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SEESCHIFFFAHRT
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HYDROGRAPHIE

Standard

Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK 3)

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in co-operation with:

Dr. Jochen Bellebaum
Dr. Klaus Betke
Axel Binder
Dr. Maria Boethling
Dr. Uwe Böttcher
Alexander Darr
Ansgar Diederichs
Dr. Volker Dierschke
Dr. Siegfried Ehrich
Dr. Michael Exo
Marcus Fleck
Joachim Gabriel
Dr. Stefan Garthe
Dr. Manfred Schultz von Glahn
Dr. Jens Heuers
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Malte Hoffmann
Anton Homm
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Dieter Todeskino
Ursula Verfuß
Dr. Helmut Wendeln
Scott Wischhof
Dr. Gerd-Peter Zauke
Catherine Zucco
Dr. Manfred Zeiler

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Part A - Framework conditions

1 Preliminary remarks

Within the framework of the approval procedure for offshore wind farms in the Exclusive Economic Zone (EEZ), potential adverse impacts of the planned facilities on the marine environment have to be assessed. Besides, following the amendment to the Seeanlagenverordnung effective 5 April 2002, an Environmental Impact Assessment according to Art. 2a, Seeanlagenverordnung, is now mandatory for most projects. In the Standards for Environmental Impact Assessments, information is provided to applicants on the scope of investigations required by the approval authority, with all relevant details and explanations. Likewise, the approval holders and operators of wind farms are provided with detailed information about the requirements for operation-phase monitoring, which is currently considered indispensable.

The Standards for Environmental Impact Assessments constitute a framework of the thematic and technical minimum requirements for marine environmental surveys and monitoring under Art. 3, Seeanlagenverordnung, as well as for monitoring during the operation phase.

The second update of the Standards for Environmental Impact Assessments is based on experience that has been gained with the versions of 20 December 2001 and 25 February 2003, and on data from the surveys that have been made. Apart from a general increase in knowledge, the findings of environmental monitoring carried out under the German Federal and State Monitoring programme (Bund/Länder-Messprogramm, BLMP) in the North Sea and Baltic Sea, the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area, and the OSPAR Convention for the Protection of the North Sea and North-East Atlantic have been taken into account.

The following international documents based on mutual exchange of information have been published:

OSPAR Commission, 2003: Guidance on a Common Approach for Dealing with Applications for the Construction and Operation of Offshore Wind Farms. Reference Number: 2003-16.
OSPAR Commission, 2004: Problems and Benefits Associated with the Development of Offshore Wind Farms. ISBN 1-904426-48-4.
OSPAR Commission, 2005: Guidance on Assessments of the Environmental Impacts of, and Best Environmental Practice for, Offshore Wind Farms in Relation to Location. Reference Number: 2005-02.
OSPAR Commission, 2006: Guidance on Offshore Wind Farms in relation to Assessments of the Environmental Impacts of Construction and Best Environmental Practice for Construction. Reference Number: 2006-5.

It should be noted that this Standard, as well as its earlier versions, has been developed in consultation with numerous experts. The fact that various concepts discussed in the course of the decision-making process have not been considered in the Standards for Environmental Impact Assessments does not imply any criticism of such concepts. The approval authority, after having consulted the experts and studied the different concepts, in each case selected one of several possible solutions and also allowed alternatives considered suitable for the procedure.

2 Possible adverse impacts

Regarding possible impacts of offshore wind farms on the marine environment, various risks have been identified for the construction, operation, and decommissioning phases. They can be summarized as follows:

2.1 Construction phase

- Visual and acoustic effects
- Annoyance by vehicles/vessels and machinery during construction
- Loss of habitats (e.g. resting and feeding areas) due to construction activities
- Pollutant emissions
- Turbidity of water due to sediment disturbance during foundation installation, cable laying and anchoring/propping of vessels and machinery on the seabed.

2.2 Operation phase

- Visual impact and annoyance due to noise emission of turbines during operation
- Shadow flicker from rotor blades
- Vibration
- Additional electric and magnetic fields
- Land use by the required infrastructure (foundations, cables etc)
- Potential discharge of pollutants (oils, greases)
- Changed sediment distribution and dynamics
- Changed current patterns
- Impact on water quality
- Collisions of birds with wind turbines
- Barrier effect on fauna (e.g. barrier effect on birds during migration, or blocking of paths between different resting and/or feeding areas
- Disturbances (e.g. birds, long-term loss of resting and feeding areas)
- Adverse impacts of maintenance and repair operations.

2.3 Decommissioning phase

- Visual and acoustic annoyance
- Annoyance from vehicle and machinery operation during dismantling activities
- Loss of habitats (resting and feeding areas) due to decommissioning activities
- Pollutant emissions
- Turbidity of water due to sediment disturbance during the dismantling of foundations (piles), lifting of cables, propping/ anchoring of vehicles and machinery on the seabed.

3 Objectives

Investigation of impacts on features of conservation interest, i.e. fish, benthos, birds, and marine mammals in order to:

- determine their spatial distribution and temporal variability in the pre-construction phase (baseline survey)

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

The purpose of the preliminary fish studies is a quantitative determination of near-bottom stationary fish species to the extent that suitable methods are available.

4 Deviation from the Standards for Environmental Impact Assessments, updates

If it is found during data acquisition and evaluation that parts of the monitoring programme are inadequate or dispensable, either with respect to the locations chosen or for any other reason, or if it is found that programme implementation is either impossible, is not feasible in the proposed way or would require disproportionate effort and expense, the approval authority may modify the monitoring programme in general or in individual cases.

In case a Strategic Environmental Assessment is available for the project area which has been prepared as part of a procedure under Art. 3a Seeanlagenverordnung (Marine Facilities Ordinance) or Art. 18a Raumordnungsgesetz (Regional Planning Act), its results shall be taken into account when determining the scope of investigations for the particular project.

Justified deviations from the concept, e.g. due to experience gained or an improved knowledge base, may be applied for or made mandatory at any time.

5 Quality assurance

For a proper evaluation, the collected data must be correct and comparable.

Persons taking part in the surveys must have adequate qualification and expertise and must be able to prove it. The names of the observers have to be noted on the survey forms.

In the planning and implementation of monitoring programmes at sea and in the evaluation of results, currently valid national and international scientific standards shall be applied. Quality requirements have to be met. Participation in quality assurance programmes, national and international inter-laboratory tests and in quality assurance workshops or programmes is required.

Ship surveys of sea birds are only allowed to be carried out by teams which have at least received instructions or preferably intensive training, e.g. by members of ESAS (Garthe et al. [2002]).

With respect to aircraft surveys of sea birds, it is essential that the observers have a secure knowledge of bird species and are familiar with aerial counting. New observers, therefore, first have to be trained in the counting method during training flights (Diederichs et al. [2002]).

Observers in radar surveys must have received instructions in radar technology and optimal operation of radar equipment from an experienced radar observer (Hüppop et al. [2002]).

The contents and implementation of such instructions have to be documented.

Proof of adequate qualification in the field of noise and vibration has to be furnished (e.g. accreditation according to DIN EN 45001 for noise and other measurements of wind turbine emissions).

6 Pilot phase

The purpose of pilot phases involving a limited number of turbines is the collection of data on the environmental compatibility of possible expansion phases. Prior to and after the pilot phase, baseline surveys and monitoring have to be carried out following notification of the probable scope of the investigations on the basis of the Standards for Environmental Impact Assessments. The scope of monitoring depends on the results of the baseline surveys, taking into account experience gained in the process.

If a national spatial planning scheme, based on implementation of a Strategic Environmental Assessment and hence legally corroborated, is in place for the area covered by the pilot and expansion phases, the requirements for operation-phase monitoring may be reduced depending on the environmental data available. Operation-phase monitoring in the above-mentioned areas is not compulsory as a prerequisite to further project planning.

7 Expansion phase

For every expansion step following the pilot phase, baseline surveys and monitoring in accordance with the Standards for Environmental Impact Assessments will be mandatory. Any modifications under item 4 above will be included in the notification concerning the scope of monitoring. If a national spatial planning concept, based on implementation of a Strategic Environmental Assessment and hence legally corroborated, is in place for the area covered by the pilot and expansion phases, the requirements for operation-phase monitoring may be reduced depending on the environmental data available.

8 Removal phase

The wind turbines including their foundations have to be removed completely, with subsequent onshore disposal.

In principle, the monitoring requirements during this phase correspond to those in the construction phase as specified in the Standards for Environmental Impact Assessments. Possible environmental impacts depend mainly on the dismantling techniques used, which are expected to undergo major developments during the coming decades when numerous oil and gas platforms are due for decommissioning. Therefore, the scope of monitoring will be determined at a later date.

9 Landscape

Within the framework of the baseline survey preceding the pilot phase, a photorealistic simulation (text and visualisation) of the landscape affected by the project has to be presented, unless the project is located farther than 50 km from the nearest point on the coast.

The visualisation should include the following:

- visualisation from coastal sites close to the project location, both at beach level and from prominent points (lighthouses, beach promenades, seawalls etc.)
- visualisation of the first expansion stage/pilot phase and of the entire wind farm in its fully expanded stage
- visualisation under conditions of optimal visibility
- visualisation shall be made from a normal perspective, i.e. no wide-angle or tele lens perspective
- visualisation with scale bar (2.40 m high, 20 cm scaling, 7 m distance from the observer) in the foreground (to demonstrate size relations)

- turbine hub height and distance between the observation point and the wind farm (kilometres) as well as position and height of the observation point, to be shown at the lower edge of the visualisation image
- presentation of an outline map indicating angle of vision.

10 Risk analysis

A state-of-the art risk analysis assessing the probability of a ship collision with a wind turbine, including an exemplary study of the consequences of a potential pollutant spill, has to be carried out and presented in the framework of the baseline surveys; the standard requirements issued by the guidelines working group of the Federal Ministry of Transport, Building and Urban Affairs have to be taken into account.

11 Procedure for the implementation and evaluation of studies relating to the construction and operation of offshore wind farms

Application for the erection of offshore wind turbines

Presentation of the following documentation:
- Literature study to characterise the planning area
- Proposal of an investigation programme in accordance with the Standards for Environmental Impact Assessments.

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Environmental Impact Assessment - baseline survey: a) preliminary studies

- Characterisation of the planning area in order to determine the project area, monitoring programme, and reference areas for the features of conservation interest.

↓

Environmental Impact Assessment - baseline survey: b) status assessment

- Investigations prior to the start of construction to characterise the environmental features of the project and reference areas, particularly with a view to species communities and their seasonal dynamics.

↓

Environmental Impact Assessment - monitoring of construction phase

- Investigations in the project and reference areas to assess impacts of the construction phase on the marine environment.

↓

Environmental Impact Assessment - monitoring of operation phase

- Investigations in the project and reference areas to assess impacts of the operational phase on the marine environment.

12 Assessment period

The following assessment periods apply to all projects:

12.1 Baseline survey

Prior to the start of construction, in accordance with the Standards for Environmental Impact Assessments, a baseline survey has to be performed which covers the investigations made during two successive, complete seasonal cycles, without any interruption. One seasonal cycle comprises 12 calendar months including the month in which the survey begins.

The baseline survey remains valid for two complete years. If construction work is not begun in the third year after completion of the baseline survey, the baseline survey normally has to be updated with an additional seasonal cycle. Other details regarding the follow-up period will be dealt with in the individual case.

12.2 Construction phase

The construction phase covers the period from the start of construction work until completion of the construction project. Construction-phase monitoring has to be performed throughout this period. If essential components are put into operation prior to completion of the construction project, operation monitoring in the project section concerned may be started in co-ordination with the approval authority. However, it must be ensured that such continued construction activities do not have a significant impact on the results of operation monitoring. The precise time for stopping the construction monitoring will be determined by the approval authority in each individual case.

12.3 Operation phase

The Standards for Environmental Impact Assessments define the operation phase as the phase following the completion of construction work, as soon as the wind turbines have been put into operation. After the wind farm has become operational, operation-phase monitoring has to be performed for a period of at least three years or, if required, up to five years in the entire project area in order to verify the assumptions made in the approval (EIA). The start of operation monitoring will be determined by the approval authority in each individual case. Any additional marine environmental protection measures which are later found to be necessary on the basis of latest findings and/or the results of operation-phase monitoring shall be included in a suitable way in the monitoring schedule.

13 Assessment areas

In each assessment area, the project area has to be distinguished from the reference area. In either case, the scope of assessment (type, purpose, and duration) shall not exceed applicable state-of-the-art scientific and technical requirements. When indicating the size of a project area, the safety zone should not be included. The individual features of conservation interest require different assessment areas in terms of size and location. If legal or factual circumstances are such that the standard size of assessment areas as defined below appears to be inadequate or unsuitable, such assessment areas shall be adjusted to local conditions by the approval authority.

The investigations prescribed in these Standards for Environmental Impact Assessments are mandatory for each developer. However, the requirement to carry out the mandatory investigations can also be met jointly by several developers in a particular area if the approval authority is of the opinion that a

jointly conducted investigation meets the requirements of the Standards for Environmental Impact Assessments with respect to the particular features of conservation interest taking into account spatial, temporal and material aspects, and provided that the area and the data to be collected for the individual features of conservation interest are sufficiently representative of all projects concerned.

13.1 Project area

13.1.1 Benthos / fish

The size of the assessment area corresponds to that of the project area.

13.1.2 Avifauna

- Aerial counts:
  The area including the reference area must cover at least 2,000 km²
- Ship based counts:
  The assessment area of a project area must cover at least 200 km² in principle.

Each project area must be surrounded by a 2 nm wide assessment area.

13.1.3 Marine mammals

- Aerial counts:
  The assessment area including the reference area must cover at least 2,000 km² and the assessment area should have a rectangular shape.
  The project area should be located in the middle of the assessment area if possible. The distance between the boundaries of the wind farm and those of the assessment area must be at least 20 km.
- Ship based counts:
  The assessment area has the same size as the assessment area for bird surveys (see 13.1.2).

13.2 Reference areas

Reference areas will be used for comparison, to document the development of features of conservation interest without the impact of wind turbines and to allow the impacts of offshore wind turbines to be identified. Investigations may be carried out jointly by several developers if a particular reference area is suitable for the project areas concerned, provided that the approval authority agrees.

Reference areas should be located outside the planning areas for other development projects. Moreover, they should be suitable for projects to be implemented at a later date. The natural ambient conditions in the reference area (location, current conditions, water depth, sediment properties, distance from the coast, size, species spectrum, number of individuals) should be comparable to those in the project area concerned. The reference area should be free of any direct influences from wind turbines.

If a reference area is located in the planning area for other projects, the following shall be taken into account:

- the distance must be large enough to avoid any significant impacts of the construction projects, and

- a reference area is required for each individual project. Reference areas used for several projects are acceptable if the natural conditions are comparable and the spatial, temporal, and material requirements of the Standards for Environmental Impact Assessments are met.

The individual features of conservation interest require reference areas of different size, location, and quality.

13.2.1 Benthos / fish

The size of the reference area should correspond to that of the project area. If the habitat of the project area is very heterogeneous (e.g. different sediment properties, hydrography or water depth), a reference area should be chosen which has a very similar habitat pattern. If such conditions do not exist in a single reference area, the reference area may also be composed of several smaller areas whose habitat patterns, in combination, correspond to that in the construction area. The individual areas should be located as close together as possible.

The reference area should be located in the vicinity of the project area but should be largely free of any impacts from the construction area. This implies also that it must be outside the propagation range of operational noise from the wind farm. To what extent wind farms affect the individual features of conservation interest often cannot be determined prior to the operation phase. Therefore, the minimum distance should be 500 m for benthos (infauna) and 1 km for fish and epifauna.

Anthropogenic influences in the reference area should be comparable to those in the construction area but without the impact of the construction activities, turbine operation and related activities.

The location of reference areas for macrozoobenthos and fish should be largely identical.

13.2.2 Avifauna

- Aerial counts:
  see project area (13.1.2)

- Ship based counts:
  The size of the reference area corresponds to the size of the assessment area for the project area.

13.2.3 Marine Mammals

- Aerial counts:
  see project area (13.1.3)

- Ship based counts:
  The size of the reference area corresponds to the size of the assessment area for the project area.

14 Reporting

The results of the baseline surveys and monitoring have to be submitted to the approval authority in the form of comprehensible expert reports. The complete raw data and investigation documents in their original form shall be stored in a suitable way by the applicant or holder of the permit and shall be made available in whole or in part to the approval authority upon request. Different storage arrangements for the raw data may be agreed with the approval authority. The data formats to be used have to be agreed with the approval authority.

14.1 Baseline surveys

After completion of the baseline surveys, an Environmental Impact Assessment (EIA) shall be presented to the approval authority. If an EIA has already been made on the basis of a study covering one annual cycle, it has to be supplemented with the data of the second annual cycle. The research data shall be provided to the approval authority upon request, but not later than the date on which the EIA is submitted.

If the planning area is located in a National Park or in its vicinity, in a Marine Protected Area or in an area that has been classified as ecologically valuable by conservation experts, an FFH study must be submitted in addition to the EIA in order to obtain approval (Art. 34, BNatSchG - Federal Nature Conservation Act).

14.2 Monitoring

The monitoring data shall be presented to the approval authority once a year, four months after completion of the annual cycle in each case. The monitoring data shall include a documentation of the status before the construction phase and of developments and changes during and after the construction phase.

On the basis of the monitoring results, the approval authority will decide on the type and scope of further investigations. Unless the applicant or permit holder in charge of the investigations proposes further investigations differing from the scope of investigations specifed in the notification and from the present Standards for Environmental Impact Assessments, the existing arrangements and monitoring periods specified in the Standards for Environmental Impact Assessments shall continue to apply.

Part B - Technical instructions for surveys of features of conservation interest

Features of conservation interest

Technical details of the investigation and monitoring to be carried out in order to protect the features of conservation interest, i.e. benthos, fish, birds, and marine mammals, will be provided in the following. The scope and targets of the investigations, methods to be used, and the evaluation basis are described for each of the features of conservation interest.

1 Benthos

The benthos investigations and monitoring comprise:

- investigation of the sediment and habitat structure and their dynamics using side scan sonar and sediment sampling (Table 1.1)
- investigation of epifauna using video equipment and beam trawl/dredge (Tables 1.2 and 1.3)
- investigation of infauna by means of grab sampling (Table 1.4)
- investigation of fouling on the underwater structure (Table 1.5)
- investigation of macrophytobenthos, if present in the area investigated (Table 1.6).

During the above investigations, measurements of salinity, temperature and oxygen levels have to be carried out at the sea surface and near the bottom in order to obtain a representative picture of the hydrographic situation in the area.

Additionally, the sediment properties
- grain size distribution (silt/clay, fine sand, medium-grained sand, coarse sand, gravel/rubble) and
- organic carbon content

have to be determined per station and throughout the assessment period.

The investigations should be carried out at the same time as the fish investigations if possible, but mutual disturbance should be avoided.

In homogeneous sandy areas, side-scan sonar surveys have to be carried out with 500 m spacing. Areas with a heterogeneous sediment structure have to be covered completely by the surveys.

The results of the sedimentological and benthological investigations should be combined in a single study.

Table 1.1: Side scan sonar (SSS) survey of sediment and habitat patterns and their dynamics

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Investigation of bottom morphology and type of substratum for benthos programme planning and interpretation of benthos data. Verification by means of video and/or grab sampling (ground truthing).	In the case of heterogeneous distributions, control survey to identify possible changes	Determination of substratum for benthos data interpretation	Determination of substratum for benthos data interpretation
Scope	Before deciding on the sampling design, an SSS survey of the seabed has to be made in order to determine the characteristic sediment structure (complete area should be covered if possible, with a transect spacing of 500 m as a minimum).	SSS survey covering the complete project and reference areas if possible (with a track spacing of 500 m as a minimum).	Surveys in the area of the single installations scheduled for biological studies. SSS transect lines to be run only in areas with heterogeneous sediment. Use of studies based on Geotechnical Site Investigation Standard.	Surveys in the area of the single installations scheduled for biological studies. SSS transect lines to be run only in areas with heterogeneous sediment. Use of studies based on Geotechnical Site Investigation Standard.
Timing	Once.	Once a year after the winter season if required.	As required.	As required.
Method	Side scan sonar (SSS) vessel speed max. 4 knots.			
Presentation of results	Maps of bottom morphology and substratum type (GIS format with the specifications: latitudes and longitudes in WGS84).			

Table 1.2: Video survey of epifauna

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Baseline description of epifauna in the project area and determination of a suitable reference area.	Medium and small scale survey of status quo ante as a basis for evaluating potential impacts of wind turbines.	Medium and small scale survey of impacts from construction activities.	Medium and small scale survey of impacts in the operation phase.
Scope	Representative use of underwater video equipment in areas with heterogeneous habitat pattern, near beam trawls (small beam trawl) and/or dredges and at grab sampling stations.			
Timing	Together with the other benthos investigations.			
Method	Video transects of about 15 - 30 min duration with a drift velocity of max 1 knot, geographic positioning of the transect and/or photo (high-resolution 6x6 camera) with 10 to 20 photos per station. The video surveys should be made using a digital camera, with each picture showing the station number, GPS data, date, and water depth if possible. At least the geographic positions have to be recorded.			
Presentation of results	Video recordings and/or photos showing at least the following details: • Abundance/frequency of rocks, shell banks etc. • Frequency of epifauna (percent cover) • Traces/dwellings of infauna (e.g. Lanice tubes) • Visible disturbances of the sediment surface (e.g. caused by fisheries) The geographic position must be allocated to each recording. A cut of the videos has to be presented.			

Table 1.3: Beam trawl / dredge surveys of epifauna

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Baseline description of the project area and determination of a suitable reference area.	Medium and small scale survey of status quo ante including seasonal dynamics, to be used as a basis for assessing possible impacts of wind turbines.	Medium and small scale survey of relevant impacts of construction measures on epifauna communities and their seasonal development.	Medium and small scale survey of impacts of the operation phase on epifauna communities and their seasonal development.
Scope	The number of beam trawl or dredge hauls per area (project/reference) depends on the number of infauna stations. Half of the infauna stations have to be surveyed by means of beam trawls or dredge hauls. In smaller areas (< 20 square nautical miles), at least 10 beam trawl surveys or dredge hauls should be conducted.			
	Random distribution of stations taking into account the complete habitat pattern determined in the side scan sonar and video surveys.			
	Once, in spring if possible.	In spring and autumn.		
Timing	Once, may serve as part of the status assessment.	At least two consecutive complete seasonal cycles prior to the start of construction.	Throughout the construction phase.	At least three years, up to five years if required, after commissioning-
Method	**North Sea:** Beam trawl with a width of 2 –3 metres and a mesh size of 1 centimetre, dredge in exceptional cases. **Baltic Sea:** Optionally beam trawl with a width of 2 –3 metres and a mesh size of 1 centimetre or dredge. Changes in the equipment standard are not allowed! Duration of bottom trawling 5 minutes, trawling speed 1 – 3 knots (trawling time 10 minutes if the hauls are also used for demersal (bottom dwelling) fish fauna). Biomass: wet weight per species.			
Presentation of results	• Total number of individuals per area, • Total biomass per area, • Number of individuals per species and area, • Biomass per species and area, • Dominance structure (related to number of individuals and biomass), • Diversity/evenness for community analysis, cluster analysis or multi-dimensional scaling.			

Table 1.4: Grab sampling survey of infauna

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Baseline description of the wind farm project area and determination of a suitable reference area.	Medium and small scale survey of status quo ante including seasonal dynamics as a basis for assessing potential impacts of wind turbines.	Medium and small scale survey of relevant impacts of construction activities on communities and their seasonal development.	Medium and small scale survey of impacts of the operation phase on communities and their seasonal development.
Scope	Sampling to investigate homogeneity of assessment areas	Coarse station grids (spacing should not exceed 1 nm) in the project and reference areas. At least 20 stations in small areas (< 20 square nautical miles). In large homogeneous areas, a spacing larger than 1 nm is possible in agreement with the approval authority. In case of different habitat structures in the area, 5 sampling stations are required for each structure.		
			Installation-based effects monitoring is additionally required in the construction phase. Installation-based monitoring has to be started upon completion of two installations.	Installation-based effects monitoring has to be carried out additionally at two wind turbines as a minimum. Sampling design: see Annex, p. 34, Fig. 1.
	At least 3 parallel samples per station.	At least 2 parallel samples per station.		
	Once, in spring if possible.	In spring and autumn. Joint station grid and installation-based monitoring.		
Timing	Once, may serve as part of the status assessment.	At least 2 consecutive, complete seasonal cycles prior to the start of construction.	One year during the construction phase.	In the first, third, and fifth year of the operation phase.
Method	Modified Van Veen grab, 0.1 m^2 sampling surface, 70-100 kg, sieve covered lid, warp-rigged. Sieve with 1000 µm mesh size; in case of large proportion of coarse and medium-grained sand or gravel, the sample should first be decanted through a sieve and rinsed at least five times. This is followed by batch-wise sieving. Documentation of the sample processing method has to be provided. Fixation in 4% buffered formalin, determination of number and composition of species , number of individuals per species, and biomass (wet weight) per species.			
Presentation of results	• Total number of individuals per area, • Total biomass per area • Distribution map of the numbers of individuals and biomass of the dominant species • Dominance structure (related to number of individuals and biomass) • Diversity/evenness for community analysis, cluster analysis or multi-dimensional scaling • Hydrographic data (*T, S,* O_2) • Occurrence and distribution of Red List species.			

Table 1.5: Investigation of fouling on underwater structures

	Baseline survey		Monitoring	
	Preliminary investigations	Status assessment	Construction phase	Operation phase
Targets			Investigation of fouling on piles, foundations, and scour protection.	Investigation of fouling on piles, foundations, and scour protection.
Scope			Survey of piles, foundations, and scour protection on at least two installations. Up to 15 m water depth, pile survey to be made by divers. At greater depth, foundations and scour protection to be surveyed by video.	
Timing			After erection of piles / foundations.	At least three years, up to five years if required, after commissioning.
Method			Taking of quantitative scratch samples (20 by 20 cm) at three depths by divers, and photo/video documentation. Determination of the number of species and species spectrum, number of individuals per species, and biomass (wet weight) per species.	
Presentation of results			• Total number of individuals per area • Total biomass per area • Individuals per species and area • Biomass per species and area • Dominance structure (related to number of individuals and biomass) • Species specific and absolute coverage • Diversity/evenness for community analysis, cluster analysis or multi-dimensional scaling • Comparison with natural hard-substrate communities - if available.	

Table 1.6: Macrophytobenthos survey

Macrophytobenthos may be present at wind farm sites in shallow water. Where macrophytobenthos is present, an additional monitoring programme has to be included.

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Baseline description of the project area and determination of a suitable reference area.	Medium and small scale survey of status quo ante as a basis for assessing potential impacts of wind turbines.	Medium and small scale survey of relevant impacts of the construction phase on communities.	Medium and small scale survey of relevant impacts of the operation phase on communities.
Scope	Transect lines with 500 m spacing – video survey of stocks in order to select assessment areas.	At least 3 transects in each habitat type occurring in the project area .		
	Once, in the period from June to September.	Once a year in the month of the baseline survey.		
Timing	Once, may serve as part of the status assessment.	At least two consecutive complete seasonal cycles prior to the start of construction.	Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	According to the HELCOM Guidelines "Monitoring of phytobenthic plant and animal communities": Mapping by divers (for safety reasons only at depths < 30m) and/or use of optical methods (digital video/photo), with coupling to the navigational system (navigation data visible) in order to monitor the species composition, distribution, and coverage.			
Presentation of results	Mann-Whitney-U test or Kruskal-Wallis test to investigate inter-annual differences, and diversity index to study changes in the species composition.			

2 Fish

Fish surveys and monitoring involve use of bottom trawls and/or beam trawls (Table 2.1). If bottom trawls cannot be deployed, set net surveys are a possible alternative. The surveys have to be accompanied by representative measurements of depth, salinity, temperature, and oxygen, which have to be recorded.

Table 2.1: Beam trawl/ bottom trawl/ set net surveys

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Single survey of fish fauna in the project area and in a suitable reference area.	Characterisation and identification of fish fauna in the project area and in a suitable reference area.	Assessment of the impacts of construction activities in the project area and comparison with a suitable reference area.	Assessment of mesoscale impacts of the wind farm based on comparative surveys in the planning area and in a suitable reference area. Assessment of microscale impacts of operation phase on the abundance of fish at the wind farm site via installation-based monitoring.
Scope	• In project and reference areas >100 km², the minimum number of hauls should be 30 each. 20 hauls will be sufficient if a beam trawl is used. • In planning, reference, and pilot areas < 100 km², the minimum number of hauls should be 20 each. 15 hauls will be sufficient if a beam trawl is used.		• In planning and reference areas >100 km², the minimum number of hauls should be 30 each. 20 hauls will be sufficient if a beam trawl is used. • In project and reference areas < 100 km², the minimum number of hauls should be 20. 15 hauls will be sufficient if a beam trawl is used. • Additionally, installation-based monitoring at two installations (about 6 days/year).	
	Spring or autumn	Twice a year: spring and autumn	Once a year in autumn. Additional sampling in spring is recommended.	
				Installation-based monitoring: At two operational wind turbines, set net surveys shall be carried out using the nets specified in the Annex, page 40, under B. From the turbines, the nets shall extend for about 190 m and shall be placed normal to the current if possible. In spring and autumn, 3 deployments each for 1-2 days.

<table>
<tr><th></th><th colspan="2">Baseline survey</th><th colspan="2">Monitoring</th></tr>
<tr><th></th><th>Preliminary investigations</th><th>Status assessment</th><th>Construction phase</th><th>Operation phase</th></tr>
<tr><td>Timing</td><td>Once, may serve as part of the status assessment.</td><td>At least two consecutive complete seasonal cycles before the start of construction.</td><td>One year during the construction phase.</td><td>In the first, third, and fifth year of the operation phase.</td></tr>
<tr><td>Method</td><td colspan="4">Equipment standard / North Sea - two alternatives:

1. 6-8 m beam trawl (proposed specification in the Annex, p. 35 beam trawl)
2. Otter trawl in combination with a 3 m beam trawl

Equipment standard / Baltic Sea:

Otter trawl (wind farm trawl) (see Annex p. 37, otter trawl)

Cod ends must have an inlet with a mesh opening of about 38 mm (mesh size 20 mm). The duration of hauls should be 30 minutes, and the towing speed 3 to 4 knots.

Sampling strategy:

Taking into account the specific conditions of the project, a random station grid is to be preferred in principle to a fixed station grid .

Sampling should be carried out during the same narrow time window each year.

Fish sampling should be carried out only during the day (sunrise to sunset).

Alternation between sampling strategies or equipment standards is not allowed!

The treatment of catches should be documented and standardised (e.g. recording of rare species in the total catch).

Documentation must also be provided on the fishing gear used.

The following data have to be recorded:

• Shooting and hauling positions, towing time, area covered
• Per fish species (acc. to ICES table): weight, number, length distribution
• Brief, semi-quantitative description of invertebrate by-catch
• Hydrographic and meteorological data

If bottom trawling is impossible:

• In the wind farm and reference areas, set net surveys using a combination of special set nets (multi-mesh, see annex, p. 42, set nets). At the wind farm, the set net shall be positioned centrally, with the largest possible distance from the individual turbines.</td></tr>
<tr><td>Presentation of results</td><td colspan="4">Documentation of status and changes (before/after) as follows:

• Total number of individuals per area
• Total biomass per area
• Number of individuals per species and area (species table)
• Abolute numbers of individuals (Table)
• Biomass per species and area
• Dominance ratios (related to number of individuals and biomass)
• Diversity
• Length frequency distribution of dominant species
• Community analysis.</td></tr>
</table>

3 Avifauna

3.1 Resting and migratory birds

Table 3.1.1: Surveys of foraging, moulting and resting birds

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Large-scale survey of the distribution and density of birds and observation of bird behaviour (flying habits, sensitivity to disturbance) in order to assess the project area's importance as a resting, feeding and/or moulting area, selection of a reference area.	Survey of bird densities and distributions to assess the area's importance as a resting, feeding and/or moulting area prior to construction.	Recording of effects on, and adaptive behaviour of, birds during the construction phase.	Recording of effects on, and adaptive behaviour of, birds during the construction phase.
Scope	Throughout the year : one ship based count per month at regular intervals if possible. Twelve additional ship based counts per year: seasonal distribution depending on area and seasonal occurrence of species. Transects cover 10% of the assessment area in each case.			
Timing	Once, may be used as part of the status assessment.	At least two consecutive complete annual cycles before the start of construction.	Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	**Ship transect surveys** (after Garthe et al. [2002] unless otherwise specified below) *Transect spacing:* • normally 3 km, up to 4 km if required (no smaller spacing to minimise disturbance) *Transect width:* • In good weather conditions, observation of 300 m to either side of the vessel, each side covered by a a team of two observers. • If dazzling sunlight renders observations impossible on one side of the ship, the other side may be used as an exception. *Transect direction:* • Cross shore if possible, in order to record gradients; e.g. in the German Bight off the coast of Schleswig-Holstein preferably east-to-west, off the coast of Lower Saxony preferably north-to-south. *Cruising speed:* • Between 7 and 16 knots. *Counting intervals:* • All birds observed on either side of the vessel must be recorded. Geographic positions are allocated at 1-minute intervals. • A complete record of all birds in flight is also required , with an indication of the flight altitude in each case. To determine bird densities, additional application of the snapshot method is indispensable during which, at 1-minute intervals (digital clock!), all birds in the transect section are recorded as „in transect" (see Annex, p. 44, Fig. 8, and Garthe et al. [2002]). The length of the section is determined by the ship's speed. With fast vessels (from 15 knots) the interval between snapshots has to be reduced to 30 seconds because the section ahead is too large for 1-minute intervals (see Annex, p. 44, Table 2 from Garthe et al. [2002]). An SAS bird form has to be used for the bird survey. Details see Annex „SAS Bird Count Form" and „How to complete the SAS Bird Count Form".			

Method (cont.)

Observer position:
- Top deck or wing of the navigating bridge, eye level of the observer at least 5 m (better: 7 m) above water level.

Survey conditions:
- The survey has to be interrupted at sea state >4. Visibility should not be less than five km.

Aircraft transect surveys
(unless otherwise specified below, according to Diederichs et al. [2002]).

Transect length:
- at least 500 km.

Transect spacing:
- Transect spacing about 3 to 5 km (no smaller spacing allowed in order to minimise disturbance).

Transect width:
- On either side of the aircraft 90° to the flight direction, three distance classes (transect bands: band A: 60° to 26°, band B: 25° to 11°, and band C: 10° to the middle between the transects (see Annex, p. 49, Fig. 9 and Table 3). An additional band D: 61° to 90° is recommended.

Transect direction:
- Cross-shore if feasible; i.e. in the German Bight off the coast of Schleswig-Holstein preferably east-to-west, off the coast of Lower Saxony preferably north-to-south.

Observers:
- At least 3 observers are required. One main observer on either side of the ship. An additional observer on the side where counting conditions are better, in order to determine any assessment errors of the main observers and allow errors in bird density computations to be estimated. Alternatively, in resting areas of black scoters, the third observer may assist the pilot in looking for flocks rising from the water in order to record total stocks and assess the accuracy of transect counts.

Counting:
- Continuous second-by-second counting.

Type of aircraft:
- In offshore surveys, only twin-engined aircraft are allowed. High-wing propeller aircraft with bubble windows.

Flight speed:
- Approx. 180 km/h.

Altitude:
- Approx. 250 feet (about 76 metres).

Flight data:
- GPS position recording every five seconds and linkage of all observation times through GPS-synchronised digital clocks.

Survey conditions:
- Surveys preferably should be made only when the water surface is calm and there are no breaking waves, max. sea state 3 (see Garthe et al. [2002]). Visibility should be at least five kilometres.

Presentation of results	Comparison of own results with those of available studies. Ship and helicopter movements during construction and maintenance operations have to be documented on the basis of AIS data (AIS, GPS etc.) and must be taken into account. Presentation of the results of the ship and aircraft transect surveys for relevant species (Annex, p. 47, relevant species). **Tables** • Presentation of seasonal mean values (seasonal allocation of seabird species according to table of Garthe et al., see Annex, p. 48, Table 4) and maximum value. • Presentation of seasonal cycle on the basis of monthly mean values. • Presentation of abundance of relevant species (Annex, p. 49: relevant species) in the project area and within a radius of 500 m, 1000 m, 2000 m, and 4000 m around the project area. • Total species list indicating individuals observed (incl. animals observed outside the transect bands). **Maps** • Point maps and sightings maps with the original positions of the birds, the positions of ships present during the surveys, and the positions of wind turbines in addition to the synoptic grid maps. • Grid maps with size classes according to Garthe (e.g. Garthe et al. [2004]). **Statistics** • Statistical verification of effects in co-ordination with the BSH. Additional presentation of the results of: **Ship transect surveys:** • Table showing mean bird densities per km² or, in the case of less abundant species, average number of individuals per kilometre covered, broken down by months indicating the value range and number of mapping cruises (density calculations for swimming birds have to be corrected on the basis of published factors or according to Buckland et al. [2001] based on own data). • Cartographic representation of densities (computation cf. above) or individuals per kilometre travelled for the most common species, on a month-by-month basis. The geographic reference for all computations is rectangles of 3' latitude and 6' longitude. The rectangles should be aligned with the geographic grid. **Aircraft transect surveys:** (Diederichs et al. [2002]) • Bird densities are computed exclusively on the basis of birds in transect band A. • Positions are indicated for all observations, linking the recorded observation time and GPS time in a Geographic Information System (GIS). • Point maps showing the distribution of birds in the assessment area, broken down by species. • Grid maps showing use of the area by abundant species, cumulative and adjusted according to observation effort.

3.2 Bird migration and other bird movements in the survey area

Table 3.2.1: Radar surveys

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Recording of bird movements (migration, foraging, flights between feeding and resting grounds).	Recording of status quo ante including seasonal dynamics.	Recording of effects on, and adaptive behaviour of, birds during the construction phase. Documentation of any evasive behaviour observed.	Recording of effects on, and adaptive behaviour of, birds during the construction phase. Documentation of any evasive behaviour observed.
Scope	Survey frequency in the main migration periods 7 days/month (not in a single block). *Main migration periods:* • North Sea: March to May, and mid-July to mid-November • Baltic Sea: March to May, and mid-July to the end of November • A survey day comprises 24 hours. The surveys should cover full 24-hour cycles in order to record bird migration and migration behaviour as evenly as possible in the course of a day. • At least 50 survey days are required in the North Sea, and 52 survey days in the Baltic Sea. During these periods, at least 900 survey hours in the North Sea, and 936 hours in the Baltic Sea, must be suitable for evaluation. Continuous deployment. In routine operaton, at least 12 to 15 radar images per hour. • The survey direction preferably should be perpendicular to the migration path.			
			Observation of flying birds' reaction to the turbines (changes in flight direction/altitude, collisions), to be recorded using state-of-the-art methods (representative samples).	
Timing	Once, may be used as part of the status assessment.	At least two consecutive complete annual cycles before the start of construction.	Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	**Radar surveys** (unless otherwise specified below, after Hüppop et al. [2002]) **Location** • Radar surveys should be made preferably at stationary locations, or alternatively on board vessels at fixed positions or moving slowly (in rough seas as they prevail in offshore sea areas, the ship will have to beat up and down in the survey area). During the construction and operation phases, the vessel or platform's location relative to the construction site should be in the direction from where most of the birds come to ensure optimal detection of the evasive movements of flying birds. **Vertical radar - mandatory use** • Quantification of flight intensities at 100-m steps up to an altitude of 1000 m, corrected. • Estimation of seasonal flight intensities. • Rough estimate of flight directions. *Survey conditions:* • Deployment also possible in stronger winds (up to min. 7 Bft or 2 m wave height) *Radar specifications:* • Vertical radar with an output of min. 25 kW, a vertical beam width of 20° to 25° and a horizontal beam width of 0.9° to 1.2°, and a transmission frequency of about 9.4 GHz (x-band radar). *Standard operating range:* • The standard operating range should be 1.5 km. Exceptions are only allowed to track, e.g., evasive behaviour of birds. **Surveillance radar - recommended use; mandatory during monitoring at fixed locations** • Recording of flight direction and intensities *Survey conditions:* • Max. 4 or 5 Bft *Radar specifications:* • Horizontally scanning radar with an output of min. 25 kW. *Standard operating range:* • The standard operating range should be 3 km. Exceptions are only allowed to track, e.g., evasive behaviour of birds.			
Presentation of results	Results of the radar observations. The altitude distribution requires a distance correction. (Comparability of results is essential in selecting equipment and making equipment settings). It takes into account the detectability and volume of the radar beam (see Annex, p. 49: distance correction for radar equipment and compare Hüppop et al. [2002] and next chapter). Results to be shown as echos per hour and kilometre.			

Table 3.2.2: Visual observations/ recording of flight calls

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Observation phase**
Targets	Recording of bird movements (migration, foraging, flights between feeding and resting grounds).	Recording of status quo ante including seasonal dynamics.	Recording of effects on, and adaptive behaviour of, birds during the construction phase. Documentation of any evasive behaviour observed.	Recording of effects on, and adaptive behaviour of, birds during the construction phase. Documentation of any evasive behaviour observed.
Scope	Simultaneous to the radar surveys			
Timing	Once, may be used as part of the status assessment.	At least two consecutive complete annual cycles prior to the start of construction.	Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	**Visual Observations/ recording of flight calls** • To determine the species spectrum of the birds detected by radar, parallel daytime visual observations and recording of flight calls at night have to be carried out. • A total of at least 50 survey days in the North Sea and 52 survey days in the Baltic Sea should be scheduled. During these periods, at least 900 survey hours in the North Sea, and 936 hours in the Baltic Sea, must be suitable for evaluation. As a rule, surveys can be conducted at up to 8 Bft and a wave height of 2.5 m. • The surveys should cover full 24-hour cycles in order to record bird migration as evenly as possible throughout the day. *Survey frequency:* • As a minimum, a 15-minute recording period per hour has to be chosen, or preferably two 15-minute periods per hour. *Location:* • The surveys should be preferably conducted using stationary platforms , or alternatively from vessels. During the construction and operation phases, the surveys should be carried out near the boundary of the construction area in order to be able to observe evasive behaviour of birds (details see radar surveys). **Visual observations** • Communication by voice between the observer watching the radar display and the visual observer may be useful. The registrations have to be made independently, however. • Registration of the species spectrum and number of birds counted in an angular field of view extending from the horizon to 45° (Binoculars with 10 x magnification or larger front lens) up to 1.5 km distance. Also undetermined birds have to be recorded (e.g. as ”pipit spec.“ or ”gray geese”). • Flight altitudes can be estimated by reference to the height of the vessel‘s deck/mast or, during the construction and operation phases, the dimensions of the wind turbines. Altitudes should be categorised as follows: 0 - 5 m, 5 - 10 m, 10 - 20 m, 20 - 50 m, 50 - 100 m, 100 - 200 m, and over 200 m. During the baseline survey, when no turbines are available for reference, all heights above 50 m shall be combined in a single category when making ship-based surveys. • Where a stable platform is available, birds have to be additionally registered by means of a spotting scope with a defined field of view (seawatching). The field of view depends on the spotting scope’s magnification and angle of view (all birds up to 5 km distance). A wide-angle spotting scope with 30 x magnification and at least 80 mm objective diameter should be used. **Registration of flight calls** • At night, flight calls have to be recorded.			
Presentation of results	List of bird species observed, broken down by day, night, and months. Registration of: • relative flight intensities per observation day/night, in tables (e.g. birds/h or calls/h), • mean relative flight intensities in the course of the day (compiled by months), • relative distribution of flight altitudes (using above levels) and flight directions for each observation day/night, in tables or as graphs averaged on a monthly basis (time-of-day distribution), • same procedure for seawatching, broken down by the most frequent species/species groups (see Annex, p. 47: relevant species). Comparison of own investigations with available data.			
			Exemplary demonstration of flight behaviour of birds approaching the turbines, recording of all reactions/ non-reactions, especially changes in flight directions and altitudes, in tabular form.	

4 Marine mammals

The investigations and monitoring relating to marine mammals comprise:
- surveys of abundance and distribution (Table 4.1)
- surveys of habitat use (Table 4.2)
- surveys of noise emission and immission (Table 4.3).

Sightings while running transects allow conclusions as to the abundance and distribution of marine mammals in the assessment area.

Stationary click detectors allow continuous monitoring of the habitat use of harbour porpoises. Click detectors have to be deployed in addition to ship and aerial surveys as a monitoring basis.

During the construction and operation of wind turbines, a broad-band noise spectrum (including structure-borne and air-borne noise) is likely to be emitted into the water. The occurrence of interferences cannot be ruled out. Measurements of immissions at particular locations and of emissions at the noise source should be made during the construction and operation phases.

Not only the emitted frequencies but also the noise characteristics (impulsiveness/tonality) have to be recorded. Via propagation computations, predictions of the expected noise pollution have to be made using noise emission data of the turbines and suitable models.

Table 4.1: Surveys of the abundance and distribution of marine mammals

	Baseline survey		Monitoring	
	Preliminary investigations	Status assessment	Construction phase	Operation phase
Targets	Stock inventory of marine mammals in the assessment area in order to assess the ecological importance of the project area for marine mammals.		Monitoring of the impacts of construction activities on the abundance and habitat use of marine mammals in the assessment area.	Monitoring of the impacts of operational activities on the abundance and habitat use of marine mammals in the assessment area, taking into account different operating modes (full load, partial load).
Scope	The aircraft transect surveys shall be conducted 12 times per year. If they are conducted together with the bird surveys (observers must be qualified for both groups), six additional aerial surveys per year covering only marine mammals have to be made. Four aerial surveys shall be made at monthly intervals between May and August. In addition, one survey each should be conducted in autumn and winter. Combined bird and mammal surveys are not allowed to be conducted in areas of high seaduck abundance. Shipping traffic within 500 m to either side of the transect should be recorded if possible.			
Timing	At least two consecutive, complete seasonal cycles before the start of construction.		Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	**Line transect method** According to the method description „Introduction into Distance Sampling“ (Buckland et al., [2001]). Monthly aircraft transect surveys are mandatory. Additional ship transect surveys are recommended. **Aircraft transect surveys** • *Altitude:* a constant altitude for the monthly aerial surveys must be determined and adhered to. The altitude may range between 250 and 600 feet. The six special harbour porpoise surveys have to be conducted at an altitude of 600 feet. • *Type of aircraft:* twin-engined, high-wing propeller aircraft with bubble windows. • *Flight speed:* Approx. 160 km/h (80 – 100 knots). • *Number of transects /spacing:* at least 10 transects. The transect spacing should be min. 3 km and max. 10 km. • *Transect length:* corresponds to the transect lengths of the baseline survey, but not less than 500 km. • *Observation method:* visual observations from aircraft require 3 observers (one observer on either side plus a second observer on one side for verification). Because of the high speed of the aircraft, dictaphones must be used to record the observations in order to avoid observation gaps while writing down notes. All parameters have to be recorded which are prescribed in the data compilation tables (tables under www.bsh.de, data formats). • *Weather-related cancellation:* reliable data can only be obtained in good weather conditions (up to sea state 2), i.e. visibility must be over 5 km, sea state not over 2 according to the Petersen scale (wind: max. 10 knots). **Ship transect surveys** • Conducted together with the bird surveys (see Annex, p. 44). All parameters have to be recorded which are prescribed in the data compilation tables (tables under www.bsh.de, data formats). • *Hydrophones:* use of towed hydrophones and click detectors is recommended in order to increase the efficiency of visual harbour porpoise surveys. **Additional information about methods** • Buckland et al. [2001], Scheidat et al. [2004], Thomsen et al. [2004], Tougaard et al. [2005], Verfuss et al. [2004].			
Presentation of results	Comparison of own results with those of available studies, also from other areas. In the case of follow-up surveys, an overall evaluation has to be made. Ship and helicopter movements during construction and operation have to be recorded using available AIS data (AIS, GPS, etc.) and shall be taken into account. **Abundance:** • Seasonal cycle of the number of animals per km transect line (monthly data on relative frequency). • Seasonal cycle of the number of animals per km2 (monthly data on absolute frequency) – if the correction factor g (0) can be determined. • Determination of effective band width on the basis of own survey data (e.g. using „DISTANCE SAMPLING“ software) is recommended. • Seasonal cycle of group sizes (monthly data on single animals and mother/calf pairs). • Rough characterisation of behaviour (diving times, swimming directions). • Changes in abundance during the observation period. **Distribution:** • Distribution of animals in the near and far fields of the site using point maps. • Changes in the distribution of animals in the near and far fields of the site during the study, based on point maps.			

Table 4.2: Surveys of habitat use

	Baseline survey		Monitoring	
	Preliminary investigations	**Status assessment**	**Construction phase**	**Operation phase**
Targets	Frequency and length of stay, behaviour of harbour porpoises (as far as possible) in the project area and at reference stations outside the project area during the seasonal cycle.		Frequency of occurrence, behaviour, and time spent during the construction activities.	Frequency and length of stay, behaviour (as far as possible) at various distances from the installations taking into account different operating modes (full/partial load).
Scope	Continuous throughout the seasonal cycle			
Timing	At least two consecutive complete seasonal cycles prior to the start of construction.		Throughout the construction phase.	At least three years, up to five years if required, after commissioning.
Method	**Requirements:** In the first year of the study, use of 3 click detectors (TPODs) in order to test the method in the individual assessment areas. If the method is found useful, the number of detectors has to be increased to at least 9 after maximally one year. In case bottlenecks occur in the delivery of the required equipment, the approval authority has to be informed of this fact. Before using the equipment, and with regard to data analysis, the Help file of the TPOD programme used has to be studied. **Calibration:** Prior to and after permanent deployment and, if possible, once during the period of deployment, a calibration among all click detectors has to be carried out. For that purpose, all detectors to be used have to be deployed together with a TPOD defined as standard. The distance among the units to be calibrated should be 0.3 to 1.5 m. The calibration period depends on the abundance of harbour porpoises in the area and must provide statistically relevant data. A correction factor relative to the standard unit should be calculated for all calibrated detectors. The standard unit preferably should not be used in the main investigation. Besides, calibration of the units in a calibration tank is recommended (suppliers are listed in the Help file of the TPOD programme). **Positioning:** At least 6 evenly distributed TPODs must be installed permanently within the area in order to record temporal differences before, during, and after construction. At least three additional TPODs must be installed permanently, and distributed as evenly as possible, outside the project area at a distance of about 1 km from the project area. **Deployment:** The deployment depth of the detectors should be at least 5 metres below the water surface but may be deeper. All detectors must stay at the same depth throughout the study period. All units have to be used with the same settings (recommended for first deployment: porpoise only, normal sensitivity, detection mode = normal, to be adjusted after first data analysis if necessary). The „minimum intensity“ setting may differ during the calibration phase to compare sensitivities, but afterwards each detector should be operated with an unchanged setting. It is recommended to use the same equipment version. It is also recommended to deploy the same TPOD, or a TPOD of similar sensitivity (or expected comparable results based on the calibration, cf. above) at a particular position. This facilitates data analysis. **Data evaluation:** Habitat use (frequency and length of stay in the area) is evaluated on the basis of porpoise positive days / hours / 10-minute and minute periods (= days/hours during which harbour porpoise sounds are recorded). Besides, during the construction phase, it is recommended to also evaluate the parameter „waiting period“ (see TPOD help). **Boundary conditions:** Fisheries surveys should not be conducted in areas where click detectors are deployed in order to avoid loss of or damage to the detectors.			

Method (Cont.)	**Additional information about methods::** Blew, J., Diederichs, A., Grünkorn, T., Hoffmann, M. and G. Nehls [2006]* Diederichs, A., Grünkorn T. und G. Nehls, [2004]* Thomsen, F. und W. Piper [2004] Tougaard, J. et al. [2005] Verfuss, U. et al. [2004] *download unter: http://www.bioconsult-sh.de/referenzen/main.htm
Presentation of results	Habitat use (e.g. daytime pattern, seasonal use) at each position and change of habitat use over time and in comparison with the other positions (project area versus surroundings). Comparison of the results with transect data. Data evaluation see Annex, p. 51: Recommendations for statistical analysis of the TPOD data collected within the framework of the Standards for Environmental Impact Assessments.

Table 4.3: Surveys of waterborne noise emissions and immissions

	Baseline Survey		Monitoring	
	Preliminary investigations	**Status Assessment**	**Construction phase**	**Operation phase**
Targets	• Prediction of noise propagation characteristics in the construction and operation phases and comparison with specific background noise measured at the location in order to obtain data for possible design improvements in order to minimise annoying noise emissions. • Measurement of hydroacoustic background noise at each location prior to construction.		Monitoring of waterborne noise emission and immission.	Monitoring of waterborne noise emission and immission near the wind turbines.
Scope	The expected levels of waterborne noise due to the construction and operation of the planned offshore wind farm have to be determined by means of forecast computations. A background noise measurement shall be made in each target area prior to the start of construction activities. During the construction phase, monitoring measurements have to be made during noisy work phases (e.g. impact pile-driving). After completion of all construction activities and commissioning of all installations, check measurements have to be made in the vicinity of the wind farm.			
Timing	• The immission prediction must be completed prior to the start of construction, and prior to the granting of approval. • Measurement of hydroacoustic background noise at the site prior to the start of construction.		Throughout the construction phase.	A final report shall be submitted to the BSH not later than 12 months after the wind farm has been put into operation.
Method	**Immission forecast** • Noise immission into the water body during construction and operation of the planned wind farm shall be determined by forecast computations taking into account the noise levels of any existing installations. The following computations are required: *For the construction phase:* • maximum sound pressure Lpeak (in dB re 1 µPa) as a function of location. • if construction operations cause impulse-type noise (e.g impact pile-driving): single-event sound pressure level LE as a function of location, as broad-band level and in 1/3-octave bands 10 Hz - 80 KHz, • equivalent continuous sound pressure level Leq (in dB re 1 µPa) as a function of location, as broad band level and in 1/3-octave bands 10 Hz - 80 KHz. *For the operation phase:* • equivalent continuous sound pressure level Leq (in dB re 1 µPa) as a function of location, as broad band level and in 1/3-octave bands for the three output levels „low“, „medium“, and „rated output“. • With regard to the operation phase, the criterion for the minimum size of the area to be covered by the noise propagation forecast shall be the hearing threshold of marine mammals and, with regard to the construction phase, the levels which are safely below those levels at which a temporary hearing threshold shift may occur in marine mammals. **Background noise measurements** • Background noise at the planned wind farm site has to be measured. Background noise comprises the sum of all natural sounds in the planning area excluding wind farm construction and operation noise and should largely exclude atypical noise from ships. The normally present sound of distant ships should be treated as background noise. • The noise measurements shall cover the 1 Hz - 20 kHz frequency range. If it should turn out that, owing to the use of different technology in the wind farm, water-borne noise is likely to be emitted also outside this frequency range, the background noise measurements should be extended to include the frequency range in question. • Contamination of the measurements by extraneous noise (caused by pitching of ship, ship machinery, movements of crew) has to be avoided. This can be done, e.g., by using a ship-uncoupled system. • The measurements shall comprise three classes of wind corresponding to sea state 1 (without precipitation) and the performance ranges medium and rated output, and shall provide an adequate statistical basis for the results. Per class of wind, at least 3 hours of measurements must be suitable for evaluation, taking into account day and night conditions. • The hydrophone should be placed about 1 m above ground. • To evaluate the measurements, Leq values (in dB re 1 µPa) averaged to 5 seconds shall be given as frequency resolved 1/3 octave bands. The documentation shall include the following data: a) L_{eq} = sound level averaged over one hour, b) L_{min} = lowest 5-second L_{eq} during the hour, c) L_{max} = highest 5-second L_{eq} during the hour.			

Method (cont.)	**Monitoring in the construction phase** • During noise-producing construction activities (e.g. impact pile-driving), spot check measurements shall be made in the environment of the construction site. At least one complete noise measurement has to be made for each type of foundation installed at the wind farm. Noise immission shall be measured during construction of the foundation, 400 - 800 m from the foundation structure, in the lower third of the water column. • If sediment properties at the turbine sites differ strongly, this fact shall be taken into account in the selection of the turbine to be monitored. Monitoring should be performed at the installation where the highest noise immissions are to be expected. • The unweighted sound pressure in the frequency range from 10 Hz to 80 kHz shall be measured. The documentation shall include the following measurements: • typical sequences of sound pressure levels at the beginning, in the middle, and at the end of construction activities and, in the case of impulsive noise (impact pile driving), the peak sound pressure level L_{θ} as broadband level in 1/3 octave bands. • equivalent sound pressure level Leq (in dB re 1 µPa) as broadband level for the entire duration of the particular construction activity (in case of a non-impulsive noise producing activity, additionally in 1/3 octave bands). **Spot check measurements after commissioning** Proof of compliance with the predicted values has to be provided. • Not later than 12 months after commissioning of the wind farm, spot check measurements of noise immissions shall be made at the three capacity output levels „low“, „medium“, and „rated output“. Spot check measurements shall be made at a distance of about 100 m from individual turbines of the wind farm. The time signal shall be recorded. Parallel to these measurements, a general noise measurement shall be made at a distance of 3 - 4 km from the outer limit of the wind farm. • The measurement evaluation should be presented as a 1/3 octave band analysis and include the following data: Leq average noise level at 5-second intervals (in dB re 1 µPa), as a 1/3 octave band analysis. All octave bands are taken into account in the evaluation: a) L_{eq} = sound energy averaged over one hour, b) L_{min} = lowest 5-second leq during the hour, c) L_{max} = highest 5-second leq during the hour. • In addition to the measurements in 1/3 octave bands, narrow-band spectra with a resolution of 2 Hz or better should be evaluated in order to identify characteristic spectral lines during turbine operation. • The measurement results have to be compared with the immission forecast data. Any relevant hydroacoustic single events observed shall be duly noted.
Presentation of results	• Detailed calculation of noise propagation during construction and operation of the turbines. • Comparison of predicted and measured immissions. • Report on source noise and noise characteristics (impulsiveness / tonality) during noisy construction activities. • Report on source noise and noise characteristics (impulsiveness / tonality) during the operation phase. • As far as possible, forecast and definition of noise impact zones regarding audibility, masking, behavioural response, damage (TTS/PTS) (fish, marine mammals) during construction and operation.

Part C - Annex
Survey of Features of Conservation Interest

1 Benthos

see Table 1.4: Grab sampling of infauna (p. 18)

Sampling design for installation-based effects monitoring

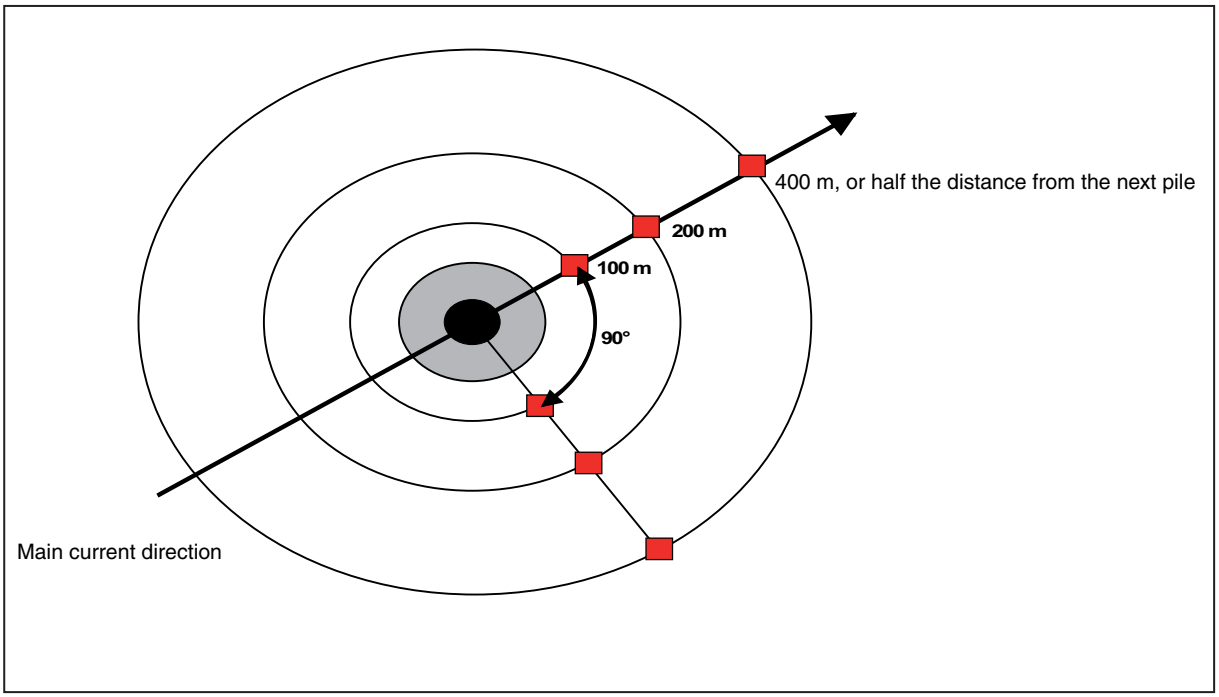

Fig. 1: Positions of sampling stations on a transect behind the pile, in the main current direction, and on a transect perpendicular to the main current direction. On each transect, three stations at a distance of 100 m, 200 m, and 400 m or half the distance from the next pile

2 Fish

see Table 2.1: Beam trawl/ bottom trawl/ set net surveys (p. 21 ff.)

2.1 Standard nets

Beam trawl for the North Sea

In the Standards for Environmental Impact Assessments, a beam trawl with a beam length of 6 - 8 metres is specified as the standard net for fish fauna studies. A 7-metre beam trawl is described in the following. The beam trawl described is standard fishing gear used on board the fishery research vessel Solea. Deviations from the standard are possible but have to be documented in a gear specification.

The beam trawl consists of an iron beam with trawlheads and the net. Fig. 2 (below) shows a sketched beam trawl. The length of the net is 21.4 m, its circumference 19 m. It consists of an upper belly, wings, and lower belly. Information about the net material cut, and assembly is provided in Fig. 3 (p. 36). The footrope of the net is a rope-wrapped chain. To catch smaller fish as well, the codend is lined with an inside webbing (inner codend) with 18 mm mesh size (10 mm mesh bar).

The iron trawl beam has a total length of 7.45 m, and the clearance between the trawlheads is 7.15 m. The height of the trawlheads on either side of the beam is 70 cm and exceeds that of the beam by 15 cm, so that the beam is 55 cm above ground. Each trawlhead is 21 cm wide.

5 tickler chains of different lengths are mounted in front of the mouth of the trawl. The chain length increases by 80 cm each from fore to aft (length of the first chain 13.3 m).

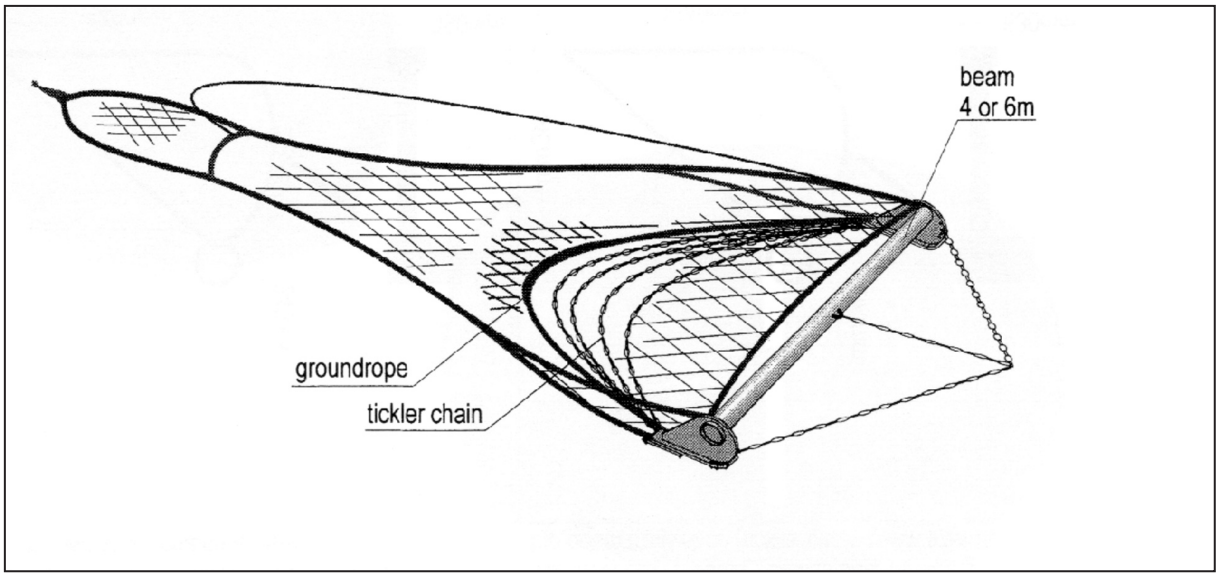

Fig. 2: Beam trawl (sketch)

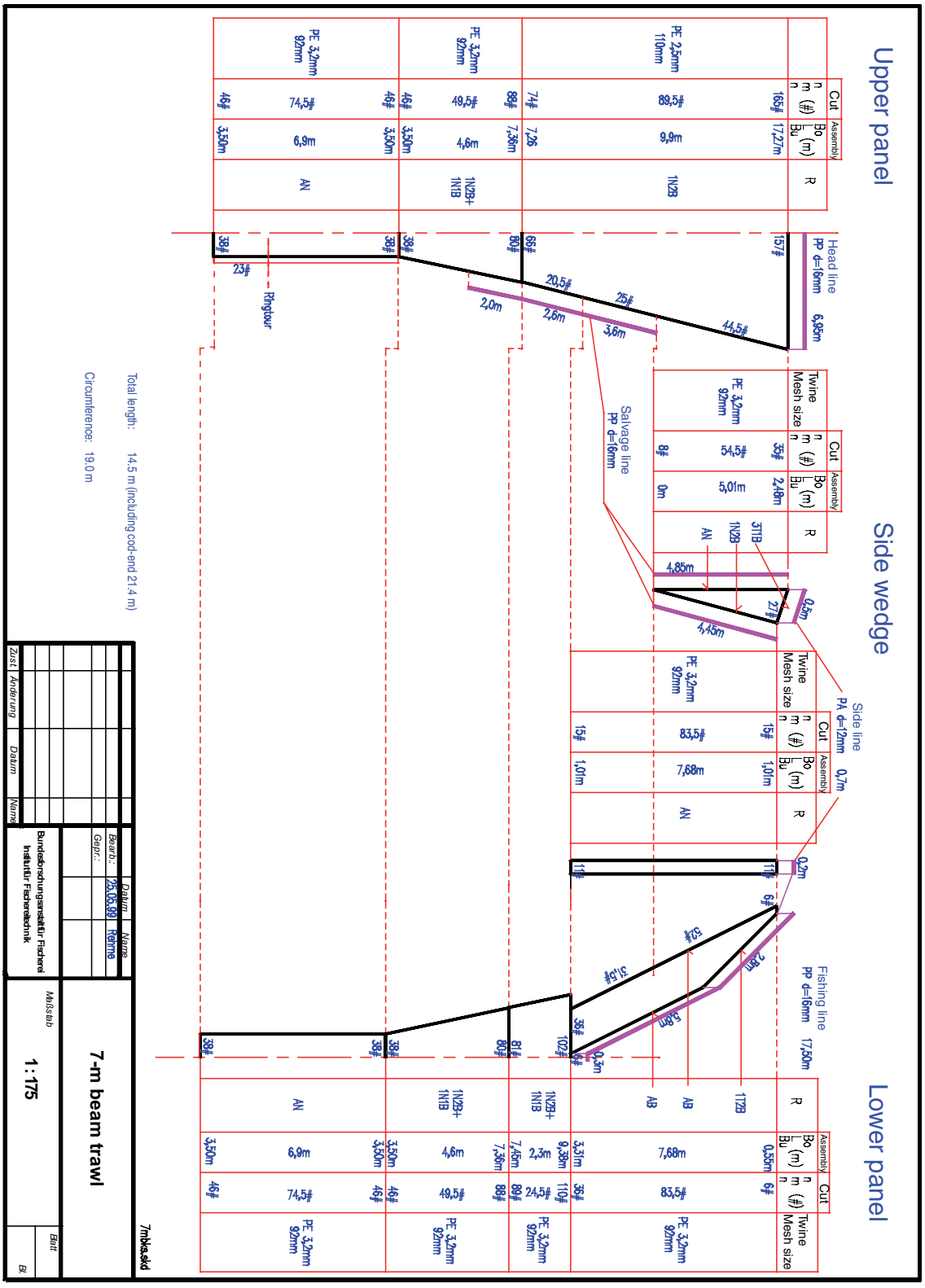

Fig. 3: 7m beam trawl: material, cut and assembly of the net

Otter trawl for the Baltic Sea (wind farm trawl)

The Standards for Environmental Impact Assessments specify an otter trawl for use in the Baltic Sea. The net shown in the drawing below has been developed especially for such ecological studies. The trawl consists of an upper belly and a lower belly. It has a total length of about 40 m (incl. cod end) and a circumference of 32.6 m. Details of the required net material, cut, and assembly are given in Fig. 4 (below). The cod end is lined with a webbing (inner cod end) of 38 mm mesh size (20 mm mesh bar). Details of the set of bridles are shown in Fig 5 (p. 38), of the head and foot ropes in Fig. 6 (p. 39).

At the projected wind farm depths, the vertical opening of the net will be about 1.5 m on average, and the horizontal opening between the wing tips about 10 m.

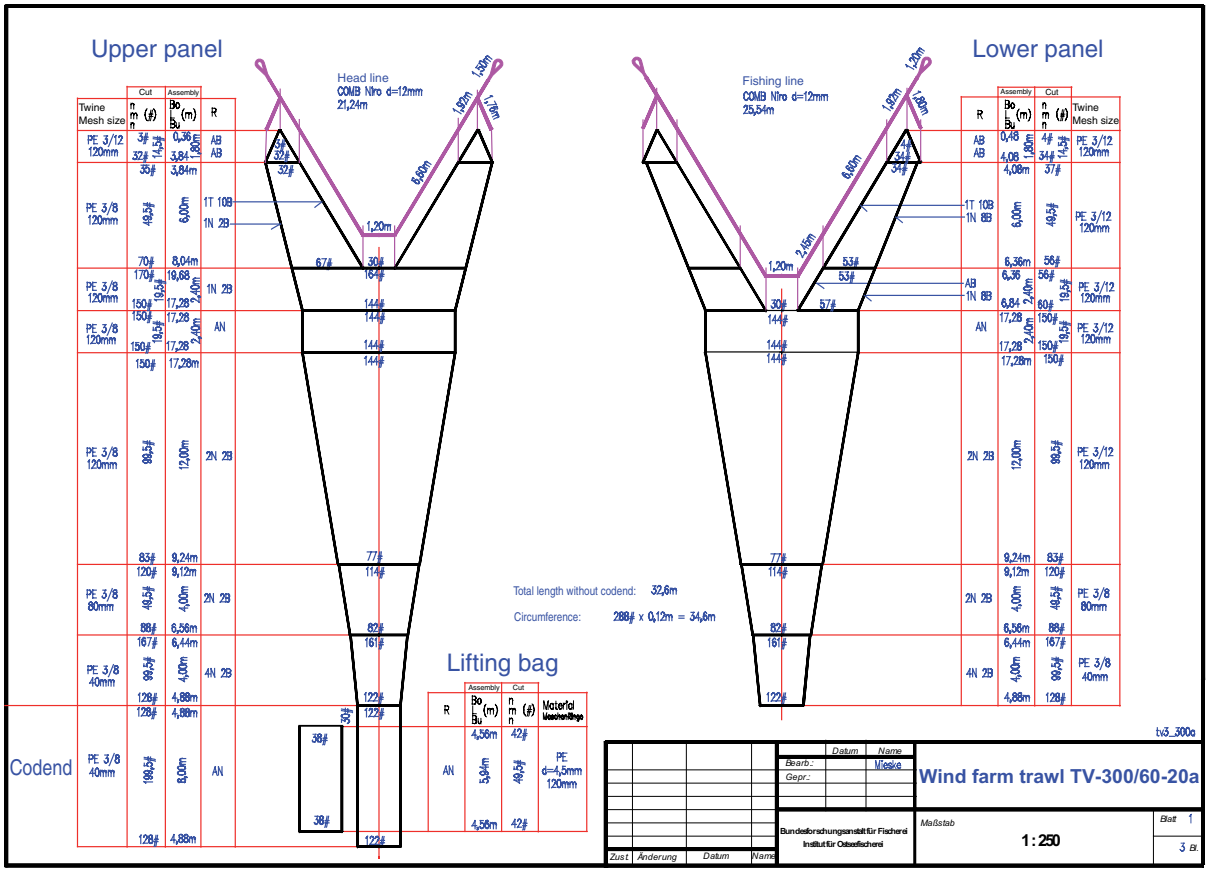

Fig. 4: Wind farm trawl: material, cut, and assembly of the net

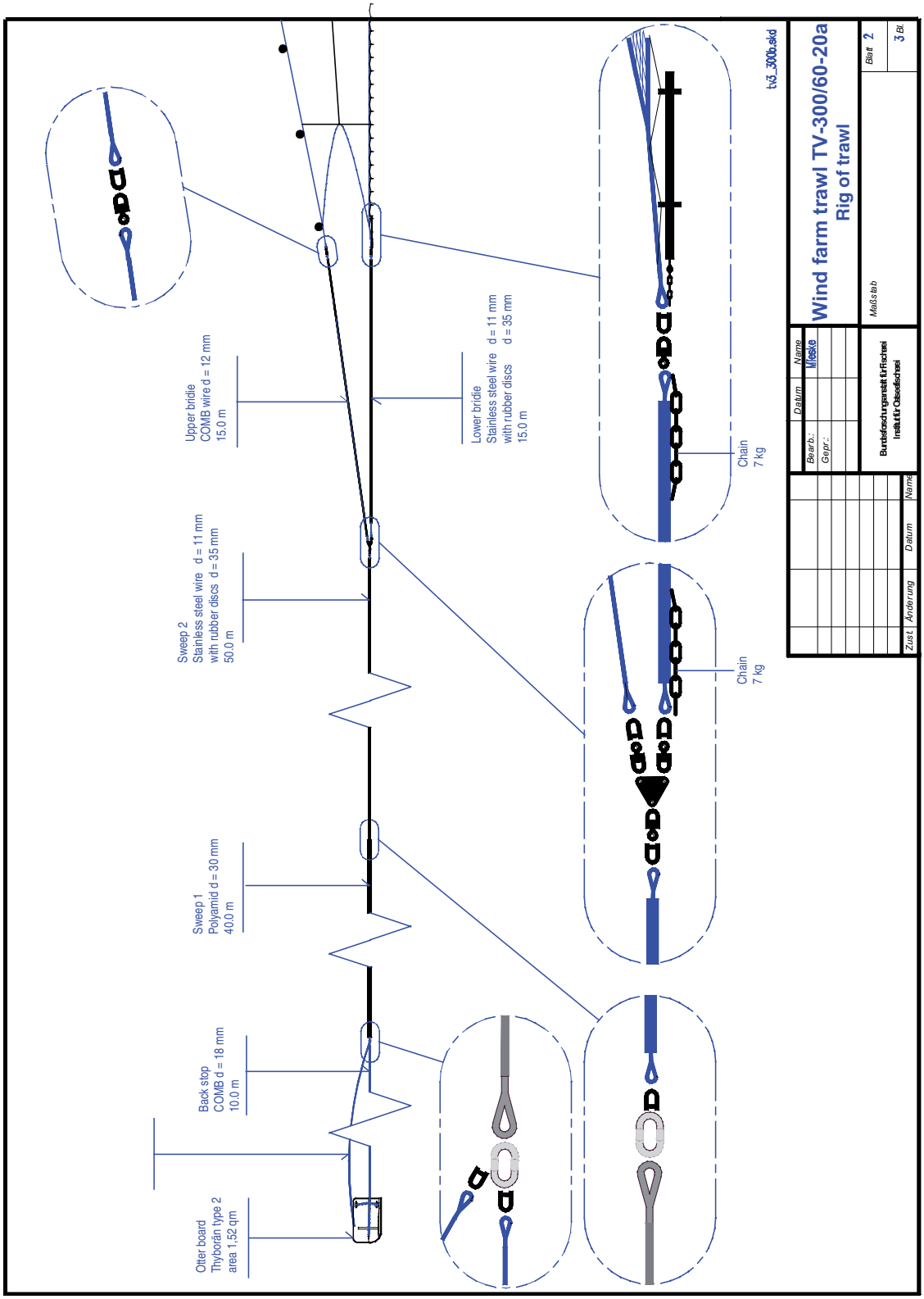

Fig. 5: Wind farm trawl: Set of bridles

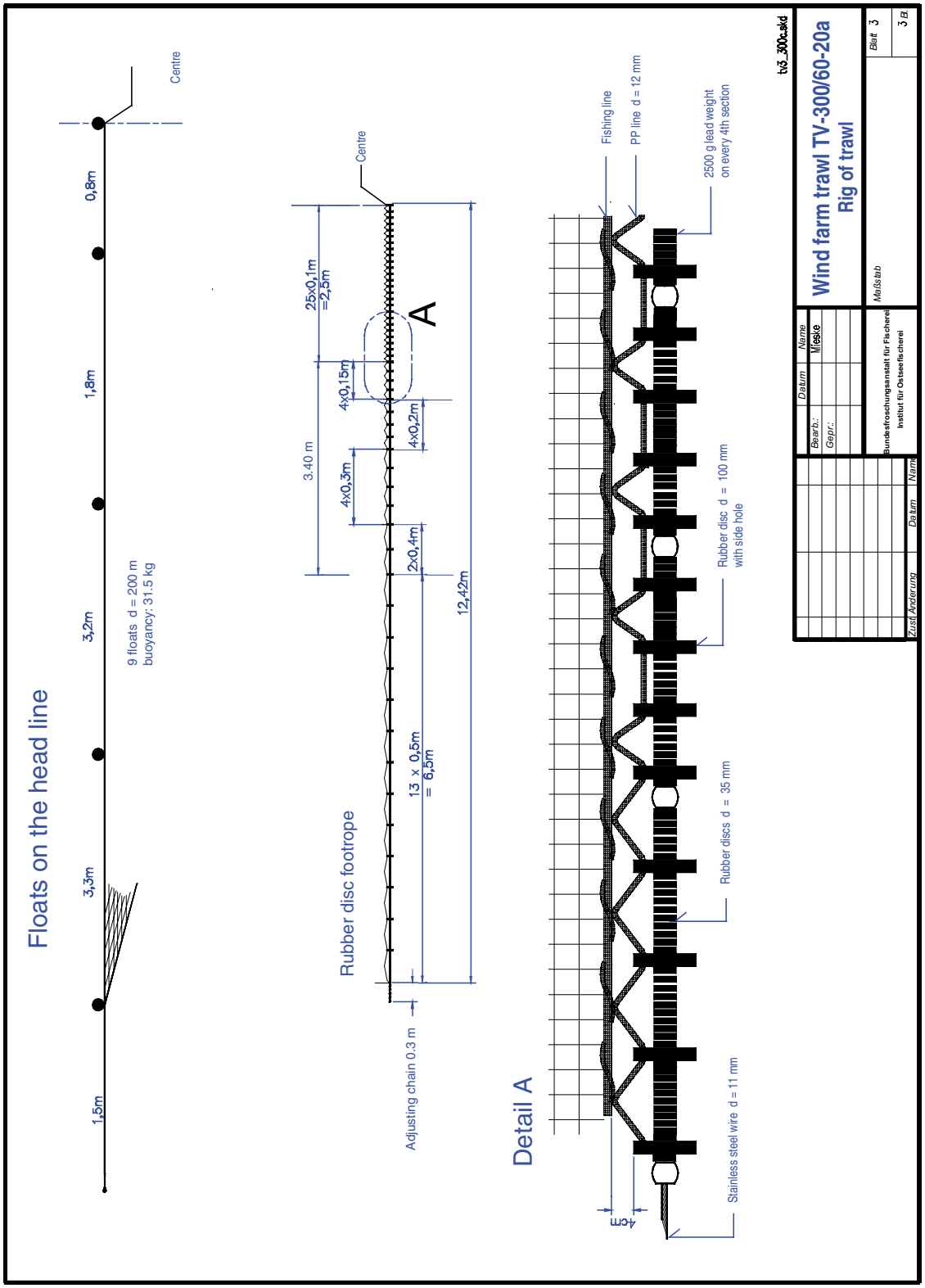

Fig. 6: Wind farm trawl: head and foot ropes

Set nets

A Description of multi-mesh set net fleet for areal surveys

Commercially available nets of different mesh size are combined to a single fleet. The floatlines and leadlines of the fleet of nets are knotted as shown in Table 1 (p. 41). Most nets available have a drop of 3 m. However, complete nets of the smallest mesh size have a drop of only 1.5, and the ready-for-use 25 mm net is only available with a maximum net height of 2.5 m. Nets of different heights can be directly connected at the lead lines, not, however, at the float lines. Fig. 7 (p. 41) shows the method of combining nets of different heights to a fleet. The total length of the nets is 204 m. Because of the need to adjust the drop heights of the different nets, the total fleet length is 210 m. The nets have to be provided with standard sink lines. Each row of nets (fleet) has to be marked by two dan buoys, each fitted with a radar reflector, dan flag, and flashing light. Two anchors attach each fleet to the ground. The price of a complete fleet ready for service is about 1,000 Euro.

B Description of the combination of set nets to be used in the installation-based surveys

Net row 1

Five commercially available set nets with 32 mm mesh size and a drop of 3 m (Table 1, item 5) shall be used. The lead lines and float lines are not connected directly but by means of distance lines of 10 m length. The row of single nets has a total length of about 190 m (other details as under A above). The price of a complete fleet ready for service is about 800 Euro.

Net row 2

Five commercially available trammel nets with a drop of 3 m (Table 1, item 4) are connected at the top and bottom with distance lines of 16.3 m length. The row of single nets has a total length of about 190 m (other details as under A above). The price of a complete fleet ready for service is about 900 Euro.

Position	Designation of ready-to-use net	Number in fleet position	Mesh size (mm)	Lenght of upper rim float line (m)	Drop (m)	Twine designation/ diameter or thickness
1 and 2	Bait fish set nets	2	10	7	1.5	Nylon monofilament 0.12 mm
Connected by PA, PE or PP braided line with 2 m spacing, diameter 6 mm: L_1 = 2,3 m and L_2 = 2,5 m (2 x 0.15 m for knots has been added per line)						
3	Set net	1	25	30	2.5	Multi-monofilament no. 0.5 x 4
Connected by PA, PE or PP braided line with 2 m spacing, diameter 6 mm: L_1 = 2,3 m and L_2 = 2,5 m (2 x 0.15 m for knots has been added per line)						
4	Trammel net	1	Inner webbing 40 Trammel 200	25	3	Nylon-Multifil/ 210/3 Nylon-Multifil/ 210/12
5	Set net	1	32	30	3	Multi-Monofil/ Nr. 0.5 x 4
6	Set net	1	38	30	3	Multi-Monofil/ Nr. 0.5 x 4
7	Set net	1	100	50	3	Multi-Monofil/ Nr. 0.1 x 4
8	Trammel net	1	Inner webbing 40 Trammel 200	25	3	Nylon-Multifil/ 210/3 Nylon-Multifil/ 210/12

Table 1: Mulit-mesh set net fleet consisting of ready-for-use single nets

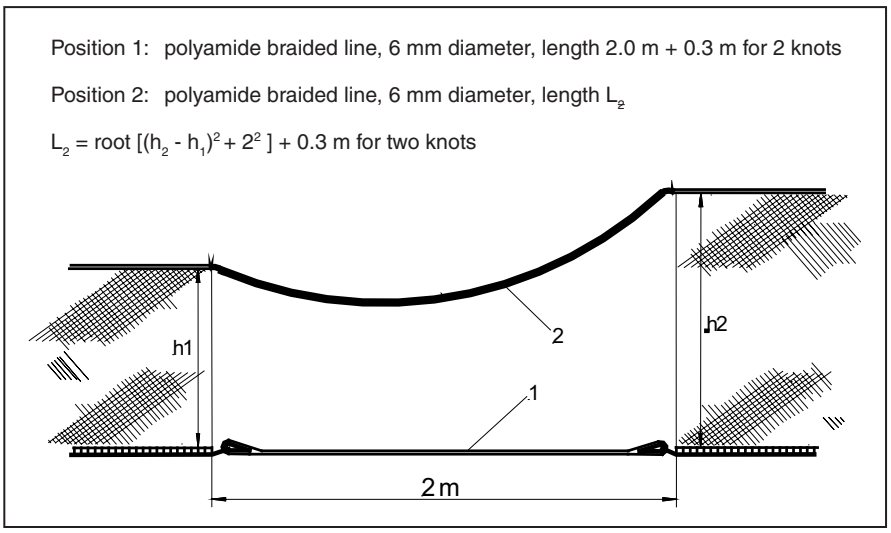

Fig. 7: Fleet of nets with different drop heights

3 Avifauna

3.1 Resting and migratory birds

Re Table 3.1.1: Surveys of foraging, moulting and resting birds (p. 23)

SAS Position Form (translated from Garthe et al. [2002])

SHIP: ..... OBSERVER: .....

DATE: ....

Number of SAS position forms: ..... PORT/ STARBOARD SIDE: .....

METHOD:

All species: .....
Flight directions: ..... Transect width: ..... m

SHIP TYPE: ..... SPEED: ..... knots

POSITION OF OBSERVER:
Top deck: .....
Navigating bridge wing: .....

OBSERVATION CONDITIONS:

Sea state: .....
Visibility: ..... km

WEATHER:

....
.....
.....

REMARKS:

.....
.....
.....

POSITIONS:

TIME	GEOGRAPHIC POSITION		REMARKS
	Latitude	Longitude	

How to complete the „SAS Position Form“ (translated from GARTHE et al. [2002])

Ship:	Name of ship.
Date:	Day, month, year.
Number of SAS observation forms:	Total number of SAS observation forms completed per ship, day and (in case of double transects) ship side (port/starboard).
Observer:	Name of observer(s) (please write full first name(s) and surname). Wherever possible, there should be at least two observers.
Counting side:	Please indicate whether the counts were made generally on the port side (P), starboard side (Stbd), or alternately depending on local conditions.
All species:	Please tick in case all species are recorded. Please indicate species, or groups of species, that have to be omitted.
Flight directions:	Indicate whether the bird flight directions noted on the observation forms are the absolute or relative flight directions (details see SAS Bird Count Form).
Transect width:	With acceptable weather conditions and sufficiently high observer position: 300 m. To be reduced to 200 m in poor weather and/or low observer position (e.g. R.B. „Aade“). Changes made during the observation must be recorded!
Ship type:	e.g. research vessel, ferry ...
Observer position:	Top deck (uppermost place on the ship), wing of the navigating bridge („balcony“ at the end of the bridge).
Speed:	In knots over ground, any speed changes should be noted in the table under „remarks“, e.g. the transition from normal to slow speed. If necessary, ask bridge personnel for information.
Observation conditions:	Information on the sea state must always be provided, information on visibility should be provided if possible. Since conditions change frequently during a count, this information may/should (also) be included in the SAS Bird Count Forms.
	Sea State Scale from 0 - 7 describing wave conditions (sea state), and thus the quality of observation conditions. In principle, the scale is based on wind speed in Beaufort (Bft). However, wind speed and sea state are only comparable if the wind acts on a large sea area for a sufficient period of time, from a particular direction and with constant wind speed (DIETRICH et al. [1975]) - a situation which hardly ever occurs in the German North and Baltic Seas . Therefore, the sea state should not be classified according to the current wind speed but exclusively on the basis of own observations using the following scale. At scale 7 or earlier, the counting has to be interrupted . Changes in the sea state have to be noted in the SAS Bird Count Form or on the SAS Position Form under „Positions: remarks“. 0 Sea like a mirror 1 Very small ripples 2 Small wavelets; crests have a glassy appearance and do not break 3 Large wavelets; crests begin to break; scattered white foam crests 4 Waves become longer; frequent white foam crests 5 Moderate waves; many white foam crests; some spray 6 Large waves; white foam crests are extensive everywhere; more spray 7 Sea heaps up; white foam from breaking waves is blown in streaks along the direction of the wind; rougher conditions **Visibility** To be estimated in relation to, e.g., aids to navigation and other ships. If visibility is **≥** 10 km, enter 10 in the column „visibility“; if it is lower, enter the number of kilometres. Changes in visibility should be noted on the SAS Bird Count Form.
Weather:	Information about the weather is not absolutely necessary for the counts, but is desirable in principle. Especially extreme conditions should be noted (i.e. conditions impairing the accuracy of the records, especially due to precipitation but also, e.g., dazzling light).
Positions:	Parallel to the bird counts, the ship positions have to be recorded regularly in order to be able to refer the observations to geographic positions. On most research vessels, the positions can be recorded automatically, e.g. at one-minute intervals. On other vessels, it may be useful to bring one‘s own GPS equipment and to record the position every minute. If none of these alternatives is feasible, the data sheet on the opposite side should be used for recording the positions, which may be taken directly from the navigational systems on the bridge. Also in the latter case, the geographic position should be recorded as often as possible, but at least once an hour (preferably more often) and whenever the ship changes its course (> 10°) or makes a major speed change. On board the passenger vessels to and from Helgoland, positions can also be derived from the buoys marking the fairway. Observers not familiar with buoys are urgently requested to first talk to experienced observers before adopting this method.
Time:	UTC, corresponding to GMT (Greenwich Mean Time). UTC corresponds to German winter time less 1 hour, or German summer time less 2 hours.
Geogr. position:	In degrees, minutes, and hundredths of minutes (as shown on GPS equipment, e.g. 54° 52.79‘ N), or as a decimal value (e.g. 54.8765° N).
Remarks:	Changes in ship‘s speed, stops, deployment and recovery of nets, inter alia, have to be recorded here. Also changes in the wind direction and speed may/should be noted here..

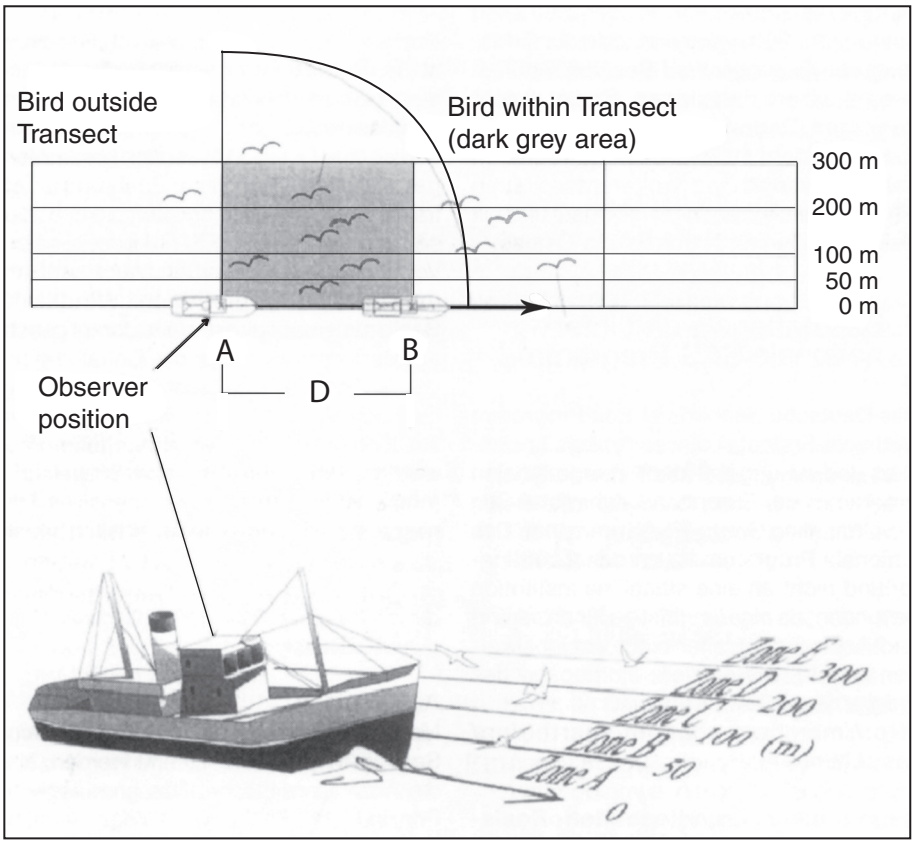

Fig. 8: Principle of transect counting after GARTHE et al. [2002].
The ship is at position B, one or half a minute after having left position A
(depending on cruising speed, and thus length of the snapshot area)

Speed (knots)	Distance covered (m)	
	in 1 min	in 30 s
7	216	108
8	247	123
9	278	139
10	309	154
11	340	170
12	370	185
13	401	201
14	432	216
15	463	232
16	494	247
17	525	262
18	556	278

Tab. 2: Length of snapshot areas as a function of ship's speed
(translated from GARTHE et al. [2002])

SAS Bird Count Form (translated from GARTHE et al. [2002]) (BSH version, February 2003)

Ship: .... *Observer:* .... *Date:* .... *Sheet No.* ..... *Of:* ......

Distance:	**Flight direction:**	**Associated with:**	**Behaviour:**	
F = flying **A** = swimming, 0 - 50 m **B** = swimming, 50 - 100 m **C** = swimming, 100 - 200 m **D** = swimming, 200 - 300 m **0** = swimming, A - D **E** = swimming, > 300 m **W** = swimming, wrong side **Transect:** **1** = outside, **2** = inside	**1** = undirected otherwise: all flight directions accurate to 10° acc. to compass rose (10° - 360°)	**12/13** = front/ foam line **14/15/16** = wood/ garbage/ oil **17** = algae, seaweed **18/21** = own/ other ship **19** = ON own ship **26** = fishing vessel **22** = buoy or other aid to navigation **28/29** = land, sand bar	**30** = + fish **31** = - fish (Alcidae, terns) **33** = feeding, no details **36** = pursuit flying, e. g. Skua **40** = scavenging **41** = feeding discards **42/43** = dipping/surface seiz. **44** = surface pecking **45/46** = deep/ shallow plunging **48** = pursuit diving, not fleeing	**49** = foraging **111** = NOT foraging **60** = resting, sleeping **61/65** = courtship/ with chicks **66** = preening **67** = (high) circling (gulls) **90** = attacked by cleptoparasite **97/98/99** = oiled /sick/ dead

SS: **Visibility:** **Counting side:**

Time	Species	Age	Plumage Cal .year	Number	Grp.	Dis-tance	Tran-sect	Flight direct.	Assoc.	Behav.	Flight altitude	Notes

Flight altitude: **1** = 0 - 5 m, **2** = 5 - 10 m, **3** = 10 - 20 m, **4** = 20 - 50 m, **5** = 50 - 100 m, **6** = 100 - 200 m, **7** = > 200 m

How to complete the SAS Bird Count Form (translated from Garthe et al. [2002])

General:	Please note ship's name, observer, date, and sheet no. at the top of each SAS Bird Count Form. Also the sea state (SS) and visibility should be noted on each page; this information is very important (see above) because conditions may change frequently. Unfortunately, this is sometimes omitted in the records.
Time:	The exact time (in hours and minutes, UTC) has to be recorded for each bird observation. IMPORTANT: at the beginning of each count, the minute **must** be recorded as well as the word START, irrespective of whether or not a bird has been observed in that minute. At the end of counting, i.e. also during brief interruptions, the word STOP has to be noted together with the exact minute. At the top of each form, the complete time (hour and minutes) has to be noted.
Species:	Abbreviations may be used for frequently observed species. The abbreviations used must always be the same. Likewise, a particular abbreviation must not be used for different species..
Age:	**A** = adult, **IM** = immature or juvenile (age in calendar years may be recorded under Plumage)..
Plumage:	**W** = winter plumage, **B** = breeding plumage, **T** = transient plumage. With respect to adult gulls, plumage information refers mainly to the head plumage. *Gannet:* plumage code from 1 to 5 (acc. to the Figure in Annex 3 in Garthe et al. [2002] or A (for adult)). *Fulmar:* **L** (for the typical, light-coloured North Sea birds; corresponds to the formerly used **LL**) or **C** (for all „coloured" individuals). *Ducks:* **M** = male, **F** = female. Never use **W!** (It stands for winter plumage). *Skuas:* **L** = light morph, **I** = intermediate morph, **D** = dark morph. A first-year bird thus is recorded as IM 1. Attention: after New Year, this bird becomes IM 2. It is important to record only the observed plumages (not the most likely plumage for the season).
Number:	Number of individuals.
Group:	Birds belonging to the same flock of birds should be recorded using identical numbers or braces.
Distance:	Use letters for swimming birds: A = 0 - 50 m B = 50 - 100 m C = 100 - 200 m D = 200 - 300 m E = more than 300 m (outside transect!). Flying birds always get the letter F, irrespective of their distance. Swimming birds in transect whose precise distance cannot be determined because, e.g., there is not enough time, are recorded as 0, which corresponds to the distance A to D (0-300 m). The same applies to individuals lifting off from the water at a distance ahead of the ship that is too great to allow their allocation to strips A, B, C or D. W is to be used for swimming birds on the other side of the ship, irrespective of their distance from the ship (no details required because this is not the counting side; such birds consequently cannot be in transect). The distance always has to be estimated perpendicular to the ship's keel line. The direct distance from the observer is not relevant. Distance estimates should be checked routinely against small (!) ships and boats, buoys or the like using radar, a commercially available range-finder, or a caliper scale (range finder according to Heinemann [1981])! 1 nautical mile (nm) corresponds to 1852 m (1/2 nm = 926 m, 1/4 nm = 463 m, 1/8 nm = 232 m).
Transect:	In transect? **Yes** = 2, **No** = 1
Flight direction:	In the case of migrating birds or other directed bird flight (without the observer needing to know where the birds are headed), the flight direction should be indicated in degrees (with a precision of 10°, taking into account the vessel's movement). Directed flight of birds carrying prey (e.g. fish) is particularly important as they may head towards a colony. Observers should record the absolute (= true) direction using a compass rose, a shipboard compass, or the compass of a GPS unit. If these methods are not applicable, the flight direction may also be recorded in relation to the ship's heading (this must be noted on the form!). 360° on the compass rose is dead ahead, 90° starboard beam (=to the right), 180° dead astern (= back), 270° port beam (= 90° to the left). The direction indicated in this way is converted to the absolute direction during data input or evaluation. Relative flight directions may be shown as arrows (upward = direction of ship movement).
Association:	Here, any association with one's own ship or other ships as well as any association with other objects on/in the sea should be noted; details are given in the appropriate box in the heading of the form. The general rule is that individuals associated with one's own ship should always be recorded as not in transect. Only in exceptional cases should they be recorded at all, e.g. in case of special observations (= rare species), extraordinary seasonal observations. At fisheries, plankton, and hydrographic stations, flocks of fulmars and gulls are often observed through which the vessels passes after the completion of sampling. Such individuals should not be counted.
Behaviour:	This category, like „Association" is highly relevant to explain the distribution and abundance of individual bird species at sea. Such distribution patterns at sea may vary considerably for different behaviours (e.g. different distribution of feeding and resting places). The behavioural categories to be distinguished are indicated at the top of the Bird Count Form..
Flight hight:	The flying height has to be noted on the Count Form. Details are given in the relevant box at the bottom of the Count Form.
Remarks:	This column is for additional details not covered by the other columns. In case of doubt, better include more details than too few.

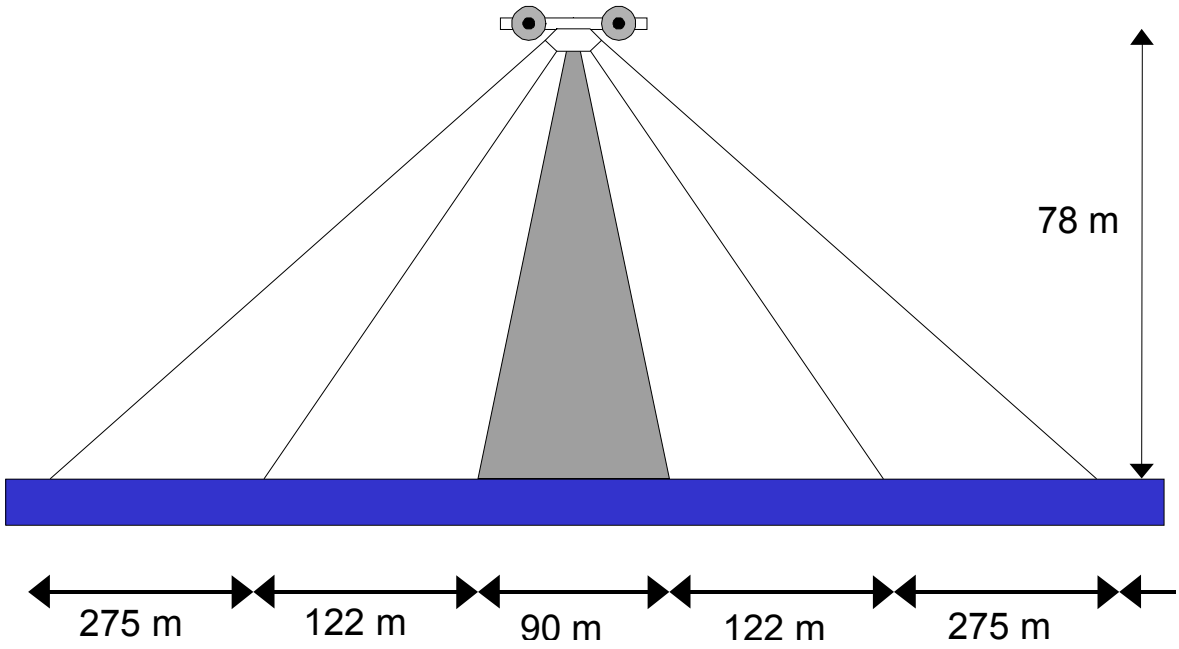

Abb. 9: Goniometric determination of transect bands at an altitude of 78 m (translated from Diederichs et al. [2002])

	Band A	Band B	Band C
Distance from plane	45 - 167 m	168 - 442 m	443 - 1500 m
Transect band width	122 m	275 m	1057 m

Tab. 3: Transect widths in aerial surveys at a transect spacing of 3 km (from Diederichs et al. [2002])

Relevant species

A single-species description is required for the following migratory bird species:

1. All species listed under Annex 1 to the EU Birds Directive.

2. All regularly occurring migratory bird species according to Art. 4, para. 2, Birds Directive, which are not listed under Annex 1. However, a generally applicable and binding list of such vulnerable migratory bird species does not exist. Information about their conservation status is available, e.g., from the species classification by European SPEC categories (Species of European Conservation Concern: BirdLife International [2004]), the European categories of conservation concern (source: Papazoglou et al. [2004]) and the species' status according to the Action Plan under the „Agreement on the Conservation of African-Eurasian Migratory Waterbirds" (AEWA). Against that background, a single-species description has to be provided for all migratory bird species listed in any of the above lists.

Species	Summer/ breeding period	Autumn/ migration	Winter	Spring/ return
Red-throated diver	16.05. - 15.09.	16.09. - 31.10.	01.11. - 29.02.	01.03. - 15.05.
Black-throated diver	16.05. - 15.09.	16.09. - 31.10.	01.11. - 29.02.	01.03. - 15.05.
Great crested grebe	16.04. - 31.07.	01.08. - 15.11.	16.11. - 29.02.	01.03. - 15.04.
Red-necked grebe	01.05. - 31.07.	01.08. - 15.11.	16.11. - 29.02.	01.03. - 30.04.
Horned grebe	16.05. - 31.08.	01.09. - 30.11.	01.12. - 29.02.	01.03. - 15.05.
Fulmar	16.05. - 31.08.	01.09. - 30.11.	01.12. - 15.03.	16.03. - 15.05.
Gannet	01.05. - 31.08.	01.09. - 31.10.	01.11. - 29.02.	01.03. - 30.04.
Cormorant	01.04. - 31.07.	01.08. - 31.10.	01.11. - 31.01.	01.02. - 31.03.
Common eider	01.05. - 31.08.	01.09. - 30.11.	01.12. - 29.02.	01.03. - 30.04.
Long-tailed duck	01.05. - 30.09.	01.10. - 30.11.	01.12. - 29.02.	01.03. - 30.04.
Black Scoter	01.06. - 30.09.	01.10. - 30.11.	01.12. - 29.02.	01.03. - 31.05.
White-winged scoter	01.06. - 31.08.	01.09. - 30.11.	01.12. - 29.02.	01.03. - 31.05.
Red-breasted merganser	01.05. - 31.08.	01.09. - 30.11.	01.12. - 29.02.	01.03. - 30.04.
Little gull	01.06. - 15.07.	16.07. - 31.10.	01.11. - 31.03.	01.04. - 31.05.
Black-headed gull	01.05. - 30.06.	01.07. - 31.10.	01.11. - 29.02.	01.03. - 30.04.
Common gull	16.05. - 15.07.	16.07. - 31.10.	01.11. - 29.02.	01.03. - 15.05.
Lesser black-backed gull	16.05. - 15.07.	16.07. - 31.10.	01.11. - 15.03.	16.03. - 15.05.
European herring gull	16.05. - 15.07.	16.07. - 31.10.	01.11. - 29.02.	01.03. - 15.05.
Great black-backed gull	01.05. - 31.07.	01.08. - 31.10.	01.11. - 29.02.	01.03. - 30.04.
Kittiwake	01.05. - 31.07.	01.08. - 31.10.	01.11. - 29.02.	01.03. - 30.04.
Sandwich tern	16.05. - 15.07.	16.07. - 15.10.	16.10. - 15.03.	16.03. - 15.05.
Common tern	16.05. - 15.07.	16.07. - 15.10.	16.10. - 31.03.	01.04. - 15.05.
Arctic tern	16.05. - 15.07.	16.07. - 15.10.	16.10. - 31.03.	01.04. - 15.05.
Guillemot	16.04. - 30.06.	01.07. - 30.09.	01.10. - 29.02.	01.03. - 15.04.
Razorbill	16.04. - 30.06.	01.07. - 30.09.	01.10. - 29.02.	01.03. - 15.04.
Black guillemot	01.05. - 31.08.	01.09. - 30.11.	01.12. - 29.02.	01.03. - 30.04.
Atlantic puffin	01.05. - 31.07.	01.08. - 31.10.	01.11. - 29.02.	01.03. - 30.04.

Table 4: Seasonal occurrence of sea birds in German waters
Source: GARTHE et al. [in preparation]

3.2 Bird migration and other bird movements in the survey area (avifauna)

re Tab. 3.2.1: Radar surveys (p.26)

The distance correction method described in the following is just an example. Each radar unit has to be corrected individually, and the formula below is by no means generally applicable.

Distance correction for radar equipment (translated from Hüppop et al. [2002])

Whether or not a bird is detected by radar depends on quite a number of factors (Eastwood [1967], Bruderer [1997a, b]). The volume covered by a radar beam increases with distance. On the other hand, the energy density of emitted radar beams decreases by the factor $4\pi R^2$ (R = distance), and the same energy loss occurs with the radar beams reflected by birds. This results in a complex relation between distance and the probability of an object being detected by radar. In order to compensate the distance-related "sensitivity" of radar equipment regarding quantitative assessments, e.g. regarding the altitude distribution, the number of echos recorded has to be corrected. We decided not to apply an experimental approach to equipment calibration (e.g. by using a model plane) but an empirical approach using collected data which was based on the assumption – confirmed by visual observations – that, firstly, there exists no land-sea gradient in bird density off Helgoland and, secondly, flight directions within the distance covered by radar are evenly distributed. Accordingly, distance correction for detectability was performed for the 50 – 150 m altitude range according to Buckland et al. [2001] using the programme Distance 3.5 (www.ruwpa.st-and.ac.uk/distance/index.html). The 50 – 150 m altitude range was chosen for two reasons: it is an altitude characterised by high bird densities, and the observation angle from the horizontal plane is almost unchanged. This helps to minimise errors attributable to the fact that the radar cross-sections of birds vary according to azimuth (angle of vision) (see Fig. 3.3 in Eastwood [1967]).

A half-normal model with cosine series expansion (Buckland et al. [2001]) was used, with three parameters to be estimated (a1-3)), which constitute a good compromise between a good fit (assessed according to the Akaike Information Criterion) and easy handling of the model:

$$y = e^{(-x^2/2\,a_1^2)} \cdot \left(1 + \sum_{j=2}^{3} a_j \cdot \cos \frac{j \pi x}{w}\right)$$

where x = distance from the radar [m], and y = detection probability, w = transect width (here: 2,500 m). The result of our modelling is shown in Fig. 10. Accordingly, the sum of all echoes for each 100 m x 100 m field of the total radar range up to 1,800 m was corrected for distance, with the maximum of the correction curve = 1 (corresponding to the assumption that all birds have been discovered within this distance).

This method is entirely satisfactory for the determination of relative flight intensity up to distances of just under 2,000 m. At larger distances, the density of values per 100 m x 100 m field is too low. A distance correction has to be performed for each individual radar unit because of production-related differences and different equipment settings. Settings must not be changed after this „calibration".

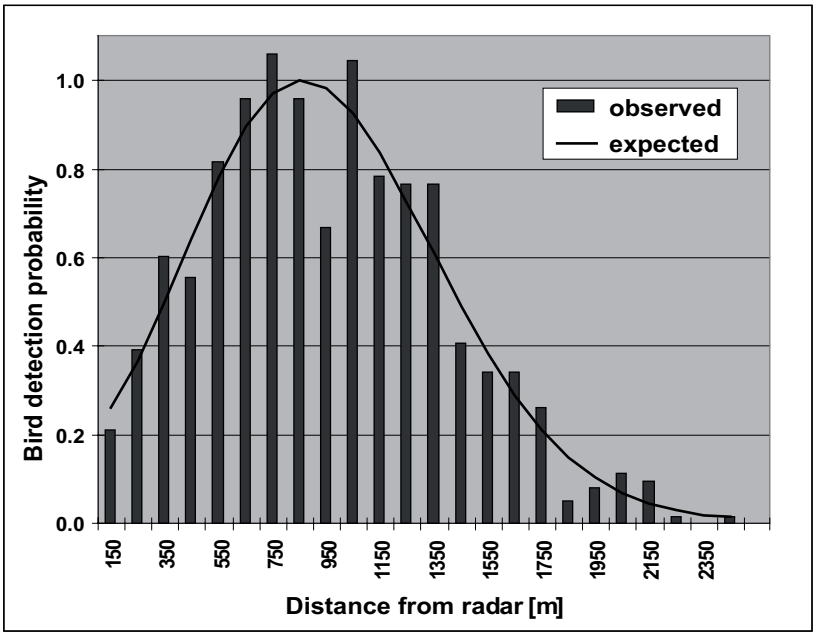

Abb. 10: Bird detection probability as a function of distance at sea (number of observations = 694)
Source: HÜPPOP et al. [2002]

4 Marine mammals

Re Table 4..2: Surveys of habitat use (p. 30)

Recommendations for statistical analysis of the TPOD data collected within the framework of the Standards for Environmental Impact Assessments

It is recommended to analyse the data by means of „repeated measures ANOVA“, which must include the place of deployment of the TPODS (within the project area versus outside) as between-subjects factor and the survey period (before start of construction, different years of construction and operation phases) as within-subjects factor. Both factors (place of deployment and survey period) can be included in the analysis as fixed-effect factors, where the individual deployment sites of the TPODs constitute the subjects (Bortz [1999]). In case there are significant effects, suitable post-hoc procedures should be used to find out between which of the survey periods significant differences exist. If the data are not suitable for parametric analysis because of their distributions, and data transformation does not lead to the expected distribution either, the significance level of the data collected during the different survey periods can be checked using a Friedman or Quade test (Bortz et al. [1990]), or an exact Friedman or Quade test, cf. Siegel und Castellan [1988], Mundry und Fischer [1998]). These tests have to be carried out separately for TPODs deployed inside and outside the project area. If significant results are obtained, again suitable post-hoc tests should be made. The two deployment sites in this case can be compared using exact Mann-Whitney U-tests, which have to be carried out separately for the different survey periods.

The immediate impact of pile driving activities is tested by an approach that does not distinguish between TPODs deployed inside and outside the project area but is based on an analysis of the relation between the number of porpoises recorded by the individual TPODs and the distance between TPODs and pile-driving sites (specific WTG). This analysis should be done by means of ANCOVA (Bortz [1999]), including the pile-driving site as factor and the distance between pile-driving site and the TPOD allocated to it as covariate. Also possible interactions between the pile-driving site and covariates must be taken into account in the ANCOVA (Engqvist [2005]). If the distribution of data is such that a parametric analysis of this type is not feasible, and data transformation does not lead to the expected distributions, a possible alternative is Spearman‘s rank correlation performed separately for the different pile-driving sites. To avoid problems attributable to multiple testing in this case, the overall significance should be determined using Fisher‘s omnibus test (Haccou und Meelis [1994]), and a one-sample t-test of the correlation coefficients obtained should be carried out (expected mean value: zero).

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Abbreviations and acronyms

AEWA	Afrikanisch-Eurasisches Wasservogelabkommen *Agreement on the Conservation of African-Eurasian Migratory Waterbirds*
AIS	Automatic Identification System
ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
Bft	Beaufort
BLMP	Bund/Länder-Messprogramm *Federal and State Monitoring Programme*
BMVBS	Bundesministerium für Verkehr, Bau und Stadtentwicklung *Federal Ministry of Transport, Building and Urban Affairs*
BNatSchG	Bundesnaturschutzgesetz *Federal Nature Conservation Act*
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ESAS	European Seabirds at Sea
FB	Fischereiboot *Fishing vessel*
FFH-Richtlinie	Fauna-Flora-Habitat-Richtlinie *Habitats Directive*
FFK	Fischereiforschungskutter *Fishing research vessel*
GIS	Geographisches Informationssystem *Geographic Information System*
GMT	Greenwich Mean Time
GPS	Global Positioning System
HELCOM	Helsinki Commission
OSPAR	Oslo Paris Commission
PA braided line	Polyamide braided line
PE braided line	Polyethylene braided line
PP braided line	Polypropylene braided line
PTS	Permanent Threshold Shift

SAS	Seabirds at Sea
SPEC	Species of European Conservation Concern
SSS	Seitensichtsonar *Side Scan Sonar*
STuK	Standarduntersuchungskonzept
TPOD	Timing Porpoise Detector
TTS	Temporary Threshold Shift
UTC	Universal Time Co-ordinated
VRL	Vogelschutzrichtlinie *EU Birds Directive*
WTG	Wind Turbine Generator

Useful links

Abkommen zur Erhaltung der afrikanisch-eurasischen wandernden Wasservögel
www.unep-aewa.org/documents/index.htm

ACCOBAMS
http://www.accobams.org/

ASCOBANS
www.ascobans.org

Birdlife International
www.birdlife.org/index.html

Bonner Konvention (Übereinkommen über die Erhaltung der wandernden wild lebenden Tierarten)
www.cms.int/pdf/convtxt/cms_convtxt_german.pdf

Bund/Länder-Messprogramm
www.bsh.de/de/Meeresdaten/Beobachtungen/BLMP-Messprogramm/index.jsp

Bundesnaturschutzgesetz
bundesrecht.juris.de/bnatschg_2002/BJNR119310002.html

Das deutsche Seabirds-at-Sea-Programm
www.uni-kiel.de/ftzwest/ag7/projekte/sas.shtml

Environmental impacts of offshore renewable energy developments. Website for the exchange of information, created on behalf of OSPAR
www.environmentalexchange.info

European Seabirds at Sea
www.jncc.gov.uk/page-1547

FFH-Richtlinie
http://europa.eu/scadplus/leg/en/lvb/l28076.htm

Guidelines for monitoring of phytobenthic plant and animal communities in the Baltic Sea. Annex for HELCOM Combine Programme
sea.helcom.fi/Monas/CombineManual2/PartC/phytobenthic_guidelines.PDF#search=%22Monitoring%20of%20phytobenthic%20plant%20and%20animal%20communities%22

Helsinki Kommission
www.helcom.fi/

Helsinki-Übereinkommen
www.helcom.fi/Convention/en_GB/convention/

Offshore-Wind
www.offshore-wind.de

Oslo-Paris-Kommission
www.ospar.org/

OSPAR-Übereinkommen
www.ospar.org/eng/html/welcome.html

Programm „Distance“ (Distanzkorrektur für Radargeräte)
www.ruwpa.st-and.ac.uk/distance/

Seeanlagenverordnung
http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/index.jsp

Vogelschutzrichtlinie
http://europa.eu/scadplus/leg/de/lvb/l28046.htm