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Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States

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Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States

Project November 2007 – October 2009

Final Report

by

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16. **Abstract**

This is the final report of the project “Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States”, which was co-funded by the German Environmental Agency (project No 380 01 173).

The main outcomes of the project are:

- The „Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States“ developed by the Baltic Environmental Forum and German consultant Dr. Jan Kube in consultation with experts from Estonia, Latvia and Lithuania. The guidelines give an overview on potential negative impacts of offshore wind farms on the marine environment and general EIA and monitoring requirements as well as give detailed guidance on methodology for relevant field investigations.
- The background paper “Legal frame for the use of offshore wind energy in Germany” prepared by RA’in Dr. Ursula Prall (April 2009)
- 3 international workshops on different aspects related to establishment of offshore wind farms and assessment of their environmental impacts.

17. **Key Words**
Offshore wind farms, wind parks, wind energy, EIA, environmental impact assessment, Baltic

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16. **Kurzfassung** Die „Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States“ wurden vom Team des Baltic Environmental Forum mit der Unterstützung des deutschen Beraters Dr. Jan Kube und in enger Zusammenarbeit mit Experten aus Estland, Lettland und Litauen erarbeitet. Diese “Guidelines” geben einen Überblick über die potentiellen negativen Auswirkungen von Offshore Windfarmen auf die Meeresumwelt mit besonderem Blick auf die Gegebenheiten in der nordöstlichen Ostsee. Sie wurden in Anlehnung an die Erfahrungen in Deutschland entwickelt und geben Hilfe zur Erarbeitung einer UVP und Monitoringkonzepten. Der vorliegende Bericht wurde im Rahmen des vom BMU/UBA geförderten Projektes “Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States” vorbereitet (FKZ 380 01 173).		
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1 Zusammenfassung

Der vorliegende Endbericht liefert eine detaillierte Darstellung der Aktivitäten, die im Rahmen des Projektes „Konzeptentwicklung zur Umweltverträglichkeitsprüfung für Off-shore Windparks im Baltikum“ (FKZ 380 01 173) im Zeitraum vom 1. November 2007 – 31. Oktober 2009 durchgeführt wurden.

Ziel des Projektes war es, die Umweltbehörden in Estland, Lettland und Litauen bei der Entwicklung eines einheitlichen Konzeptes zur Durchführung für Umweltverträglichkeitsprüfungen (UVP) für Offshore Windparks zu entwickeln, die auf den deutschen „Standards für UVP“ des BSH basieren sollen. Darüber hinaus sollte das Konzept dazu dienen, eine Grundlage zu schaffen, um die nationale Gesetzgebung, die in dieser Hinsicht in den baltischen Staaten noch unzureichend ist, zu verbessern. Eine erste UVP sollte im Rahmen des Projektes testweise, und mit Unterstützung durch deutsche Berater, in Estland durchgeführt werden und als Modellstudie für die Zukunft dienen, um fortan kompetent und professionell UVPs durch Experten vor Ort eigenständig durchführen zu können.

Das Projektmanagement lag in Händen des Bewilligungsempfängers, dem Baltic Environmental Forum (BEF) Lettland, und die Ausführung erfolgte in Kooperation mit BEF Estland und BEF Lettland, sowie den Umweltberatern von Hendrikson & Ko. (Estland). Außerdem war als Unterauftragnehmer das Institut für angewandte Ökologie (Neu Brodersdorf) Teil des Projektteams.

Im Lauf des Projektes wurden folgende Aktivitäten durchgeführt: Kick-off Meeting in Tallinn, Estland (27-28.11.2007); ein weiteres Kick-off Meeting in Berlin (05.02.2008); Recherchen für die estnische Pilot-UVP für die Windfarmprojekte Neugrund und Hiiumaa; Beratung hierzu via E-mail und einem Projekttreffen (11-12.03.2008 in Tallinn) zwischen den estnischen Experten und dem deutschen Berater, Herrn Jan Kube; ein großer internationaler Workshop zu “Planung von Offshore-Windfarmen gemäß Natura 2000-Anforderungen: Rechtsrahmen, Auswirkungen, Untersuchungsstandards und -verfahren” (29-30.05.2008 in Sigulda, Lettland); Kommunikation mit zuständigen Behörden und Interessensvertretern (Juni-Okt. 2008); ein Baltischer Workshop zu “Methoden für Umweltverträglichkeitsprüfung für Off-shore Windparks“ (5-7.11.2008 in Kabli, Estland); ein Baltischer Workshop „3. Seminar zu Umweltverträglichkeitsprüfung für Offshore Windparks vis-à-vis Natura 2000 und andere Landnutzungen: Was für einen gesetzlichen Rahmen wir brauchen?“ (15-16.04.2009 in Riga, Lettland); ein Estnisher Rundtisch/Seminar zu „Offshore Windparks in Estland und relevante Umweltvertraglichkeitsprüfung“ (21.05.2009 in Tallinn, Estland); Herausgeben einer Broschüren in Estnisch zu „Umweltverträglichkeitsprüfung für Offshore Windparks“; Ausarbeitung des Leitfadens für UVP für Offshore Windparks für Baltische Staaten und ein Baltishes Evaluation Meeting. Information über das Projekt kann man in http://www.bef.ee/index.php?id=694 finden.

2 Introduction

The present report shall describe the activities carried out in the frame of the project „Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States " from November 2007 till October 2009.

The aim of the project was the support of the Estonian, Latvian and Lithuanian environmental authorities with the development of a concept for EIA for off-shore wind parks, based on the German "Standards for the Environmental Impact Assessment" of off-shore wind parks (BSH). Additionally, the concept should serve as guidelines including guidance for necessary procedures and checks adjusted to national legal requirements and conditions. Furthermore, the first EIA for an offshore wind farm in Estonia was planned to be attended by experienced German consultants and led to a positive result. It should serve as a model case for future concept development with the ambition to conduct future EIA in marine areas in a competent and professional way by local specialists.

The project was managed by the grant beneficiary, the Baltic Environmental Forum Latvia, and implemented in co-operation with the Baltic Environmental Forum Estonia, Baltic Environmental Forum Lithuania, Estonian environmental consultant Hendrikson & Ko and the German subcontractor Institute for Applied Ecology.

The project duration began on 1 November 2007 and ended on 31 October 2009. The initial total project budget was 172,290 EUR with a funding of 75,000 EUR from the German Federal Environment Agency. In November 2008 an extension of the project was applied due to the need to organise one more workshop on legal aspects related to the establishment of offshore wind farms. The wish for such a workshop was expressed by the Baltic competent authorities in the international workshop in Sigulda in May 2008. The application for extension was approved and the project budget was increased for 26 500 EUR.

The key project actions have been: the kick-off meeting in Tallinn, Estonia (27-28.11.2007); kick-off meeting in Berlin, Germany (05.02.2008); investigations for Estonian pilot EIA cases for Neugrund and other offshore wind farm projects; consultation of Estonian pilot EIA cases through e-mail communication and a meeting (11-12.03.2008 in Tallinn, Estonia) between Estonian experts and the German consultant Jan Kube; a big international workshop on "Planning offshore wind farms in line with Natura 2000 requirements: legal frame, impacts, investigation standards and procedures" (29-30.05.2008 in Sigulda, Latvia); communication with competent authorities and other stakeholders, collection of additional information about developments in the countries, inner communication of the project team, preparing and carrying out a Baltic workshop on "Methodology for assessing impacts of offshore wind farms on biodiversity and landscape" (5-7.11.2008 in Kabli, Estonia); an international event "3rd Seminar on EIA for off shore wind farms vis-à-vis Natura 2000 and other land uses: Which kind of legal frame we need?" (15-16.04.2009 in Riga, Latvia), an Estonian round table on "Offshore wind farms in Estonia and assessment of their environmental impacts" (21.05.2009 in Tallinn, Estonia); publishing a leaflet in Estonian on "Environmental impacts of offshore wind farms and their assessment"; development of the Guidelines for EIA for offshore wind farms in the Baltic States (Oct. 2008-Oct. 2009) and a Baltic meeting on "Evaluation and final approval of guideline texts" (27.10.2009).

Information about the project can be found at http://www.bef.ee/index.php?id=694

3 Project team

The beneficiary of the grant and the managing organisation of the whole project was the Baltic Environmental Forum Latvia.

	Organisation/Country	Address, Phone, Fax, E-Mail	Team members	Role
1	Baltic Environmental Forum Latvia	Doma laukums 1-53 LV-1050 Riga Latvia T. +371 6735 7552 F. ++71 6750 7071 @. Heidrun.fammler@bef.lv	Ms. Heidrun Fammler Mr. Edgars Bojars Ms. Ilze Kergalve	Project Management (Ms. Fammler) Background info search, preparation of meetings/ seminars, Baltic guidelines (Mr. Bojars) Technical assistance (Ms. Kergalve)
2	Baltic Environmental Forum Estonia	Liimi 1 10621 Tallinn Estonia T. +372 6597 029 F. +372 6597 027 @ merle.kuris@bef.ee	Ms. Kai Klein Ms. Merle Kuris	Project coordination in Estonia (Ms. Klein) Background info search, preparation of meetings/ seminars, Baltic guidelines (Ms. Kuris)
3	Baltic Environmental Forum Lithuania	Vivulskio 14/8-6 LT-03221 Vilnius Lithuania T. +370 5213 8155 F. +370 5213 5068 @ zymantas.morkvenas@bef.lt	Mr. Zymantas Morkvenas	Project coordination in Lithuania, Background info search, preparation of meetings/ seminars, Baltic guidelines
4	Hendrikson & Ko Ltd.	Raekoja plats 8 51004 Tartu Estonia T. +372 7409 806 F. +372 7384 162 @ kuido@hendrikson.ee	Mr Kuido Kartau	Pilot EIA for Neugrund windfarm project in Estonia, participation in development of Baltic guidelines
5	Institute for Applied Ecology (subcontractor)	Alte Dorfstr. 11 18184 Neu Brodersdorf Germany T. +49 38204 6119 F. +49 38204 61810 @ kube@ifaoe.de	Mr Jan Kube	Subcontracted for consultation of Estonian pilot EIA cases, preparation of seminars and Baltic guidelines

4 Report on Activities

The following activities have taken place in the frame of the project:

	Activity	Date	Place	Country
1	Kick-off Meeting	27-28 Nov 2007	Tallinn	Estonia
2	Collection of background information in the Baltic countries	November 2007-January 2008	Tallinn, Riga, Vilnius	Estonia, Latvia, Lithuania
3	Kick-off meeting with UBA	5 Feb 2008	Berlin	Germany
4	Investigations and EIA for Neugrund and other offshore windfarm projects in Estonia	Nov 2007 – Oct 2009		Estonia
5	Expert meeting for consultation of Estonian pilot EIA cases	11-12 March 2008	Tallinn	Estonia
6	Project team meeting for preparation of the international workshop	9 May 2008	Riga	Latvia
7	International workshop on "Planning offshore windfarms in line with Natura 2000 requirements: legal frame, impacts, investigation standards and procedures"	(28)29-30 May 2008	Sigulda	Latvia
8	Follow-up of the May workshop, communication with stakeholders, information search	June-October 2008	Tallinn Riga Vilnius	Estonia Latvia Lithuania
9	International workshop on "Methodology for assessing impacts of offshore windfarms on biodiversity and landscape"	(4)5-7 Nov 2008	Kabli	Estonia
10	3rd Seminar on „EIA for offshore wind farms vis-à-vis Natura 2000 and other land uses: Which kind of legal frame we need?"	15-16 April 2009	Riga	Latvia
11	Estonian round table on "Offshore windfarms in Estonia and assessment of their environmental impacts"	21 May 2009	Tallinn	Estonia
12	Publishing a leaflet in Estonian on "Environmental impacts of offshore windfarms and their assessment"	May 2009	Tallinn	Estonia
13	Development of Guidelines for EIA for offshore windfarms in the Baltic States	October 2008 – October 2009		Germany, Estonia, Latvia, Lithuania
14	Baltic expert meeting on "Evaluation and final approval of guideline texts"	27 October 2009	Sigulda	Latvia

The following chapters provide a summarised overview of the main activities and results of the project.

4.1 Investigations and EIA for Neugrund wind farm project in Estonia

This activity was implemented by the project partner Hendrikson & Ko and its subcontractors Estonian Marine Institute and Estonian Ornithological Society.

The main activities have been:

- Environmental impact assessment of the Neugrund offshore wind farm;
- Consulting different competent authorities about management of marine areas and legal framework related to the development of offshore wind farms;
- Bird investigations in Neugrund area carried out by the Estonian Ornithological Society;
- Investigations of benthos and fish carried out by the Estonian Marine Institute.
- Preliminary bird assessment for Orajõe offshore wind farm project has been prepared.
- Participation in the project events;
- Participation in the development of the Baltic Guidelines.

Draft EIA report for Neugrund wind farm has been prepared. However, officially the process did not move on during the project duration due to the lack of relevant legislation in Estonia.

4.2 Expert meeting for consultation of Estonian pilot EIA cases

The expert meeting "Evaluating potential impacts of offshore wind farm development on MPA" was organised by BEF-Estonia on 11-12 March 2008 in Tallinn. 10 experts conducting inventories and EIA for Neugrund and Hiiumaa offshore wind farm projects as well as German consultant Jan Kube and representative of BEF-Estonia participated in this meeting. **The goal of the meeting** was to inform about and discuss the design of environmental baseline investigations for offshore wind farm projects in Estonia (Neugrund/Hiiumaa).

Main discussion points:

Preliminary results were presented to describe the status quo of the environmental conditions, to identify open gaps in the investigation programme, and to discuss the potential effects on marine biodiversity, which could show up during construction/operation of the wind farms.

The main conclusions:

Birds

Neugrund & Hiiumaa projects are located on shallow banks surrounded by deeper waters. Bird surveys undertaken so far outline the outstanding importance of the shallow banks for benthophagous waterfowl in the open sea of this region. Especially long-tailed ducks occurred in numbers of international importance throughout the winter season from October until April.

It was concluded that the investigation programs (ship based surveys at Neugrund, aerial surveys at Hiiumaa) suffer from the limited amount of survey data and need to be extended (more surveys according to the international standard methods), since significant effects due to habitat losses are predictable.

Mammals

No investigations were carried out to survey marine mammals. Seals are very difficult to investigate offshore. Porpoises are far too rare.

Fish

A complex array of multi-mesh gill net catches was designed/carried out to investigate benthic species. The results provide a very good overview on the occurrence/abundance of common benthic species in relation to well-known coastal habitats. However, information on rare/protected species could not be obtained due to their rarity or pelagic nature. Special investigations were carried out, therefore, to gather information on the ecology of rare pelagic species (i.e. whitefish). The intensity of fish investigations by far exceeded the program of the German standard.

The fish data do offer only little information to evaluate potential impacts. A literature overview will be prepared in addition to gather all available information on underwater noise, electro-magnetic fields, etc.

Marine habitats/benthic invertebrates

Investigations on marine habitats and benthic invertebrates for Neugrund included side scan sonar, bathymetric mapping, extensive photo sampling, quantitative sampling of hard bottom fauna/flora, and fouling experiments. Distribution maps for all species were computed by kriging. The intensity of benthic investigations was comparable to the program of the German standard.

The Neugrund area might be designated as a reef according to the EU Habitat Directive (Natura 2000). Due to the shallow nature of the Neugrund area, large parts of the limestone plateau are overgrown by benthic algae. The flora is expected to be influenced by ice scraping during severe winters.

Species diversity of algae/benthic invertebrates is generally low in the Gulf of Finland (because of the low salinity). Due to the fact, that hard bottom epifauna is prevailing at Neugrund, only minor effects are expected by the presence of wind turbine foundations. However, important open questions remain since the technology of construction (foundations, cables) is still under consideration. Furthermore, the role of potential effects on ice mobility is difficult to evaluate.

4.3 International workshop on “Planning offshore wind farms in line with Natura 2000 requirements: legal frame, impacts, investigation standards and procedures”

The workshop “Planning offshore wind farms in line with Natura 2000 requirements: legal frame, impacts, investigation standards and procedures” took place on 29-30 May in Sigulda, Latvia.

The goals of the workshop were:

- to discuss the current situation, problems and needs concerning planning and impact assessment of offshore wind farms in the Baltic States, and
- to learn from experiences of other countries (Germany, Denmark, Sweden, Netherlands) with the aim to avoid negative impacts of this new economic activity on nature values in the Eastern Baltic Sea.

The workshop brought together different Baltic stakeholders related to the topic: developers, consultants, ministries dealing with environment, economy & planning issues, subordinated institutions of ministries, scientists, environmental NGOs, as well as guest experts from „old EU countries" – in total almost 70 participants. Feedback from all of them was that the workshop gave a lot of new information and enabled to discuss and define the main gaps and necessary next steps for the Baltic States.

Conclusions from the workshop:

- The Baltic countries have similar problems: offshore wind energy as new development, gaps in legislation, lack of political vision and strategic planning of use of marine areas, lack of data on marine environment and lack of knowledge on environmental impacts of offshore wind farms and methodology for their assessment.
- The necessary next steps for the Baltic States would be:
    - Development of political vision for offshore wind energy and maritime strategy;
    - Coordinated Baltic baseline ecological survey on seabirds and bird migration to define suitable areas for offshore wind farms and SPAs;
    - Development of legislation and licensing procedure for offshore wind farms;
    - Development of methodological guidelines for EIA for offshore wind farms.
- The next planned events:
    - Workshop on methodology for EIA for offshore wind farms planned in autumn 2008;
    - It was proposed to organise a workshop on legal issues and licensing procedure (involving lawyers and relevant officials from the Baltic States and Germany) – probably in autumn 2008.

The report of the event is available at

http://www.bef.ee/files/c274/Report_Windfarm%20WS_29-30.05.08.pdf

4.4 Follow-up of May workshop, communication with stakeholders, information search

The draft report of the workshop on "Planning offshore wind farms in line with Natura 2000 requirements: legal frame, impacts, investigation standards and procedures" (29-30.05.2008 in Sigulda, Latvia) was sent to all participants and comments received were incorporated into the final report. Furthermore, the results of the workshop were communicated to Baltic stakeholders and general public through a summarizing article published in internet (see the English version in the annex 1 of the 2nd interim report). The project team has communicated with the competent authorities and followed the further developments in all three Baltic countries.

In Estonia a target to install 900 MW of wind energy has been set and negotiations between Ministry of Economic Affairs and Communications, Ministry of Environment and Ministry of Justice are going on about developing the legislation to solve the problems concerning ownership and use of the seabed and relevant permitting procedures. The current submitted EIA applications are frozen until the unclear legal situation will be solved.

In Latvia an inter-ministerial working group has been established and started to work in September 2008. The main aim is to develop a policy planning document or informative report on potential areas in the EEZ and Territorial Sea where wind farm potential could be investigated, as well as legal act development or improvement needs in wind energy field according to competencies of ministries.

In Lithuania the new government after very recent parliamentarian elections has at first to be formed and it will possibly change all recent developments (similar discussion on permit issues like in Estonia and Latvia). However, energy and electricity supply were a hot issue during election campaigns and it is planned by the winning coalition to establish an energy ministry as new institution and to revise the energy supply strategy of Lithuania. Renewable energy and nuclear energy are important issues on the political agenda.

4.5 International workshop on "Methodology for assessing impacts of offshore wind farms on biodiversity and landscape"

The workshop "Methodology for assessing impacts of offshore wind farms on biodiversity and landscape" took place on (4)5-7 November 2008 in Kabli, Estonia.

The goals of the workshop were:

- to discuss and agree on the best methodology for assessing impacts of offshore wind farms on biodiversity and landscape;
- to provide input for the guidelines for EIA for offshore wind farms in the Baltic States, and
- to exchange experience between experts from the Baltic States, Germany and UK.

The key experts from the Baltic States dealing with marine investigations and impact assessments were invited to the workshop – in total there were 32 participants, including the consultant on biological issues – Dr. Jan Kube, and a landscape expert from UK – Mr. Simon Bell.

The workshop included in-depth methodological discussions on 5 biological topics – benthos, fish, marine mammals, seabirds and migratory birds. Additionally there was a separate working group on assessment of visual and landscape impacts of marine wind farms. The landscape topic was included on request of Baltic EIA experts because assessment of visual and landscape impacts is an obligatory part of EIA but there is lack of knowledge on relevant methodology in the Baltic States.

During preparations of the workshop, the detailed discussion points for each session were prepared and sent to the participants in advance, together with additional background materials (e.g. German EIA Standards prepared by BSH).

Result of the workshop:

- The draft methodology for the Baltic States for assessment of impacts of marine wind farms on benthos, fish, marine mammals, seabirds and migratory birds was defined.
- In the landscape group the main principles of landscape and visual impact assessment (LVIA) were introduced and the assessment methodology was discussed. It was proposed that at least the main principles and steps of LVIA could be included in the Guidelines for EIA for offshore wind farms in the Baltic States. It was also decided that the topic needs further development.
- The further information needs and steps concerning development of the Baltic guidelines were agreed.
- The first draft of the Guidelines for EIA for offshore wind farms in the Baltic States was prepared based on input from the workshop.

4.6 3rd seminar on "EIA for offshore wind farms vis-à-vis Natura 2000 and other land uses: Which kind of legal frame we need?"

The 3rd seminar on EIA for off shore wind farms vis-à-vis Natura 2000 and other land uses: Which kind of legal frame we need?" took place on 15-16 April 2009 in Riga, Latvia.

The goals of the workshop were:

- To get a full picture on the complexity of the issue and place the environmental aspects into the frame;
- To view the situation in the Baltic States vis-à-vis German experience and discuss action needs for each of the aspects, and
- To learn from experiences of Germany with the aim to avoid a few mistakes or complicated procedures.

The main discussion topics were:

- The current status concerning offshore wind energy in Germany and in the Baltic States;
- Why should offshore wind farms be built? – General and financial conditions and relevant EU and national legal framework;

- Where could offshore wind farms be built? – Maritime spatial planning, potential conflicts with other uses of marine areas and relevant legal framework;
- Under what circumstances should an offshore wind farm be licensed? - Different aspects to be considered (environmental issues, security at sea traffic, other public interests);
- Permitting procedures for offshore wind farms and relevant competent authorities;
- Grid connection and other technical aspects.

An overview was given on how the above-mentioned aspects are organised in the Germany and in the Baltic States; the existing gaps were analysed with help of the German consultant Dr. Ursula Prall and the next steps for the Baltic States were discussed.

The target group of the event included Baltic authorities responsible for environmental impact assessment, nature conservation, spatial planning, renewable energy and use of marine areas (including Exclusive Economic Zone); wind energy associations, developers and EIA experts. In total there was 55 participants from Germany and the Baltic States.

Based on presentations of Dr. Prall, an in-depth background paper on “Legal frame for the use of offshore wind energy in Germany” was prepared. The background paper can be found at http://www.bef.ee/files/c274/Background_paper_Prall_15-16.04.09.pdf

The seminar report includes a summary of the Baltic presentations and the main points from the seminar discussions. The report of the event can be found at http://www.bef.ee/files/c274/Report_LegalWS_15-16.04.09.pdf

4.7 Estonian round table on "Offshore wind farms in Estonia and assessment of their environmental impacts"

Estonian round table on “Offshore wind farms in Estonia and assessment of their environmental impacts” took place on 21 May 2009 in Tallinn, Estonia.

The goals of the round table were:

- To bring together different stakeholders to discuss the goals and further activities related to development of offshore wind farms in Estonia;
- To discuss the problems related to the use of offshore wind energy and try to find solutions together;
- To introduce the Baltic guidelines for EIA for offshore wind farms and discuss its further use in Estonia.

54 participants from different Estonian stakeholder groups participated in the event: representatives from Estonian Parliament, Ministry of Economic Affairs and Communications, Ministry of the Environment, Ministry of Interior, Environmental Board, Maritime Administration, scientific institutions, NGOs (Estonian Ornithological Society, Estonian Fund for Nature, SEI-Tallinn), EIA consultant companies, wind energy developers etc.

Madis Laaniste from Energy Department of Ministry of Economic Affairs and Communications introduced the coming EU RES Directive and tasks for Estonia to implement it. Merle Kuris from BEF-Estonia gave an overview on the main conclusions of the international seminar on EIA for off shore wind farms vis-à-vis Natura 2000 and other land uses: Which kind of legal

frame we need?“ (15-16.04.09, Riga, Latvia). Georg Martin from Estonian Marine Institute, Tartu University presented aspects to be considered when selecting locations for offshore wind farms and introduced the main principles of maritime spatial planning. Kuido Kartau from Hendrikson & Ko introduced the current situation and practical experiences concerning EIA for offshore wind farms in Estonia. Merle Kuris introduced the Baltic Guidelines for EIA for offshore wind farms being prepared in the frame of the project financed by the German Federal Environment Agency.

The main conclusions of the round table were:

- Development of the thematic plan for use of renewable energy in Estonia has been planned several years ago but still not started.
- According to the new EU RES Directive and Estonian Energy Sector Development Plan, Estonia has to develop an action plan for the use of renewable energy by June 2010. Ministry of Economic Affairs and Communications is currently preparing the proposal for development of this action plan.
- In addition to other ministries it is important to involve also NGOs in the development of the action plan for the use of renewable energy.
- It must be carefully analysed, which renewable energy sources to use and how much, to plan it best way from environmental as well as economic point of view. Other energy sources needed for balancing of fluctuations of wind energy can decrease its “renewable nature”.
- Currently there are no ready solutions for selection of locations of offshore wind farms in Estonia.
- Development and step-by-step implementation of principles of maritime spatial planning would help to select locations for offshore wind farms.
- Only 1/3 of Estonian marine areas is more or less systematically investigated by now. It is important to ensure systematic collection of baseline information for maritime spatial planning and decisions concerning use of marine areas.
- The opinion was expressed that the introduced Baltic Guidelines for EIA for offshore wind farms probably require too much from a developer. Some of the investigations should actually be implemented by the state (e.g. telemetry investigations of seals or radar studies of bird migration). However, it was admitted that the state has currently no financial resources for such investigations.
- It was proposed that assessment of impacts of offshore wind farms on migratory bats should be added to the Guidelines. Information for that could be taken from “Guidelines for consideration of bats in wind farm projects” developed by Eurobats (available at www.eurobats.org).

4.8 Publishing a leaflet in Estonian on "Environmental impacts of offshore wind farms and their assessment

The leaflet was published by BEF-Estonia in May 2009. It gives a short overview on pros and cons of wind energy, describes the potential impacts of offshore wind farms on the marine environment and introduces necessary investigations for assessment of those impacts.

The leaflet is meant for giving an overview of the issue for officials, wind farm developers and interested general public.

The Baltic Guidelines for EIA for offshore wind farms developed in frame of the project "Concept development for an environmental impact assessment for offshore wind parks in the Baltic States" were used for compiling the content of the leaflet.

The leaflet (in Estonian) can be found at http://www.bef.ee/files/c274/tuulepargid.pdf

4.9 Development of Guidelines for EIA for offshore wind farms in the Baltic States

The outline of the Guidelines for EIA for offshore wind farms in the Baltic States was prepared based on German "Standards for the Environmental Impact Assessment" of off-shore wind parks (BSH). However, as the conditions in the Baltic States are different, the German methodology cannot be copied one-to-one. During the workshop in November 2008 the experts agreed on the detailed content of each chapter and on data and information needs from the Baltic States as input to the guidelines. The first draft of the Guidelines for EIA for offshore wind farms in the Baltic States was prepared based on input from the workshop.

During November 2008-May 2009 the draft compiled based on results of the methodological workshop (5-7.11.08) was discussed and commented by the Baltic experts and the 2nd draft was prepared.

A meeting of the project team and Jan Kube took place on 17 April 2009 to discuss the finalization of the Guidelines.

The 3rd draft of the Guidelines was prepared in May 2009 and sent to the Baltic experts for final checking in June 2009.

During May – October 2009 the final draft of the Guidelines was discussed with stakeholders, including competent authorities in Estonia, Latvia and Lithuania.

Several smaller meetings (among the project team as well with the national competent authorities) were carried out during June - October 2009 to finalize the Guidelines as well as to discuss their further use in Estonia, Latvia and Lithuania.

The draft guidelines were introduced and discussed in the Estonian round table on "Offshore wind farms in Estonia and assessment of their environmental impacts" that took place on 21 May 2009 in Tallinn, Estonia.

On 27th October 2009 a Baltic expert meeting on "Evaluation and final approval of guideline texts" took place in Sigulda, Latvia. Marine experts, EIA experts as well as representatives of state authorities from the three Baltic States participated there. The final draft of the

Guidelines and its further use in the Baltic States was discussed and the results of the whole project were evaluated at the meeting.

The final draft of the Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States was prepared in October 2009.

In Estonia where an additional funding for the project was received from the NGO Fund financed by the EEA and Norwegian Financial Mechanisms, the full version of the Guidelines was translated into Estonian language. In Latvian and Lithuanian languages the summary versions explaining the content of the Guidelines were produced. The English as well as national versions of the Guidelines were distributed to the relevant experts and authorities and are also available on web sites of BEF-Latvia, BEF-Estonia and BEF-Lithuania.

The Baltic Guidelines for EIA for offshore wind farms (in English) can be found in Annex 1 of the current report and at

http://www.bef.ee/files/c274/Baltic_offshore_windfarm_EIA_guidelines.pdf;

Estonian version of the Guidelines at

http://www.bef.ee/files/c274/Juhend_MeretuuleparkideKMH_.pdf;

Summary of the Guidelines in Latvian at http://www.bef.lv/391/796/;

Summary of the Guidelines in Lithuanian at http://www.bef.lt/naujiena.php?id=1258020715

4.10 Baltic expert meeting on "Evaluation and final approval of guideline texts"

On 27th October 2009 Baltic expert meeting on "Evaluation and final approval of guideline texts" took place in Sigulda, Latvia. Marine experts, EIA experts as well as representatives of state authorities from the three Baltic States participated there. The final version of the Guidelines and its further use in the Baltic States was discussed and the results of the whole project were evaluated at the meeting.

The main conclusions were:

- The project was very useful for Baltic marine biologists and EIA experts who now have much better understanding of possible environmental impacts of offshore wind farms and their assessment methodology;
- Overview about international practice given in the project workshops was also very interesting and useful;
- The Baltic experts appreciate also the international contacts created by the project that can be used also in future for experience exchange and co-operation;
- Unfortunately, despite of the efforts of the project, fewer results have been achieved in the field of legal framework – relevant legal framework is still not place in the Baltic States. The project has been active and successful to bring together stakeholders and to discuss about the topic but the real final results in the legal system are still missing.

However, the example from Germany also showed that this is a long-years project and obviously the Baltic states are not taking shorter time than Germany, Sweden and others. For sure the experience of Germany and other countries shared in the project events will be definitely considered and used.

- The Guidelines for EIA for offshore wind farms produced by the project is a valuable guidance material for the experts as well as for the state authorities evaluating the EIA programmes and reports and making decisions. It is planned to implement the standards in future projects and a first attempt has been done with submission of a large scale LIFE+ project where Estonian and Latvian partners plan to carry out a model EIA for OWF in the Gulf of Riga (results from project evaluation are expected in spring 2010).

5 Project evaluation

5.1 Results of the project

The project „Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States " has fulfilled its aim to support the Estonian, Latvian and Lithuanian environmental authorities with the development of a concept for EIA for off-shore wind parks, based on the German "Standards for the Environmental Impact Assessment" of off-shore wind parks (BSH).

In co-operation of Baltic experts and German consultant Jan Kube the "Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States" were developed. It is valuable guidance material for marine biologists, EIA experts, developers as well as for competent authorities/decision makers of the Baltic States. The guidelines were also translated into Estonian and the summaries into Latvian and Lithuanian languages.

In the frame of the project 3 big international workshops have been organized that offered a great opportunity for the Baltic States to exchange experience with Germany and other countries having more experience on offshore wind farms, assessment of their environmental impacts as well as relevant legal framework.
The background paper "Legal frame for the use of offshore wind energy in Germany" prepared by RA'in Dr. Ursula Prall was valuable background information for the Baltic States currently developing their legal frame for establishing offshore wind farms.
The Baltic experts appreciate also the international contacts created by the project that can be used also for future co-operation.

Also Estonian round table on "Offshore wind farms in Estonia and assessment of their environmental impacts" (21 May 2009 in Tallinn) was very successful and together with the published Estonian leaflet on "Environmental impacts of offshore wind farms and their assessment" contributed to stakeholder communication and awareness on the issue in Estonia.

The first Estonian EIAs for Hiiumaa and Neugrund offshore wind farms were consulted by the German consultant Jan Kube. As result, the investigation programmes were adjusted as much as possible and valuable advice was received concerning interpretation of inventory results. However, officially the EIA processes could not move on during the project duration (even the EIA programmes could not be approved), as the relevant legislation was not in place yet in Estonia.

For the same reason (lack of legal frame for establishment of offshore installations in Estonia) also the initial plan to test the developed methodology for EIA investigations during pilot EIA for Neugrund offshore wind farm could not be implemented. However, for the "unofficial" investigations the recommendations and information received from the project were considered by Hendrikson & Ko as much as possible.

The project has also excited the interest of developers: a new project application was developed by BEF in co-operation with Eesti Energia where it is planned to test the developed investigation methodology in practice in the pilot EIA for an offshore wind farm in the Gulf of Riga.

5.2 Legal frame and procedures for EIA for offshore wind farms in the Baltic States – status in 2009

The legal frame for establishing offshore wind farms and carrying out relevant EIA is not yet in place in any of the Baltic States. However, it is clear that the Baltic States try to use the existing legislation, procedures and structures as much as possible.

5.2.1 Estonia

Environmental Impact Assessment and Environmental Management Act is regulating SEA, EIA and Natura 2000 assessment. According to this act, installation of wind farms in water bodies requires EIA due to significant environmental impact. However, use of the seabed is not regulated by legal acts yet.

According to the new draft act it is planned that the procedure for establishing an offshore windfarm includes the following stages:

1. application for state consent for use of the seabed given by Estonian Government;
2. application for permit for the special use of water and EIA;
3. application for building permit and building of the wind farm;
4. application for permit for use of the construction.

The main competent authority would be Ministry of Economic Affairs and Communications, only permit for special use of water is given by the Ministry of the Environment. Ministry of Economic Affairs and Communications must consult with Ministry of the Environment, Ministry of Defence, Maritime Administration and other institutions if needed.

Currently the sea is owned by the state in Estonia. According to the new draft act the territorial sea is planned to be excluded from state ownership – it would be public water body without any ownership.

Currently (Dec. 2009) the discussions on draft legislation regulating use of the seabed are going on between different ministries and stakeholders, so there can be still many changes.

5.2.2 Latvia

Legal bases for permitting and licensing are not yet fully developed for the EEZ and Territorial Sea. As there are no corresponding legal acts, all applications for activities in the Continental Shelf and EEZ are being examined by the Cabinet of Ministers, which decides on issuing a permit. During 2009, the Ministry of Economy had to develop draft regulations that will determine procedure for obtaining permits/licences and building procedure in the continental shelf and EEZ, and the Ministry of Finance had to develop a draft legal act on uniform criteria for imposing fees for using the continental shelf and EEZ. The both legal acts are still in development stage and most probably will not be prepared until the end of 2009. According to Law On Environmental Impact Assessment (1998), a preliminary assessment (screening) is needed for building offshore in the Territorial Sea and EEZ.

Additionally, harmonisation with other institutions is needed: with Maritime Administration on shipping safety issues and with Marine and Inland Waters Administration on impact on fish resources and aquatic ecosystems; with the Ministry of Defence on military security reasons and with the Ministry of Transport on flight safety. Necessary licenses include

building licence, licence to provide the service (to provide electricity), permit for installation of electricity alliances (extend capacities). Cabinet of Ministers makes decisions until procedures will be developed.

In 2008, Ministry of Environment established an interministerial/interinstitutional working group. One of the main aims is legal act development or improvement in offshore wind energy field according to competencies of ministries.

5.2.3 Lithuania

There is no united permitting system developed but many of the key elements exist. Rights to use the seabed are not regulated yet and seem to be the most difficult issue (For Butinge terminal the government formed a special building commission for the building permit). According to the UNCLOS convention, the state has the rights to use the seabed in EEZ for *inter alia* production of the energy from wind. And, the state has to establish procedures for installing the structures in the EEZ. Ministry of Environment has been tasked to develop missing legislation for constructions in the EEZ already in 2004 but so far this task is not fulfilled. It is not decided yet if it will be solved with amendments to the existing legislation or establishment of a new permitting system devoted to the sea.

5.3 Situation concerning offshore wind farms in the Baltic States in 2009

There are no offshore wind farms yet in the Baltic States.

5.3.1 Estonia

EIAs for 2 offshore wind farms - Hiiumaa (600-1000 MW) and Neugrund (ca 100 MW) started but in 2008 the permitting was stopped until the legislation for building into the sea will be developed. There is also interest from Eesti Energia and some other companies to develop offshore wind farms.

5.3.2 Latvia

Permit for new installation introduction is issued for 4 companies.

5.3.3 Lithuania

Currently there are three approved EIA programmes. In project "AVEC" two areas (together app. 70 km^2) are being studied. The potential power could be up to 300 MW. In project "BALTIC ENERGY GROUP" four areas (190km^2) are being studied; the total power up to 850 MW. This project was introduced to public. In project "FOEDUS" three areas (150 km2) are being studied. The total power is planned to be 700 MW. Soon the introduction to public will be organized.

6 Annex 1: Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States

Guidelines for the investigation of the impacts of offshore wind farms on the marine environment in the Baltic States

Photo: Vestas Wind Systems A/S

Baltic Environmental Forum 2010

The Federal Environment Agency points out that selected environmental aspects which might need to be investigated in the environmental impact assessment of a specific wind farm in the eastern Baltic Sea are not mentioned in the Guidelines.

This concerns harbour porpoises in particular. According to current information available to the Federal Environment Agency, their population in the central and eastern Baltic Sea is now approaching extinction. This makes it essential to prevent any additional pressure on the animals to avert any further risk. The Federal Environment Agency therefore considers it necessary that environmental impact assessments include a comprehensive assessment of impacts on harbour porpoises. The standard investigation concept of the German Federal Maritime and Hydrographic Agency (http://www.bsh.de/en/Products/Books/Standard/index.jsp) may serve as an example of a suitable investigation methodology.

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Content

Introduction

Potential negative impacts of offshore wind farm projects have to be investigated as part of the approval procedure through an **Environmental Impact Assessment (EIA)**.

EIA is a procedure required under the terms of Directive 97/11/EC amending Directive 85/337/EEC on assessment of the effects of certain public and private projects on the environment. EU Member States, including the Baltic States, have transposed the requirements of these directives into their EIA legislation and procedures. Member State EIA procedures vary in their details but the practical stages in most systems are generally the following:

1. Project preparation and application to Competent Authority –submission of the application for development consent to the Competent Authority.

2. Screening - The process by which the Competent Authority takes a decision on whether or not EIA is required. Public must be informed about the decision.

For offshore wind farms screening is required in Latvia and Lithuania. In Estonia EIA is obligatory for wind farms installed into the water.

3. Scoping – The process of identifying the content and extent of the Environmental Information to be submitted to the Competent Authority under the EIA procedure. As result of scoping the EIA programme is prepared, which is subject for public consultation.

4. Environmental Studies – The surveys and investigations carried out by the Developer and the EIA Team in order to prepare the Environmental Impact Statement (EIS) for submission to the Competent Authority.

5. Preparation of Environmental Impact Statement (EIS). The draft EIS is a subject for consultation with Statutory Environmental Authorities, other interested parties and the public. Results of the consultation have to be considered when preparing the final EIS.

6. Decision by the Competent Authority and announcement of the decision (including the reasons for it and a description of the measures required to mitigate adverse environmental effects).

7. Post-decision monitoring if the project is granted consent.

The current Guidelines provide help for the following stages of the EIA for offshore wind farms:

- scoping (preparation of EIA programme);
- environmental studies and preparation of the Environmental Impact Statement;
- monitoring of the effects of the project once it is implemented.

Although several effects have been analysed during compliance monitoring in recent years on a project level (Horns Rev and Nysted offshore wind farms in Denmark, Utgrunden wind

farm in Sweden, Nordzeewind in The Netherlands), a number of open issues remain to be answered especially in relation to potential cumulative effects, on both national and international scale, respectively. Furthermore, the existing amount of information about the Baltic marine environment is still far too incomplete to be sufficient for a verifiable desk study approach.

Thus a standardised field survey is the key prerequisite for

1. a reliable validation of conservation objectives as part of the EIA,

2. an investigation of potential cumulative effects across projects

Thus the implementation of guidelines for a standard approach, developed in consultation with numerous experts, provides relevant information for applicants on the scope of investigations required by the approval authorities. A thorough baseline approach in accordance to international standards of marine environmental investigations also forms the basis for the compliance monitoring of predicted effects during the operation of an offshore wind farm.

These guidelines focus on the assessment of impacts on specific abiotic and biotic environmental components and visual and landscape impacts – components where in practice problems regarding the appropriate scope of investigations may arise. Other environmental compounds required in EIA´s as e.g. climate and water are not mentioned in the guidelines since it seems that in this area a sufficiently elaborated scientific knowledge exits. The principles could also be a base when considering which investigations are required for other offshore infrastructure projects.

The current guidelines have been developed in consultation with experts from Lithuania, Latvia, and Estonia. This report has been prepared in the frame of the project “Concept development for an environmental impact assessment for off-shore wind parks in the Baltic States”, which was co-funded by the German Environmental Agency (project No 380 01 173).

1. Potential hazards

A number of potential negative impacts may result from the construction and operation of an offshore wind farm. Different potential hazards must be considered during installation, due to the presence of the installation itself, and during operation.

Construction / De-commissioning

- Displacement of animals resulting from disturbances (noise and light emissions, traffic)
- Emission of pollutants
- Seabed intervention works (impact on seabed morphology and structure, re-suspension of sediment)

Operation

- Change in local oceanography (currents, vertical mixing processes, blocking effects in the vicinity of submarine ridges and shallow lagoons)
- Change in local ice conditions (ice breaking through maintenance traffic, change in drift ice movements, change in freezing performance)
- Creation of artificial hard substrate (reef effect)
- Scour effects at the base of foundations
- Displacement of animals by wind turbines and noise emissions (barrier effects above and below the sea surface, respectively)
- Collision risk for birds and bats
- Electric and magnetic fields at DC-cables
- Heating at AC cables

2. General EIA & Monitoring requirements

Baseline investigation

A thorough field investigation of the project area is required for the description and validation of the status quo (baseline investigation for the EIA).

An EIA for an offshore wind farm has to cover the following topics:

- The description of the status quo of the protection objectives (EIA, habitat & bird directives, protection of species)
- Validation of the status quo
- Description of potential impacts/interactions
- Description of potential cumulative effects
- Potential mitigation measures
- Monitoring concept (feed-back, compliance)

An EIA should assess impacts on the following protection objectives:

- Humans
- abiotic environmental components: water, soil, climate
- biotic environmental components: spermatophytes & algae, benthic invertebrates, fishes, seabirds, marine mammals, migrating birds and bats, biodiversity
- landscape
- objects of cultural value (i.e. archaeological sites)

Each protection objective will require a certain evaluation in space and time to enable for a sufficient description of the status quo and its validation. Minor species diversity together with a low inter-annual variability in oceanographic parameter led to conclude that a one-year-investigation is sufficient for the baseline investigation for most conservation objects in the eastern Baltic Sea region. However, annual variability in winter severity (especially ice conditions) is a major source of inter-annual variation in seabird and seal distribution within a certain area during winter and spring. For these conservation objects, therefore, a field survey in two successive years is recommended to obtain a reliable basis for the compliance monitoring during operation. The size of the assessment area will differ between protection objectives according to the scale of potential impacts:

Seabed, Benthos & Fishes

The size of the assessment area corresponds to the project area. The project area should be surrounded by a zone of one nm to cover the range of potential hazards.

Seabirds

The size of the assessment area should cover 150-200 km² (80-100 nm observations on effort) for ship surveys and about 1.000 km² (400 km on effort) for aerial surveys. The baseline investigation has to cover two entire annual cycles as a basis for the compliance monitoring during operation.

Bird migration

Proper project related bird migration investigations can be carried out only for those projects which are located within 15 km distance from the shore (either mainland or island).

A comprehensive baseline investigation combining simultaneous sea watching and radar observations across Lithuania, Latvia, and Estonia as well as an international analysis of short-term recoveries of ringed birds (preferably during the breeding season) is recommended to provide a reliable assessment of the collision risk and potential barrier effects.

Seals

Seals cannot be investigated in relation to a given project area, except during the ice season. Aerial surveys carried out during the ice season should cover an area of about 1000 km² (400 km on effort). Aerial seal surveys have to be carried out during the ice season in two successive winters as a basis for the compliance monitoring during operation.

Remote sensing is the only tool which can be used for habitat mapping. About 10 seals should be tagged with telemetry devices, therefore, during the baseline investigation by every application.

Feedback monitoring during construction

A feedback monitoring might be required during construction to ensure maximum acceptable impact thresholds for certain protection objectives (i.e. sediment spills during seabed intervention works, noise emissions during ramming of mono-pile foundations, etc.).

Compliance monitoring during construction and operation

The before-after-construction-investigation (BACI) forms the basis of the compliance monitoring which aims to demonstrate that the project stays within the predictions about potential environmental impacts drawn in the EIA.

A considerable small scale variability of environmental conditions of the Baltic Sea off Lithuania, Latvia, and Estonia prevents from implementing reference areas into the overall monitoring approach. The implementation of a comprehensive database, gathering raw-data from all offshore EIA (at least at national level), is recommended instead, to provide the indispensable background information on the overall development of the marine ecosystem.

Environmental investigations will be very difficult to undertake during the construction phase within a project area because of safety reasons. Hence, compliance monitoring will start predominantly during operation. However, selected conservation objectives will require a start of the monitoring already during the construction phase (seabirds, seals). According to existing knowledge, succession of marine benthic communities will last for about three years. Field investigations for the compliance monitoring should last, therefore, for three successive years during operation.

Based on current knowledge, it is difficult to provide precise recommendations on investigation tasks, methods, etc. for the compliance monitoring. Due to the technical restrictions someone will face while operating in an offshore wind farm, proper monitoring methods are still under development for most conservation objectives. Thus, this guideline will only provide an outlook for the later obligations of the compliance monitoring.

3. Investigations and monitoring of impacts on oceanography

Potential blocking effects of gravity foundations might cause oxygen depletion events in adjacent bays or lagoons, resulting in overall changes in the composition of benthic and fish communities outside the wind farm. Changes in the local ice conditions will probably cause alterations of succession of benthic communities in shallow waters (< 5 m water depth) and of habitat suitability for seabirds and seals.

3.1 Baseline

Oceanographic data (salinity, oxygen, current regime, ice pattern) are required to understand the vertical stratification of marine communities and the spatial distribution of seabirds. Oceanographic information should be gathered by both direct offshore measurements and desk studies.

3.1.1 Direct measurements offshore

Measurements of salinity, temperature and oxygen should be undertaken during all benthos and fish surveys, both at the sea surface and at the sea floor.

3.1.2 Desk studies

To analyse the oceanography of an area under consideration, data from nearby monitoring stations (e.g. HELCOM monitoring programme, national monitoring for the Water Framework Directive) should be compiled.

Hydrodynamic modelling has to be performed for project areas characterised by special current regimes (up-welling, coastal currents).

A compilation of ice conditions has to be carried out (long term variation in regional ice coverage, composition of ice types, and relevance of drift ice movements).

Modelling of project induced changes in local ice conditions (maintenance traffic, drift ice movements, and ice formation) has to be performed for project areas, covered regularly by ice. Satellite images are generally available for validation of model results, short range ice dynamics models exists for Gulf of Riga (Wang et al. 2003).

3.2 Compliance monitoring

Oceanographic parameter should be measured during the operation of the wind farm as part of the compliance monitoring.

Frequent measurements of salinity, temperature and oxygen should be undertaken by remote sensing devices installed either at the transformer platform or at a turbine foundation.

Satellite images should be analysed to describe changes in ice conditions.

4. Investigations and monitoring of impacts on the seabed

Potential impacts on the seabed include re-suspension of fine sand during seabed interventions (trenching, pile driving), scour effects around the foundation, the change in substrate composition by the introduction of artificial hard bottom (gravity foundations, scour protection, etc.).

Severe effects may result from construction works in areas dominated by natural hard bottom, especially limestone.

4.1 Baseline

Geophysical investigations include:

- sediment relief (side scan sonar, resolution 10 cm)
- bathymetry (echo sounder)
- acoustic profiling (sub bottom profiler)
- sediment parameter (grain size, loss on ignition; sampling design in accordance with macrozoobenthos investigations)

One survey during baseline investigations is sufficient.

The geophysical investigation of the seabed has to be carried out (including data analysis and GIS implementation) as the **basis** for the design of all biological investigations.

4.2 Compliance monitoring

A side scan sonar survey should be performed after construction.

5. Investigations and monitoring of impacts on benthos

Potential impacts on benthos include:

- seabed intervention works during construction
- change in local current regime
- change in ice conditions
- scour effects
- artificial reef effect
- heating by cables (AC)
- electric and magnetic fields at cables (DC)

Benthic communities include macro algae and spermatophytes as well as benthic invertebrates invading soft substrates or settling on hard bottom. Different investigation methods have to be combined, therefore, to cover all compartments.

5.1 Baseline

Measurements of salinity, temperature, and oxygen have to be carried out at a representative number of stations during the survey.

Results of geophysical investigations are a key prerequisite for the investigation programme.

5.1.1 Baseline infauna

Infauna investigations include identification of species, and measurements of abundance and biomass. In addition, the length of bivalves should be measured for a sufficient number of samples (indicator for seasonal anoxia; provides information on harvestable food supply in important sea duck feeding areas < 20 m water depth).

Quantitative grab sampling should be used for investigating soft bottom benthic organisms. Samples of macrofauna (benthic animals which can be caught by a sieve with a mesh size 0.5 mm) are taken with a 0.1 m² Van Veen grab (40-75 kg). Smaller grabs can be applied in case of operating from smaller vessels (e.g. handheld Ekman-Lenz sampler) in shallow waters (< 5 m depth). Alternatively, shallow water soft sediments can be sampled by hand-operated corer via SCUBA diving (diameter 10 cm). The bottom sampler has to be pushed carefully into the bottom to approximately 20 cm depth, upper end has to be closed with a lid and then gently taken out together with the sediment. A minimum of three replicates has to be taken per station when using a corer to obtain a representative number of species per station.

All samples have to be washed through a 0.5 mm gauze and preserved either with 4 % formalin neutralized with Borax ($Na_2[B_4O_5(OH)_4] \cdot 8\ H_2O$) or deep frozen. Further treatment of material has to be performed according to HELCOM, (1988, 1997). Organisms are identified to species level where practicable and counted. Biomass is determined preferably as dry weight (g m^{-2}).

From each Van Veen grab a small tube filled with sediment should be collected for analyses of sediment parameter (grain size, loss on ignition) according to HELCOM standards.

Sampling should be carried out in late summer. One high-resolution survey should be performed. The project area should be investigated by stratified sampling rather than taking parallel samples at a smaller number of stations. The sampling design should be defined based on the results of the geophysical surveys. All depth strata and sediment types have to be covered by a sufficient number of samples for habitat and spatial modelling.

Statistical treatment of data should include community analysis (PRIMER 6, Plymouth Marine Laboratory) and spatial analysis (i.e. kriging).

5.1.2 Baseline epifauna / macrophytes

Epifauna investigations include investigation of species, their abundance and biomass.

Sampling by SCUBA divers

On hard bottoms, plants and animals are scraped from the measured surface (20 x 20 cm) of stones using a 0.04 m² Kautsky type frame. 4-8 samples are taken per station depending on the heterogeneity of the seabed. All quantitative samples collected by SCUBA divers have to be treated in the same way as indicated for grab samples.

SCUBA diver sampling should be restricted to < 15 m water depth.

Sampling should be carried out in late summer. The sampling strategy should be designed based on the results of the geotechnical surveys and underwater video surveys. Quantitative hard bottom samples aim to assign abundance and biomass values to photos/videos processed by image analyses to obtain closure/abundance and biomass values for algae, blue mussels or barnacles.

Video survey

Based on the results of the geophysical survey, representative investigations by underwater video or photo sampling should be carried out especially on hard bottom. A variety of tools are applicable: photo samplers, drifters, sledges, or ROV.

Estimates for abundance and biomass should be derived from image analyses (selected, representative sample video images/photos) combined with results from scratch samples collected by SCUBA divers.

Results from geophysical and benthos surveys are combined to produce a habitat distribution map of the project area. Habitats are designated according to the Natura 2000 and EUNIS systems (by applying national/regional standards).

5.2 Feedback monitoring

A feedback-monitoring of turbidity should be performed in case the EIA predicts significant negative impacts from re-suspension of silt sediments or limestone from drilling operations. Turbidity monitoring includes measurements of concentrations of particulate matter in the water column and image analysis (aerial/satellite images).

5.3 Compliance monitoring

Infauna, epifauna, macrophytes should be investigated by the same methods as applied during the baseline investigation over a period of three successive years during operation to investigate large scale succession of the project area.

The epifauna of artificial hard bottom (foundations, scour protection) should be investigated by ROV and SCUBA divers (< 15 m water depth) as described above for three turbines.

6. Investigations and monitoring of impacts on fishes

Potential impacts on fish include:

- seabed intervention works during construction
- ramming noise for mono-piles, noise from ship traffic
- change in local current regime
- change in ice conditions
- scour effects
- artificial reef
- heating by cables (AC)
- electric and magnetic fields (DC)

6.1 Baseline studies

Measurements of salinity, temperature, and oxygen have to be carried out at a representative number of stations during the survey.

Results of geophysical investigations are a key prerequisite for the investigation programme.

Fish investigations include identification of species, and estimation of abundance and biomass. In addition, body length should be measured.

6.1.1 Demersal species

Demersal fishes should be investigated by bottom-set gill net fishing according to national monitoring schemes. Bottom trawling cannot be deployed in many areas because of abundant hard substrates. Furthermore, trawling might not be allowed in certain wind farms during operation (risk of damaging the farm internal cable grid).

The choice of gill net mesh sizes should be similar with those used in the coastal fish monitoring. All basic methods and differences by countries are presented in the guidelines published by HELCOM (Guidelines for HELCOM coastal fish monitoring sampling methods; July, 2008). The fleet of sampling nets consists of bottom set gill nets, which are 1.8 m (6 feet) deep and made of spun green nylon (14, 17, 21.5, 25, 30, 33, 38 mm mesh size) or transparent monofilament nylon (42, 45, 50, 55, 60 mm mesh size). Such net set consisting of many gill nets of different mesh size are referred as “station”. The nets may be set in a random sequence in a fishing station. Meshes are measured from knot to knot – it means the bar length (a) are measured (alternatively, it is possible to measure the diameter of the “hole” - A; at that case the result will be ~ 2 times bigger).

Sampling gill net construction: a net piece (bundle) of 60 m length and 3 m height in lap (stretched) is hanged to a 27 m float line (head line) (35 cm between floats, buoyancy of 6 g/m), to a 33 m lead line (weight 2.2 kg/100 m) and to a 1.8 m side (vertical) line. Yarn

thickness is no. 110/2 for all mesh sizes, according to the Tex-system (e.g., 110/ 2 means 2 filaments each weighting 110 g per 10 000 m).

The set of nets (further referred as “station”) should consist of at least 8 different mesh sizes with the minimum bar length of 14 mm and maximum of 60 mm. The mesh sizes should be selected close to the geometric progression. Nets should be bottom-set (i.e. not pelagic) with the height of at least 1.8 m. Since fishing gill nets amortize rather quickly occasional broken meshes are tolerated.

Gill nets are set directly to the sea bottom, as lightly stretched fleet (line) using the anchors and buoys in both end. The sampling fleet (station) has to be set within the certain sea depths limits. The station grid has to cover the depth layers of the area under consideration (i.e. 20 m (18-22 m), 13 m (12-14 m), 8 m (7-9 m), 5 m (4-6 m), and 3 m (2-4 m), respectively). Within each depths layer, three stations should be sampled per every trip. The minimum number of stations per trip for each certain area sampled, should be not less than 8, despite there may be less than 3 depths layers. The position (longitude, latitude), oceanographic data (see above) and also weather conditions must be registered at the beginning of both, each setting and hauling of gill nets.

Differences occur between the countries in fishing duration in coastal fish monitoring. In Estonia the nets are set between 18 and 21 hrs and collected between 8 and 11 hrs during the following day. Since day-length varies considerably between seasons the setting and lifting times may also vary. However, nets should be always set before the sunset and taken after the sunrise. Timing for setting and lifting should vary as little as possible within a certain fishing campaign.

The baseline fish investigations should cover a complete seasonal cycle and should consist of at least one campaign during the following seasons: spring, summer, autumn.

Presentation of results

In order to enable comparisons with other databases (in which stations do not overlap fully in sense of mesh size selections) catch must be registered by separate nets (for each captured fish: station location, station depth, mesh size, fish length and weight).

- Catch per Unit Effort (CPUE) data by stations and mesh sizes
- Weight per Unit Effort (WPUE) data by stations and mesh sizes
- Dominance ratios
- Length-frequency distribution of dominant species
- Community analysis

6.1.2 Pelagic species

The investigation of pelagic fish will not provide reliable project related information. Thus, investigation of pelagic fish species will not be recommended because of technical reasons.

6.2 Compliance monitoring

Bottom-set gill net fishing should be carried out as part of the compliance monitoring during

the second and third year of operation of the wind farm (when sediments are recolonised by benthic invertebrates and fouling communities are established at foundations). Methods and analyses should follow the same procedures as applied during the baseline investigations. Perhaps, future developments will provide other investigation tools for remote sensing of fish behaviour inside offshore wind farms (echo sounder, video tracking, etc.).

7. Investigations and monitoring of impacts on marine mammals

The potential impacts on marine mammals include

- seabed intervention works during construction
- ramming noise (monopiles), noise from ship traffic during construction
- change in ice conditions
- noise emissions during operation
- maintenance traffic
- artificial reef

7.1 Baseline

A site specific investigation of seals (both grey and ringed seals) is difficult to obtain. Although, knowledge on overall population size and location of important haul out sites has recently improved, little information is available about the offshore behaviour, since seals spend most of the time diving. Visual observations are, therefore, almost impractical. Remote sensing is almost the only tool applicable to investigate the use of offshore habitats.

7.1.1 Remote sensing

Remote sensing by Fastlock® GPS positioning systems has been approved during current investigations in Estonia and elsewhere (see reference list) to provide an excellent data accuracy (30-60 m). Various manufacturers have devised tracking solutions for a wide range of pinniped (seals and sealions) research projects. Dive profiles, foraging trip information and oceanographic data can be obtained by tracking these animals.

Remote sensing of seals from Estonian haul out sites recently revealed that their preferred feeding grounds might be far away from their preferred haul out site. It is still difficult, therefore, to link importance of certain offshore areas to nearest haul out sites.

A validation of offshore habitats can be obtained by establishing a joint database for large-scale offshore infrastructure projects. Each applicant (i.e. project) should tag a minimum of 10 seals with telemetry devices at seal haul-out sites in the vicinity of his project area for baseline investigations. Tracking data have to be processed to provide information on homerange, habitat use of study area throughout the year, migration track routines, etc. The amount of project area specific information will increase with the number of applications. Thus, even if no site specific information might be obtained during a certain application procedure, the situation might have improved until the start of construction (providing than a suitable basis for compliance monitoring).

7.1.2 Aerial surveys during the ice period

Sea ice is the crucial breeding habitat for ringed seals. Also grey seals prefer drifting sea ice for breeding, but seal pups can survive also when born on land. Ringed seal breeding success depends, therefore, on presence of ice and ice structure. Ringed seals need pack ice and ice ridges with snow hummocks.

Seal distribution on ice during breeding and moulting season should be studied by aerial censuses in March/April twice per winter in two successive years (about 1000 km² investigation area, 400 km on effort, 15 % minimum coverage of survey area). Detailed description of line transect method used in Baltic is described by T. Harkonnen and S. Lunneryd (1992).

Telemetry, aerial survey, remote sensing ice data, ice modelling and ice based field data have to be combined for a validation of potential breeding habitats.

Predictive modelling of ice movements should be applied for evaluation of importance of the area for breeding seals.

7.1 Compliance monitoring

Compliance monitoring should implement a replication of tagging 10 seals from nearby haul out sites.

Aerial surveys should be carried out again during the ice season as described for the baseline investigation.

The development/application of image analysis for aerial photography seems will be required for the immediate wind farm area.

8. Investigations and monitoring of impacts on seabirds

The potential impacts on seabirds include

- Avoidance response (displacement from feeding areas, barrier effects);
- Physical habitat loss/modification;
- Collision risk (mortality)

8.1 Baseline

About 20 different seabird species might use a certain offshore area during the course of a year: divers, grebes, sea ducks, diving ducks, mergansers, gulls, terns, and auks. Some species occur only during the breeding season, some species rest during the migration periods, others stay over winter or moult during summer. Seabird surveys, therefore, will have to be carried out throughout the year.

Two different survey techniques are currently available: ship based surveys, and aerial surveys. International standard routines exist for both survey methods (i.e. Camphuysen et al. 2004). Ship surveys usually provide higher data quality for most species than aerial surveys. However, ship surveys will be difficult in shallow areas (< 10 m water depth) according to the recommended standards (see below). Ship surveys might be impractical during the ice season.

Furthermore, line transect surveys can hardly produce reliable density estimates for species with a clumped distribution pattern (i.e. long-tailed duck concentrations on small ridges). Both methods are likely to be inapplicable during compliance monitoring because of safety reasons. The development of new survey techniques (i.e. image analysis of aerial photographs, Groom et al. 2007) is highly recommended, therefore.

8.1.1 Ship transect surveys

Ship surveys should aim for a spatial analysis of absolute bird densities (including seasonal variation) in the vicinity of the project area.

Ship surveys should be carried out 10 times per year in two successive years. Application documents can be based on the results of the first year, but a second year of investigation is mandatory to obtain reliable results during the operational monitoring.

Ship-based surveys should follow a methodology standardised for north-western European sea areas, also known as the ESAS standard (Webb & Durinck 1992). From the compass platform on top or the wings on the side of the bridge, two observers count all flying and swimming individuals within a 300 m wide transect on each side (optimum, requires 5-6 observers; minimum one side survey with 3-4 observers) of the vessel running parallel to the keel line of the observation platform. Simultaneously, the geographic position (at 1 min interval) should be recorded. Birds are usually detected by sight, but in the Baltic Sea the use of binoculars is obligatory. Records include identification of species, number of individuals, and (if possible) age and sex of the sighted individuals. Observations are distinguished between sighted individuals within and outside of transect to enable

calculations of abundance (e.g. individuals per km²). All individuals swimming within transect in a distance of 0-300 m from the ship are recorded as within the sampling transect.

Flying individuals are recorded using the 'snapshot' method. They are only recorded as within transect if they are flying in transect at the time of a snapshot count. All individuals swimming or flying outside the sampling transect as well as all birds flying in the transect area between the times of a snapshot count are recorded as outside transect. The snapshot method is applied to correct for overestimation of particularly mobile species.

Survey routines should follow the recommendations given by **"Standards for the Environmental Impact Assessment"**(German Federal Maritime and Hydrographic Agency).

According to the ESAS standards, observations should be carried out from an observer height > 5 m at a cruising speed from 7 to 16 knots. The recommended effort is 80-100 nautical miles per survey. As in winter there is only 6 hours of sun light two cruising days are needed per survey in winter (requires vessels which can operate 24 hours per day). Transects should run across ecological gradients (from the shore to the open sea). They should run from west to east off Lithuania and Latvia and from north to south off Saaremaa and the Estonian north coast, respectively. Transect spacing should be between 3 and 4 km. The survey has to be interrupted at sea state >4. Visibility should not be less than 2 km.

Survey data (raw densities) should be corrected by applying distance sampling statistics (Buckland et al. 2001, current software: **Distance 5.0**, Thomas et al. 2006) to calculate absolute densities (birds per km²). Densities should be compared between a) the total investigation area, b) the factual project area, and c) a 2 km impact zone around the wind farm, respectively. The method chosen for analysis should take into account the strong spatial variation of bird densities in the Baltic Sea.

For relevant sea duck feeding areas, the harvestable food supply at the start of a wintering season should be documented for monitoring purposes (harvestable fraction of mussels and clams, see benthos section for methods).

8.1.2 Aerial transect surveys

Aerial surveys should aim for a spatial analysis of (relative/absolute) bird densities (including seasonal variations) in a larger area. Analysis will be partly restricted to genus level because of identification problems (divers, auks, gulls, grebes).

Aerial surveys are an alternative for the ice period and shallow areas where ship surveys are not applicable. Aerial surveys should be carried out four times per year and in two successive years.

Line transect surveys should be conducted by using a twin-engined high-winged aircraft with bubble windows flying at an altitude of 250 ft. and 100 kts (180 km/h) speed. According to the standard line-transect protocol (described by Noer et al. 2000, Diederichs et al. 2002, and Camphuysen at al. 2004), one or to two observers on each side of an aircraft record every bird swimming or flying together with the time of observation (to the nearest second) on a voice recorder. Observations are made without binoculars in a 397 m wide transect which is subdivided into 2-3 zones (Fig. 1). The outer limits of these zones are identified using a protractor (see Pihl & Frikke 1992 and table 1). While the published standard uses two zones, recent work in Denmark and Germany has shown that a division into three zones

increases the reliability of density estimates. Note that three zones may be difficult to apply when birds occur in very high densities.

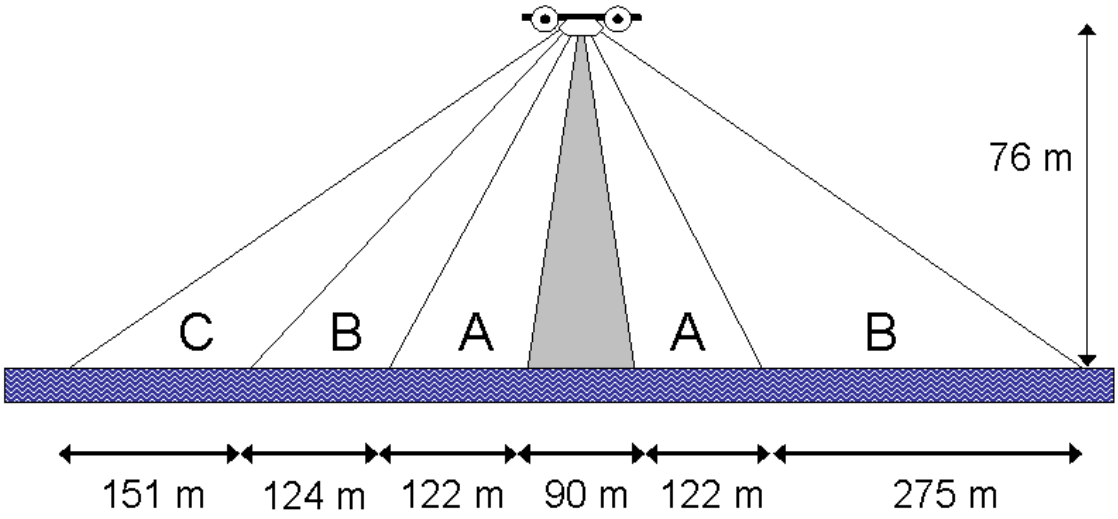

Figure 1: Transect division for aerial seabird surveys: published standard (right side), and recommended division (left side) (from Diederichs et al. 2002, adapted).

Table 1: Recommended division of the transect band for aerial surveys

Zone	D *	A	B	C	E (outside)
published standard					
outer limit, protractor angle (degrees)	60	25	10		4
outer limit, distance from platform (m)	45	167	442		1115
zone width (m)	45	122	275		673
total transect width (m)				397	
recommended change					
outer limit, protractor angle (degrees)	60	25	15	10	4
outer limit, distance from platform (m)	45	167	291	442	1115
zone width (m)	45	122	124	151	673
total transect width (m)				397	

* invisible (below aircraft)

Survey routines should follow the recommendations given by **"Standards for the Environmental Impact Assessment"**(German Federal Maritime and Hydrographic Agency). During flight position of the aircraft should be recorded by GPS tracking at 5 sec interval (minimum). Observations have to be assigned to position (by using observation time record).

Transects should run across ecological gradients (from the shore to the open sea). They should run from west to east off Lithuania and Latvia and north south off Saaremaa and the Estonian north coast, respectively. Transect spacing should be between 3 and 6 km. Surveys are only possible when the water surface is calm and there are no breaking waves, with a maximum sea state of 3 (see Garthe et al. 2002). Visibility should be at least 5 km, and

analysis of data recorded with glare (usually only on one side of the platform) should be avoided.

Survey data should be corrected by applying distance sampling statistics to calculate absolute densities (birds per km²). This method relies on the assumption that **all** birds close to the transect line (i. e. zone A of the transect) are detected (Buckland et al. 2001). This assumption is usually not met in aerial surveys (although observers should concentrate on detecting birds in zone A). In order to correct for the birds missed in zone A, a double observer design should be applied, with two observers count the birds simultaneously on the same side of the aircraft. Detection probability for each species can then be estimated using mark-recapture distance sampling statistics (implemented in Distance 5.0, Thomas et al. 2006).

Densities should be compared between a) the total investigation area, b) the factual project area, and c) a 2 km impact zone around the wind farm, respectively.

8.2 Compliance monitoring

Surveys should be carried out in two successive years during operation. The compliance monitoring should aim to compare the density of seabirds inside a wind farm, in a circumventing 2 km impact zone, and in the baseline study area, respectively.

Whether ship-based or aerial surveys as described above can be applied inside a given wind farm area depends on the spacing of turbines. An alternative method based on aerial photographs should be further developed to enable for a promising BACI design of the compliance monitoring.

Aerial photography from an altitude of 1,640 ft (app. 500 m, i.e. above the turbines) has important advantages:

- it will not disturb seabirds (currently Common Scoters are frequently chased from the transect by the approaching aircraft)
- risks to pilots, observers, etc. in the vicinity of a wind farm are avoided
- Aerial photographs provide raw data which can be reanalysed at a later stage.

Automatic image analysis tools will allow for:

- Calculation of absolute densities
- Calculation of absolute densities for species with a clumped distribution

High resolution digital SLR cameras (> 15 megapixel) mounted on twin-engine planes equipped for routine vertical aerial photography should be able to produce pictures of sufficient resolution for seabird detection and identification. However, software solutions for automatic image analysis are currently under development and not commercially available (Groom et al. 2007). They will have to be developed by seabird specialists together with software experts. Regional solutions are likely to be beneficial since treatment of ice will be a special feature of aerial images from the Baltic States.

9. Investigations and monitoring of impacts on bird migration

The validation of potential risks to migrating birds predominantly refers to the collision risk of nocturnal migrants. Attraction by artificial light might increase the risk. Barrier effects might be of relevance for waterfowl migration at low altitude (e.g. divers and sea ducks). Both effects might be negligible when focussing on a single wind farm project but they potentially cause severe hazards to populations when considering several thousand turbines from different applications.

9.1 Baseline

About 200 bird species migrate across the Baltic Sea twice annually. More than 500 Mio. individuals might pass the Baltic States during autumn migration. Different bird species exert a variety of different migration strategies:

- waterfowl (flapping; diurnal/nocturnal)
- raptors/cranes (flapping/soaring; diurnal)
- diurnal passerines (flapping)
- nocturnal passerines (flapping).

Birds migrate up to an altitude of about 3000 m. Only about 5-10 % of the birds fly below 100 m altitude during daytime. About 50 % of all birds migrate at night. Hence, all methods which can be applied to investigate bird migration are highly selective (table 2). Several methods are difficult to apply from vessels.

Table 2: Restrictions in quantitative/qualitative detectability of birds aloft offshore.

Species group	**Method**	**Spatial range**	**Diurnal limitations**	**Applicability (species restrictions)**
Waterfowl quantitative	Seawatching	2-5 km (according to observer height) 100 m altitude	Only during daylight	Only diurnal migrants (which pass by during daylight)
Waterfowl quantitative	Horizontal radar (platform required)	10 km	Only up to 3 Bft (sea clutter hides echoes on radar screen)	species identification only possible during daylight in combination with telescope
Waterfowl qualitative	Acoustic registration	?		Only some waders
Waterfowl qualitative	Vertical radar (platform required)	?		Impractical, because waterfowl comprises only for about 5 % of the migratory volume

Species group	Method	Spatial range	Diurnal limitations	Applicability (species restrictions)
Waterfowl qualitative	Fixed beam radar (platform required)	5 km		Impractical, because waterfowl comprises only for about 5 % of the migratory volume
Raptors/ cranes quantitative	Sea watching	2-5 km (according to observer height) 300 m altitude	Only during daylight (cranes migrate also at night)	all
Diurnal passerines quantitative	Sea watching	100 m, 50 m altitude	Only during daylight	Only diurnal migrants (which pass by during daylight), Only 5-10 % of the migratory volume
Diurnal passerines qualitative	Vertical radar (platform required)	1.5 km		Only recognition of flocks
Diurnal passerines qualitative	Fixed beam radar (platform required)	3 km		Only recognition of flocks
Nocturnal passerines quanitative	Vertical radar (platform required)	1.5 km		No qualitative approach
Nocturnal passerines quanitative	Fixed beam radar (platform required)	3 km		Recognition of species groups
Nocturnal passerines qualitative	Acoustic registration	?		Highly selective

As a consequence, one has to consider that field investigations carried out offshore from a vessel will not provide sufficient information for a reliable risk assessment, especially when considering potential cumulative effects.

A proper validation of potential (cumulative) negative effects to migrating birds is difficult to obtain for a single project. It is recommended, therefore, to investigate potential negative effects on an international level (across all three Baltic States). Such an approach should include:

- A joint analysis of short term recoveries of ringed birds (preferably ringed at the breeding ground) including the Baltic States as well as Finland and western Russia to identify populations migrating across the eastern Baltic Sea.
- Simultaneous standardised seawatching (from sunrise to sunset) in Lithuania, Latvia, and Estonia (in ideal also including southern Finland) at selected appropriate sites (peninsulas and islands) to identify migration bottlenecks and to evaluate diurnal migration traffic rates.
- Simultaneous quantitative investigations of nocturnal migration by the use of fixed beam radar at representative sites across Lithuania, Latvia, and Estonia (2-3 devices in parallel) to evaluate migration traffic rates.
- Population modelling to establish species/population specific thresholds for additional adult mortality caused by collisions at offshore wind turbines.

The result of such an approach would enable authorities to plan the overall capacity for the erection of offshore wind turbines in the eastern Baltic Sea.

9.2 Compliance monitoring

Information on collision rates of nocturnal migrants at offshore wind farms is still missing on a worldwide perspective. Thus, the implementation of a monitoring of collisions is highly recommended. At present, there are no tools available to quantify collisions. However, the collision risk model of Band et al. (2006, http://www.snh.org.uk/) allows calculating collision rates if relevant model input data can be provided. These data include:

- mean traffic rates outside the wind farm (at risk altitude)
- mean traffic rates in the vicinity of the turbine (avoidance/attraction).

There is still no method to measure attraction or avoidance by artificial light for nocturnal migrating birds to be considered in this model.

Methods to obtain these data are currently under development:

- Fixed beam radar monitoring at wind farm (mean traffic rate estimate)
- Automatic video recording of birds in the vicinity of the rotor (quantification of avoidance/attraction behaviour).

10. Assessment of landscape and visual impacts

Recommendations given here are based on presentation of Mr. Simon Bell (Estonian University of Life Sciences) and discussions at the workshop on "Methodology for assessing impacts of offshore wind farms on biodiversity and landscape" (5-7.11.2008 Kabli, Estonia).

As the first step the visual capacity of the landscape shall be assessed. The assessment should be based on strategic approach to avoid case-by case situations. The method for assessment shall be very objective, robust, rational and repeatable (it can not be just expert judgement).

The assessment should address two kinds of impacts:

- Effects on landscape (landscape impact);
- Effects on people (visual impacts).

In case of wind farms it is essential to take into account the cumulative effect of several wind farms as well possible cross-border impact.

The Zone of Theoretical Visibility is defined (ZTV) as the study area of the particular project, in case of a wind farm it extends up to 35 km. However it is impacted by various conditions, such as land forms, land use, etc.

Probability of landscape change in larger scale (based on spatial development plans, economic situation etc.) can be taken into account when assessing the landscape and visual impacts, but it would be hard to predict a change in very particular point.

For assessment of the landscape perception, the Virtual landscape theatre is used (such is constructed also in Tartu). Also sociological methods, e.g. questionnaires, risk analysis method, conjoint choice experiments can be applied.

Recommendations for application of the method for landscape and visual assessment in the Baltic States:

The general approach and method presented by Mr. Simon Bell is well tested and can be transferred to the Baltic situation. Its main advantage is reducing the subjectivity of the assessment by following the elaborated scheme, which is very rational and robust.

The main steps for applying the method are following:

1. To clarify availability of the technical instruments and background information (e.g. landscape characterisation maps);
2. To analyse regional development plans, comprehensive plans, territorial plans;
3. To identify landscape resources:
    a. Description of the landscape character;
    b. Identification of valuable landscapes (to be protected by national law);
    c. Identification of the cultural values of the landscape.

4. Identification of the visual resources – defining of view points for visual impact assessment. View points shall be the most representative and to be agreed with local authorities. In case of offshore wind farms the view points shall be also on the water.

5. Assessment of the sensitivity of the landscape and visual resource;

6. Assessment of the magnitude and significance of the landscape and visual effects;

7. Identification of the mitigation measures (e.g. layout/location; number and colour of the wind turbines);

8. Cumulative impact assessment with other development projects.

Summary of methodology used to assess landscape and visual sensitivity for the baseline assessment (*by Simon Bell, Estonian University of Life Sciences*)

Identification of the landscape resources likely to be affected occurring within the study area

1. The landscape resources considered for assessment are defined as:
   - Physical resources on site such as trees, hedges, other vegetation or structures;
   - The landscape character types occurring within the study area derived from the landscape character assessment;
   - Designed Landscapes occurring within the area e.g. manor parks;
   - Nationally designated landscapes (National Parks and other protected landscapes);
   - Locally important landscapes designated by local authorities or from the comprehensive plan.

These should be checked through fieldwork to ensure that the descriptions given were up to date and correct.

Identification of the visual resources likely to be affected occurring within the study area

2. The viewpoints (places from where people would be able to see the development) are scoped initially from the ZTV map (if available) as potential viewpoint locations accessible by both residents and visitors. The rationale for their selection is to establish a broad sample ranging around the area and at different distances from the site. Viewpoint locations included residential areas, roads carrying national, regional or local traffic, and specific viewpoints, such as from hill summits, major heritage sites or visitor attractions.

3. Following the scoping of potential viewpoints as a desk study site visits are undertaken. Each potential viewpoint is visited. Because the ZTV is based on

landform it takes no account of the presence of screening elements such as trees, woodland or buildings. This may mean that while the development is potentially visible in fact it cannot actually be seen. This can only be assessed on the ground. Panoramic photographs are then taken following the recommended practice.

Viewpoint photography

4. The photography follows a standard recommended method to enable confidence to be placed in the eventual assessment. Photographs are usually taken with a focal length of 50mm, which fairly closely reflects the focal length of the human eye and therefore the landscape looks proportionally correct. Sufficient photographs are taken having a significant overlap with their neighbours to enable panoramas to be created. The panoramas show an angle of view of at least 90^{o}. The digital photos are then joined using special software and a seamless panorama is the result.

5. The lighting conditions of the photographs should be bright but not necessarily sunny and cloudless and care should be taken to ensure that they reflect the typical lighting effects. For example, southwards looking views tend to be back-lit much of the day, and this should be used for the photographs.

6. At each viewpoint, as well as taking the photographs, information is collected on aspects that contribute to visual sensitivity, such as overall visibility, the numbers of people likely to see the view and the nature of the viewing experience.

Assessment of the sensitivity of the landscape resources

7. Landscape effects arise from changes as a result of development which may affects its features, character and quality. The scale and significance of the potential affect must be examined with regard to a number of factors associated with the sensitivity of the landscape resource, such as its importance, intactness, quality and capacity to accept change. The assessment of sensitivity, magnitude and significance are kept separate and clearly described so that the contribution of each element can be identified.

8. The sensitivity of the landscape to change is defined for each landscape character type as high, medium, low or negligible, based on professional interpretation of a combination of all or some of the following criteria given in Table 3:

Table 3. Factors contributing to the sensitivity of the landscape

	sensitivity of the landscape resource			
criteria	high	medium	low	negligible
landscape designations	landscape designated for its national landscape value	landscape designated for regional or county-wide landscape value	landscape designated for local value or valued locally as for example as an important open space	no designations present
landscape quality	distinctive landscape with strong sense of place and integrity	distinctive landscape with strong sense of place but with some detractors	landscape with relatively ordinary characteristics, some detractors	featureless, spoiled or mundane landscape with weak sense of place
cultural heritage interests	contains features or sites of national importance	contains sites of regional importance	contains some sites of local importance	few sites or features of importance
landscape characteristics such as pattern, scale, form, tranquillity, wildness	landscape with characteristics that are highly sensitive and highly affected by development	characteristics moderately sensitive to change wind farm development	characteristics not greatly affected wind farm development	characteristics relatively unaffected wind farm development
Proportion of resource in ZTV	Large proportion affected; site lies in it	Moderate proportion affected	Small proportion affected	Very small proportion affected
Distance from the site	Close to the site; site lies in it	Within 15km	Beyond 15km	Beyond 15km

Assessment of the sensitivity of the visual resources

9. Visual effects result from the changes in character and quality in people's views arising from the development. The significance of the impact is determined by the sensitivity of the visual receptor and the magnitude of the visual effect. The assessment is usually made from a combination of wireframe renderings of the proposed development from each viewpoint and also using photomontages based on panoramic photographs taken from each viewpoint.

Visual sensitivity

10. The degree to which people are sensitive to and concerned about landscape change depends on several factors, as recommended in the Guidelines for Landscape and Visual Impact Assessment:
    - The visibility of the landscape;
    - The number of people who see the landscape;
    - The nature of the viewing experience

11. *The visibility of the landscape* depends mainly on the topography, the presence of elements that block or screen views and the amount of the landscape

accessible to potential viewers. The viewpoints scoped within the study area may range from open and unobstructed to those heavily affected and partly screened by trees, buildings or other features. Landform is the major landscape element to screen views and the use of the visibility analysis to create the ZTV means that this is already taken into account, except for identifying how many or how much of a development is visible from a given point. The other factors that affect visibility are the distance to the site from the viewer and the viewing direction in relation to the lighting direction. Up to 5km away a site can be considered as foreground and highly visible, possibly dominating views, while from 5km to 15km the site will be seen as part of the general landscape. Beyond 15km it is more likely to be seen as part of the background and attention is easily diverted from it. The use of a 35km ZTV radius removes potential viewpoints that are too far away and the lighting direction varies from view to view, so will be considered separately.

12. *Numbers of viewers:* There is usually little or no hard data available on the number of viewers seeing the proposed development. However, it can be inferred from information on population and from observation of the study area the strength of the settlement pattern of towns and villages and the number and importance of roads and places used for recreation in a given area. Some viewpoints are used by fewer people since they are on less important roads or at smaller settlements.

13. *The nature of the viewing experience:* People who live in a particular area experience the landscape all year round together with its changing moods. They are used to seeing the landscape as it is and may not react favourably to changes taking place. Visitors to the area may see the landscape primarily from the roads, although footpaths also provide a limited but significant type of experience. Travellers see it as a moving experience and may spend greater or lesser times travelling through or around the landscape seeing the development. Local people driving to and from work or local services are likely to be more sensitive than purely business or commercial travellers passing through. Tourists driving to experience the countryside will also be more sensitive. Table 4 categorises these criteria into different levels of contribution to sensitivity.

14. The method of using the criteria to assess the overall sensitivity of each viewpoint is to look at the balance between each criterion and to make a judgement of the importance of each factor.

Table 4. Calculation of visual sensitivity

Degree of contribution to sensitivity	Factors affecting sensitivity		
	Visibility	Numbers of people	Nature of the viewing experience
High	Development is clearly visible from the viewpoint Landscape is open and unobstructed Viewing distance up to 5km from the site	Large numbers of residents High volumes of travellers	Residential viewing Local travellers frequently using the area Recreation and tourism visitors spend time in the area
Medium	Development is mostly visible from the viewpoint Landscape is partly open and unobstructed Viewing distance from 5-15 km from the site	Moderate numbers of residents Moderate numbers of travellers	Residential viewing Local travellers Some recreation and tourism visitors to the area
Low	Development is partly visible from the viewpoint Landscape is mostly obstructed by objects in the view Viewing distance 15-35km from the site	Small numbers of residents Small numbers of travellers	Some residential viewing Travellers mainly on business Few if any recreation or tourism visitors.

General recommendations:

- Landscape and visual assessment of the wind parks shall not be carried out case-by-case, but following more strategic approach for the whole country. First, the appropriate areas for wind park development shall be defined on the national level. In case of off-shore wind farms, they have to take into account wind conditions and geology and should exclude the MPAs.
- The strategic guidelines developed on national scale have to be fed into regional and local spatial plans.

11. References

11.1 Paper

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11.2 Relevant homepages

Helsinki Commission (Manual for Marine Monitoring in the COMBINE Programme of HELCOM):
http://www.helcom.fi/groups/monas/CombineManual/en_GB/Contents/

German Federal Maritime and Hydrographic Agency (Standards for offshore EIA):

http://www.bsh.de/en/Products/Books/Standard/index.jsp

RUWPA (Distance homepage, statistical analyses of line transect data):

http://www.ruwpa.st-and.ac.uk/distance/

Plymouth Marine Laboratory (Primer-E Ltd):

http://www.primer-e.com/

Scottish National Heritage (collision risk model of Band et al. 2006):

http://www.snh.org.uk/
http://www.snh.org.uk/pdfs/strategy/renewable/COLLIS.pdf

Sirtrack (seal tracking devices):

http://www.sirtrack.com/
http://www.smru.st-andrews.ac.uk/Instrumentation/pageset.aspx?psr=274

Swedish Environmental Protection Agency (results from Vindval research programme 2005-2007):
www.naturvardsverket.se

Noordzeewind (monitoring at offshore wind farm Noordzeewind, The Netherlands 2006-2012):
http://www.noordzeewind.nl/

Danish Energy Authority (results from offshore wind farm monitoring in Denmark):

http://www.ens.dk/graphics/Publikationer/Havvindmoeller/index.htm

EUROBATS (Guidelines for consideration of bats in wind farm projects):

http://www.eurobats.org/publications/publication_series.htm