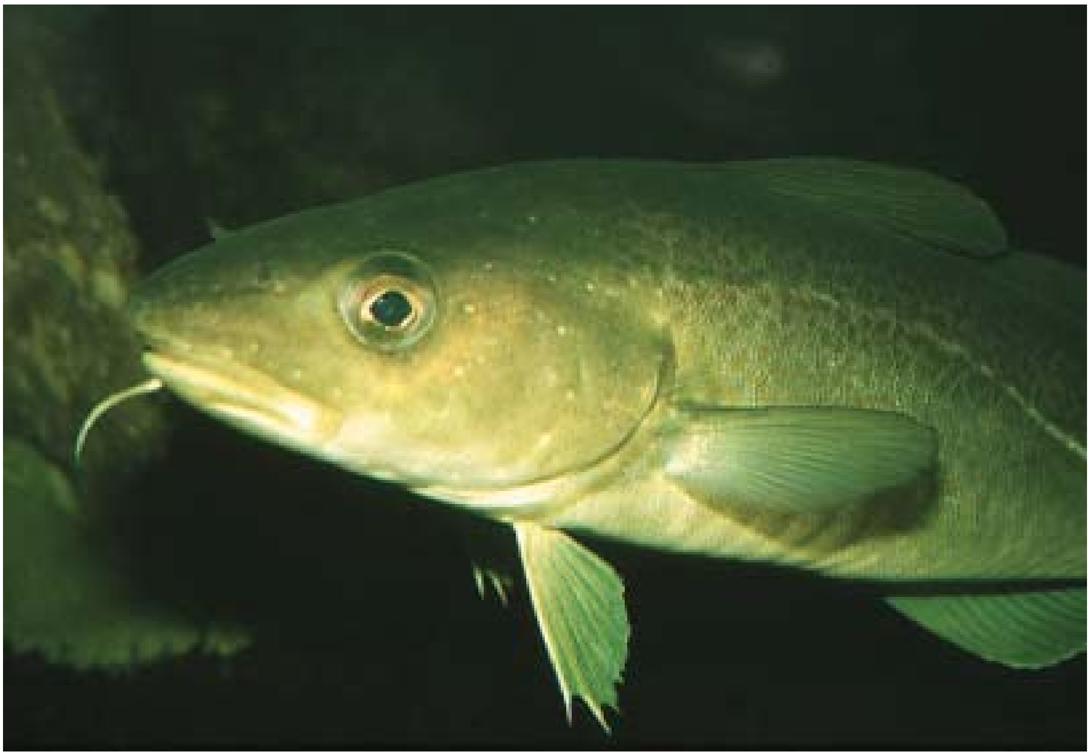
The pilot study will in the spring of 2005also conduct a comprehensive eco-integration study of the area.

The result of all investigations carried out, will form the basis for a future proposal for a control program, that can then commence as soon as the permits are granted. Suggestions on the contents of the program will be discussed in cooperation with the Fishermen's Federation and preliminary discussions are already taking place.

14.3 Birds

The control program for birds will focus on closely describing and documenting how the water fowl flocks fly before, during and after the farm is built. The studies will result in the knowledge of how much extra energy the birds must use to pass the farm, as well as documenting collisions if these, contrary to expectations, should occur. The surveillance is suggested to be both visual and through radar, preferably from stations onshore and from locations within the farm area.

The proposed program has been developed by the ornithologist Jan Pettersson and can be found in Attachment 8.5.



14.4 Current conditions

In order to get a comprehensive view on the hydrographic impact that the turbines cause, a proposed control program has been developed by SMHI (Attachment 13.3).

The program intends to map the average salt water levels and the variability during the season that the mixing is most intense and it is most likely that an inflow occurs. The survey is conducted by measuring the water flow with acoustic current-meters mounted on the seabed at various positions at Kriegers Flak during a period of three autumn or winter months. The salt level and temperature variations are also measured during this period.

In connection with the installation, recovery and service of the measuring instruments, information is gathered by acoustic current-meters mounted on ships as well as by a salt and temperature probe.

To get a detailed picture of the variation of the mixing process close to a wind turbine, the turbulence around a wind tower is measured from a ship using a free-falling microstructure meter, which also measures salt levels and temperature fluctuations. The measuring is done during an intensive period of about one week. Information about the current in lee of the tower is measured during the same intensive period with a ship-mounted acoustic current meter. From these readings, a detailed picture of the increase in turbulence and mixing can be calculated.

A calculation of the total effect of all the towers in the farm can therefore be made using the mapping of the mean condition.

The procedure enables a complete verification of the calculations done on the farm's impact on the deep-water situation in the Baltic Sea.

14.5 Shipping / Risks

A proposed control program for shipping has been developed by the SSPA. The program will verify that the calculated risks have not been underestimated and it will be focused on minimizing risks and consequences of collisions between ships and the farm.

During both the development and operational phases, the area will be sectioned off and surrounded by a safety zone. The program includes routines and information duties for the follow-up of the sea traffic that passes by the farm, measures for when ships deviate from the recommended distance of passage, measures if there is risk of collision, as well as measures if a collision occurs. The different parties will be identified as well as their responsibilities and tasks to ensure that the program is obeyed effectively. Special measures for smaller ships including fishing boats and recreational vessels will be given. Responsibility for the information will be specified.

The proposed control program in Attachment 12.3 should be seen as a backbone of a more complete program. An operative control program can only be developed when the conditions for the construction of the farm have been formulated, areas for sectioning off etc. have been decided and actions and decisions within the German and Danish zones have been made

Collected judgement

15. Collected judgement

15.1 Globally

The countries within the EU produce an increasing amount of energy. To solve the climate problems that currently exist, international co-operation is crucial. The EU has played a vital part in the international climatic change negotiations. The commission has started a program against climate changes and the parliament and counsil have adopted the directive 2001/77/EG, which deals with the promotion of electricity produced by renewable energy sources. A guiding goal in the directive is that within the union, the share of electricity from renewable energy should be 22 % in 2010 as compared to 14 % in 1997.

The electricity production from wind power replaces electricity from sources burning fossil fuels. This is due to that since 1990 the electrical system of the northern European countries is linked together through a common market place, Nordpool, and as such constitutes a system where there is plenty of fossil electricity production.

Sweden and Norway have, through the existing electrical grid, the possibility to increase the export of environmentally friendly electricity. By producing wind power electricity in Sweden, the emission of climate gases, sulphur dioxide and other substances is reduced, as other places in the North European electrical production system can cease producing fossil fuelled electricity.

The plant's planned production of 2 100 GWh, corresponds to a saving on the environment of:

- Reduced mining of approximately 840 000 tons of coal/year
- Reduced carbon dioxide emission by approximately 2 100 000 tons/year
- Reduced sulphur dioxide emission by approximately 2 520 tons/year
- Reduced nitrogen dioxide emission by approximately 2 100 tons/year

(Source: SOU 1999:75)

15.2 Regionally

The wind farm planned by Sweden Offshore at Kriegers Flak could help reach the goals set for Swedish energy politics. With 128 turbines of 5 MW, 2,1 TWh of electrical power could be produced, i.e. 20 % of the planning target for wind power development set by the parliament. This equates to an annual consumption of domestic electricity for about 420 000 houses.

The development of the farm would also mean that the planned goal for Skåne of 2 TWh is reached through a coherent farm at the furthest possible distance from the coast.

One usually says that wind power generates 4,5 job opportunities per MW. The project would therefore generate close to 3000 jobs.

15.3 Locally

15.3.1 Development phase

Ships that are used in the construction phase could become a temporary hazard for traffic in the area.

Noise and vibrations from the work ships and from the foundation laying could have a negative impact on fish and mammals. As the construction phase is time-limited, combined with the fact that measures will be taken for mammals to be removed during this phase, the impact is seen as small.

Clouding and changes to sedimentation can lead to plants, macrozoobentos, fish roe and spawn getting covered. This could lead to a decline in growth and in the worst case to death. Cloudy waters can lead to habitat changes for mobile species. The amount of disturbed sediment during this phase depends on the seabed conditions and the method used. Measures will be taken to stop sediment spreading. The impact is time limited and there is no important occurrence of protection-worthy species or biotopes in the area. The impact caused by clouding and sedimentation is therefore regarded as being insignificant.

15.3.2 The operational phase

The farm will have an impact on the landscape picture but the visual disturbance from the shore will be insignificant as the farm seldom will be visible from the coast during daytime. As the rules for hazard lighting are under review, it is not yet determined how and in what way the lighting will be visual from land.

At closer distances the turbines will dominate the landscape picture. Seen from passing ships, the impact on the landscape picture will be significant.

The risk for birds colliding with the turbines is regarded as small since studies show that birds swerve for offshore turbines. This has also been determined by the collision-risk review carried out on behalf of Sweden Offshore.

The risks for ships colliding with turbines has been calculated on behalf of Sweden Offshore by both the SSPA and GL and has is regarded to be very small. If an accident would occur, the negative consequences could be great.

If a safety zone is imposed and commercial fishing thereby is hindered, this could have a positive impact on the fish population. A safety zone would have short-term negative impact on commercial fishing but positive long-term effects (through a so called spill-over effect). The commercial fishermen that will be affected negatively, will be compensated for their loss by the company. As the wind farm only occupies about 1,5 % of the area which is of national interest for commercial fishing, this can not be seen as rendering it more difficult for commercial fishing within the area of national interest.

15.3.3 The dismantling phase

During the dismantling phase, the impact will be similar to that during the construction phase. The difference is that there will probably be less noise, vibration and sedimentation, as the part of the foundation that is below the seabed will be left.

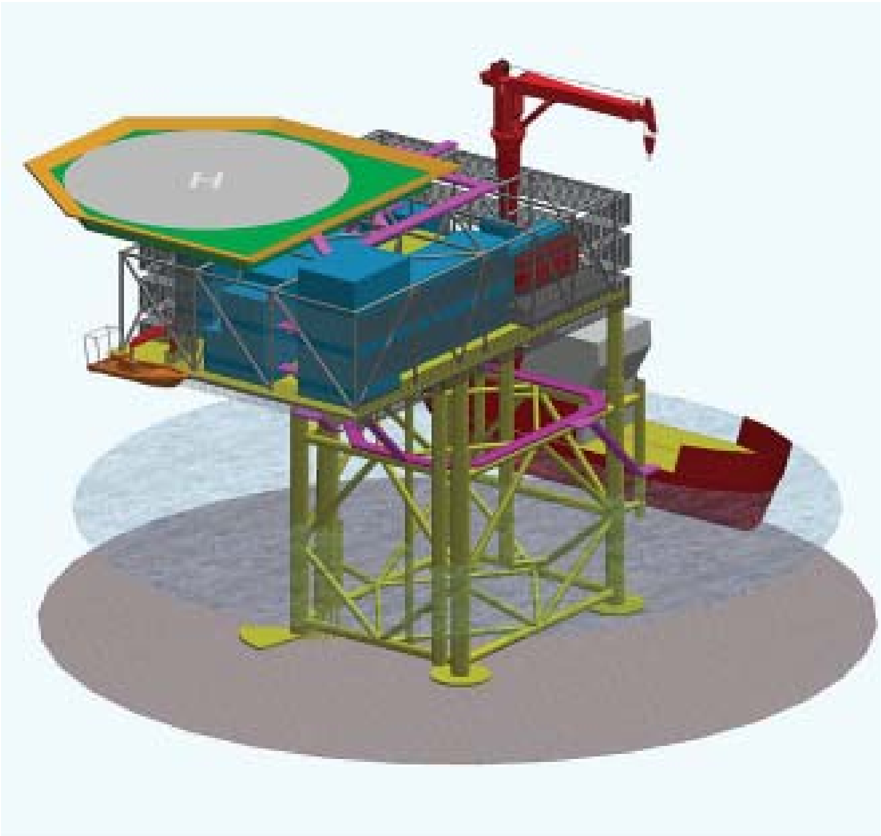
During this phase there is also no risks for any protected species or biotope to be affected.

Cable laying

16. Cable laying

In order to fulfill the demands of an application according to paragraph 4 a of the Continental Shelf regulations, regarding laying of underwater cable on the continental shelf outside Swedish territorial waters, this section will deal with cable laying.

As the information of cable laying in full could be of interest in order to gain a total picture of the project, we give below a short description of the cable laying from Sweden's territorial borders towards land and of the localized connecting points to the grid.



Schematic figure of transformer station, Ramboll, DK

16.1 Location

Sea laid feeding cable will be laid between the separate turbines and the two transformer stations and between the transformer stations and land. The transformer stations are planned to be located centrally in the wind farm and the distance between them to land will be about 30 km.

During the early consultation, a number of different alternative landing points were presented (points were the cable reaches land), see map below.

From these landing points, cables will be laid to the connection points (the transmission grid).

The connection of the wind farm to the grid is planned in two phases. In phase 1 on land, 340 MW is planned to be connected to the grid at Trelleborg North and in phase 2, 300 MW is planned to be connected to the connection point Arrie (Västra Kärrstorp). These two stations are existing transformer stations.

16.2 Design

The transformer stations will be mounted on a platform standing on four steel legs driven into the seabed. It is likely that monopile or tripod foundations are to be used. For information regarding these foundations, see Chapter 5.4.2.

The size of the platforms will be 40 x 40 metres. They are to be placed about 10 metres above sea level and the transformer stations will be about 15 metres high. The total height of the construction above sea level will be about 25 metres.

Equipment on the transformer stations will be installed to assure that the safety technique will function in an emergency.

The connection between the wind farm and the grid is planned via a three phase AC link. All together, it is likely that four sea cables and four land based cables will be used. The cable is built up in multiple layers separated from each other by bitumen. No liquid substance is used in the cables. The surrounding material is made of a thick, protective covering containing steel wires.

The sea cable connecting the wind farm to land will probably have an outer diameter of between 15 and 20 cm and the weight will be about 80 kg/metre.

The cable used within the wind farm will be thinner and weigh less than the cable used for the land connection.

The cables will be dug, plowed or washed 0.8 – 1.0 metres into the seabed (slightly deeper near the coast). Where the seabed structure does not allow the cable to be washed down due to stones, rocks etc, the cable will instead be securely anchored to the seabed.

At the landing points a shaft will be dug for each cable or alternatively a larger shaft for all cables.

Also on land the cables will be dug down to a depth of about one metre. The laying of the cables will need a working area of around 8–12 metres. Within this area, shafts will be dug, cables laid in position and joined. The cables will be transported to the working area on cable drums each containing 60-100 metres, depending on diameter.

Transformer station, Nysted wind farm

16.3 The effects on the environment and the consequences thereof

16.3.1 The Construction Phase

16.3.1.1 The Sea

Temporarily, the water will become cloudy and the sediments will be affected in connection with the laying of cables and construction of the transformer stations.

As mentioned earlier, the cables will be placed under the seabed by washing, plowing or digging. In all cases, a temporary clouding of the water will occur. The extent of the spread of sediment is dependant on the nature of the bottom and currents.

Were digging will occur (nearest to the coast) the shifted material will be put back and where plowing and washing will occur, the softened material will be put back in the cable shaft. A reasonable view is that within a year or two the seabed will return to its natural state.

When the seabed material has been put back, the water will become clear again.

During the construction of the transformer stations, physical impact will occur similar to that accounted for in Chapters 5.7.1.1. and 5.7.1.2.

As a relatively insignificant and temporary clouding of the water will occur, the impact on flora and fauna will be negligible.

The stationary flora and fauna existing in the area where washing/digging will occur (or piling/drilling for the foundations of the transformer stations), will be damaged or suffer from severely changed living conditions. The algae will in this area be torn up and drift away. Benthic animals will be exposed and may possibly move to other habitats.

Fish will look for food among the uncovered organisms.

During the construction phase, increased traffic will occur in the area where the cable is laid. This will affect both commercial shipping and fishing. As this disturbance is limited in time, the negative effects will be small.

16.3.1.2 Land

As the cable laying mainly will occur across cultivated land, only a temporary impact on the land use will occur. Crops will be damaged and there will be a certain impact on the use of land during the work, especially during wet weather. Crossing drainage must be dug that will be damaged but repaired when the work has finished and the area been restored.

The cable laying has been planned so that protection worthy environments and objects will be avoided. The construction may hit upon unknown ancient remains, but this will be dealt with in accordance with the Swedish National Heritage Law. The impact on animals and humans is judged as negligible as the activity can be compared to conventional light entrepreneurial activities. Noise limits will be in accordance with the rules of the Swedish Environmental Protection agency.

16.3.2 The Operating Phase

16.3.2.1 The Sea

The cables will cause a magnetic field with a strength of 3.5 µT at maximum use. As a comparison, it could be mentioned that a vacuum cleaner and an electric drill at a distance of 30 cm would generate a magnetic field corresponding to 20 µT and a TV set 5 µT. The magnetic field generated by the cable would decline rapidly with the distance and end at a distance of 20 metres, see picture below. Left then will be the natural magnetic field of the earth measuring 50 µT.

No electric fields will occur as the cables will be screened.

On the other hand, a secondary electric field will be generated. This field is, however, very faint and will be of no consequence.

The cables generate heat and calculations have been made in order to find out whether the cables would generate any significant heat. During these calculations, a worst scenario of maximum output and summer temperature of the water were used. The result showed no significant increase in temperature of the seabed.

16.3.2.2 Land

After the construction area has been restored, the land can again be used as before. The cables will generate some heat but this will have no negative impact on the surroundings. Maintenance and supervision will in principle only take place during digging activities around the cables or when a fault has been reported.

There will be restrictions in the vicinities of the cables regarding digging, use of explosives and erection of buildings..

16.3.3 The dismantling phase

During the dismantling phase, the transformer stations and cables are planned to be removed and a similar impact as during the construction phase is therefore expected.

16.4 Time schedule

The consultation process for the cable have been divided into two parts. One part deals with the cable laying at sea and the other on land. Early consultation regarding cable laying at sea, including landing points, were carried out during spring/summer of 2004 and a decision regarding considerable environmental impact was received in September that year.

Extended consultation will take part in the beginning of 2005 and a permit application is planned to be handed in before the summer of 2005.

The consultation process for laying the cable on land, has not yet begun but considerable research work of possible routes has begun by Flygfältbyrån in Malmö. In addition, the Danish company NVE is working on a study of the impact on the electrical grid. An permit application for laying the cable on land is planned to be submitted before the summer of 2005.

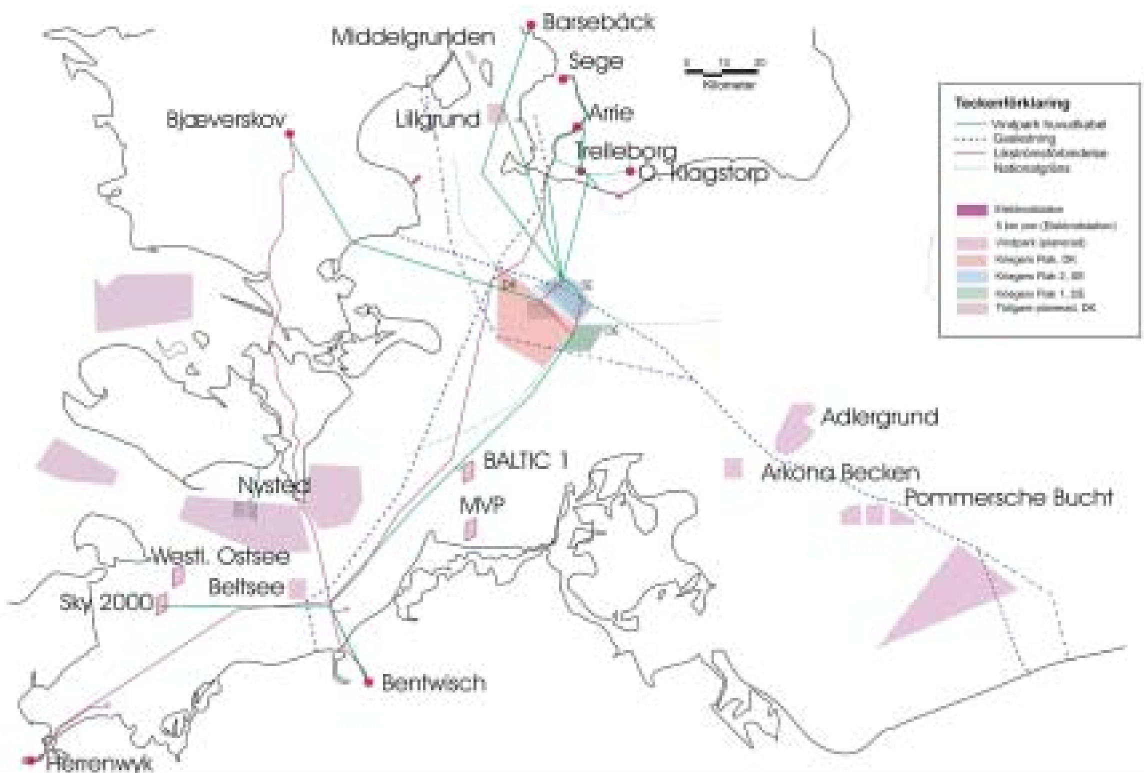
16.5 Connection possibilities from a larger perspective.

A very likely scenario is that Sweden, Denmark and Germany will lay AC cables to roughly the same area at Kriegers Flak. It is likely to be three AC radial connections with an investment cost of SEK billions. The developers want to use a well known, well tested and robust technique with the lowest possible cost.

Seen from a slightly larger perspective, it will, however, be natural to ask the question, if not already from the outset, it would be natural to prepare for an upgrade of the installation to manage power transmission between the countries via Kriegers Flak, both from an operational point of view of the respective grids and for economic reasons.

To make transmission possible between the countries, direct current (DC) must be used in one form or another.

Naturally, this will present new principal and operational problems which will need to be dealt with. At this moment in time however, it is assumed that it is



Existing and planned wind farms in the south-western Baltic politically as well as technically possible to carry this through.

The possibilities to make use of new installations, also for power transmission, is important for as number of reasons.

In the short and medium term, before cost effective energy storage has been introduced, good transmission conditions would be the best way to off-set some of the negative sides of wind power, e.g. surplus of power or the fact that there occasionally is no wind. As a rough guide it is assumed that a distance of 600 km is needed in order to reach a wind speed based de-correlation, where, in the short and medium term, transmission is of great importance.

If a large amount of wind power is connected radially to each country, it will gradually be necessary to extend the already existing co-operation agreements, as each country will possess so much uncontrollable power. In this, there are large indirect, additional costs which could also be taken into account when an initial additional investment is considered.

Another viewpoint is that it is not necessarily best that the wind power produced on the Swedish part of Kriegers flak that, at any given moment consumed in Zealand, should burden the Öresund connection between Skåne and Zealand. The same will apply if the capacity will be used in Germany. It would then be unnecessary to have it first transmitted up to Skåne and then down to Germany via the Baltic Cable. The extreme case would be when there already is 600 MW transmitted south and the capacity thereby is fully utilised. The less capacity limiting bottle-necks, the better the power market will function. In the same way new transmission capacity (spin-of possibility from wind power integration) could, in itself, add to improving the power market in that the impact of possible bottle necks are reduced by establishing new cross-border lines.

It is suggested that this aspect is considered and that the potential is analysed and looked upon closer.

Even it is not be an easy task to find quick solutions on the above mentioned conditions, this must not block attempts to find forward looking solutions that could fulfil all considerations, as future physical operation and thereby indirect economic consequences are of an even larger dimension. Sweden Offshore will, therefore, investigate this alternative further.

17. Bibliography

Ahlén, Ingemar, Lotker Bach, de Jong Johnny. 1997. Migratory behaviour of bats at south Swedish coasts. Z. Säugetierkunde

Ahlén Ingemar, Fauna & Flora 97:3, 2002. Fladdermöss och fåglar dödade av vindkraftverk,

Alerstam, T. 1975b. Crane Grus grus migration over sea and land. Ibis 117: 489-495.

Alerstam, T. & S. Ulfstrand. 1972. Radar and field observation of diurnal bird migration in South Sweden, Autumn 1971. Ornis Scand. 3: 99-139.

Bergman, G. & K.O. Donner 1964. An analysis of the spring migration of the common scoter and the long-tailed duck in southern finland. Acta zoologica fennica 105: 1-59.

Berndt, R.K. & G. Busche 1993. Vogelwelt Schleswig-Holsteins – Bd. 4: Entenvögel II. Karl Wachholtz Verlag Neumånster.

BirdLife International 2003. Windfarm and birds: An analysis of the effekts of Windfarms on birds, and guidance on enviromental assessment criteria and site selection issues, Written by BirdLife International on behalf of the Bern Convention, September 2003

Boverket 1995. Allmänna råd 1995:1.

Boverket, 1995. Etablering av vindkraft på land. Allmänna råd 1995:1.

Boverket 2002, Planering och prövning av vindkraftanläggningar. remissmaterial 2002-10-18

Boverket, 2003, Slutrapport June 2003, Förutsättningar för storskalig utbyggnad av vindkraft i havet, Vänern och i fjällen,

Degn, U. 2000. Offshore wind turbines – VWM. Underwater noise measurements, analysis and predictions. Odegard & Danneskiold-Samsoe A/S, Report No. 00.792 rev. 1 SEAS, Haslev, Danmark

Dehnhardt, G.; Hanke, W. & B. Mauck. 2001. Hydrodynamic trail following in seals: a new way for underwater orientation. Abstract 14th Biennal Conference on the Biology of Marine Mammals, Vancouver, Canada, Nov 28 – Dec 3, 2001: 56 pp.

Dietz, R.; Teilman, J. & O.D. Henriksen, O. 2003. Movements of seals from
Rødsand seal sancturay monitored by satellite telemetry. NERI Technical
Report No. 429.

Ehrich, S. 2000. Auswirkungen von Offshore-Windkraftanlagen auf die Fischfauna. Bundesforschungsanstalt für Fischerei, Institut für Seefischerei, Hamburg, 1-7 (unveröff.).

Fiskeriverket. Bakgrundsmaterial för utredning av möjligheten att införa fiskestopp i ett skyddat marint område.

Fiskeriverket 2002. Kunskapsläget vad gäller den havsbaserade vindkraftens effekter på fisket och fiskbeståndet. Rapport 2002-08-28

Greenpeace 2003. Skydda livet i havet - inrätta fler marina skyddsområden, May 2003.

Gärdenfors U. 2000. Rödlistade arter i Sverige

2000. Artdatabanken SLU Uppsala.

Hansen, L. 1954. Birds killed at lights in Denmark 1886-1939. Vidensk. Medd. Naturh. Foren. Kopenhagen 116: 269-368.

Hansson, S. (1995). En litteraturgenomgång av effekter på fisk av muddring och
tippning, samt erfarenheter från ett provfiske inför Stålverk 80. TemaNord 1995:513

Hastings et al. 1996. Effects of underwater sound on hair cells of the inner ear and lateral line of the oscar (Astronouts ocellatus).

Institut für Ostsee forschung, Warnemünde, On the pathways and mixing of saltwater plumes in the Arkona sea,

Jonasson Kjell December 2004. Elforsk, Ljud i havet - påverkan på marina djur.

Karin Hollertz och Rutger Rosenberg 2001. Marina utsjöbankar – kunskapsöversikt och biologisk värdering, rapport till Naturvårdsverket, September 2001.

Hvidt, C. B.; Bech, M. & Klaustrup, M. 2004. Monitoring programme – status report 2003. Fish at the cable trace. Nysted Offshore Wind Farm at Rødsand, Bio/consult as.

Karlsson, J. 1998. Inventering av marina makroalger i Halland 1997: Lilla Middelgrund. Tjärnö Marinbiologiska Laboratorium, Göteborgs universitet.

Koschinski, S., Culik, B.M., Henriksen, O.D., Tregenza, N., Ellis, G., Jansen, C., and Kathe, G. 2003. Behavioural reactions of free-ranging porpoises and seals to the noise of a simulated 2 MW windpower generator. Marine Ecology Progress Series 265: 263-273, 2003.

Koschinski et al 2003 (från Wahlbergs studie)

Larsson, Ann-Katrin 2000, Försöksanläggning för havsbaserad vindkraft i Nogersund – slutrapport, Elforsk Rapport 00:07 (www.elforsk.se)

Länsstyrelsen i Skåne län, remissrapport 2002-10-31. Vindkraft i Skåne, analys av konsekevenser av olika scenarier.

H.U. Lass 2003, Über mögliche Auswirkungen von Windparks auf den wasseraustausch zwischen Nord- und Ostsee, 2003, IOW Warnemünde

Margareta Olsson, 1998, Effektivt tillståndsarbete för havsförlagda vindkraftverk, Elforsk Rapport 98:18 (www.elforsk.se)

McCauley et al. 2003. High intensity anthropogenic sound damages fish ears.

Moore P.G. 1977. Inorganic particulate suspentions in the sea and their effekts on marine annimals. Oceanogr. Mar. Biol. Ann. Rev. 15, 225-363,

Naturvårdsverket 2001. Vindkraft till havs – en litteraturstudie av påverkan på djur och växter. Rapport 5139.

Naturvårdsverket, 2003. Art- och naturtypsvisa vägledningar för Natura 2000 (Marina miljöer och dyner) www.naturvardsverket.se/dokument/natur/n2000/2000dok/vagledn/bevplan/bevvagle.htm

Nordel 2004. Kraftbalanser för treårsperioden 2002-2004,

Nordel 2002. Nordisk Systemudviklingsplan

Nordel 2002. Power and Energy Balances, Retrospect 2003, Forecast 2007.

Pettersson Jan and Stalin Thomas, 2003. Influence of Offshore Windmills on migration birds – in southeast of Sweden.

Richardson, W.J.; Greene JR.; C.R.G.; Malme, C.I. & D.H. Thomson. 1995. Marine mammals and Noise. Academic Press, San Diego: 576 pp.

Rosenberg, R. 1982. Några lekplatser för sill i Skagerrak och Kattegatt. Meddelande från Havsfiskelaboratoriet, Lysekil. Nr 283.

Scheidat, M.; Kock, K.-H. & U. Siebert. 2003. Summer distribution of harbour porpoise (Phocoena phocoena) in the German North and Baltic Sea. working paper presented at the 2003 ASCOBANS meeting.

SGU, 1994 (Hittade hänvisningen i Fiskeriverket)

SOU 1998, Vindkraften – en ren energikälla tar plats. Lägesrapport 1998, Vindkraftsutredningen SOU 1998:152 (http://miljo.regeringen.se/propositionermm/sou/index.htm)

SOU 1999. Rätt plats för vindkraften ,del 1 och 2 Slutbetänkande 1999, Vindkraftsutredningen SOU 1999:75 (http://miljo.regeringen.se/propositionermm/sou/index.htm)

Statens Energimyndighet, June 2002. Elmarknaden 2002, ET 9:2002,

Statens Energimyndighet, May 2001. Vindkraften i Sverige.

Svenska Kraftnät AB, slutrapport, 2002-08-21. Övergripande förutsättningar för storskalig utbyggnad av vindkraft i havs- och fjällområden.

Teilmann, J. & M. P. Heide-Jørgensen 2001. Sæler i Østersøen, Kattegatt og Limfjorden 2000. In: K. Laursen (ed.) Overvågning af fugle, sæler og planter 1999-2000, med resultater fra feltstationerne. Faglig rapport fra DMU nr. 350: 103 S.

Wahlberg/Westerberg 2004, Fish and wind farms, MEPS 28-09-2004

Wahlberg Magnus and Westerberg Håkan, 2003. A comment on fish hearing and sounds from offshore mills.

Westerberg, H. Fiskeriverket, 1996. Ljud- och vibrationsmätningar vid broar.
Westerberg Håkan 1997. Havsbaserat vindkraftverk vid Nogersund; Effekter på blankålsfisket, PM 970404, 1997.

WWF, 2003, Benefits Beyond Boundaries: The Fishery Effects of Marine Reserves, www.panda.org/downloads/marine/benefitsbeyondbound2003.pdf

Ødegaard & Danneskiold-Samsøe, March 2000. Offshore Wind Turbines – VVM, Underwater Noise Measurements, Analysis and Predictions.

Further references in the Attachments.

18. Abbreviations and explanations

Kriegers Flak I = the project that is developed on the German side of Kriegers Flak by the group (Ostsee Offshore Wind AG)
Kriegers Flak II = the project that is being developed on the Swedish side of Kriegers Flak by Sweden Offshore
IOW = Institut fur Ostseeforschung, Warnemunde
IfAÖ = Institut fur Angewante Ökologi
EIS = Environmental Impact assessment
EC = The Swedish Environmental Code
BSH = Bundesamt für Seechiffahrt und Hydrographie
GL = Germanische Lloyd

Capacity (energy per time unit)
1 kilowatt (kW) = 1 000 W
1 megawatt (MW) = 1 000 kW
1 gigawatt (GW) = 1 000 000 kW
1 terawatt (TW) = 1 000 000 000 kW
Energy (capacity times time)
1 kilowatt-hour (kWh) = 1 000 Wh
1 megawatt-hour (MWh) = 1 000 kWh
1 gigawatt-hour (GWh) = 1000 000 kWh
1 terawatt-hour (TWh) = 1 000 000 000 kWh

19. Table of Attachments

1. General

1.1 Contact persons and addresses

2. Technical information

2.1 Coordinates and maps for the wind farm

2.2 Example: technical description of the RePower 5 MW wind turbine

2.3 Example: technical description of the Enercon 4,5 MW wind turbine

3. Consultation

3.1 Account of early consultation

3.2 Decision by the Skåne County Council regarding considerable environmental impact

3.3 Account of extended consultation

4. Seabed conditions

4.1 Mosaik Kriegers Flak Sweden – example of seabed investigations (Weigt – Nautic Nord, December 2003)

4.2 Overview map of marine seabed investigation (Marin Mätteknink AB, autumn 2004)

4.3 Preliminary geotechnical report (SGI, November 2004)

4.4 Ship wrecks at Kriegers Flak (extract from Kriegers Flak – Marine seabed investigation, Marin Mätteknik AB, autumn 2004)

4.5 Crossing cables (extract from Kriegers Flak – Marine seabed investigation, Marin Mätteknik AB, autumn 2004)

5. Hydrography

5.1 Report on the Kriegers Flak planned wind farm in relation to current and transport processes (Hydromod, October 2003)

5.2 A simple account of the deep Water impact at Arcona due to the Kriegers Flak foundations (SMHI, November 2004)

5.3 Proposed control program regarding hydrography (SMHI, November 2004)

6. Flora and benthic fauna

6.1 Vertebrates and macrophytes at Kriegers Flak (IfAÖ, September 2004)

6.2 Proposed control program regarding epifauna, infauna and macrophytes (Kjell Andersson, Lund University, November 2004)

7. Fish and commercial fishing

7.1 Commercial fishing at Kriegers Flak, investigation period 1998 – 2002, data from the ICES area IIId-24 (IfAÖ, October 2003)

7.2 Addition to the fishing report for square 39G3 (IfAÖ, November 2004)

7.3 Fish at Kriegers Flak, investigation period 2002 – 2003 (IfAÖ, September 2004)

7.4 Report about fish on the Swedish side of Kriegers Flak, investigation period spring 2004 (IfAÖ, September 2004)

7.5 Fishing on the south coast – a summary (Stig Lundin, November 2004)

7.6 Observed fish species, Latin names and classification

8. Birds

8.1 Resting water fowl at Kriegers Flak (IfAÖ, September, 2004)

8.2 Migrating birds at Kriegers Flak (IfAÖ, September 2004)

8.3 Spring migration of water fowl over Kriegers Flak in the south-western Baltic (Jan Pettersson, November 2004)

8.4 Cumulative effects for migrating birds due to wind farms at Kriegers Flak (Jan Pettersson, November 2004)

8.5 Proposed control program for birds (Jan Pettersson, November 2004)

9. Bats

9.1 Can migrating bats from the south coast of Skåne pass Kriegers Flak? (Ingemar Ahlén, Institute for natural protection biology, SLU; Rune Garell and Karin Garell Lundberg)

10. Sea living mammals

10.1 Sea living mammals at Kriegers Flak (IfAÖ, October 2003)

11. Visualisation

11.1 Visualisations (Lantmäterite, November 2004)

11.2 Expert opinion

12. Shipping

12.1 Offshore-based wind farm – Kriegers Flak II, Sweden, summary of collision risk analysis (Germanischer Lloyd, November 2004)

12.2 Risk analysis wind farm “Kriegers Flak II” (SSPA, November 2004)

12.3 Proposed control program regarding the collision risk between ships and the wind farm (SSPA, November 2004)

13. Grid connection

13.1 Electric integration of Kriegers Flak II in the Swedish southern electrical grid (NVE, September 2003)

13.2 Basis for early consultation, cabling at sea (Sweden Offshore, May 2004)

1

Wind farm, view from Trelleborg, 30 km, 128 pc, height 170m

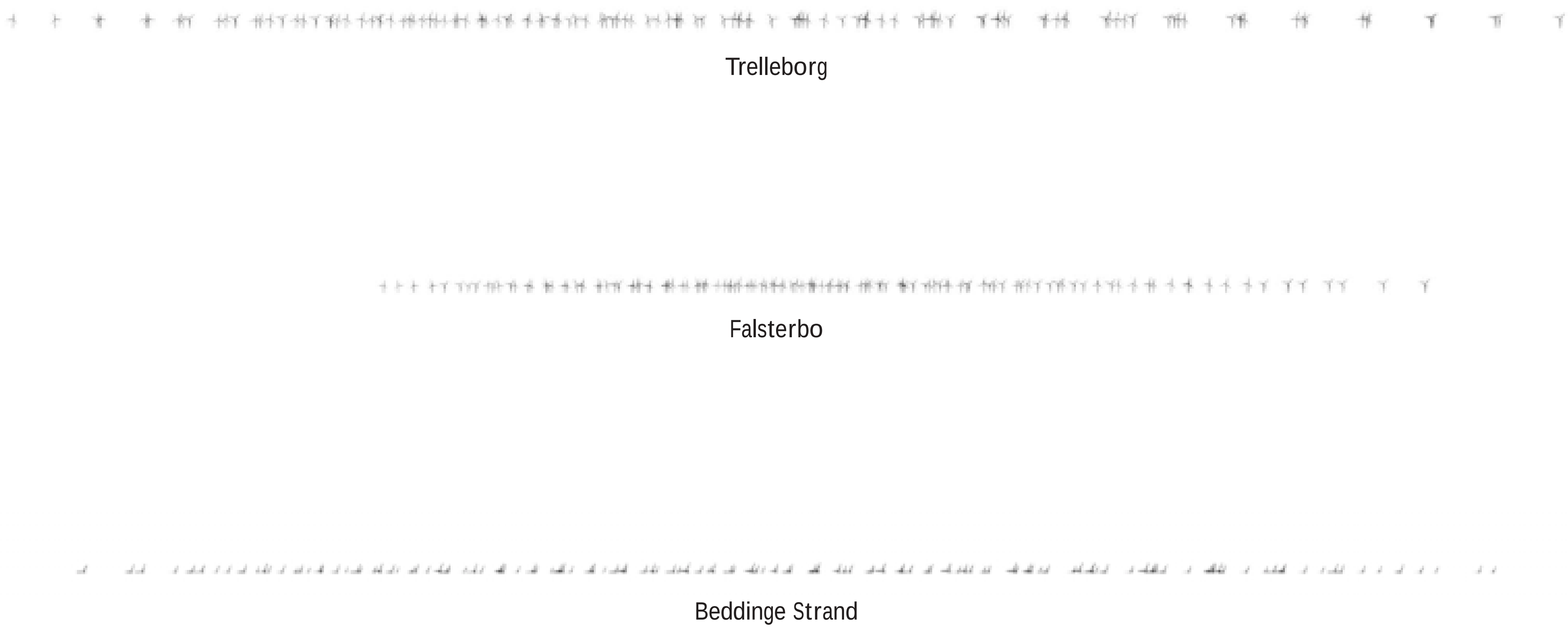
2

Wind farm, view from Trelleborg, 30 km, 128 pc + German wind farm, height 170m

Wind farm, view from Trelleborg, 30 km, dawn,128 pc, height 170m

Wind farm, view from Trelleborg, 30 km, cloudy,128 pc, height 170m

3


Trelleborg
Falsterbo
Beddinge Strand

Wind farm, view from ships bridge, 1,8 km, height 170m

Wind farm, view from ships bridge, 3,6 km, height 170m

6

Wind farm, view from Møn, 30 km, 128 pc, height 170m

Wind farm, view from Møn, 30 km, 128 pc + German wind farm, height 170m

8

Wind farm, view from Rügen, 42 km, 128 pc, height 170m

9

Wind farm, view from Rügen, 42 km, 128 pc + German wind farm, height 170m