Federal Agency for Nature Conservation

Symposium

Towards an Environmentally Sound Offshore Wind Energy Deployment

23rd to 26th January 2012

Stralsund

Final Report

Insel Vilm

INTERNATIONAL ACADEMY FOR NATURE CONSERVATION

Symposium venue

arcona Hotel Baltic
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SCOPE AND AIMS

Offshore wind energy plays a central role in building a carbon neutral energy system and in meeting the climate targets set internationally. In the coming years, a considerable number of offshore wind turbines will be installed in the North Sea and the Baltic Sea. However, the construction and operation of wind farms will affect the marine environment, as already seen with existing installations.

To set the agenda towards an environmentally sound offshore wind energy deployment, the German Federal Agency for Nature Conservation held a symposium on the subject in Stralsund, Germany, on January 23rd – 26th 2012. The symposium awakened great interest from the invited parties: originally planned to number 30 to 35 participants, the symposium was actually attended by 48 participants from six countries: Belgium, Denmark, Germany, The Netherlands, Sweden and United Kingdom.

Twenty presentations were given by national and international experts on up-to-date research results, regulations and requirements with regards to nature conservation and offshore wind farms, with particular focus on marine mammals, sea birds, migratory birds, and fish. The aim was to identify and describe research priorities and needs of action for the further expansion of offshore wind energy.

The symposium served as a platform for experience exchange between scientists, members of consenting and nature conservation bodies, as well as NGOs. Lectures, working groups and discussions gave opportunities to discuss the most relevant impacts on the marine environment, and to address solutions. In addition, the symposium provided an opportunity for building networks and co-operation between the participating institutions, and for enhancing knowledge exchange between international experts.

The symposium consisted of six thematic sessions. The aim of the first three sessions was the determination of the impact of offshore wind energy deployment on marine animals, with special focus on fish (session I), marine mammals (session II) and birds (session III). These sessions also outlined the sensitivities of these taxa. Session IV dealt with the concerns and demands of nature conservation agencies and environmental organisations to the deployment of offshore wind energy. Session V introduced the present regulatory framework in different countries with regards to nature conservation issues. Finally, session VI included the presentation of various methods leading towards an environmentally sound offshore wind energy deployment. As an example, an approach for a common data base was shown.

RESULTS OF THE SYMPOSIUM

Talk sessions and discussions

A keynote speech given by the President of the German Federal Agency for Nature Conservation, Prof. Dr. Beate Jessel, opened the talk sessions of the symposium. Prof. Jessel gave an overview of the framework requirements for an environmentally sound offshore wind energy deployment from the Federal Agency's perspective.

The following presentations revealed the differences in the countries' milestones and timelines used to meet their set climate targets. They showed the diversity in the experiences with environmental impact assessment, and in the strategies of the different countries towards an environmentally sound offshore wind energy deployment.

The environmental monitoring conducted during the construction of offshore wind farms

in Denmark, Germany and The Netherlands revealed specific negative effects on marine animals. The magnitude of these effects was found to be diverse at different wind farm locations. There is a general concern that evidence is often lacking about the effects at the population level. Scientific research is needed to close knowledge gaps and to provide solid information for the regulation process. Modelling approaches have been used to bridge the gaps. The models allow for quantifying effects like collision mortality or consequences on the fitness caused by changes in physical conditions in relation to displacement, which potentially can cause adverse impact at a population level.

Pile-driving noise is regarded as a major concern for **marine mammals and fish**, causing behavioural changes, temporary habitat loss, or even physical injury. This concern is approached differently across countries:

- Germany set a specific dual noise emission threshold in order to prevent auditory damage to harbour porpoises. Construction noise has to be kept below a sound exposure level (SEL) of 160 dB and a sound pressure level (SPL) of 190 dB re 1 μPa_{P-P} at 750 m distance from the piling site. At the same time, the absence of marine mammals in this zone must be ensured, for example, by acoustic deterrent devices, surveys and a soft-start procedure.
- In The Netherlands, a seasonal exclusion for pile-driving activities between 1st of January and 30th of June was defined to protect key species (seals and harbour porpoises) and fish larvae as a food basis for seabirds living in the protected habitat, Wadden Sea.
- In Denmark and the United Kingdom, marine mammals are kept from the piling site with the help of acoustic deterrent devices, and a soft-start procedure is employed to enable animals to move away and thus avoid hearing damage from forthcoming high noise levels.

Mitigation measures for reducing pile-driving noise are under development in Germany, The Netherlands and Denmark. The results of offshore demonstration projects are promising. In 2011, piling noise emissions were sufficiently reduced to meet the defined German threshold values by applying a large bubble curtain. Various effective noise mitigation measures will be available on the market in 2012. It is to expect that they can be regarded as state-of-the-art technology in a short timeframe. In parallel to noise mitigation systems, alternative low noise foundations are also under development, such as gravity foundations and suction buckets.

Operational noise is of less concern for marine mammals, but may still affect the behaviour of **fish**. For investigating the effect of noise on fish, particle motion measurements should be included in the environmental impact assessment.

For migrating **birds and seabirds**, the risks of collision with wind turbines, and habitat loss are a concern. Spatial planning, wind farm design, and thoroughly planned illumination of the turbines are key issues in reducing adverse impacts.

The cumulative effects of anthropogenic impacts of all kinds within and across countries were a major point of discussion. Animals experience pressures not only from the expanding offshore wind energy, but also from hunting, fisheries, shipping, pollution, military activity, seismic technologies, and other anthropogenic activities. Furthermore, the distribution of marine animal species often ranges over an area covering several countries, accumulating impacts in the different states. A negative impact experienced in one country can also affect the population status of a migratory species at a later stage when it moves to another country. This may be exemplified for instance by a protected breeding colony of Gannets, where adverse effects on the birds in their wintering quarters can

have an impact on the population, even though it happens far away from the actual protected area. Additionally, the impact of activities within one country may also reach across borders, such as far propagating noise. For managing and investigating cumulative effects, national and international cooperation are necessary. International agreements and directives have to be strengthened by the nations, and cooperation between all stakeholders should be enhanced in order to involve all of them in the process of evaluating and minimizing cumulative impacts. In the meantime, minimizing negative impact has to start at a national level, building a basis for international cooperation.

Facing the same problems across countries, it is important to establish ways of sharing existing results and findings. It was suggested that relevant information, contained in national reports, should be opened up for international access by translating them into English and/or supporting peer-reviewed publications. The standardization of methods should facilitate international exchange and ensure the consistency in data acquisition. Data gathering and sharing could be enabled by a common European data base. The initialisation of such a data base was presented in one of the talks, developed within the framework of GP Wind, an Intelligent Energy Europe project.

For judging the dimension of anthropogenic impacts, a call for more basic research on relevant species of marine mammals, migrating birds and seabirds, was expressed. The research should focus especially on the animals' behaviour, fitness, vital rates and migration patterns to provide baselines and to derive scientific valid thresholds. For species like fish and bats, the relevance of the impact is still unknown and has to be assessed whilst the anthropogenic impact has hardly been investigated at a population level. This should be considered as another focus for research with regards to the species' conservation status. In parallel to research on animals and animal populations, there should also be focus on investigating mitigation strategies and measures.

Attention was drawn to the need for economic efficiencies – not all costs needed for conducting the above mentioned research can be passed on to the offshore wind energy industry. Funding could be derived by an international funding pool fed by all stakeholders. This kind of research and data sharing calls for a higher level of coordination. A higher level coordination enables interdisciplinary and cross-country research with a broader perspective, and a consistent data acquisition and analysis, which will allow for a reduction of uncertainties and the establishment of scientifically valid thresholds.

Working groups

WORKING GROUP 1

The coherence of the Natura 2000 network: outlining the management approaches in different countries

CHAIR AND SUMMARY: KATHRIN AMMERMANN & CLAUDIA HILDEBRANDT

PARTICIPANTS: KRISTIN BLASCHE, EMMA COLE, FOLCHERT VAN DIJKEN, ULF HAUKE, CAROLIN KIEß, SIMONE VAN LEUSEN, TORLEIF MALM, DAVID OWAIN CLUBB

Working group 1 dealt with the following questions:

1.) What is the status of Natura 2000 in different countries?

2.) What are the impacts on protected areas, and what mitigation measures have been taken?

3.) What are the future tasks required regarding Natura 2000?

What is the status of Natura 2000 in different countries?

In **Sweden**, Natura 2000 sites are found in the Kattegat, Baltic Sea and the Bothnian Bay. Features under the Habitats Directive are (amongst others) the marine diversity (Kattegat), the long-tailed duck (Baltic Sea), benthic organisms as well as fish biodiversity (Bothnian Bay). There is no protected site for the harbour porpoise, as it is thought to be almost extinct. At present, no wind farms are allowed within Natura 2000 sites, but discussion on this matter is ongoing within the government.

In **The Netherlands**, the coastline from Bergen and the Wadden Islands forms a protected area. Natura 2000 sites are in process at the Dogger Bank, Oysterground or Bruine Bank. Features under the Habitats Directive in these Natura 2000 sites are (amongst others): gas fountains, the bivalve species *Arctica islandica* or birds like the long-tailed duck and auks. No areas have been designated as yet specifically for harbour porpoises. In The Netherlands, there are no major objections against wind farms in Natura 2000 areas, as studies that have been conducted indicated no significant adverse effects on birds from existing or planned wind farms. There is still the possibility to put restrictions on the permits if future investigations come to a different result. One permit has already been denied due to a possible impact on birds.

In the **United Kingdom**, no areas have been designated specifically for harbour porpoises, although in Wales and Scotland, bottlenose dolphin sanctuaries do exist. Special Protected Areas (SPAs) are found along the coast for breeding birds. Sandbanks, reefs and mud habitats are designated as Natura 2000 sites. There are plans in the UK for wind farms within the Natura 2000 site of the Doggerbank, a sandbank habitat, and within the "Moray Firth" SAC.

In the **German EEZ of the North Sea**, several protected areas are, among other features under the Habitats Directive, designated for (*inter alia*) harbour porpoises, common seals and grey seals at, for example, Dogger Bank and Sylt Outer Reef as well as Borkum Reef Ground. Furthermore, the Eastern German Bight is especially important to sea birds in the southern North Sea (SPA), for example for wintering black throated and red throated divers (*Gavia arctica* & *G. stellata respectively*).

In the **German EEZ of the Baltic Sea**, Natura 2000 sites can be found in the Fehmarn Belt, Kadet trench, Western Rønnebank, Adler Ground and Pomeranian Bay (with Odra Bank). One feature under the Habitats Directive in these Special Areas of Conservation (SAC) is the harbour porpoise. An SPA for birds is found in the Pomeranian Bay.

In Germany, feed-in tariffs are paid for electricity from offshore wind farms outside protected areas, but not for wind farms inside marine Natura 2000 sites.

In general, there are requirements to assess cumulative impacts across country boundaries and to find a coordinated way of acting, for example in the area of Dogger Bank. No common rules do exist against constructions in Natura 2000 sites, although building on reefs has to be avoided.

What are the impacts on the protected areas, and what mitigation measures have been taken?

In general, for an appropriate assessment of the impact (EIA), baseline information (especially in the UK) is often lacking for species and / or habitats.

Noise, cable connections, and maintenance vessels can cause negative impacts on Natura 2000 sites if a wind farm is build in the vicinity of protected areas.

Illumination of the wind turbines can have a negative impact on birds under certain weather conditions, enhancing the collision risks of bird species. It is questionable how to manage that.

Switching off turbines during mass migration may be one solution, although forecasting the migration is a problem as well as the switching-off itself, because of economical interests. It may also affect the stability of the power supply.

In Germany, disturbance has to be avoided within SPAs for divers, and thresholds for displacement of local bird populations do exist (e.g. for Guillemots, a displacement of up to 10% is allowed).

Due to economic competition, applications commonly contain e. g. different types of foundations, resulting in a late decision on the fundament types and pile driving procedures.

What are the future tasks regarding Natura 2000?

In The Netherlands and the United Kingdom, the designation of Natura 2000 sites has yet to be completed. A better understanding is needed with regards to the impact on species within Natura 2000 sites, caused by their displacement, by collision risk, and when their migration routes are affected. A realistic judgment of impacts on the sites is difficult. Noise is a big problem, especially for marine mammals, as well as for fish (which are also common prey species).

The lack of data has to be counteracted.

WORKING GROUP 2: OUTLINING RESEARCH NEEDS ON MITIGATION MEASURES AND TECHNICAL SOLUTIONS (MARINE MAMMALS AND FISH)

CHAIR AND SUMMARY: URSULA VERFUß & TOBIAS VERFUß

PARTICIPANTS: BRUNO CLAESSENS, MICHAEL DÄHNE, KIM DETLOFF, ANSGAR DIEDERICHS, SOPHIE HANSEN, ANNE HERRMANN, CHRISTOPHER HONNEF, SANDER DE JONG, LAURA KLEIN, PAUL LEPPER, JENS LÜDEKE, PATRICK MILLER, CHRISTINA MÜLLER-BLENKLE, JAKOB TOUGAARD, STEFANIE WERNER

In working group 2, the following questions were discussed:

1. Which impacts and effects caused by the deployment of offshore wind energy are seen as relevant?

2. What are the research needs in relation to wind energy deployment?

3. Which approaches are proposed to manage cross-border and cumulative effects?

Which impacts and effects caused by the deployment of offshore wind energy are seen as relevant?

Noise impact and habitat change are seen as the most relevant impacts:

Noise impact can cause behavioural changes, temporary or permanent shifts of the animals' hearing thresholds (TTS, PTS), masking of relevant sound (e.g. natural or communication sound), which is especially affecting fish, and non-auditory injury. While TTS/PTS and non auditory injury are primarily relevant during the construction phase, masking and behavioural changes also concern the operational phase, but only within short distances of the turbines.

Change in community composition is one of the major features of habitat change. Prey availability may change temporarily during construction (due to noise and sediment spills, for example), or permanently during operation (due to trawling exclusion, scouring, for example). Barrier effects caused by large offshore wind farms and subsea power

cables might affect migratory fish species.

Physiological effects (e.g. stress) and secondary effects (e.g. fishery exclusion that shifts pressure to other areas) were mentioned as relevant effects.

It was noted that special attention should be drawn to the issue that any (individual) impact has to be seen as more relevant for nature reserves and ecologically important areas.

What are the research needs with regard to wind energy deployment?

- Population effects on sensitive species:
    - fitness consequences;
    - vital rates (reproduction, growth, survival).
- Long term studies of key species on the
    - basic ecology;
    - cumulative effects, taking into account multiple stressors.
- Research should focus on an ecosystem approach,
    - looking for functions and interactions;
    - defining key species.
- Vibration analysis (i. e. particle motion) to understand the effect of wind energy deployment on fish.
- Development and testing of noise mitigation technologies should continue, with focus upon:
    - reduction of sound emission during the construction period;
    - presence/absence checks on deterrent devices.

What approaches are proposed to manage cross-border and cumulative effects?

The working group proposed to create mechanisms to centralize some research efforts from individual developers to (inter)national bodies. For this, research categories should be divided into site/project specific research and general research. Money should be given to a research fund, shifting the responsibility away from the developers.

Information should be shared in a timely fashion by publishing the results in open or peer reviewed media. International collaborations should be enhanced by EU funding programmes, such as FP8 and Life+. The need for strategic environmental impact assessment was seen in contrast to site specific approaches. Furthermore, interagency cooperation should be enhanced, and the implementation process of the Marine Strategy Framework Directive (MSFD) should be strengthened, as well as the upcoming European Maritime Spatial Planning Directive and Regional Sea Conventions. Highly beneficial would be an internet platform providing reports and opportunities for data exchange.

WORKING GROUP 3

Outlining research needs on mitigation measures and technical solutions
(migratory birds & seabirds)

CHAIR AND SUMMARY: THOMAS MERCK & MATTHIAS STEITZ

PARTICIPANTS: JAN BLEW, JAMES BURT, SJOERD DIRKSEN, LUCY GREENHILL, REINHOLD HILL, IB KRAG PETERSEN, BETTINA MENDEL, STEPHAN SEDLACEK

The discussions in the working group on offshore wind farms and both migratory birds

and seabirds have been based on the following questions:

1. Are suitable technical solutions available or under development to reliably detect collision events?

2. How do you approach the problem of cumulative impacts concerning habitat loss of sensitive seabirds?

3. How is the problem of large scale offshore development tackled with respect to migrating birds?

4. Are technical and/or logistical measures in use to minimise collision risk for migrating birds?

Conclusions and Recommendations

General:

From a scientific point of view, the impact of offshore wind farms on birds should best be assessed at the population level, most probably only achievable by modelling. Consideration of the cumulative impacts provides an essential basis for this assessment.

International sharing of reports, etc, should be facilitated, and raw data should be made publicly accessible as far as possible.

Migratory birds:

To better understand and assess the impact of offshore wind farms on migratory birds, there is a need for (further) research *inter alia* both concerning basic knowledge on migration patterns and on the specific impacts of turbines/wind farms.

- Year-round baseline surveys of migrating birds at various fixed stations are needed.
- There are various technical measures under development to detect collision events, such as surveillance radar, pencil beam radar, camera systems, etc.
- The knowledge concerning species specific responses of flying birds (day/night) to turbines/offshore wind farms is still insufficient.
- The influence of light intensity, colour and blinking frequency on the responses of migrating birds should be further investigated.
- Various possible mitigation measures have been discussed, some of them with some doubts on their effectiveness and possible ecological side effects:
    - suitable choice of wind farm location;
    - re-design of the lighting scheme;
    - turbine free corridors to let the birds fly through;
    - shut-down of both lights and turbines (in case of mass migration);
    - illumination of the rotor blades to make the turbines visible to birds (?);
    - sound to make the turbines audible to birds (?)
- For weather dependent and area specific migration intensity, a forecasting tool should be developed to predict mass migration early enough to take appropriate mitigation measures. To do so, there is the need for
    - modelling of migration patterns;
    - development of an online system to validate mass migration events offshore at low altitudes

Resting seabirds:

There is still insufficient knowledge on the spatial and temporal distribution of seabirds (in general terms).

When assessing the significance of an impact, the study population would be best based upon units of biological significance; failing these, other geographical units, for example administrative boundaries, could be adopted.

Further data on species-specific responses to offshore wind farms with respect to displacement, are needed. Research should be conducted in areas with suitable densities of the species of concern; this will probably need a multi-disciplinary approach.

Long-term studies should be performed to detect possible habituation to disturbance.

There is a need to survey seabirds from platforms next to wind farms (for baseline and impact studies), *inter alia* to enable behavioural studies to take place: do seabirds entering the wind farm behave normally?

The impact on the fitness of displaced and of indirectly affected individuals (in areas to which other individuals have been displaced) should be investigated. The relationship of bird densities to habitat features and to feeding resources has been mentioned not only in this context as an important parameter and appropriate research is needed.

With respect to minimising the impact of offshore wind farms on resting birds, discussion took place as to whether the design of the wind farm (for example, the distance between the turbines) could be a possible mitigation measure.

SUMMARY

Offshore wind energy plays a central role in meeting the various climate targets that have been set. In the coming years, a considerable number of offshore wind turbines will be installed in the North and Baltic Seas. However, the construction and operation of wind farms will affect the marine environment, as already seen with existing facilities.

In January 2012, the German Federal Agency for Nature Conservation held a symposium in Stralsund, Germany, to set the agenda for an environmentally sound offshore wind energy deployment. Twenty presentations were given by national and international experts dealing with up-to-date research results as well as regulations and requirements with regards to nature conservation and offshore wind farms, with particular focus on marine mammals, sea birds, migratory birds, and fish. The aim was to identify and describe research priorities and needs for action in the light of the further expansion of offshore wind energy.

The presentations revealed the differences in the milestones and timelines used to meet the set climate targets, in the level of experiences with environmental impact assessment, and in the strategies of the different countries towards an environmentally sound offshore wind energy deployment.

Pile-driving noise is a major concern with regards to marine mammals and fish, causing behavioural changes, temporary habitat loss, or even physical injury if no noise mitigation and deterring devices are applied. This concern is approached differently in different countries. Mitigation measures for reducing pile-driving noise are under development and the results are promising. It is to be expected that various effective noise mitigation measures will be available in the near future. Alternative low noise foundations are also under development.

For particular seabird species, non-transient habitat loss is of great concern. Another, species specific, concern for some seabird and migrating bird species is the risk of collision with wind turbines. Spatial planning, wind farm design, and thoroughly planned illumination of the turbines are key issues for reducing the impact of offshore wind farms on birds.

Within the discussions, a major issue was the cumulative effect of anthropogenic impacts of all kinds on the marine environment. Effects on the marine environment are caused not only by the expanding offshore wind energy, but also by hunting, fisheries, boat traffic, pollution, military activity, and other anthropogenic activities, within and across countries.

For managing and investigating cumulative effects, national and international cooperation is necessary. International agreements and directives have to be strengthened, and co-operation between all stakeholders should be enhanced. In the meantime, minimizing negative impact has to start on a national level, building a basis for international cooperative work.

Ways of sharing results and findings have to be established by opening up, translating, and / or publishing relevant information, and by gathering and sharing data in a common European data base.

More basic research, focused especially on the animals' behaviour, fitness, vital rates and migration patterns, was recommended, to provide baselines and to derive scientifically valid thresholds. Research should also focus on evaluating anthropogenic impact at a population level. In parallel to this, there should also be focus upon investigating and applying mitigation strategies and measures.

This kind of research and data sharing calls for a higher level of coordination and for funding, which could be derived through an international funding pool financed by all stakeholders, keeping the costs reasonable and economically efficient for the industry. A higher level coordination enables interdisciplinary and cross border research with a broader perspective, as well as a consistent data acquisition and analysis, which would allow for a reduction of uncertainties and the establishment of scientifically valid thresholds.

During the symposium, three working groups were established. The first working group outlined the management approaches in different countries with regards to the coherence of the Natura 2000 network. The current status of Natura 2000 was described, as well as the impacts on protected areas and mitigation measures. It was noted that a better understanding is needed for the assessment of the impact on features as designated under the Habitats Directive within Natura 2000 sites.

The second working group outlined the research needs on mitigation measures and technical solutions with regards to marine mammals and fish. Noise impact (piling noise) and habitat changes were seen as the most relevant impacts. Attention should be drawn to physiological effects (e.g stress) and secondary effects (e.g. fishery exclusion that shifts pressure to other areas). Amongst research needs, investigations on sensitive species with regards to population effects were seen as important. Long term studies of key species were proposed to understand their basic ecology and cumulative effects. Research should focus on an ecosystem approach. Vibration analysis (particle motion) is important for an understanding of the effect of wind energy deployment on fish. The development of noise mitigation technologies should continue, and their effectiveness needs to be tested. For managing cross-border and cumulative effects, the creation of mechanisms to centralize some research efforts from individual developers to (inter)national bodies was proposed. The need for strategic environmental impact assessment was seen in contrast to site specific approaches, next to enhancing co-operation, and strengthening directives and conventions.

In the third working group, research needs on mitigation measures and technical solutions for migratory birds and seabirds were discussed. In this group, researching the impact at the population level, assessing cumulative impacts, enabling public access to raw data, and sharing reports internationally, were all proposed. With regards to resting seabirds, long-term studies and behavioural studies (in general and specific to wind farms) should be conducted, as well as research on the fitness of the population, impacted by displacement and indirect effects. Biologically meaningful units should serve as study populations, and areas should be selected for research with suitable species densities.

For migratory birds, a year-round baseline survey was suggested. The impact of specific parameters in relation to turbine lightening, such as light intensity, colour and blinking frequency, should be investigated. Spatial planning and specific wind farm designs were mentioned as possible mitigation measures. Finally, research should focus upon forecasting migration intensities to enable wind turbines to be shut down in time during mass migration events.

ZUSAMMENFASSUNG

Die Offshore-Windenergie spielt eine bedeutende Rolle bei der Erreichung der gesteckten Klimaschutzziele. In der Nord- und Ostsee soll in den kommenden Jahren eine beachtliche Anzahl an Windenergieanlagen installiert werden. Untersuchungen an bereits existierenden Windparks zeigen, dass von Bau und Betrieb der Anlagen jedoch erhebliche Auswirkungen auf die Meeresumwelt ausgehen können.

Auf Einladung des Bundesamts für Naturschutz fand im Januar 2012 in Stralsund ein Symposium zum umweltverträglichen Ausbau der Offshore-Windenergie statt. Nationale und internationale Experten stellten in zwanzig Vorträgen aktuelle Forschungsergebnisse vor, den jeweiligen Genehmigungsrahmen verschiedener europäischer Länder dar und formulierten Anforderungen für den weiteren Ausbau der Offshore-Windenergie aus Sicht des Naturschutzes. Inhaltliche Schwerpunkte der Tagung lagen vor allem auf Meeressäugetieren, See- und Zugvögeln sowie Fischen. Das Symposium zielte auf die Identifizierung und Darstellung des weiteren Forschungsbedarfs sowie die Konkretisierung des Handlungsbedarfs in Bezug auf den weiteren Ausbau der Offshore-Windenergie ab.

Aus den Vorträgen wurde deutlich, dass innerhalb der EU-Mitgliedsstaaten durchaus unterschiedliche Zielvorgaben und Zeitpläne zur Erreichung der Klimaschutzziele definiert worden sind. So gibt es in den einzelnen Ländern unterschiedliche Erfahrungen mit Umweltverträglichkeitsprüfungen und vielfältige Strategien hinsichtlich eines umweltverträglichen Ausbaus der Offshore-Windenergie.

Ein zentrales Anliegen für einen umweltverträglichen Ausbau der Offshore-Windenergie stellt die Vermeidung bzw. Verminderung der während der Pfahlrammungen entstehenden hohen Schallemissionen dar. Wenn keine Schallminderungsmaßnahmen eingesetzt oder Vergrämungsmaßnahmen getroffen werden, kann der entstehende Schall bei Meeressäugetieren und Fischen Verhaltensänderungen hervorrufen, zu temporären Habitatverlusten führen oder sogar physische Verletzungen verursachen. In den einzelnen EU-Ländern wurden unterschiedliche Lösungsansätze entwickelt, um diesem Problem zu begegnen. Primäre und sekundäre Schallminderungsmaßnahmen befinden sich derzeit in der Entwicklung. Ausgehend von vielversprechenden Zwischenergebnissen ist zu erwarten, dass mehrere wirksame technische Lösungen in naher Zukunft Marktreife erlangen. Auch alternative und weniger lärmintensive Gründungsmethoden befinden sich in der Entwicklung.

In Bezug auf einige besonders störungsempfindliche Seevogelarten, wie z.B. den streng geschützten Seetaucher, stellt die durch Offshore-Windparks verursachten Lebensraumverluste ein vordringliches Problem dar. Zudem besteht für Zug- und Seevögel beim Durchfliegen von Windparks die Gefahr, mit Offshore-Windenergieanlagen zu kollidieren. Das Kollisionsrisiko ist abhängig vom artspezifisch unterschiedlich ausgeprägten Meide- und Flugverhalten. Um negative Umweltauswirkungen auf Vögel zu minimieren, kommt der Raumplanung eine Schlüsselrolle zu. Daneben sind auch das Windpark-Design, d. h. die Anordnung der Windenergieanlagen und der Anlagenbefeuerung von Bedeutung.

Ein wesentlicher Aspekt in den Diskussionen während des Symposiums war die Bewertung von kumulativen Wirkungen der unterschiedlichen anthropogenen Einflussfaktoren auf die Meeresumwelt. Hier sind neben der expandierenden Offshore-Windenergie auch die Fischerei, der Schiffsverkehr, die Verschmutzung der Meere sowie militärische und andere Aktivitäten - wie Kies- und Sandabbau - zu nennen. Die daraus entstehenden kumulativen Effekte sind sowohl auf nationaler Ebene als auch länderübergreifend zu

betrachten.

Um solche kumulativen Effekte zu untersuchen, wurde die Notwendigkeit zu nationalen und internationalen Kooperationen betont. Zu diesem Zweck sollten insbesondere internationale Abkommen und Richtlinien gestärkt und bestehende Kooperationen zwischen allen Interessensgruppen ausgebaut werden. Parallel dazu sollten die Anstrengungen zur Minimierung der Umweltauswirkungen auf nationaler Ebene fortgeführt werden.

In diesem Zusammenhang wurden der Informationsaustausch und die Verbreitung von wissenschaftlichen Ergebnissen und Erkenntnissen besonders hervorgehoben. Einschlägige Studien sollten aus den jeweiligen Landessprachen ins Englische übersetzt werden, um sie im internationalen Raum verfügbar zu machen. Relevante Forschungsergebnisse sollten vermehrt in anerkannten Fachzeitschriften veröffentlicht werden. Daneben sollten die erhobenen Umweltdaten in einer gemeinschaftlichen Europäischen Datenbank zusammengeführt und für die Forschergemeinschaft nutzbar gemacht werden.

Für die Bewertung von Auswirkungen und für die Festlegung von Erheblichkeitsschwellen und Grenzwerten werden naturschutzfachliche Grundlagendaten benötigt. Hierzu sollte zum einen die Verhaltensforschung intensiviert werden, zum anderen sollten die biologische Fitness, das Wanderverhalten und dynamische Populationsparameter (d. h. Vitalraten wie Mortalität, Fertilität etc.) erforscht werden. Ein weiterer Schwerpunkt sollte auf die Entwicklung und Anwendung von Minderungsmaßnahmen und -strategien für die Schallemmissionen gelegt werden.

Diese Forschungsaktivitäten und der Datenaustausch erfordern eine übergeordnete Koordination sowie Fördermittel, die z. B. über einen internationalen Fonds bereitgestellt werden könnten, der von allen Interessensgruppen finanziert wird. Hierdurch könnte der Beitrag der Industrie auf ein angemessenes Maß begrenzt und ein effizienter Mitteleinsatz gewährleistet werden. Die Koordination auf übergeordneter Ebene ermöglicht interdisziplinäre und länderübergreifende Forschung mit einer breiteren Herangehensweise, einer konsistenten Datenerhebung und einheitlichen Analysemethoden. Hierdurch werden Unsicherheiten reduziert und die Erhebung von wissenschaftlich fundierten Grenzwerten ermöglicht.

Im Rahmen des Symposiums wurde drei Arbeitsgruppen durchgeführt. Die erste Arbeitsgruppe skizzierte die Managementansätze verschiedener Länder in Bezug auf die Kohärenz des Natura 2000-Netzwerkes. In diesem Zusammenhang wurden der aktuelle Status von Natura 2000-Gebieten beschrieben, relevante Umweltbelastungen auf diese Schutzgebiete thematisiert und mögliche Schutzmaßnahmen skizziert. Es wurde angemerkt, dass ein besseres Verständnis nötig ist, um Auswirkungen auf die Arten in den Natura 2000-Gebieten bewerten zu können.

Die zweite Arbeitsgruppe erörterte den bestehenden Handlungs- und Forschungsbedarf bzgl. der Schutzgüter Meeressäugetiere und Fische. Aus Naturschutzsicht ist der bei der Errichtung der Anlagen entstehende Rammschall problematisch. Als weitere wesentliche Umweltauswirkung sind Habitatveränderungen anzusehen. Wichtig erscheinen darüber hinaus physiologische Effekte (wie z. B. Stress) und indirekte Einflussfaktoren wie z. B. der Ausschluss von Fischereiaktivitäten aus Offshore-Windparks, der zu einer vermehrten Belastung von Schutzgebieten führen kann. Als prioritärer Forschungsbedarf wurde die Untersuchung von Populationseffekten bei empfindlichen Arten eingestuft. Langzeitstudien werden benötigt, um das Verständnis für die grundlegenden Lebensweisen von Schlüsselarten und die auf sie wirkenden kumulativen Effekte zu verbessern. Dabei sollte die Forschung auch ökosystemare Zusammenhänge wie z. B. Nahrungsketten berücksichtigen. Darüber hinaus erscheint die Analyse von schallinduzierten Teilchenbewegungen wichtig, um Auswirkungen durch den Bau und Betrieb von Offshore-Windenergieanlagen auf Fische bewerten zu können. Außerdem ist es wichtig, die technologische Entwicklung von Schallminimierungsmaßnahmen fortzusetzen und ihre Wirksamkeit zu untersuchen. Um länderübergreifende und kumulative Effekte zu managen wurde vorgeschlagen, einen Mechanismus zu entwickeln, der einige Forschungsansätze zentralisiert, weg von den einzelnen Bauträgern und hin zu nationalen und internationalen Institutio-

nen. Neben der Förderung von Kooperationen und der Stärkung von Richtlinien und Konventionen wurde im Unterschied zu vorhabensbezogenen Studien ein Bedarf an strategischen Umweltverträglichkeitsprüfungen aufgezeigt.

Die dritte Arbeitsgruppe diskutierte über (technische) Lösungsansätze zur Vermeidung und Verminderung negativer Umweltauswirkungen auf See- und Zugvögel. In dieser Arbeitsgruppe wurden die Erforschung populationsbezogener Auswirkungen, die Abschätzung kumulativer Effekte, der öffentliche Zugang zu Rohdaten sowie der internationale Austausch von Studien und Berichten vorgeschlagen. Langzeit- und Verhaltensstudien von rastenden Seevögeln sollten durchgeführt werden, sowohl im allgemeinen als auch speziell mit Bezug zur Windenergie. Weiterhin sollte der Einfluss von Verdrängungs- und indirekten Effekten auf die Fitness von Populationen untersucht werden. Biologisch sinnvolle Einheiten sollten als Referenzpopulation dienen, und Gebiete mit einer angemessenen Artendichte ausgewählt werden. Für Zugvögel wurde eine ganzjährige Erfassung als Grundlage für weitere Erhebungen vorgeschlagen. Der Einfluss von bestimmten Parametern der Anlagenbefeuerung wie Lichtintensität, Farbe und Blinkfrequenz sollte genauer untersucht werden. Die Raumplanung sowie umweltverträgliche Windparkdesigns wurden als mögliche Verbesserungsmaßnahmen genannt. Zusätzlich sollte sich die Forschung auf die Vorhersage von Vogelzugintensitäten konzentrieren, um durch eine zeitweise Abschaltung der Windturbinen Massenkollisionsereignisse zu vermeiden.

ACKNOWLEDGEMENTS

We are grateful to our colleagues from the BfN division INA-Vilm, especially Martina Finger, Norbert Wiersbinsky, Thomas Merck, and Matthias Steitz for their support with the organization of this symposium. We would also like to thank Sophie Hansen for taking and writing the minutes and Anne Herrmann for her great help during the symposium. Our gratitude goes to all referees for their contributions to the symposium, and to Peter Evans for proof reading the general text of the final report.

PROGRAMME

Monday, 23.01.2012

18:00 Welcome

KATHRIN AMMERMANN, BFN

18:15 Organisational notes

Dr. URSULA VERFUß

18:30 Round of introductions

Tuesday, 24.01.2012

KEYNOTE SPEECH

8:30 Framework requirements for an environmentally sound offshore wind energy deployment - the perspective of the German Federal Agency for Nature Conservation
Prof. Dr. BEATE JESSEL, PRESIDENT OF THE BFN

SESSION I

A. MONITORING EXPERIENCES IN GERMANY AND UK

B. THE EFFECTS OF OFFSHORE WIND FARMS ON FISH

Chair: Dr. URSULA VERFUß

9:00 Co-ordination of ecological research accompanying the alpha ventus project
KRISTIN BLASCHE, BSH, D

9:30 How relevant are the effects of wind farm noise on fish?
Dr. MATHIAS H. ANDERSSON, FOI, S

10:00 Experiences from the United Kingdom: Monitoring, Modelling and Uncertainty
LUCY GREENHILL, JNCC, UK

SESSION II

THE EFFECTS OF OFFSHORE WIND FARMS ON MARINE MAMMALS

Chair: TOBIAS VERFUß, PTJ

11:00 Offshore wind energy and marine mammals – Identified issues and perspectives
Dr. JAKOB TOUGAARD, INSTITUTE OF BIOSCIENCE, DK

11:30 How critical is the impact of underwater noise on marine mammals?
Dr. PATRICK MILLER, UNIV OF ST ANDREWS, UK

12:00 Determination of noise exposure criteria – the German approach
STEFANIE WERNER, UBA, D

SESSION III

THE EFFECTS OF OFFSHORE WIND FARMS ON BIRDS

Chair: THOMAS MERCK, BFN

13:30 Effects on flying birds in Offshore Wind farm Egmond aan Zee (OWEZ)
SJOERD DIRKSEN, BUREAU WAARDENBURG, NL

14:00 Does offshore wind farm development result in habitat loss for seabirds?
Dr. MARDIK LEOPOLD, IMARES, TEXEL, NL

14:30 How critical is habitat loss?
IB KRAG PETERSEN, AARHUS UNIVERSITY, DK

15:00 Discussion on sessions I to III

16:30 – 18:00 Parallel working groups WG1 (Natura 2000), WG2 (Marine Mammals and fish) and WG3 (Sea-birds and migratory birds)

20:00 Discover Stralsund – guided tour through a world heritage

Wednesday, 25.01.2012

SESSION IV

SPECIES AND AREA PROTECTION DEMANDS

Chair: Dr. MATTHIAS STEITZ, BFN

8:50 Making blue energy green – Overview of main issues
Dr. TORLEIF MALM, UNIV OF STOCKHOLM, S

9:10 Implementation and demands of species and area protection with regards to offshore wind farms – an NGO perspective
Dr. KIM C. DETLOFF, NABU, D

9:30 Species protection and offshore wind energy – the German approach
THOMAS MERCK, BFN, D

10:00 Species and area protection with regards to offshore wind farms
Dr. FOLCHERT VAN DIJKEN, MINEL&I, NL

SESSION V

THE REGULATORY FRAMEWORK FOR NATURE CONSERVATION IN THE LICENSING PROCEDURE

Chair: KATHRIN AMMERMANN, BFN

11:00 The licensing procedure in Germany
SIMONE VAN LEUSEN, BSH, D

11:30 Offshore wind & the environment: the UK planning system
EMMA COLE, DECC, UK

12:00 The Netherlands licensing procedure offshore wind farms
SANDER DE JONG, RIJKSWATERSTAAT NOORDZEE, NL

SESSION VI

IMPLEMENTATION OF SPECIES & AREA PROTECTION DEMANDS: PROTECTION AND MITIGATION MEASURES

Chair: CLAUDIA HILDEBRANDT, BFN

13:30 Noise mitigation measures & low-noise foundation concepts – state of the art
TOBIAS VERFUß, PTJ, D

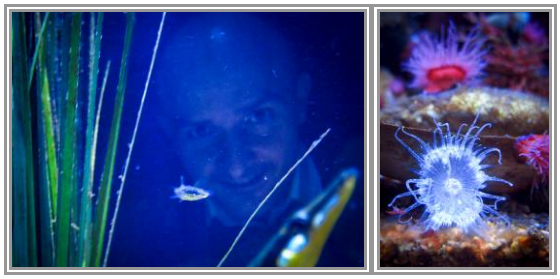
14:00 Migrating birds and offshore wind turbines: How to reduce collisions and avoidance behaviour?
REINHOLD HILL, AVITEC RESEARCH GBR, D

14:30 GP Wind Project: Good Practice Guide & Toolkit
BRUNO CLAESSENS, APERE ASBL, B

15:00 Discussion on sessions IV to VI

16:30 – 18:00 Parallel working groups 1 to 3

19:45 Guided tour through the OZEANEUM



Fotos (OZEANEUM): Lucy Greenhill

Thursday, 26.01.2012

9:00 – 10:30 Parallel working groups 1 to 3

SESSION VII

WORKSHOP RESULTS & CLOSING

Chair: KATHRIN AMMERMANN, BFN

11:00 Working group 1
CLAUDIA HILDEBRANDT

11:20 Working group 2
DR. URSULA VERFUß

11:40 Working group 3
THOMAS MERCK

12:00 Discussion of the symposium outcomes, suggestions for future events

13:00 End of the symposium

KEYNOTE SPEECH

Framework requirements for an environmentally sound offshore wind energy deployment - the perspective of the German Federal Agency for Nature Conservation

PROF. DR. BEATE JESSEL, PRESIDENT OF THE FEDERAL AGENCY FOR NATURE CONSERVATION (BFN)

(Please see corresponding presentation file for related slides)

It is my great pleasure to welcome you to our symposium "Towards an Environmentally Sound Offshore Wind Energy Deployment" here in Stralsund, organised by my colleagues from the Federal Agency for Nature Conservation.

The German Federal Agency for Nature Conservation

The German Federal Agency for Nature Conservation (Bundesamt für Naturschutz - BfN) is the German government's scientific authority with responsibility for national and international nature conservation. It is one of the government's departmental research agencies and is responsible to the German Ministry for Environment, Nature Conservation and Nuclear Safety (BMU). The Agency provides the German Environment Ministry with professional and scientific assistance in all nature conservation and landscape management issues and in international cooperation activities. BfN furthers its objectives by carrying out related scientific research and is also in charge of a number of funding programmes. In its work it follows an integrated approach that is not only dedicated to species and habitat conservation but aims at integrating sustainability and nature conservation issues into land use such as agriculture, forestry and water management.

Our Federal Agency additionally performs important enforcement work under international agreements on species conservation and marine nature conservation, the Antarctic Treaty and the German Genetic Engineering Act. In this context it is worth mentioning that we are the responsible authority for the enforcement of nature conservation issues within the German marine Exclusive Economic Zone (EEZ).

Conservation and sustainable use of biological diversity

Biological diversity, including the diversity of ecosystems and ecological communities, habitats and landscapes, diversity between species, and genetic diversity within species is under severe pressure. It is widely agreed that biological diversity should be preserved in its different dimensions, including species, genetic diversity and also the diversity of biotopes. Internationally, the goals for nature conservation are set by the Convention on Biological Diversity (CBD). They were the basis for the European Strategy on Biological Diversity and for respective national policies. We all know that we have failed to reach the goals to halt the loss of biological diversity or even to significantly reduce the rate of reduction set for 2010. But that is no reason to give up but to increase the efforts. In November 2007, the German National Biodiversity Strategy was adopted by the German Cabinet, providing targets and measures for a whole range of issues regarding biodiversity. For marine conservation, one of the goals is the achievement of a good environmental status (GES) by 2021. That is where we are up to.

Several conventions have been ratified in order to structure, organise and thus foster the international efforts to protect the marine environment. Examples are the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention), and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). The OSPAR Convention for example is the legislative instru-

ment regulating international cooperation on environmental protection in the North-East Atlantic.

On the other hand human beings and nature face the threats of climate change requiring the restriction in the intensive use of fossil fuels, which are not everlasting anyway. As a consequence, many countries promote the production of renewable energies:

In Germany, at least a share of 30% from renewable energy of the country's electricity supply should be met by 2020. As part of the amendment to the Renewable Energy Act in July 2011, the national target was set to a minimum of 35% share of renewable energies in electricity consumption up to 2020, 50% up to 2030, and 80% up to 2050 respectively. The share of renewable energies in total gross energy consumption should be increased by 2020 to at least 18% and the energy concept of the federal government of September 2010 set a target of 60% share of renewables by 2050.

To achieve these objectives, major efforts are needed. The expansion of renewable energies is a central component to achieve the climate protection goals, and offshore wind energy will have to play a prominent role in the future. The German Federal Government has committed itself both to international and national targets of climate protection and to the protection of biological diversity, the latter playing a crucial role regarding sinks and sources of climate gases and thus contributing to the climate protection as well. To achieve both targets, smart strategies are needed to at least minimise or mitigate the negative impacts of the development of renewable energies, including those of wind farms in the marine environment. Not to forget to mention that from the operational point of view, it is also a question of following laws and regulations. So it is also in the interest of investors and constructors of wind farms to avoid any legal risks.

Offshore wind energy in Europe and Germany

The EU´s climate and energy policy is the key driver behind the growth of renewable energies in Europe, including Offshore-Wind-Energy. All member states of the European Union have to make their contribution to the fulfilment of these goals.

With respect to offshore wind energy in European countries (see slide no. 6 in the related presentation) the UK alone represents almost 45% of the installed capacity in Europe. It is expected that, by 2020, 18 European countries will have fully developed their offshore capacity. Offshore wind energy is currently most developed amongst the North Sea countries. Taking into consideration that only 2.3% of all the registered projects have so far been realised, the big need of nature-friendly strategies concerning the offshore wind deployment in the near future is quite obvious.

In the German EEZ of the North Sea and Baltic Sea, there are 28 Offshore-Windparks (OWP) with an installed capacity of about 9.5-10 GW already consented (as of January 2012, calculated on the basis of 5 MW per wind energy turbine, see slide no. 7 of the related presentation). In addition, applications for 84 further OWP with a joint capacity of more than 32 GW have been submitted. At present, two commercial OWPs with a calculated capacity of 800 MW are under construction in the EEZ of the North Sea. The test field "alpha ventus" with 12 WET and 60 MW has been connected to the power grid since 2009. The first commercial German OWP "Baltic 1" consisting of 21 wind energy turbines and with a capacity of 48 MW started its operation at the beginning of 2011 in the coastal waters of Mecklenburg-Western Pomerania.

The two maps on slide nos. 8 and 11 of the presentation show the spatial distribution of the Offshore Wind Farm Development in the German North and Baltic Sea. As you will see, the largest activities have taken place in the North Sea, whereas in the Baltic Sea only a few wind parks are currently planned. The EEZ of the North Sea covers 28.520 km², consented and planned offshore wind park projects cover 5.305 km² representing 18,6 % of this area.

OWP that are consented and proposed until now in the entire German EEZ cover an area of about 5.797 km². The German EEZ of the North Sea and Baltic Sea covers 32.970 km², so OWP account for about 17,5 % of the EEZ-area. This is a noteworthy area, I would say. In addition you can see that the Natura 2000-sites designated in the EEZ under the Habitats (green) and Birds Directive (blue). If we combine these areas with those of other projects and activities in the EEZ such as gravel dredging and extraction, installation of grid connections and piping, gas extraction, use for military purposes and shipping routes (slide no. 9), it is obvious that the space still available in the EEZ becomes less and less whilst possible conflicts increase. This becomes even more evident if we include the intensity of fishing as shown in slide no. 10.

Especially after the so-called turn-around of the energy system in Germany in 2011, the Federal Government wants to accelerate the deployment of offshore wind energy as an essential component for an environmentally sound supply of energy and to expand it to 25 GW of installed capacity until 2030. This target will already be exceeded by the offshore wind parks that have already been built or are in process of being built in the German EEZ - at least if one assumes the currently maximum available capacity of a wind energy turbine (WET) to be 5 MW.

Due to the lack of experience concerning the impacts of offshore wind turbines on the marine environment, actually a gradual extension was determined to ensure the precautionary principle was applied by the Federal Government. Research findings concerning best environmental practice and for nature compatible offshore wind farms were meant to set the requirement for the further realisation of wind parks. Nevertheless, the current practice of giving permits does not follow this step-wise wind-energy deployment procedure any more.

Potential impacts of offshore wind farms on the marine biota

Constructing and running wind parks holds some risks for marine biodiversity. The table on slide no. 12 shows potential impacts of offshore wind farms on the marine biota. You can distinguish between "noise impact", which affects especially the harbour porpoise, "habitat loss", which particularly affects resting birds, "collision risk" for migrating birds and bats, and "damage of legal protected biotopes" such as sandbanks or reefs.

These impacts are related to different legal provisions such as the European Habitats and Birds Directives but also to our national nature conservation laws, and have to be taken into consideration within the approval procedure of offshore wind farms. The construction and operation of offshore wind parks in the German EEZ requires an approval under the Marine Facilities Ordinance (Seeanlagenverordnung, SeeAnlV). An approval has to be granted so long as the project does not conflict with shipping, marine environmental, spatial planning or other overriding public interests. The Federal Maritime and Hydrographic Agency (BSH) is the leading approval authority for offshore wind farm development projects in the German EEZ but within this procedure, our agency is responsible for all nature conservation issues.

Offshore wind farm projects comprising more than 20 turbines require an environmental impact assessment based on the Environmental Impact Assessment Act (UVPG). The publication "Standards for environmental impact assessments" constitutes a framework of a minimum of thematic and technical requirements from marine environmental surveys and monitoring. It has been prepared by the BSH and provides information for applicants. This includes all results of investigations required by the approving authority and all relevant explanations in detail. Likewise, holders and operators of wind farms are provided with detailed information about the requirement for operation phase monitoring, which is currently considered to be indispensable.

The objectives are to investigate impacts on features of conservation interest in order to:

- determine their spatial distribution and temporal variability in the pre-construction phase

- monitor the effects of construction, operation and decommissioning
- establish a basis for evaluating the monitoring results.

In the view of the Federal Agency, the requirements of the "Standards for environmental impact assessment" generally satisfy the assessment requirements for impacts on the marine environment caused by offshore wind farms.

The legal framework

Another legal basis relevant for the deployment of offshore wind farms is the Renewable Energy Sources Act (EEG). Its purpose is to increase the share of renewable energy sources in electricity supply and to meet the national targets as shown at the beginning of my speech. It also defines inter alia the tariff paid for electricity gained from offshore installations. The basic tariff amounts to 3.5 cents per kilowatt-hour. The tariff goes up to 19 cents per kilowatt-hour as a "sprinter-bonus" - an economic incentive for rapid implementation of offshore-wind farms constructed until 2018.

No tariffs are paid for electricity from offshore projects licensed after December 2004 within designated Marine Protected Areas (or qualified and identified to become Natura 2000 sites).

A further part of the legal framework regarding construction and operation of offshore wind parks are the provisions of nature conservation. During the last ten years, some legal changes took place with relevance to the German EEZ:

- Since 2002, the provisions of "Natura 2000" apply to the German EEZ.
- Since 2010, legal instruments of the Federal Nature Conservation Act (Bundesnaturschutzgesetz - BNatSchG) such as the protection of species and of biotopes are extended to the German EEZ.

These extensions have to be considered in all approval procedures from then on.

The species protection according to the provisions of the European Habitats and Birds Directives, which have been integrated into our national nature conservation law, prohibits the injury or killing as well as the significant disturbance of wildlife of strictly protected species and the European bird species.

The provisions on legally protected biotopes prohibit measures that may lead to the destruction or any other significant adverse impacts on biotopes listed in § 30 of the Federal Nature Conservation Act. The German impact regulation under the Nature Conservation Act as a national rule has been extended to the EEZ, too. According to this national requirement which has to be applied area-wide, impacts have to be avoided or mitigated with priority, and for the remaining impacts, compensation measures have to be carried out. These rules have been extended also to the EEZ. They have been suspended for offshore wind parks until the 1st January 2017 but have to be applied for cable connections.

The competent authorities are the Federal Agency of Nature Conservation regarding species protection and protection of biotopes, and the Federal Maritime and Hydrographic Agency regarding appropriate assessment reporting/Habitats Directive assessment, and impact mitigation regulation.

Furthermore, the Regional Planning Act plays an important role in the German EEZ. The revision of the Regional Planning Act in 2006 led to an extension of spatial planning to the EEZ under the jurisdiction of the Federal Ministry of Transport, Building and Urban Development (BMVBS) and the Federal Maritime and Hydrographic Agency. The purpose of the Act and the subsequent planning in 2009 is to resolve conflicts between different interests in the EEZ as shipping, fishing, use of wind energy and marine environmental protection. It also serves for identifying suitable areas for the use of offshore wind energy. From the nature conservation's point of view, it is regrettable that this steering tool

hasn't been used more for allocating sites for offshore wind farms which are more compatible with nature conservation.

Research on potential impacts

Assessing and mitigating the impacts of wind farms requires knowledge and research work. Pile driving, as used in the construction of offshore wind farms, is an activity that has the potential to cause injury and/or disturbance for marine mammals and other marine animals.

The noise emission during the pile driving process can have various impacts on marine species, ranging from exposure causing no adverse impacts to behavioural disturbance, loss of hearing and mortality. Furthermore, noise emissions can cause disturbance that is likely to impact upon survival, reproduction, movements and distribution. For harbour porpoises, noise emission from a level of 164 dB causes a temporary threshold shift, which from a legal point of view is considered as an injury. The pile driving process may emit noise at a level of 230 - 240 dB (Peak to Peak) at a distance of 1 m. Pile driving without mitigation measures may lead to displacements amounting to several hundred square kilometres. At present, the level of noise emission that causes displacement is in discussion.

There are several research and monitoring programmes investigating, amongst other questions, the distribution and avoidance behaviour of harbour porpoises. There will be additional monitoring research at a specific test field for gravity foundation. Furthermore, there is research in progress on several technical mitigation measures and around the wind farms.

Operating wind turbines have the potential to affect resting and migrating birds or bats by habitat loss, by collision, or by exhaustion through avoidance behaviour.

Some resting birds, e.g. the most disturbance-sensitive divers (red- and black-throated diver) avoid wind turbines at a range of at least 2 kilometres. This can lead to habitat loss in a larger area and can have a significant impact on the local population. Therefore, for the German EEZ, we have come to the agreement that no future offshore wind farms will be approved in the main area of aggregations of divers. At present not much is known about significant effects on the population of several species or possible adaptation effects at a species level.

Offshore constructions and, in particular, operating wind turbines have the potential risk of collision or exhaustion by avoidance and energy-consuming detours for flying birds or bats. Illuminated structures such as wind turbines with its navigational lights can attract birds and increase the risk of collision even more.

A significant mass collision risk is especially high during phases with bird mass-migrations along with particular weather parameters. In these cases a shutdown of the wind turbines should be considered. Nevertheless the definite extent of the impact on birds and bats are still unknown and there remains a need for research about actual collisions resulting and avoidance behaviour of migrating birds and bats. Possible cumulative impacts in interaction with other projects have also to be taken into consideration. Further research is required on the range of light effects and particularly on the significance of light intensity and light colour. At present, there is a research programme in progress regarding requirements of navigational lights, considering safety aspects as well as mitigation of the collision risk.

Constructing and operating of offshore wind farms have a diverse impact on marine biota and there is also still a lack of knowledge on the magnitude of its effects. However, provisions of nature conservation have to be observed. Therefore, several requirements have to be fulfilled to comply with both European and national environmental law. The relevance of the impact upon protected areas (Natura 2000 areas and protected biotopes) has to be assessed. Furthermore, certain thresholds for significant disturbance of

protected species like the harbour porpoise have to be considered. In particular, certain thresholds for significant disturbance of species have to be considered as well (reference: local population). This obligation exists because in the German environmental law on habitat protection, a prohibition of significant impairment is fixed and has to be respected.

The challenges of handling the lack of knowledge, the still ongoing development of techniques, and the obligation to meet the legal provisions, all remain. The best strategy to comply with the law is to reduce the unavoidable impact as far as possible. But there are also some approaches to solve the conflict between the objective to advance offshore wind energy and nature conservation.

Mitigation measures

The table on slide no. 23 shows examples of mitigation measures for the reduction of impacts from under water noise, e.g. the well-known bubble curtain, which will – when well applied – reduce the sound exposure level by 10 to 15 dB. We generally hold the opinion that bubble curtains can be considered as the best available technology; other promising technical processes are still about to be developed.

To shape the expansion of offshore wind energy use, there is a strong need for different mitigation and avoidance measures. It has been a requirement of the Federal Government since 2002 to realize an offshore wind energy development which is compatible with nature and with the respective laws, giving it full protection. In the first place there is the deliberate choice of sites that are suitable from a nature conservation point of view (e.g. to keep protected areas like Natura 2000 areas, bird migration corridors, aggregation areas of seabirds and harbour porpoises, and protected biotopes clear from any disturbance). Depending on site and project specific facts, there are different additional technical, organisational or constructional avoidance and mitigation measures necessary to protect the marine environment. These are noise input mitigation measures or exclusion of noise intensive construction operations in areas with high abundances of noise sensitive species, particularly at important times such as reproductive seasons of the harbour porpoise. Moreover, a smart management of construction periods of parallel ongoing construction projects is crucial. In addition, environmentally friendly installation methods, "bird-friendly" labelling of the wind energy turbines (WET), and switch-off of WET during heavy migration phases can all contribute to the protection of seabirds, resting and migrating birds and bats.

The development, testing and implementation of further technical mitigation measures to achieve the limit values for noise pollution requested by the nature conservation legislation must receive from our point of view first priority.

Beyond that, there is a strong need for more ecological research regarding both the actual status and the continuous monitoring in the context of particular offshore projects.

This includes research for the development of efficient noise mitigation measures, on the impact of multiple sound reinforcement or parallel pile driving at different sites, and the cumulative impact of long construction phases. Furthermore, until now, not much is known about the impact of noise emissions on fishes and other marine species, for example invertebrates.

Issues to be raised

During this workshop we would like to discuss these points of interest with you, as designated experts in the field of the marine environment. First of all, we would like to know how the approval proceedings are managed in other countries. In which ways are nature conservation aspects involved? Further questions relate to which threshold assumptions are approvals based on? Which mitigation measures are mandatory and actually performed? How is best environmental practice defined? What counts as "state of the art"?

Which species and habitats are relevant? For Germany, relevant species and habitats are marine mammals, resting and migrating birds, bats, legally protected biotopes like sandbanks, riffs, coarse sand areas, and mud grounds with drilling megafauna. Does this coincide with the experiences of other countries?

I wish you all a fruitful symposium with lots of answers and constructive inputs which will bring us further on our way towards a sustainable and nature friendly future energy supply!

ABSTRACTS

SESSION I

Co-ordination of ecological research accompanying the alpha ventus project

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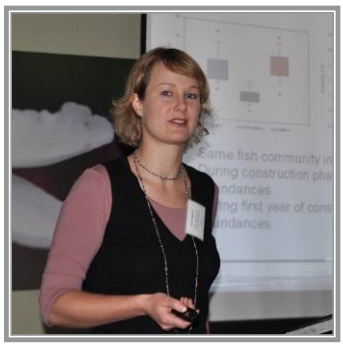
HOMEPAGE: HTTP://WWW.BSH.DE/STUKPLUS



Bundesamt für Seeschifffahrt und Hydrographie (BSH, Federal Maritime and Hydrographic Agency) is in charge of co-ordinating the research project for ecological studies accompanying the alpha ventus offshore project (StUKplus). In the alpha ventus test field, StUKplus supplements the mandatory ecological monitoring carried out by the operator in compliance with the BSH's Standards for Environmental Impact Assessments (StUK3). The ecological research project, funded with €5 million by the Federal Ministry for the Environment (funding number : 0327689A), allows existing Standards to be supplemented in terms of size, scope, and contents. Besides, novel observation methods have been applied for the first time.

The purpose is to obtain additional information about the ecological impacts of offshore wind farms and to evaluate the StUK3 Standard.

A before/after comparison study is carried out as part of effects monitoring. In this context, comprehensive preliminary studies on benthos (bottom organisms), fish, passage migrants, migratory birds and marine mammals were carried out in the test field as early as 2008. Underwater noise measurements have been carried out as well. Comprehensive data are already available from the preliminary studies and construction phase. However, in order to be able to assess responses of animals to the wind farm built in their habitat, long-term studies extending several years into the operating phase of the wind farm will have to be conducted.

How relevant are the effects of wind farm noise on fish?

DR MATHIAS H. ANDERSSON & PROFESSOR PETER SIGRAY

DEPARTMENT OF UNDERWATER RESEARCH, FOI - SWEDISH DEFENCE RESEARCH AGENCY, SWEDEN

There are large gaps in our understanding how fish populations are affected by anthropogenic noise caused by the construction and operation of offshore wind farms. These issues are of great relevance due to the fact that the construction of offshore wind farms will increase all over the world in near future. The hearing range in most fish overlaps in frequency with many anthropogenic sound sources. This could cause negative effects on fish as they use sound for various purposes such as spawning, communication as well as avoiding predators and during navigation.

Construction noise like pile driving creates high levels of sound pressure and acoustic particle motion in the water and seabed. The noise levels are high enough to cause physical injury as well as behavioural reaction and are still audible at tens of kilometres distance. To date, only the US has inferred interim criteria on noise levels hazardous to fish. NOAA Fisheries uses a precautionary approach for assessing, and minimizing, the potential effects on fish. So far no country has any established levels for behavioural reactions in fish.

The operational noise levels are much lower than pile driving however it is a source that is continuously emitting noise for many years and might cause indirect effects that effects the long term survival of the population.

What noise level a fish will be subjected to is determined by several factors such as the noise source level, water depth, sediment characteristics and the sound propagation (temp, salinity) and ambient noise. How a fish will react is determined by the biology of the fish in terms of its hearing ability, behaviour and life history.

This paper makes a summary of possible negative effects from noise on fish, both from pile driving and operational noise. Examples of noise measurements and modelling done at Swedish wind farms are presented as well as experimental studies of behavioural reactions from cod and sole exposed to pile driving noise. A coarse attempt is made to give estimates for zone ranges where injury occurs as well as behavioural changes.

Experiences from the United Kingdom: Monitoring, Modelling and Uncertainty

LUCY GREENHILL, JOINT NATURE CONSERVATION COMMITTEE, UNITED KINGDOM

The presentation looks at the monitoring experience within the UK, and the extent to which this has improved our understanding of the impacts of offshore wind farms. While some specific studies have been informative, project-focussed monitoring has not yet enabled statistically confident conclusions, due to poor definition of objectives and insufficient power of data to detect change attributable to wind farms. Key knowledge gaps remain such as the population level effects of disturbance to marine mammals and actual collision risk to seabirds. Consequently, along with the need for collaboration in gathering of key evidence, there is focus on modelling techniques for predicting impacts, such as displacement modelling, collision risk modelling and population modelling. These are necessary to communicate the risks of offshore wind farms to features of conservation importance and enable decision-making in accordance with the requirements of the Habitats Directive.

SESSION II

Offshore wind energy and marine mammals – Identified issues and perspectives

DR. JAKOB TOUGAARD, DEPARTMENT OF BIOSCIENCE, AARHUS UNIVERSITY, DENMARK

The first offshore wind turbines were installed 20 years ago but during the first 10 years only small scale projects were realised. From 2002 and onwards large scale wind farms began to appear and by now more than 1000 turbines with a total capacity exceeding 3 GW is in operation. Despite this high number and high public and professional concern about possible detrimental effects on marine life, relatively little is known about actual effects on marine mammals of construction and operation. To date the effects on marine mammals has been studied during construction and/or operation in only 6 out of 35 wind farms with 5 turbines or more currently in operation.

Nevertheless, some general conclusions can be drawn from these six wind farms. In most cases pronounced effects on harbour porpoises were seen during construction, in particular in connection to pile driving of steel monopiles for foundations. Pile driving has repeatedly been shown to affect porpoise behaviour at great distances (up to and possibly beyond 20 km) and effects on seal haul-out behaviour have been observed in a single

case. The results were confirmed in a controlled exposure study which demonstrated reactions of harbour porpoises to pile driving impact noise at received levels around 140 re. 1 µPa pp. Effects of operating wind farms are less consistent and range from negative (deterrence) over neutral, to positive (attraction). Noise levels from operating turbines are very low, and it appears unlikely that deterrence can be directly attributed to the noise. This combined with the lack of a uniform response across different wind farms suggests that other factors confound and modulate porpoise reactions to wind farms in operation. In general there appears to be little conflict between marine mammals and operating offshore wind farms, but continued focus should remain on the construction phase, in particular pile driving operations.

The effects of noise on marine mammals: a review and description of a research effort to specify dose-response relationships for behavioural effects of sonar on free-ranging whales

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(6) Institute of Sound and Vibration Research, University of Southampton, United Kingdom
(7) Kelp Marine Research

Intense sounds in the sea have been shown in numerous studies to affect or have the potential to affect marine mammals in multiple ways, including hearing effects and changes in behavior that can potentially be harmful to individuals and populations. The concept of 'zones of influence' fist proposed by Richardson in 1995 is helpful as a framework to evaluate potential risks to marine mammals. Of paramount importance in the assessment of the potential biological significance of intense sounds, such as sonar or pile-driving, is understanding of the amount of habitat over which undesirable effects are expected to occur. Our international research collaboration ('3S') is conducting experiments designed to reveal the thresholds at which free-ranging whales in Norwegian waters start to respond to sonar signals. To date, 15 experiments have been conducted with killer, pilot, sperm, and minke whales. After recording natural behaviour patterns using visual tracking and observations aided by an animal-attached tag, we transmit sonar signals in exposure sessions starting at 6-8 km distance and low source levels. A well-established method for calculating preliminary dose-response relationships for toxicity of newly-developed drugs for humans (Phase-I trials) is well suited to examination of whale-sonar interactions. In our study, killer whales often avoided the sonar source, and the calculated population mean threshold of 140 dB SPL corresponded to 4 km distance. There is continued uncertainty about what aspect of the received sonar signal drives responses, and whether distance from the source modulates responsiveness independently of the received sonar level.

Determination of noise exposure criteria – the German approach

STEFANIE WERNER, UBA, GERMANY

In order to promote the use of windpower as a renewable energy source in the German offshore sector, Germany has licensed, as of January 2012, 25 offshore wind farms with a total of 1787 turbines in the German EEZ of the North Sea and three offshore wind farms with a total of 240 turbines in the German EEZ of the Baltic Sea.

To avoid physical harm to harbour porpoises from pile driving noise, the German Federal Environment Agency (Umweltbundesamt, UBA) recommends the application of a dual criterion for noise protection, which includes first considering safety margins in order to take into account the effects of cumulative exposure. The licensing authority, the German Federal Maritime and Hydrographic Agency (BSH) introduced 2003 standard threshold values for piling noise based on a first advice of UBA. Since 2008 these threshold values are legally binding.

The talk gives an overview about the scientific backup behind the dual criterion for avoiding Temporal Threshold Shift (TTS) in harbour porpoises (Phocoena phocoena) and a short outlook about possible technical mitigation measures to comply with it. Furthermore aspects will be considered which are not yet covered by this approach, such as reflections on physical impairment of other groups such as fish due to pile driving noise and the handling of the second important impact category of behavioural responses.

In addition these national efforts on regulating and mitigating noise from pile driving activities are linked to the implementation process of the Marine Strategy Framework Directive. The MSFD requires Member States to evaluate the inputs from the different continuous and impulsive underwater noise sources waters and assess their singular as well as cumulative impacts on affected marine organisms.

SESSION III

Effects on flying birds in Offshore Windfarm Egmond aan Zee (OWEZ), The Netherlands, an overview of methods and results; cumulative effects as a challenge and reflections on the way forward

SJOERD DIRKSEN, BUREAU WAARDENBURG, THE NETHERLANDS

Offshore wind farms may affect seabirds by causing collisions, barrier effects, or disturbance. In the Dutch North Sea, flight patterns and flight behaviour of birds were studied within the framework of a three-year effect-study in the Dutch Offshore Wind Farm Egmond aan Zee, following a two-year baseline study.

Fieldwork was carried out between 2007 and 2010. Fluxes, flight altitudes and deflection of flight paths of local and migrating seabirds as well as migrating landbirds, were studied with both visual as well as continuous radar observations. A horizontal and a vertical radar were equipped with Merlin software (DeTect Inc.) to allow automated data recording and processing. These radars provided continuous data on flight paths, including data during nighttime and adverse weather.

Flight paths of many different species were registered visually. Interspecific variation in reactions was considerable, while intraspecific variation was low. Reactions of the birds to the wind farm could be separated in four categories. Local birds either did avoid the wind farm (e.g. gannets) or did not (e.g. cormorants attracted to the wind farm from the main

land). Similarly, migrant birds either did (e.g. geese) or did not avoid the wind farm (e.g. terns, nocturnal thrushes).

Seasonal and diurnal variations in bird activity were recorded in both flux and flight altitudes from sea level up to 1.5 km. High altitude passages were mainly nocturnal migratory birds including waders and thrushes. Movements during the day at lower altitudes primarily included gulls, cormorants and alcids.

Although the effects of this wind farm are limited, cumulative impacts of the developments planned may be of significance. In the presentation, our approach to this will be addressed in brief. In order to assess the potential impacts of further wind farms on bird populations within the Dutch sector of the North Sea, a two-step modelling approach was applied. Step one involved constructing matrix-based population models for bird species occurring within the Dutch North Sea. Bird populations included both seabirds and coastal species breeding on the Dutch coast, as well as key passage migrants from populations further away, mainly the coastal areas bordering the international North Sea and further north. This was done for Dutch national populations as well as for international populations on a large regional scale.

Step two involved assessing the ability of the populations to sustain changes in increased mortality. Various wind farm scenarios were modelled in order to provide a range of estimates of increased bird mortality due to collisions. Also for disturbance (via loss of habitat) and barrier effects (via higher energy demands) a semi-quantitative estimate of the impact was made under the assumption that these aspects result in an increased mortality (but on a lower scale than collisions).

Finally, the results will be evaluated: a comparison with predictions and expectations, and a view on the way forward.

This study was commissioned by 'Noordzeewind' (a joint venture of Nuon and Shell Wind Energy).

Does offshore wind farm development result in habitat loss for seabirds?

DR. MARDIK LEOPOLD, IMARES, TEXEL, THE NETHERLANDS

The seas are getting busier. There has been a boom of oil and gas platforms which are relatively small and stationary, but not alone. There is also a web of shipping lanes, getting ever fuller with moving ships. Now, new building sites are being filled with wind turbines which are both stationary and moving. Seabirds that once had the seas for themselves, are being confronted with human activities that occupy increasing proportions of their habitats. Question is: can they deal with this, or our occupancy of the seas simply mean less habitat for seabirds, and ultimately, fewer seabirds? Are the seas filled to capacity with seabirds, or is there room to spare? Are certain parts of the seas of higher value to birds (and to which birds) than other parts, in other words can we build wind farms in places that have relatively little impact on seabirds? And if such information would be available to governments (and it is!), do governments include seabirds into their equations? And should they? Are birds conservative, scared and helpless, or can they learn to live in wind farms, or even learn to exploit them? Are the seabirds of today the same seabirds of tomorrow, or can they surprise us and if they can, how should this impact the planning process of integrating more wind farms into the busy seas of tomorrow? What have we learnt so far and how can and should this help us?

In the Netherlands, we looked at several aspects of this complex problem. We monitored the two existing wind farms from the time before construction (T-0) until the present, more than 5 years later. The next two parks will receive similar seabirds monitoring. As present wind farms are still small and widely apart, impacts in terms of habitat loss are negligible, given the vastness of the sea. There are, however, big plans for the future: 20

more wind farms and maybe very big ones. These would take up much more space, and, on top of this, concentrate shipping in the remaining space. A seabird would find little "empty" space between all these wind farms and shipping lanes in the very worst case scenario. Careful planning of where to build wind farms would thus be good for seabirds. We looked at spatial differences of seabird vulnerability to wind farms, both at a North Sea scale and at the scale of Dutch waters only. Interestingly all of our neighbouring countries tend to plan and build some of their wind farms near our borders, so it would be useful to develop a North Sea wide approach to the problem of at sea wind farm planning.

In the meantime, we are learning from our seabirds surveys. So far, we have seen that avoidance by seabirds of wind farms is mostly less than 100%: some birds do get into the existing wind farms. Avoidance in most species is thus only partial, but also often difficult to measure. Our present wind farms have, quite by accident, been built in an area that was never very attractive for seabirds. Several birds simply do not normally get out there (divers, grebes, seaduck, fulmars), others that are considered vulnerable (auks), have "always" had reduced densities here: from T-0 onwards. Low seabirds densities mean little scope for impact, but also little scope for finding such an impact. On top of this, auks show signs of learning: we have been seeing increasing numbers of both guillemots and razorbills within wind farm perimeters.

How critical is habitat loss?

IB KRAG PETERSEN, AARHUS UNIVERSITY, DENMARK

At present Denmark had large scale operating wind farms for 7 years. Waterbird distributions have been monitored in these areas from 1999, giving way for comparison of pre- and post-construction waterbird distributions. This presentation will present results from these investigations. Common Scoters initially used the area of the wind farm less than they did the surrounding areas, but after 5 years of operation the birds accepted to be present within the turbines. Long-tailed Duck showed reduced densities in the wind farm area, even after 5 years of operation. Divers seems to avoid the wind farm area and a zone around these. None of the bird species studied showed increased densities in the wind farm areas after the installation of the turbines.

A specific challenge is to evaluate the impact on the population level of a displacement of birds. If the conditions for birds are exactly as good in the areas to which the birds are displaced, then an impact on the population level is not expected. But if conditions are worse in the new areas, how do we evaluate if this will apply a population limiting change. We have tested the use of an agent-based model for Red-throated Diver in the Baltic and northern parts of the North Sea to address this question. With this model we could evaluate different offshore wind farm development scenarios and their potential impact on the Red-throated Diver population. Results from this study will be presented.

The low altitude aerial survey line transect method has been challenged as aircrafts are not allowed to operate within the wind farms in several countries. We have therefore developed an image survey method, using very high resolution images obtained from an altitude of 475 m to localize and identify waterbirds. The images are geo-rectified so that birds identified from the images can be displayed with a high geographical accuracy. Birds are found in the images using an automated pattern-recognition system. This method will be shortly presented.

SESSION IV

Making blue energy green – Overview of main issues

DR. TORLEIF MALM, UNIV OF STOCKHOLM, SWEDEN

Increasing energy demands, depletion of oil resources and recognition of the effects of a changing climate resulting from fossil fuel use, require a shift in the balance of energy sources. Off shore wind-power generation capacity is anticipated to grow significantly as the world makes attempts to transition to a lower carbon economy. Engineering solutions now allow terrestrial concepts to be reconsidered in a marine environment. However, any type of energy production will exert some impact on the local and global environment. In reducing the atmospheric impacts from our present energy sources, we must avoid replacing one set of significant impacts with another. Whilst acknowledging that research into the impacts of the off shore wind farm industry is still in its infancy, it is widely regarded that the risk for impacts on the marine environment may not be negligible and must be taken seriously. Wind farms may also be beneficial for the marine environment in several aspects, including trawling exclusion and reduction of eutrophication and marine pollution. Science-based evidence should be used to help guide marine impact avoidance and mitigation. As knowledge and experience builds with further development, the understanding of potential negative as well as positive impacts will improve; in the interim, there is the urgent need to draw on current knowledge. This document assists in addressing this situation.

Implementation and demands of species and area protection with regards to offshore wind farms – an NGO perspective

DR. KIM C. DETLOFF, NABU, GERMANY

Marine wind farms can provide an important contribution to climate protection and energy security. However the rapid expansion of marine renewable energy uncertainly puts risk on marine wildlife and ecosystems. Cumulative and synergistic adverse effects, especially by simultaneous project realizations, have to be considered carefully. Potential adverse impacts are varying, depending on techniques operated and areas affected, ranging from displacement and avoidance to physical injury and death.

The challenge for all stakeholders is to bring offshore wind farm construction and operation in line with national and European species protection laws, in particular the Habitats and the Birds Directive but with obligations from regional Conventions as well (e.g. OSPAR and HELCOM).

Spatial and temporal planning and regional coordination seems to be important to avoid marine ecosystems degenerating to industrial deserts. Marine protected areas designated for endangered species and particular sensitive feeding and breeding grounds have to be excluded from wind farm expansions. Furthermore they have to be safeguarded against far-ranging and cumulative adverse impacts, i.e. noise impacts and barrier effects.

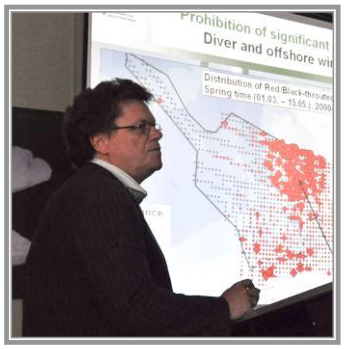
During the construction phase, it seems critical to make progress with mandatory measures to mitigate noise and to promote alternative technologies, such as drilling or floating foundations. Few, but effective high-power turbines (5-6 MW) should be preferred instead of numerous less-efficient ones. But it is not only the construction phase causing risks to marine life. Operating wind farms do cause risks to migrating birds and bats and potentially lead to the dislocation of migration routes.

Effective planning is also essential for the grid connection of the wind farms: An overriding regional concept is needed to connect clusters of wind farms instead of each single wind farm by itself. Cable capacities should be maximized and each cable line should be used for several cables. Protected areas and particular sensitive habitats should be avoided as far as possible.

All wind farm projects have to be complemented by independent conservational effect monitoring. Latest changes in scientific knowledge and technical development have to be acknowledged and implemented in running projects.

Species protection and offshore wind energy – the German approach

THOMAS MERCK, BFN, GERMANY



The development of the use of offshore wind energy in the German parts of the North Sea and the Baltic Sea takes place predominantly in the respective Exclusive Economic Zones (EEZ). With the revision of the German Federal Nature Conservation Act in 2010 most of the regulations that have been in use since decades on land and in the territorial seas have been extended to the EEZ. Following the provisions on the protection of species, amongst others, it is now legally prohibited to injure or kill wild living specimens of the 'specially protected species'. In addition, the disturbance of specimens of 'strongly protected species', is prohibited in case the disturbance impairs the conservation status of the local population of the species concerned.

In the frame of the German approval procedures the prohibition of injury/killing is taken into consideration in particular when assessing the impact of underwater pile driving noise on marine mammals and the risk of resting and migrating birds (and bats) to collide with the rotor blades and the tower. To prevent injuries of marine mammals a threshold noise level is currently applied. Suitable site selection is one of the mitigation measures applied to avoid significant additional mortality of migrating birds.

To prevent sensitive sea birds, such as sea divers, to suffer habitat loss due to disturbance by operational offshore wind farms no further offshore projects will be approved in the main spring-time resting area of these species in the German North Sea. In this context, the pile driving noise again is one of the key aspects. Noise-induced disturbance will displace, at least temporarily, marine mammals from their habitats. To avoid such disturbance becoming significant it is currently being discussed to restrict pile driving in some areas in certain times of the year.

Due to the still developing knowledge of how the construction and operation of offshore wind farms impact marine species a number of ecological research projects are being granted by the German authorities.

Species and area protection with regards to offshore wind farms

DR. FOLCHERT VAN DIJKEN, MINISTRY OF ECONOMIC AFFAIRS, AGRICULTURE AND INNOVATION, THE NETHERLANDS

The southern part of the North Sea is one of the most intensive used seas in the world. Increasing shipping traffic, seismic exploration and the destruction of the debris of the last war (detonation of mines etc.) contributes to a rise in noise above and below the sea surface. In the first decennia of the 21th century the construction of wind farms are planned in the Netherlands economic zone of the North Sea. International agreements require good environmental status for the ecosystem.

The impact of the underwater noise upon sea mammals is hardly known and therefore a masterplan was developed by the leading authorities to formulate a list of priorities of the research questions, to fill in crucial gaps in our knowledge. The Ministry of Infrastructure and Environment and the Ministry of Economic Affairs and Innovation assigned the research which scientists and policy makers stated as the most urgent. A short list with the most critical research questions was distilled from the longer list and the investigations started in 2010.

The Marine Strategy Directive, OSPAR and the ASCOBANS agreement all focus on the sound production as one of the main potential causes for the deteriorating of the sea ecosystem. Seamammals are at the top of the food chain and therefore their wellbeing is an good indicator of the level of a good environmental status.

The Netherlands therefore started in cooperation with stakeholders a process to make a Harbour Porpoise Protection Plan. This plan with the support of the stakeholders has been presented to the Minister of EL&I and the recommendations for scientific research on the impact of sound on *Phocoena phocoena* will be executed in the next years. Research on monitoring and assessing the presence and distribution of the porpoises in the Netherlands part of the North sea will be intensified, and studies on hearing of sound by the porpoises will continue.

SESSION V

The licensing procedure in Germany

SIMONE VAN LEUSEN, BSH, GERMANY

So far the Federal Maritime Agency has granted 28 approvals for offshore-windparks in the German Exclusive Economic Zone (EEZ) of the North Sea and the Baltic Sea, currently another 83 applications are being processed. In the presentation I will describe the application and execution process as well as the spatial plan as background for the planning and the cable connection to the mainland.

A major focus within the regulatory planning and realisation progress is on nature conservation. Extensive investigation and monitoring programs are compulsory. Threat to marine environment is one of the aspects in the Marine Facilities Ordinance (Seeanlagenverordnung) that can lead to the decline of an application for an offshore windpark. In addition there are legal requirements in the Federal Nature Conservation Act as well as the European Bird and Habitat Directives with regard to site, species and biotope protection.

The approvals contain numerous standard regulations with regard to nature conserva-

tion. Examples will be made, especially regarding protection and mitigation measures. A lot of effort is made by the industry to develop mitigation measures to reduce noise immissions during construction. Examples for techniques and results will be given. Also a testing area for turbines founded on heavy weight foundations is being planned. The concept will be described.

Offshore wind & the environment: the UK planning system

EMMA COLE, DECC, UNITED KINGDOM

The UK government is committed to deploying renewable energy as a means of reducing carbon emissions (we have a legal obligation to do this) and increasing energy security. Offshore wind will play a major part in meeting our 2020 renewable energy targets, and in decarbonisation beyond 2020. There is also great economic potential, with offshore wind bringing investment and jobs. The UK is the market leader in deploying offshore wind, with the Department of Energy and Climate Change's (DECC) 2011 Renewable Energy Roadmap setting out the potential for 11-18GW of capacity by 2020.

Environmental impacts of offshore wind deployment are managed through a several, linked processes. DECC conducts Offshore Energy Strategic Environmental Assessments, which make recommendations about siting offshore wind farms as well as research gaps and the need for mitigation measures. The Crown Estate (TCE) – landlord of the seabed for this purpose – issues lease options or agreements for lease, for development of specific areas of the seabed. This has been done in 'rounds', which have mainly been shaped by developer interest, though the largest, Round 3, is different, with TCE identifying large zones within which developers then identify project locations. Once a developer has a lease agreement, they must go through several processes leading up to application for planning consent. This includes: preparing an Environmental Statement (Environmental Impact Assessment); gathering information to inform an Appropriate Assessment, where relevant; preparing a Statement of Community Consultation; and preparing a draft Development Consent Order (monitoring and mitigation measures are likely to be proposed at this stage).

Applications for consent are considered by different authorities depending on where in the UK a project is located, and on the size of the project. Planning decisions on projects in English and Welsh waters are framed by National Policy Statements on energy. These clarify the national need for new, significant infrastructure energy projects (including offshore wind farms), and advise the decision-making authority about the impacts and acceptability of new energy developments, and how impacts should be mitigated. The UK Government and Devolved Administrations continue to look for ways of improving and speeding up the planning process.

Some key challenges going forward include: understanding and assessing cumulative impacts, and impacts on mobile species (particularly birds and marine mammals); making sure projects are not unnecessarily restricted by designation of new protected areas; and implementing the Marine Strategy Framework in a way which does not unnecessarily restrict deployment of renewables.

The Netherlands licensing procedure offshore wind farms

SANDER DE JONG, RIJKSWATERSTAAT NOORDZEE - THE NORTHSEA DEPARTMENT OF THE AGENCY FOR INFRASTRUCTURE AND ENVIRONMENT, THE NETHERLANDS.

The licensing procedures for offshore windfarms in the Netherlands is very much in development. At this moment applying for a permit to build an offshore windfarm is impossible. The government stated that with the recent 12 new permits (possible 3000 MW) and only financial support (subsidy) for 3 permits (720 MW) it is not feasible that more permits will lead to more offshore wind.

The current political climate is not much in favour of (expensive) offshore wind. In 2015 it is possible that offshore wind will get a new financial boost when its clear that offshore wind is necessary to meet green energy targets but that is not clear at the moment.

Furthermore, the basic principles of licensing offshore windfarms is likely to change in the future. Where in Round 1 and Round 2 the companies that applied for a permit were allowed to find their own space with an important constraint that it must be free of other spatial constraints such as shipping lanes, sand extraction areas, offshore oil and gas production, cables and pipelines, etc.

For the future Round 3 areas are designated for large offshore windfarms. But without new green energy targets and the necessary means of subsidies or other financial support it is not likely that those designated areas will be opened for permit application.

The most recent Round 2 permits brought challenges for shipping, helicopters used for offshore mining and ecology. In environmental studies (eia) cumulative effects could not be ruled out and therefore mitigational measures were necessary. This lead to some denials for permits and to restrictions for piledriving in the 11 of the 12 permits that could be issued. Piledriving is only allowed in the period 1 july - 31 december to avoid impact on fish larvae and seals / harbour porpoises. The restrictions are based on desktop studies and are currently reviewed with ecological research.

SESSION VI

Noise mitigation measures & low-noise foundation concepts - state of the art

TOBIAS VERFUß, PTJ, GERMANY

Underwater noise in the seas increased substantially in the past decades. This is caused by a variety of sources, i. a. boat traffic, seismic surveys, military sonar use, and last but not least impact pile driving associated with the installation of numerous offshore wind turbine foundations. With regard to marine mammals and fish, piling noise is considered as major environmental impact: Strong impulsive sounds can damage or even kill marine animals in the vicinity of the sound source, and sensitive species may be displaced from their habitats. To avoid or at least reduce these adverse impacts on the marine environment, the German regulatory authority for offshore wind farms BSH requires the industry not to exceed a sound exposure level (SEL) of 160 dB re 1 µPa and a peak level (Lpeak) of 190 dB re 1 µPa at a distance of 750 m from the emitting source. This dual threshold criterion was derived by investigations on harbour porpoises.

The compliance with this demand commits the offshore industry either to use noise miti-

gation measures for jackhammers, or to apply low-noise foundation concepts like gravity based foundations or drilling technology for monopiles. In the recent years, many R&D efforts have been made to develop and test effective noise mitigation systems like bubble curtains, noise mitigation screens or hydro sound dampers. Nevertheless, real scale experience in the harsh offshore environment was widely lacking. In 2008 and 2009, two prototype bubble curtains were successfully applied during the installation of the FINO3 research platform and the piling of a tripod foundation at the wind farm alpha ventus. Even though a noise reduction of 12 dB (SEL) and 14 dB (Lpeak) was achieved, the defined threshold level was still exceeded. Nowadays, promising noise mitigation systems and low-noise foundation concepts emerge from the prototype stadium to qualified solutions. Based on new results from offshore tests at the German wind farm projects Borkum West II and BARD Offshore 1, as well as a comparative study in the Lübeck Bay in 2011, it seems just a question of time that some of them can be described as state of the art.

Migrating birds and offshore wind turbines: How to reduce collisions and avoidance behaviour?

REINHOLD HILL, AVITEC RESEARCH GBR, GERMANY

Possible effects of offshore wind farms on migrating birds are currently a major topic of debate. Regarding plans for the establishment of high numbers of offshore wind turbines in the German Bight (North Sea), this issue is of direct concern to a very important area along the East Atlantic Flyway which is frequented twice a year by millions of migrating birds, which have been declared a protective good.

Within the framework of scientific projects at two research platforms in the North Sea, FINO1 located in close vicinity to the first German wind park "alpha ventus", and FINO3, and environmental impact assessments studies potential impacts have been identified and data recorded in long-term monitoring programmes from previous years onward up to date and ongoing. Methods of data collection include: visual and acoustic observations, vertical and horizontal scanning marine radars, video systems, thermal imaging devices and ultimately, the number of dead animals found on the research platforms.

The results show actively migrating birds to be at risk of collision with vertically erected anthropogenic structures. Although collision events may be rare, single mass-collisions affect high numbers of different bird species. Especially thrushes (Turdus sp.) but also other short- and medium distance migrants appear highly affected. Conversely, long distance migrants are clearly underrepresented. The reasons here for are not known.

Investigations so far have shown that weather conditions in correlation with nightly illuminated anthropogenic structures are influencing the birds' risk of collision. While the respective weather conditions may be obvious and easily characterized (e.g. cloud cover, reduced visibility, strong winds), the effective mechanism of illumination remains widely unclear. Therefore collision mitigation at night is still very difficult.

We further provide information on the avoidance behaviour of birds migrating at day. Species diversity of migrants observed in areas with wind turbines were clearly reduced compared to those areas without turbines. Analyses revealed potential species specific differences in avoidance behaviour. Further analyses will concern the underlying mechanisms of avoidance behaviour.

GP Wind Project: Good Practice Guide & Toolkit

BRUNO CLAESSENS, APERE ASBL, BELGIUM

The GP WIND PROJECT

Launched on 1 August 2010, GP WIND is an Intelligent Energy Europe (IEE) funded project which aims to reconcile the development of onshore and offshore wind energy projects with environmental objectives.

The project consortium, lead by the Scottish Government, brings together industry and project developers, regional and local authorities, environmental agencies, NGOs and academia from 8 European countries (Belgium, Spain, Ireland, Italy, Malta, Norway, Scotland and Greece).

PROJECT SCOPE :

The GP WIND project addresses barriers to the development of onshore and offshore wind generation. By recording and sharing good practice, GP WIND will help developers, regional and local authorities, environmental agencies and NGOs to reconcile wind energy development with the wider environmental objectives and to involve communities in planning and implementation.

By bringing together stakeholders from different countries to share experiences, GP WIND partners are developing a good practice guide and a 'how to' toolkit, which will be used to facilitate deployment of renewable energy in support of the 2020 targets.

The case GP Guide and Toolkit will be based on 16 case studies, the theme of which was chosen by the partners as representing the main issues of concern under the overarching theme of Environment and Communities.

The 16 themes are:

1. Species impact offshore and onshore
2. Impact on habitats
3. Biodiversity
4. Tackling cumulative impact issues
5. Systems and process for monitoring impacts; Examples of environmental mitigation techniques
6. Carbon accounting for wind farms
7. Construction and operation of facilities in the marine environment
8. Offshore - Human commercial activities: fisheries, marine industries, seabed issues, landfall sites
9. Communications, awareness, information cascades
10. Landscape & managing visual impact
11. Dealing with noise issues
12. Conflict with other economic interests including tourism
13. Community concerns and acceptance - how to achieve buy-in
14. Community benefit schemes
15. Dealing with complex or entrenched public perception issues
16. Undertaking socio-economic impact assessment

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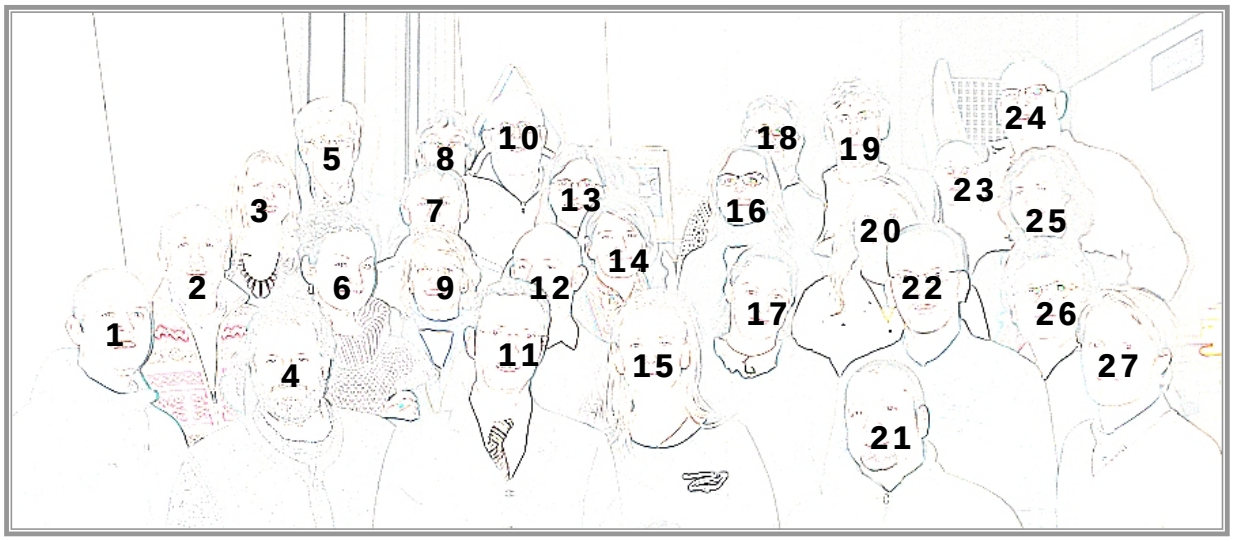

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