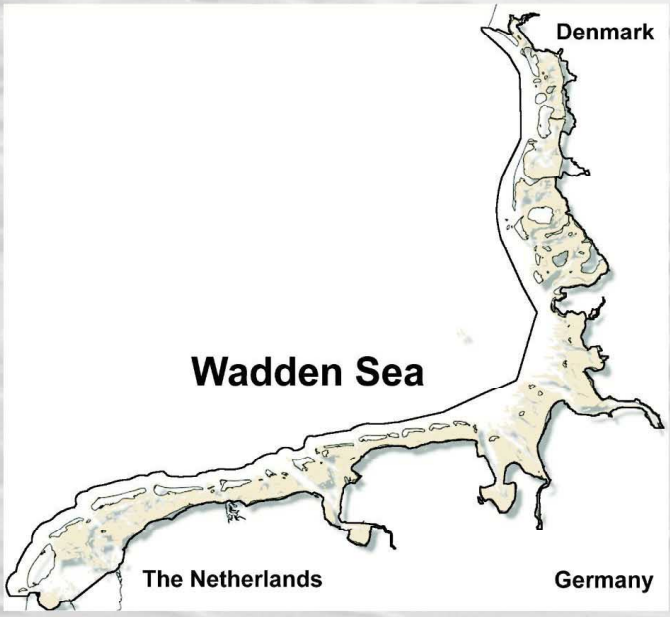
EU Habitat Directive Implementation

Paul Fels

Implementation of the EU Habitat Directive for Monitoring and Reporting in the Wadden Sea Area



Common Wadden Sea Secretariat

Universiteit Utrecht
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2001

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Utrecht University
Department of Science, Technology and Society

October 2001

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Report number for the department of Science, Technology and Society: NWS-I-2001-29

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Prologue

Context and aim

The general aim of the project that resulted in this report is to analyse how the monitoring and reporting necessary for the EU Habitat Directive can be implemented for the Wadden Sea.

The report is a result of my trainee job executed at the Common Wadden Sea Secretariat (CWSS) in Wilhelmshaven (Germany) from June until October 2001. The trainee job is a part of my MSc graduation in Environmental Biology at the Utrecht University, the Netherlands. It is done in the context of the Science, Policy and Management program organised by the department of Science, Technology and Society of the Utrecht University. Next to a theoretical component given at the University, an external trainee job is part of this program.

The trainee job is intended to get (more) experience with policy and management related subjects. The aim is to learn more about the policy and management related to the nature conservation by international co-operation, and the functioning and the activities of a policy related organisation. Another goal of the trainee job is to learn to translate and/or apply biological knowledge for the benefit of policy and/or management related questions. The Habitat Directive is one of the most important policy tools to conserve nature in Europe. More experience with the applications of this Directive is therefore very relevant for my study Environmental Biology.

The author is responsible for the contents of this report. The CWSS, the department of Science, Technology and Society of the Utrecht University and the supervisors do not necessarily share the points of view and conclusions.

Acknowledgements

First of all, I would like to thank Mr. H. Marencic for the supervision at the CWSS and for all other efforts that made my stay in Wilhelmshaven possible, convenient and pleasant. Second, thanks to my supervisor from department of Science, Policy and Society of the University of Utrecht, Mr. H.W. Waardenburg, for his part of the supervision. Third, I thank the people who read and commented (a part of) the concept for this report as well: Mr. J. A. Enemark and Mr. F. de Jong (both CWSS). I appreciate their efforts very much. Further, I would like to thank the rest of the staff of the CWSS, Mrs. B. Reineking, Mrs. M. Polanski, Mr. G. Lüerßen and Mr. M. Vollmer for their help and for giving me the possibility to execute my trainee job at the Secretariat. Also thanks to Mrs. E. Boswinkel for answering my language questions. Furthermore, I am grateful to all people who provide information concerning my subject: Mr. C. Donnelly (English Nature Midlands Team), Mrs. E. Murray (English Nature), Mr. B. Sanderson (Countryside Council for Wales), Mr. J. Le Roux (Overleg Orgaan Waddeneilanden), Mr. J. Davies (Joint Nature Conservation Committee), Mr. K. Laursen (Danmarks Miljøundersøgelser, NERI), Mr. A. Ssymanck (Bundesamt für Naturschutz), Mr. D. Evans (European Topic Center on Nature Protection and Biodiversity) and Mr. A. Kellermann (Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer). For the financial contribution for this trainee job I would like to thank the faculty of Biology and Foreign affairs office of the Utrecht University. For bringing me on the idea of executing my trainee job at CWSS, I thank Mrs. L. Fels. Without her extensive contacts, this report would not exist.

Also thanks to all people who came all the way from the Netherlands to visit me in Wilhelmshaven: my parents, Mr. & Mrs. E. Boswinkel, Mrs. L. Fels, Mr. K. Hendrie, Mr. P. Altink, Mrs. L. Peeman, Mr. J. Keune, Mrs L. Hartog, Mr. M. Feith, Mr. J. Hiddink, Mr. J.P. van Zijl and Mrs. W. Ottens. For all the 'mail-updates' I thank Mr. B. Coumans. And all the rest who wrote me emails about their adventures back in the Netherlands... thanks!

Abstract

In this report it is analysed how the monitoring and reporting required for the EU Habitat Directive can be implemented in the Wadden Sea Area.

Monitoring and reporting for the Habitat Directive
One of the purposes of the Habitat Directive is to maintain or restore the habitats and species of European Community interest, which are listed in the Directive, at a Favourable Conservation Status. Furthermore, it is directed towards the establishment of a coherent European ecological network, called NATURA 2000, to ensure that biodiversity is maintained. This network constitutes a.o. of all areas designated as Special Areas of Conservation under the Habitat Directive. The designation is based on the habitats and the habitats of the species listed in the Directive.

For the habitats and species listed in the Habitat Directive, the Member States should report to the European Commission about the status, the management measures taken and the implementation and effect of these measures. Also the assessment of the implementation of the plans and projects not directly related to conservation management for the area but which might have an effect on the listed habitats or species should be reported. To be able to report this, monitoring is needed. A common strategy for monitoring marine sites has not yet been developed on the European level.

Based on the national reports of the Member States, the European Commission will prepare a composite report. This report will include an assessment of the status of the habitats and species listed in the Habitat Directive on a European level. It will also include a description of the contribution of NATURA 2000 to the preservation of the species diversity, the natural habitats and the wild fauna and flora in the European Union. To be able to compose a European wide report, a unification of the contents and structure of the national reports is necessary. To facilitate this, the Europe Commission should provide clear and straightforward guidelines for the monitoring, assessment and reporting procedures related to the Habitat Directive. Also co-operation between Member States is very important. The exchange of information on methods to monitor and the way the reporting will be done, can help to tune the assessment and reporting methods and procedures of the different Member States and can increase the efficiency of those methods and procedures. Furthermore, co-operation between the countries can reduce the total amount of efforts needed to monitor and report about the border crossing habitats and species.

Monitoring and reporting in the Wadden Sea
The three Wadden Sea countries have decided to co-ordinate their activities and measures in the Wadden Sea a.o. to implement international legal instruments in the field of nature conservation. This means that the monitoring and reporting for the Habitat Directive in the Wadden Sea should be co-ordinated trilaterally. In frame of the co-operation, monitoring and reporting of the Wadden Sea Area on a trilateral level already takes place. These monitoring and reporting activities will have to be adjusted to meet the requirement of the Habitat Directive.

As monitoring and reporting activities are already conducted in the Wadden Sea, establishing a sufficient program is easier and requires less efforts than for areas outside the Wadden Sea without any monitoring or reporting activities present. Therefore, the Wadden Sea programs could efficiently provide a good example of how to meet the requirements of the Habitat Directive.

The Guiding Principle for the Wadden Sea is a “Wadden Sea which should develop, as far as possible, in a natural and sustainable way”. Based on this Principle, trilateral targets were developed and a Wadden Sea Plan with common management measures was established in 1997. To assess to what extent the targets have been reached monitoring is needed. Monitoring parameters can be deduced by specifying the Wadden Sea targets. For this specification it should be determined which characteristics are the most important to assess the targets. Specifying the Wadden Sea Plan targets is essential for an assessment that meets the Habitat Directive requirements. As management measures are derived from

specifications of the targets, assessment of the targets includes an assessment of the measures. The derived monitoring parameters can also be used to assess the status of the feature. However, additional parameters to assess the status of the entire Habitat Directive habitat might be necessary. The development of monitoring strategies should be done by experts at the different (sub-)features.

By specifying the targets, conservation objectives are set for specific characteristics of habitats and species. As in most cases the conservation objectives cannot be quantified, the assessment will have to be based on expert judgement. Theoretical concepts and/or, if available, information from reference situations in the Wadden Sea itself or in comparable ecosystems elsewhere can be used for the assessment. The assessment results and the monitoring, assessment and reporting procedures should be evaluated, including advises for future policy and management. The report can provide an important part of the information needed for an evaluation of the national nature policy.

The results from the evaluations done in frame of specific management plans and for plans and projects with a possible effect on habitats or species subject to the Habitat Directive, should provide the information necessary to report about the specific measures applied and the plans and projects implemented. The results of these evaluations can also be used to assess the status of the habitats and species. Furthermore, other national, European and international nature conservation programs, conventions and directives may include monitoring, assessment and reporting activities. As far as they also apply to the Wadden Sea or to habitats comparable to habitats in the Wadden Sea, their results, methods and guidelines can be used and/or the activities can be co-ordinated with the activities for the Habitat Directive in the Wadden Sea. The co-ordination is necessary in order to increase the efficiency of all monitoring and assessment programs and to avoid double work. The Habitat Directive is, for example, closely related to the Bird Directive. The protected habitats of the two Directives together will form the NATURA 2000 network. As both directives require monitoring and reporting, it could be proposed to the European Commission to compose one report on NATURA 2000, combining the assessments for the two Directives.

Other, closely connected, areas should be taken into account in the assessment and reporting activities. These areas may not entail habitats listed in the Habitat Directive. For example, the offshore area is closely connected with other areas of the Wadden Sea Area but the offshore area of the Wadden Sea does not contain Habitat Directive habitats. As this area might contain important ecological features, the European Commission should considered to include additional offshore habitats in the Habitat Directive.

Alien Invasive Species

Alien Invasive Species are considered the second largest threat to indigenous species, only after habitat destruction. In the Wadden Sea Area several Alien Invasive Species might form or already form a threat. As the NATURA 2000 network aims at protecting biodiversity, these species should also be considered in the reporting activities. Research on this topic might be necessary and policy and management will have to be established.

Budget

The monitoring and reporting activities should take the given budget limits into account. It should be considered if the costs of monitoring and reporting for the Habitat Directive relate reasonably with the total budget available. It might be expected that for the first monitoring and reporting cycle more efforts are needed than for further monitoring and reporting cycles. The establishment of monitoring and reporting procedures and finding out what the European Commission requires exactly will require extra efforts. After having established the procedures and knowing what is required, the efforts needed can be significantly decreased.

Concomitant research

For some habitats and species listed in the Habitat Directive, basic information about their characteristics is lacking. It is difficult to set targets, to monitor and to report about these species and habitats. Therefore, concomitant research is needed a.o. to gain more information about the most important characteristics of habitats and species and about the

way these characteristics can be monitored. Novel insights can also lead to changes in the characteristics to be monitored. Some, previously considered insignificant, characteristic might be added, while others, which importance was previously overestimated, might be deleted from the monitoring program.

Contents

1. Introduction

The Wadden Sea is a shallow sea extending along the North Sea coasts of the Netherlands, Germany and Denmark. It is a highly dynamic ecosystem with tidal channels, sands, mudflats, salt marshes, beaches, dunes, dike slopes, river mouths and a transition zone to the North Sea: the offshore zone. The present form of the Wadden Sea is the result of both natural forces and action by man. Of greatest influence on the shape and functioning are the daily tides. Twice a day, on average 15 km^3 of seawater enters the Wadden Sea. This doubles the volume to some 30 km^3. With the water from the North Sea, large amounts of sand and silt are imported which partly settle in places with little water movement. During low tides large parts of the Wadden Sea emerge. These so-called tidal flats cover about two-thirds of the tidal area and are one of its most typical characteristics. Nowhere in the world can such a large unbroken stretch of tidal flats be found. They account for 60 percent of all tidal areas in Europe and North Africa.

Since 1978, the Netherlands, Denmark and Germany have been working together on the protection and conservation of the Wadden Sea covering management, monitoring and research, as well as political matters. The 13,500 km^2 large area of the trilateral co-operation is called the Co-operation Area. In 1982, a Joint Declaration on the Protection of the Wadden Sea was agreed upon in which the countries declare their intention to co-ordinate their activities and measures for the protection of the Wadden Sea. The Common Wadden Sea Secretariat (CWSS) was established in 1987 as the secretariat for the trilateral co-operation. Its primary task is to support, initiate, facilitate and co-ordinate the activities of the trilateral collaboration.

Since the 8th Ministerial Conference in Stade (1997), the arrangements of the Wadden Sea co-operation have been embedded in the Trilateral Wadden Sea Plan (WSP). It is a statement on how the three countries envisage the future co-ordinated and integrated policy and management of the Wadden Sea and the activities that must be carried out to achieve the commonly agreed targets. The basis for the trilateral target concept was laid at the 6th Wadden Sea Conference (Esbjerg, 1991), at which the so-called Guiding Principle of a "Wadden Sea which should develop, as far as possible, in a natural and sustainable way" was adopted. It was agreed that this Guiding Principle must be specified by means of ecological targets. The main element in the ecological target concept is the presence of all typical Wadden Sea habitats in their natural state.

1.1 EU Directives

The three Wadden Sea countries intend to co-ordinate their activities and measures for example to implement a number of international legal instruments in the field of nature conservation, a.o. the Bird Directive, the Habitat Directive and the Water Framework Directive. These Directives apply to the marine environment of the European Union as well as to the terrestrial and freshwater environments. Directives are the most important rules in the European nature conservation law. Unlike Regulations, Directives must be implemented into the national law of the Member States.

1.1.1 Bird Directive

The goal of the Council Directive 79/409 EEC of 1979 on the *Conservation of wild birds* (the Bird Directive; Council of the European Communities, 1979), amended by the Commission Directive 91/244/EEC, is to improve the conservation of all breeding, resting, moulting and wintering bird species. For the conservation of bird species mentioned in Annex I of this Directive and for all regularly occurring migratory bird species, the Member States have to designate Special Protection Areas (SPAs) (Bird Directive: Article 4). All SPAs together will form a network of protected areas for the Annex I and migratory bird species. Next to habitat conservation, a number of prohibitions of activities that directly threaten birds (e.g. the taking of eggs) and associated activities such as the trade of living or dead birds are stated in this Directive. Furthermore, rules concerning hunting are stated. These rules limit the number of birds that can be hunted, the period during which they can be hunted and the methods of

hunting permitted. For the above-mentioned prohibitions and for hunting, exceptions are possible, but these exceptions must meet strict requirements, including the absence of alternative satisfactory solutions.

1.1.2 Habitat Directive

Council Directive 92/43 EEC of 1992 on the *Conservation of natural habitats and of wild fauna and flora* (the Habitat Directive; Council of the European Communities, 1992), amended by Directive 97/62/EC, requires, a.o. that the Member States designate Special Areas of Conservation (SACs) for specified habitats and habitats of specified species of wild plants and animals. The selection of the SACs should only be based on nature conservation criteria. For the SACs the Member States shall establish the necessary conservation measures involving the appropriate management plans. Natural habitat types of Community interest for which SACs should be designated, are defined in Article 1c and listed in Annex I of the Directive. These habitats include natural and semi-natural ecosystems. For the conservation of some of the listed habitat types, the so-called priority natural habitat types, the Community has a particular responsibility. Species of Community interest are defined in Article 1g and listed in Annex II and/or Annex IV or V of the Directive. Some of these species are priority species for which conservation the Community has a particular responsibility. The species mentioned in Annex II are species whose conservation requires the designation of SACs. Annex IV species are in need of strict protection, including the prohibition of certain means of capture/killing, collection and commercial exploitation. In Annex V species are listed whose taking in the wild and exploitation may be subject to management measures. The species lists of the different Annexes are partly overlapping, but every Annex contains species that are not mentioned in the other Annexes.

The Habitat Directive has several goals. One of the purposes is to maintain or restore the habitats and species of European Community interest at a Favourable Conservation Status within their natural biogeographic zone. The Directive also aims to make a contribution to sustainable development of the designated sites. Furthermore, it is directed towards the establishment of a coherent European ecological network, called NATURA 2000, to ensure that biodiversity[1] is maintained. The Habitat Directive is a major contribution by the European Union to the Convention on Biological Diversity (CBD) (Secretariat on the Convention on Biological Diversity (SCBD), 1992) agreed by more than 150 countries at the 1992 Rio Earth Summit. The NATURA 2000 network constitutes all areas designated as SACs under the Habitat Directive and all areas designed as a SPA under the Bird Directive. Furthermore, "where they consider it necessary, Member States shall endeavour to improve the ecological coherence of NATURA 2000 by maintaining, and where appropriate developing, features of the landscape which are of major importance for wild fauna and flora [...] (Habitat Directive: Article 3 (3)). " [...] Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species" (Habitat Directive: Article 10).

The NATURA 2000 network in the Wadden Sea is subject to the trilateral Wadden Sea policy and activities. At the Trilateral Governmental Conference in Stade in 1997, “the Ministers *note* that major parts of the Wadden Sea Area have been listed as a habitat area by the competent authorities in accordance with Article 4 of the EC Habitat Directive and/or Article 4 of the EC Bird Directive [...]. A majority of the Wadden Sea Area is hence, now part of NATURA 2000” (Stade Declaration, 1997: §18; see also appendix 6). Furthermore, “The Ministers *recognise* that there are differences in the delimitations of the listed areas and, therefore, *agree* to work further towards a more coherent NATURA 2000 area for the Wadden Sea" (Stade Declaration, 1997: § 19). Several activities are currently in progress to implement the Habitat Directive in the Wadden Sea concerning the nomination of additional parts, the preparation of management schemes and the implementation of an appropriate

[1] A definition of biodiversity is given in the glossary.

monitoring. As agreed by the Ministers, these activities are co-ordinated within the trilateral co-operation.

1.1.3 Water Framework Directive

Next to the Habitat Directive and the Bird Directive the Wadden Sea is subject to Directive 2000/60/EC of 2000 of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (the Water Framework Directive; European Parliament and the Council of the European Communities, 2000). This Directive requires the Member States to prepare river basin management plans and covers all Community waters: inland surface waters, transitional waters, coastal waters and groundwater. The overall environmental target is to achieve a good water status by 2015 in all categories. For marine areas, the estuaries and the coastal waters up to one nautical mile from the baseline of the territorial sea are subject to the Water Framework Directive. NATURA 2000 forms an integral part of this Directive (European Commission DG ENV, 2000).

1.2 Monitoring and reporting for the Habitat Directive

The purpose of designating and conserving SACs is to maintain or restore the habitats listed in Annex I, and the habitats of the species listed in Annex II of the Habitat Directive to a “Favourable Conservation Status”. Favourable Conservation Status is defined in Article 1 of the Directive. In summary, for Annex I habitats, it means that conditions have been established which ensure that the extent and range of the habitat, and the populations of the constituent species of that habitat, will be maintained or increased over time. For Annex II species, it means that conditions have been established which ensure that the viability, population size and range of that species will be maintained in the long-term (Council of the European Communities, 1992). To determine whether a Favourable Conservation Status is achieved, monitoring of SACs is necessary.

The Habitat Directive includes a number of specific provisions that require the undertaking of monitoring and reporting on SACs. The most important are:

- Article 11: “Member States shall undertake surveillance of the conservation status of the natural habitats and species [...] with particular regard to priority natural types and priority species”.
- Article 17: “Every six years […] Member States shall draw up a report on the implementation of the measures taken under this Directive. This report shall include in particular information concerning the conservation measures referred to in Article 6 (1) as well as evaluation of the impact of those measures on the conservation status of the natural habitat types of Annex I and the species of Annex II and the main results of the surveillance referred to in Article 11. The report, in accordance with the format established by the committee, shall be forwarded to the Commission and made accessible to the public".

Thus, concerning the habitats and species of the Habitat Directive, the Member States should report about the status, the measurements taken and the implementation and effect of these measures. Also the assessment of the implementation of the plans and projects not directly related to conservation management for the area but likely to have a significant effect thereon (Habitat Directive: Article 6 (3)) should be reported. To be able to report this, monitoring is needed. A common strategy for monitoring marine sites has not yet been developed on the European level (Trilateral Monitoring and Assessment Group (TMAG), 2001a). Moreover, a format of the national reports, to be provided by the European Commission according Article 17 of the Habitat Directive, has not been made available yet (Rückriem & Roscher, 1999).

Based on the national reports of the Member States, the European Commission will prepare a composite report. This report will include an assessment of the status of the Habitat Directive habitats and species on a European level. Based on this assessment, the report will contain a description of the contribution of NATURA 2000 to the preservation of the species diversity, the natural habitats and the wild fauna and flora in the European Union.

1.3 Ongoing monitoring and reporting in the Wadden Sea

1.3.1 Trilateral monitoring

Assessments of the quality status of the Wadden Sea ecosystem are an important basis for political decision making. At the 5th Trilateral Governmental Conference (TGC) in 1988 it was declared that a continuous overview of the Wadden Sea ecosystem is a necessary prerequisite for the protection of the Wadden Sea. It was decided to install a common monitoring program with the aim of continuously assessing the ecological state of the Wadden Sea. At the 6th TGC in 1991 it was decided to develop a joint, harmonised monitoring program that is able to record the status of the Wadden Sea and allows an assessment of the ecosystem as a whole. An expert group (the Trilateral Monitoring Expert Group, TMEG) was installed with the terms of reference to develop a concept for such a program. One of its tasks was to elaborate the concept for an ecological monitoring which will enable a continuous evaluation of the ecological state of the Wadden Sea as a basis for trilateral political measures. In 1993 the concept was adopted and the program started with a subset of parameters based on the existing and not yet harmonised national monitoring programs in January 1994. Since then, the program has been further developed by the Trilateral Monitoring and Assessment Group (TMAG). At the 7th TGC in 1994 the first phase of the common monitoring program for the Wadden Sea, the Trilateral Monitoring and Assessment Program (TMAP), was installed that based on national programs with certain parameter sets in common. The TMAG is responsible for the implementation and co-ordination of the TMAP. The overall aim of the TMAP is to provide a scientific assessment of the status of the ecosystem and to assess the status of the implementation of the targets as entailed in the Wadden Sea Plan of 1997 (TMAG, 2001a). The TMAP combines a comprehensive set of physical, chemical, biological and socio-economical parameters with concomitant ecological research. Another important element of the TMAP is the establishment of a common data management system. At the start the TMAP was based on a series of scientific hypotheses, based on “Issues of Concern”. During the implementation and elaboration of the TMAP, the emphasis of the program has shifted from the hypotheses towards assessing the targets, because the targets, which were not established yet at the time of the start of the TMAP, became the main focus in the trilateral activities.

Although the TMAG tries to implement the TMAP since 1993, only a part of it is actually implemented because of technical and financial restrictions (Bakker *et al.*, 1998; TMAG, 2001a). At the 8th TGC in Stade (1997), the ministers adopted a sub-set of the TMAP parameters (the so-called Common Package) to be implemented with priority. The parameters of the Common Package (see appendix 1) were selected from the TMAP. This selection was based on the information requirements of the targets and “Issues of Concern”, as well as on the technical effort needed for the implementation, their importance for the targets, the cost-benefit relation, and whether the parameters are already part of a national monitoring program (TMAG, 2001a). Most parts of the Common Package are implemented.

The three Wadden Sea countries have decided to co-ordinate their activities and measures a.o. to implement the Habitat Directive. Therefore, next to the evaluation and assessment of the implementation of the WSP, the TMAP should also take the requirement of the Habitat Directive into account. To meet the requirements of this Directive, the TMAP, and the associated Common Package, might have to be optimised (TMAG, 2001a).

1.3.2 Trilateral reporting

The results of the assessments are published a.o. in so-called Quality Status Reports that are, in principle, prepared every three - five years. The Quality Status Reports (QSRs) describe and evaluate the current ecological condition of the Wadden Sea (e.g. De Jong *et al.*, 1993, 1999). The evaluation is based on information about the pollution status, the intensity of human activities and the status of flora and fauna. The changes in the status and the possible causes are identified. The QSRs also consider the main important political decisions within the trilateral co-operation, most notably the adoption of a common delimitation of the Wadden Sea Area, of common targets for the different Wadden Sea habitats and of a common management plan, the Trilateral Wadden Sea Plan. Next to the QSRs, also assessment reports about specific subjects are published. For example,

assessment reports on breeding birds (e.g. Rasmussen, 2000) and on migratory birds (e.g. Poot *et al.*, 1996) are regularly published. Also unforeseeable events like the mass eider mortality in the south-western part of the Wadden Sea in the winter of 1999/2000 (see Blomert & Reineking, 2001), are evaluated and reported as well.

To separate the 'scientific' reports from the 'policy' reports, the effect of trilateral policy and management measures in the Wadden Sea is assessed in the Policy Assessment Report (PAR; e.g. CWSS, 2001b). The PARs are based a.o. on the results of the QSRs and evaluates the status of the Wadden Sea and implementation of the trilateral policy and management as stated in the Ministerial Declarations and the Wadden Sea Plan. The PARs are an input to the Trilateral Governmental Conferences and a basis for (new) agreements in the Ministerial Declarations.

1.4 Monitoring the status and the effect of measures

The Habitat Directive requires a.o. information about the status of the habitats listed in Annex I of the Habitat Directive and occurring in the Wadden Sea and about the effects of management measures in these habitats. To determine which parameters to monitor, the theoretical concept presented in figure 1 is introduced here. The terms used are partly based on the UK Marine SACs project. The term feature is used in this report to indicate the habitat or species for which the site was selected, meaning a habitat mentioned in Annex I or a species mentioned in Annex II of the Habitat Directive.

First it is determined which Annex I habitats occur in the Wadden Sea. The large geographical scale (e.g. estuaries) and the imprecise, broad definition of some marine and coastal features means that units, called sub-features, have to be introduced to get a practical handle on the measurement of these features (Earll, 1999). A sub-feature is defined as an ecological important subdivision of the feature (English Nature: Murray, pers. comm.). Annex I habitats may contain several sub-habitats. For example the Annex I habitat “mudflats and sandflats not covered by seawater at low tide” includes the sub-habitats mussel beds and seagrass fields. Here, these sub-habitats are called sub-features of the feature “mudflats and sandflats not covered by seawater at low tide”.

Second, the (sub-)features are connected to conservation objectives and management measures. For the (sub-)features in the Wadden Sea, targets are stated in the Wadden Sea Plan of 1997 (see appendix 2). These targets are the conservation objectives and/or describe the desired (favourable) status. To assess whether these objectives are met and/or whether the desired status is reached or maintained, monitoring is required. To be able to determine what to monitor the targets should be specified. It should be indicated more specifically which characteristics of the (sub-)features are important for the management objectives and/or for desired (favourable) condition. For example, for the target 'a more natural development of the mussel beds' it should be specified what is ‘natural’. 'Natural' could for example mean a certain size frequency distribution of the mussels in a mussel bed. Management measures are based on the targets. For each target category Wadden Sea specific measures and projects aiming at implementing the targets have been specified in the WSP (1997). Mostly these measures are not based on the whole target but on specifications of this target. For example, fishery could be assumed to have a negative effect on the natural distribution of mussel beds. Based on this specification of the target "[...] a more natural [...] development of natural mussel beds [...]", measures might be taken to reduce the effect of fishery. Because the measures are based on the targets or their specifications, monitoring should be based on the targets and their specifications.

Third, by specifying the targets, attributes can be derived. Attributes are selected characteristics of an (sub-)feature which provides an indication of the condition of the (sub-) feature to which it applies (English Nature, 2000). These attributes can be related to monitoring parameters. Using the same example as above, the length of mussels could be an attribute that indicates the size. The related monitoring parameter can be the length frequency distribution of a sample of mussels.

Fourth, based on the monitoring results and by using the specifications of the targets and additional information like reference situations or theoretical concepts, it can be assessed to what extent the targets have been reached. For the assessment of the target 'a

natural distribution of mussels beds' reference situations can be historical values like areas where mussel beds used to occur. Theoretical concepts like models or in this example, areas where mussel beds could potentially occur, can also be used in the assessment procedure. To determine if the Favourable Conservation Status of the whole feature is achieved, the monitoring results for all attributes of all sub-features should be aggregated. If, for example, targets are only set for some sub-features, the aggregation of the results might not be sufficient to assess the status of the entire feature. In this case, additional monitoring parameters are needed.

In case the Favourable Conservation Status is not achieved, the reasons should be indicated. If, for example, the desired condition is impossible to achieve, other targets or their specifications might be needed. Furthermore, the attributes determined might be unable to determine the state of the specifications of the targets. In this case the attributes should be adjusted. Not having reached the targets might also be the result of ineffective measures. Measures might have to be adjusted or new measures might have to be established.

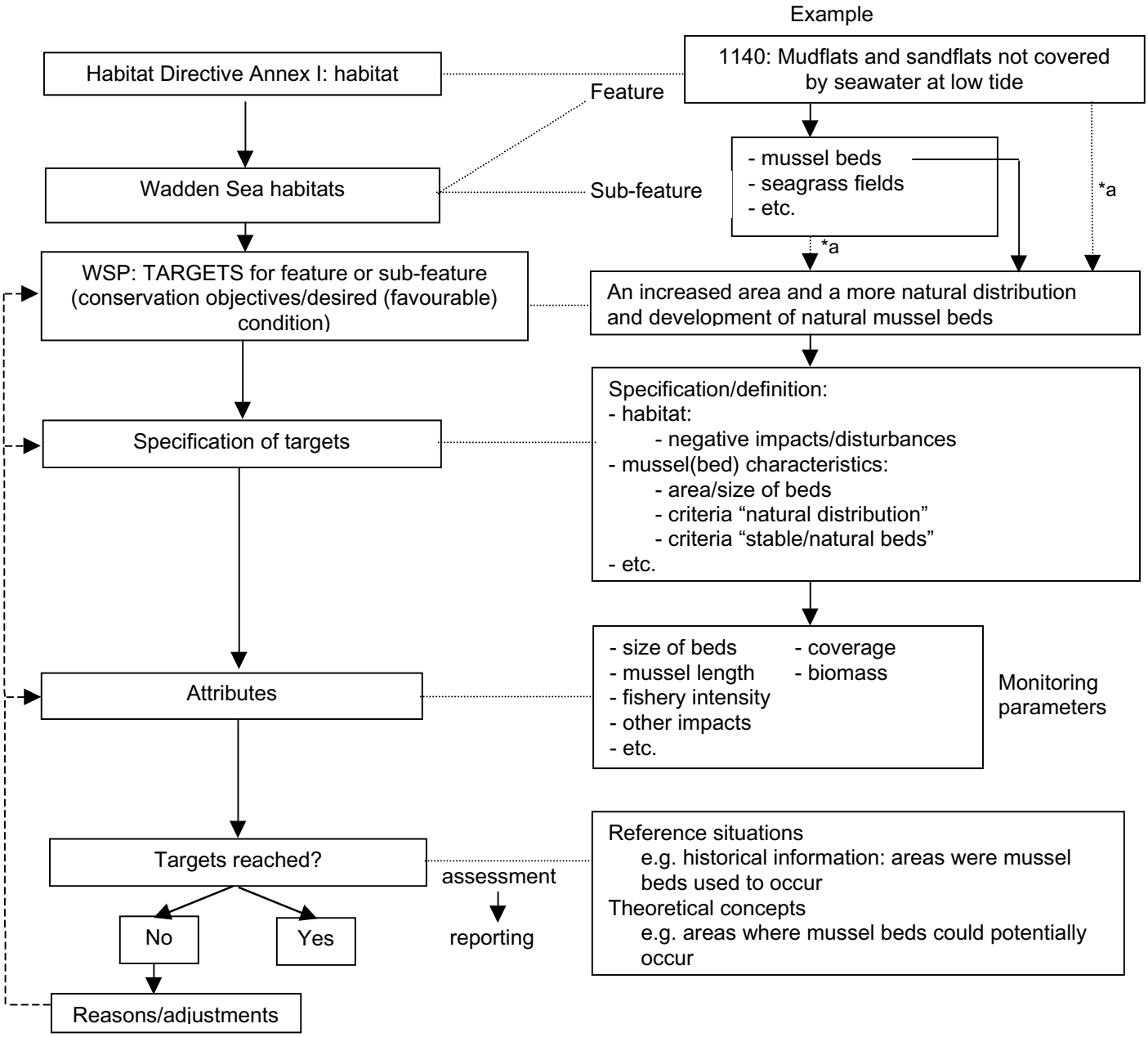


Figure 1. *The theoretical concept to monitor and assess the status of Annex I habitats in the Wadden Sea and the effects of management measures in these habitats. *a = targets can be set on both features and sub-features. Further explanations see text.*

Concerning the conservation objectives[2] in the Wadden Sea, different levels of detail can be distinguished. For the whole Wadden Sea the Guiding Principle is the conservation objective. For the features described in the Habitat Directive, the conservation objective is restoration or maintenance of the Favourable Conservation Status. For different habitats, areas and species in the Wadden Sea, different targets of the Wadden Sea Plan (1997) are the conservation objectives. The specifications of these targets (figure 1) are conservation objectives for specific characteristics of these habitats, areas and species. From these conservation objectives the attributes and related monitoring parameters can be derived.

1.4.1 Monitoring for the Habitat Directive in the Wadden Sea

The general aim of the project that resulted in this report is to analyse how the monitoring and reporting necessary for the EU Habitat Directive can be implemented for the Wadden Sea. Figure 2 shows how this project fits into the theoretical concept of figure 1. It is analysed which features and sub-features occur in the Wadden Sea (1 and 2 in fig. 2). The related targets of the Wadden Sea Plan (WSP) of 1997 are given (2 and 3 in fig. 2). How the attributes and related monitoring parameters can be derived from the specification of the targets for features and sub-features described in the WSP (1997) (3, 4 and 5 in figure 2) is explained by using one feature as an example. Based on this, the establishment of a monitoring program that meets the Habitat Directive requirements is discussed (*b in figure 2). Using the results of the monitoring program, the status and the effects and implementation of management measures can be assessed (6 and 7 in figure 2). These results have to be reported to the European Commission. A possible set up of such a report for the Wadden Sea is proposed in this report. Overall, the shortcomings and possible adaptations of the current activities to meet the monitoring and reporting requirements of the EU Habitat Directive are discussed as well (*b in figure 2).

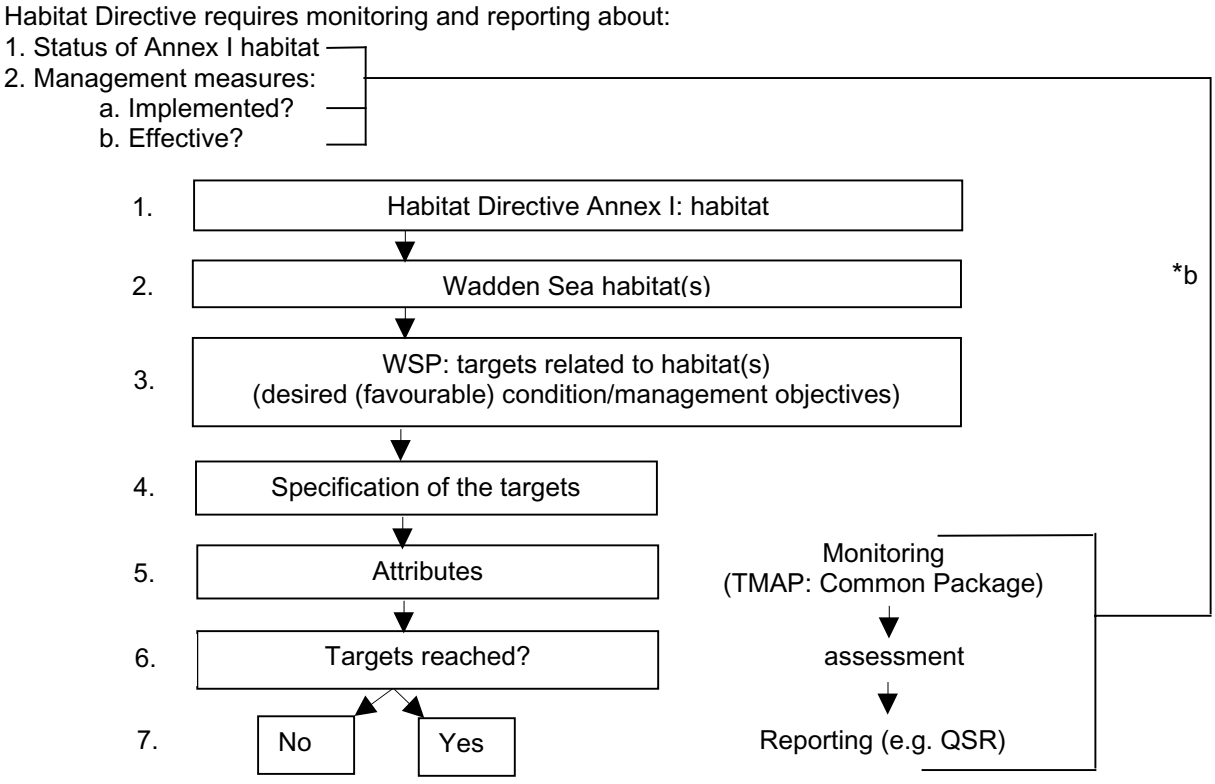


Figure 2. *Fitting of the subject of this report into the theoretical concept given in figure 1.*
**b: Assess to what extent the monitoring and reporting going on in the Wadden Sea (TMAP and e.g. QSR) meets the requirements of the Habitat Directive (1, 2a and 2b).*

[2] Conservation objective is defined in the glossary.

1.5 Scope of the report

This report is not meant to be a monitoring and reporting handbook. It is meant to provide proposals and input to discussions concerning the monitoring and reporting needed to fulfil the requirement of the Habitat Directive. The stages 1, 2 and 3 of figure 2 are described for all Annex I habitats occurring in the Wadden Sea. For one example, also the stage 4 and 5 of figure 2 are studied. In this analysis it is indicated which targets should be specified and what could be specified. This serves as an example of how analysing to what extent the monitoring program meets the requirements of the Habitat Directive could be done. The actual optimisation of the monitoring program should be a result of expert judgements for the specific (sub-)features.

In this report, the discussion about the specification of the targets is mainly related to specification of the targets to be able to derive monitoring parameters. For the specification of the targets the most important characteristics of a feature should be identified and parameters should be deduced from that. The results of monitoring these parameters indicate something about these characteristics. As these characteristics are indicated as the most important characteristics of the feature, these characteristics should also be taken into account in the assessment for the feature. To be able to assess to what extent the status of the features represent the Favourable Conservation Status or whether management has positively effected the status in the direction of the Favourable Conservation Status, the preferred status and the preferred effect should be defined in terms of these characteristics. This can be done by, for example, using the status observed in undisturbed reference areas. Although some general remarks about how the desired status could be defined and which problems are associated with it are given, a comprehensive discussion about defining the preferred status for features is not the scope of this report. It is indicated that important characteristics should be identified and conservation objectives set, but how to set those objectives exactly is not discussed in detail.

This report is partly based on suggested approaches for monitoring and reporting in frame of the Habitat Directive done for other European areas. Especially the results of the UK Marine SACs project and the results of the project "Evaluation of the conservation status of natural habitat types according to the Habitat Directive" carried out by the Bundesamt für Naturschutz in Bonn (Germany) are used. It should be stressed that these approaches are only suggestions and intended to be used as an input to discussions and not as comprehensive monitoring and reporting strategies. Although the approaches differ considerably and several aspects are disputable, these are not discussed in this report.

As the number of Annex II species in the Wadden Sea is small and information about these species is generally scares, this report is mainly focussed on the monitoring and reporting of Annex I habitats.

1.6 Methods

To analyse how the monitoring and reporting necessary for the EU Habitat Directive can be implemented for the Wadden Sea the following procedure was followed.

First it was analysed which habitats and species, listed in the Habitat Directive, occur in the Wadden Sea. Amongst others, the descriptions of the habitats given in EC interpretation manual, the TMAP evaluation report and the TMAP classification system for beaches and dunes were used for this.

Second, the monitoring and reporting required by the European Commission was studied by using a.o. the text of the Habitat Directive and by using the monitoring and reporting approach proposed in the UK Marine SACs project and the approach proposed for Germany (Rückriem & Roscher, 1999). People involved in the implementation of the Habitat Directive were contacted for more information on monitoring and reporting for the Habitat Directive. They gave some information themselves and/or gave literature references. Additional information on the two above-mentioned approaches was given as well.

Third, the monitoring and reporting going on in the Wadden Sea was studied using literature available at the Secretariat and by contacting people involved in these activities in the Wadden Sea (e.g. members of the Trilateral Monitoring and Assessment Group).

Fourth, the information collected was structured and the report written. Based on the gathered information, the implementation of the monitoring and reporting required for the Habitat Directive in the Wadden Sea was discussed. The proposals made for the format of the report to the EC were primarily based on the UK Marine SACs approach and on Rückriem & Roscher (1999). The concept of developing a monitoring strategy was illustrated using one habitat listed in the Habitat Directive as an example. The concept versions of this report were adjusted using a.o. the comments of the supervisors on these concepts.

Next to printed literature sources, online sources were used. Internet sources are included in the literature list by referring to the year they were accessed.

1.7 Structure

Chapter 2 deals with the Annex I habitats and the Annex II species occurring in the Wadden Sea Area and with the Wadden Sea Plan targets related to these habitats and species.

In chapter 3 the monitoring required for the Habitat Directive and how to meets these requirements is discussed. As deriving attributes for the (sub-)features requires the specification of targets, targets specification is also discussed.

In chapter 4 the reporting requirements of the Habitat Directive are described. A format of the report to the European Commission is proposed. This includes proposals of how to report to what extent the Favourable Conservation Status has been reached.

Chapter 5 consists of a discussion of the subjects of the previous chapters. Conclusions are drawn and proposals and suggestions are given as well. In chapter 6 the conclusions and recommendations of the report are listed.

Appendix 1 gives an overview of the parameters groups of the Common Package, and appendix 2 of the trilateral targets.

Appendix 3 describes the habitats listed in Annex I of the Habitat Directive and appendix 4 the species listed in Annex II of the Habitat Directive, which occur in the Wadden Sea.

In appendix 5 gives an example of how the targets of the Wadden Sea Plan could be specified to derive monitoring parameters and how to analyse to what extent the current trilateral monitoring program in the Wadden Sea meets the requirements of the Habitat Directive for one Annex I habitat.

Next to the literature used, a glossary with explanations and/or definitions of the used terms and abbreviations is given at the end of this report.

2. Habitat Directive habitats and species in the Wadden Sea Area

This chapter deals with the habitats listed in Annex I and the species listed in Annex II of the Habitat Directive, which occur in the Wadden Sea Area.

The habitats given in Annex I of the Habitat Directive which occur in the Wadden Sea are listed in table 1 and described in appendix 3. In appendix 3, per Annex I habitat, it is given which sub-features are present in the Wadden Sea. The targets of the Wadden Sea Plan (WSP) of 1997 (see appendix 2) related to these sub-features are given as well.

The Wadden Sea Plan is part of the trilateral conservation policy and management and aims to achieve a full scale of habitat types that belong to a natural and dynamic Wadden Sea. Each of these habitat types needs a certain quality (natural dynamics, absence of disturbance, absence of pollution) that can be reached by proper conservation and management. The quality of the habitats shall be maintained or improved by working towards achieving targets that have been agreed for six habitat types. These targets are valid for the whole area of the trilateral co-operation, be it with a differentiation in scale, place and time. Supplementary, targets on the quality of water and sediments have been adopted as well as targets on birds and marine mammals and on landscape and cultural aspects. In table 3, the relations between the targets of the WSP and the Annex I habitats occurring in the Wadden Sea are indicated.

In the description of the Annex I habitats in appendix 3, the Annex II species present in a habitat are indicated as well. These species are only mentioned if it is sure that the habitat is important for that species. For example, the Annex II seal species (the Common and Grey Seal) might be present in different habitats. However, it is only mentioned in those habitats that are known to be important for these species.

Birds are not listed in the Habitat Directive, but may be an important sub-feature of those habitats. Targets for birds are stated in the WSP (1997). The associated conservation measures can be aimed at the habitat conditions and could influence the status of those habitats. Therefore, appendix 3 also indicates the presence of bird species and function of the habitats for those species (e.g. breeding area). Birds are only mentioned for those habitats important for one or more of the targets for birds. Meaning that the habitat should be important for feeding, breeding, roosting and moulting, and/or natural flight distances for birds.

In appendix 4 the species mentioned in Annex II of the Habitat Directive and occurring in the Wadden Sea (listed in table 2) are described. In Annex II of the Habitat Directive the listed species are ordered by taxon. In the Wadden Sea Plan (1997) targets are only set for the two seal species and the Harbour Porpoise. For many Annex II species occurring in the Wadden Sea, information is lacking. As information is especially lacking for the Annex II fish species, these are not mentioned in appendix 3. These species can be assumed to be present in some of the seawater containing habitats.

It is not known if there are species listed in Annex IV and/or V, which are not mentioned in Annex II, occurring in the Wadden Sea. Therefore, these Annexes are not discussed here.

2.1 Habitat classification

The numbers used in Annex I of the Habitat Directive to indicate the habitats are used here as well. These numbers are based on the hierarchical classification of European habitats developed by the CORINE Biotopes project. This classification system will be replaced by the EUNIS habitat classification system which is still in development (see Davies & Moss, 1999; Moss & Davies, 1999; European Environmental Agency (EEA), 2001). The EUNIS (European Nature Information System) system will be used for all EU related reporting requirements including reporting for the EU Directives. The EUNIS habitat classification builds upon the CORINE Habitat classification and its successor the (ongoing) Palaearctic[3]

[3] The palaearctic is a subregion of the Holarctic Realm, including Europe, North Africa, western Asia, Siberia, northern China and Japan.

Habitat classification, developed for the Council of Europe, but restructures and redefines this classification. It is further refined in the marine sector by the addition of units developed by marine conventions (OSPAR, Barcelona and Helcom) and the BioMar project. Aims of the EUNIS habitats Classification are to provide a common language to describe habitats (biotope types) throughout the geographically range, to enable mapping of the units described at the regional level, and to allow aggregation, evaluation and monitoring of habitat Units (Ostermann, 2000).

Table 1. *Annex I habitats occurring in the Wadden Sea. These habitats are described in appendix 3.*

1			**COASTAL AND HALOPHYTIC HABITATS**
	11		**Open sea and tidal areas**
		1110	Sandbanks which are slightly covered by sea water all the time
		1130	Estuaries
		1140	Mudflats and sandflats not covered by seawater at low tide
		1160	Large shallow inlets and bays
		1170	Reefs
	12		**Sea cliffs and shingle or stony beaches**
		1210	Annual vegetation of drift lines
	13		**Atlantic and continental salt marshes and salt meadows**
		1310	*Salicornia* and other annuals colonising mud and sand
		1320	*Spartina* swards *(Spartinion maritima*e)
		1330	Atlantic salt meadows *(Glauco-Puccinellietalia maritima*e)
2			**COASTAL SAND DUNES AND INLAND DUNES**
	21		**Sea dunes of the Atlantic, North Sea and Baltic coasts**
		2110	Embryonic shifting dunes
		2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
		2130	Fixed coastal dunes with herbaceous vegetation ('grey dunes')
		2140	Decalcified fixed dunes with *Empetrum nigrum*
		2150	Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)
		2160	Dunes with *Hippophaë rhamnoides*
		2170	Dunes with *Salix repens* ssp. *argentea (Salicion arenaria*e)
		2180	Wooded dunes of the Atlantic, Continental and Boreal region
		2190	Humid dune slacks
4			**TEMPERATE HEATH AND SCRUB**
		4010	Northern Atlantic wet heaths with *Erica tetralix*
		4030	European dry heaths

Table 2. *Annex II species occurring in the Wadden Sea. These species are described in appendix 4. (source: TMAG, 2001a; CWSS, 1993).*

Animals	Mammals	Rodentia	*Root vole (Microtus oeconomus arenicola)*
		Phocidae	Common Seal (*Phoca vitulina*)
			Grey Seal (*Halichoerus grypus*)
		Cetacea	Harbour Porpoise (*Phocoena phocoena*)
	Fish	Petromyzoniformes	River lamprey *(Lampetra fluviatilis)*
			Sea lamprey *(Petromyzon marinus)*
		Salmoniformes	Houting (*Coregonus oxyrhynchus*)
		Clupeiformes	*Alosa* spp.
Plant		Orchidaceae	*Fen orchid (Liparis loeselii)*

Table 3. *Targets per habitat listed in Annex I of the Habitat Directive and occurring in the Wadden Sea. The habitat types indicated by the numbers are given in table 1 and described in appendix 3. All targets of the Wadden Sea Plan (1997) are mentioned in appendix 2. The targets on "Landscape and culture", "Offshore area" and " Rural area" could not be related to habitats mentioned in Annex I of the Habitat Directive.*

Targets		1110	1130	1140	1160	1170	1210	1310	1320	1330	2110	2120	2130	2140	2150	2160	2170	2180	2190	4010	4030
WATER + SEDIMENT																					
Background level natural micropollutants		X	X	X	X																
Concentrations of man-made substances as resulting from zero discharges.		X	X	X	X																
A Wadden Sea which can be regarded as an eutrophication non-problem area.		X	X	X	X																
SALT MARSHES																					
An increased area of natural salt marshes.			X					X	X	X											
An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.			X					X	X	X											
Improved natural veg. Structure incl. pioneer zone artificial salt marshes.			X					X	X	X											
TIDAL AREA																					
A natural dynamic situation in the tidal area.			X	X	X																
An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas.		X	X	X	X																
Increased area + a more natural distribution and development of natural:	Mussel beds	X		X	X	X															
	Sabellaria reefs	X		X	X	X															
	Zostera fields	X	X	X	X																
BEACHES AND DUNES																					
Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.							X				X	X	X	X	X	X	X	X	X		
An increased presence of a complete natural vegetation succession.							X				X	X	X	X	X	X	X	X	X	X	X
ESTUARIES																					
Protection valuable parts of estuaries.			X																		
Maintaining +(as far as possible) restoring the riverbanks in natural state.			X																		
BIRDS																					
Favourable conditions for migrating and breeding birds:	A favourable food availability	X	X	X	X	X	X			X									X		
	A natural breeding success		X				X	X	X	X	X	X	X	X	X		X		X	X	X
	Sufficiently large undisturbed roosting and moulting areas	X	X		X				X	X	X	X	X						X	X	X
	Natural flight distances	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X
MARINE MAMMALS																					
Viable stocks and a natural reproduction capacity of the Common Seal including juvenile survival.		X									X										
Viable stocks and a natural reproduction capacity of the Grey Seal including juvenile survival.		X									X										
Viable stocks and a natural reproduction capacity of the Harbour Porpoise		X																			

2.2 Designation of the Wadden Sea as a coherent special conservation area

At the trilateral level, some work on the designation of the Wadden Sea as a coherent special conservation area in the framework of NATURA 2000 has already been done. At the 6th Trilateral Governmental Conference (TGC) on the Protection of the Wadden Sea (1991), the participants agreed “to undertake the necessary steps to establish a coherent special conservation area covered by a co-ordinated management plan for the Wadden Sea, stretching from Esbjerg to Den Helder, taking into account the requirements of the EC Bird Directive 79/409/EC [and] the forthcoming Habitat Directive [...]” (Esbjerg Declaration, §5). In implementing this decision the Trilateral Working Group (TWG) decided to develop a draft designation of the whole Wadden Sea as a coherent special conservation area in the framework of the Habitat Directive. The TWG therefore installed an ad-hoc working group 'EC Habitat Directive' which was instructed to make an inventory of habitats and species in the Wadden Sea on the basis of the Habitat Directive. The working group was also instructed to make suggestions for the delimitation of the coherent special conservation area “Wadden Sea” on the basis of ecological criteria. In 1993 a report (CWSS, 1993) was submitted by the working group to the TWG, which contained the technical requirements for the designation of the Wadden Sea as a coherent special conservation area in the framework of NATURA 2000. For the 9th TGC (2001) new developments on the designation of the Wadden Sea as a coherent special conservation area in the framework of NATURA 2000 are presented a.o. by a map showing all proposed sites of Community interest for the Habitat Directive in the Wadden Sea Area. This map is given in appendix 6.

3. Monitoring to meet the Habitat Directive requirements

In this chapter the monitoring necessary to meet the Habitat Directive requirements is discussed. This chapter mainly focuses on the monitoring of the habitats mentioned in Annex I of the Habitat Directive. By using the example described in appendix 5, it is indicated how monitoring parameters can be deducted via the attributes derived from the specification of the targets for the (sub-)features (see introduction: figure 1 and 2). As deriving attributes for the (sub-)features requires the specification of targets, targets specification is also discussed here. The monitoring strategy for all features should be established by experts at the different (sub-)features.

3.1 Monitoring requirements of the Habitat Directive

The monitoring necessary depends on what should be reported to the European Commission. As described in the introduction, concerning the habitats and species of the Habitat Directive, the Member States should report about the status, the measurements taken and the implementation and effect of these measures. Also the assessment of the implementation of the plans and projects not directly related to conservation management for the area but which might have an effect on the listed habitats and species should be reported (Habitat Directive: Article 6 (3)).

The purpose of the designation and management of SACs is to maintain or restore the habitats listed in Annex I, and the habitats of the species listed in Annex II of the Habitat Directive to a Favourable Conservation Status. Monitoring should therefore provide information to assess to what extent the Favourable Conservation Status has been reached or is maintained. Article 1(e) of the Habitats Directive states that "conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory [...]". The conservation status of a natural habitat will be taken as 'favourable' if:

- its natural range and areas it covers within that range are stable or increasing;
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and,
- the conservation status of its typical species is favourable.

The three aspects, the area, the structure and functioning of a habitat and its typical species, on which these criteria are based, all look to be crucial in the development of a monitoring program (Earll, 1999). Furthermore, the threats a feature faces or might face are important for the assessment of the Favourable Conservation Status. A feature that has a favourable status for all its sub-features, but which status is seriously threatened, might be considered to have an unfavourable conservation status as a whole. Table 4 gives the aspects on which the criteria, mentioned in the Habitat Directive, for a Favourable Conservation Status of habitats are based. Rückriem & Roscher (1999) state that some of the aspects listed in this table, e.g. the natural range, can only be assessed on a national or even international scale and not per designated site. However, for the Wadden Sea information on the range of most habitats on the national or even European scale can be provided. This because some habitat types only occur in the Wadden Sea Area of a Member State and the extent of many habitat types in the Wadden Sea is a major part of its total range in the Member State or even in Europe (e.g. tidal flats). Therefore, these aspects should also be taken into account in the monitoring program for the Wadden Sea.

For species, the Habitat Directive defines the conservation status in terms of all the influences acting upon the species, which may affect the long-term distribution and abundance of its populations.

Table 4. *Aspects on which the criteria, mentioned in the Habitat Directive, for a Favourable Conservation Status of habitats are based (based on table 2.2 and 2.4 in Rückriem & Roscher, 1999).*

Range	Natural range
	Area it covers within that range
Structure and functions	Abiotic factors
	Maintenance and use
Characteristic species composition	Characteristic species composition
	Use of sub-features based on these characteristic species
Threats	Large scale threats
	Local threats

3.2 Meeting the monitoring requirements of the Habitat Directive

To meet the reporting requirements of the Habitat Directive, monitoring the designated sites is needed. A common strategy for monitoring marine sites has not yet been developed on the European level (TMAG, 2001a).

For each of the Annex I habitats the theoretical concept described in the introduction (figure 1 and 2) can be used to determine to what extent the current monitoring activities in the Wadden Sea (e.g. the Common Package) are sufficient and which optimisations are necessary to meet the monitoring requirements of the Habitat Directive. The example described in appendix 5 illustrates how the theoretical concept can be applied for the Annex I habitat “mudflats and sandflats not covered by seawater at low tide” (1140). In summary this means specifying the WSP targets for the (sub-)features and deriving the attributes and monitoring parameters from these specifications. Comparing the derived monitoring parameters with the existing monitoring program will indicate the gaps in current monitoring and indicates what adjustments should be made to meet the Habitat Directive requirements.

3.2.1 Monitoring the status and measures

For the assessment of the conservation status of a feature the criteria based on the aspects listed in table 4 should be considered. Although monitoring derived from targets could be sufficient for the monitoring required to assess these criteria, additional parameters providing information for the whole feature might be needed. To determine the natural range of a feature, and the area it covers within that range, information is required about the location and area of the feature. The physical structure of the feature could be monitored to provide information to assess the 'structure and functions' of the feature (Earll, 1999). For tidal flats, for example, the monitoring of the sediment structure can provide information for this assessment (see appendix 5). The monitoring of the characteristic species composition could be based on targets set for these species and the associated sub-features, as described in appendix 5. For specific threats, monitoring parameters can be established. For example, to monitor the possible negative effect (possible threat) of the cockle fishery, monitoring parameters might have to be established, as discussed in appendix 5.

Monitoring and assessment of the status of an Annex I habitat are methodologically strongly related to monitoring and assessment of the effect of management measures. This is especially the case for management measures aiming at conserving the status of a habitat. In this case, the evaluation of the conservation status and the evaluation of the impact of the performed measures can often be performed simultaneously (Rückriem & Roscher, 1999). Assessing that the status is still favourable might lead to the conclusion that the effect of the management measures was positive (or at least not strongly negative). Although the final goal of measures aiming at changing the undesired status into a Favourable Conservation Status is to reach the Favourable Conservation Status, these measures often have specific intermediary goals. Next to an assessment to what extent the Favourable Conservation Status has been reached for the feature subject to these measures, the extent to which the intermediary goals of the measures have been reached should be assessed. For example, it could be found that the total area of mussel beds in the Wadden Sea is too low to assume a Favourable Conservation Status for mussel beds. If it can be assumed that this is caused by the disturbance of fishery, a measure could be

established to reduce the amount of fishery in areas where mussel beds occur. Next to an assessment to what extent the final goal of this measure has been reached, i.e. an area large enough to assume a Favourable Conservation Status of mussel beds in the Wadden Sea, an evaluation of this measure should include an assessment of the intermediate goal, i.e. a reduction in the amount of fishery.

The assessment of individual management measures might require consideration of issues specific to these measures, which general monitoring programs, like the TMAP, cannot assess. For example, if a measure is taken to reduce the disturbance of birds by aeroplanes by increasing the minimum flying height in order to increase the number of birds breeding in the area, only the objective, more breeding birds in the area, can be monitored in a general program. An evaluation of this measure should also include, for example, measurements of the actual reduction of noise. Also assessing the implementation of the measure, are aeroplanes actually flying higher than the minimum flight height, is not the scope of general monitoring programs. Information on the effectiveness and the implementation of management measures will therefore largely depend on the evaluation procedure of the individual measures in specific management plans. The same counts for the plans and projects not directly related to conservation management for the area. The authorities responsible for the management measures, plans or projects are responsible for this evaluation. The evaluation procedure of a measure is a part of the total management procedure for that measure, plan or project.

3.2.2 Factors to consider

When selecting attributes and monitoring parameters, several factors should be considered (Earll, 1999). For example, an attribute should be measurable, i.e. easy to relate to a monitoring parameter. The monitoring parameter itself should also be measurable within reasonable confidence limits (TMEG, 1993). An attribute should also be able to provide as much information about the (sub-)feature as possible, i.e. be as effective as possible. For example, the length of mussels not only provides information about the size distribution of mussels in a mussel bed, but also about their age distribution (see appendix 5). Furthermore, an attribute should be capable of being monitored practically and economically. It should be more readily measured, technically and/or cheaply, than alternative attributes providing similar information. All parameters, derived from the targets, together should provide as much information of the status of the whole feature as possible. This reduces the number of additional parameters to be measured to assess the status of the feature. To be able to explain biological changes, correlation with a wide range of physico-chemical parameters will be required (Earll, 1999). All factors mentioned here should be kept in mind when establishing the final monitoring program including the selection of the parameters to monitor.

3.2.3 Existing programs

Existing programs could make a significant contribution to monitoring sites subject to the Habitat Directive in terms of providing data at a site where sampling stations fall within the site boundary. Similarly, these existing programs can make an important contribution to the development of monitoring strategies and the interpretation of results (Davies *et al.*, 2000).

3.2.4 Monitoring species

To assess the conservation status of species, all the influences acting upon the species, which may affect the long-term distribution and abundance of its populations should be taken into account. Such an assessment requires systematically and continuously collected data (i.e. monitoring) in order to describe the status and development of the population of the species concerned as well as its natural range and habitat (Pihl *et al.*, 2001).

3.3 Specification of the targets for monitoring and assessment

The specification of the Wadden Sea Plan targets mentioned in the theoretical concept (figure 1 and 2) can be considered as setting conservation objectives for specific characteristics of the (sub-)features. A conservation objective is defined in Earll (1999) as “a statement of the nature conservation aspirations for features or areas, expressed in terms of the favourable conditions that we wish to attain for the features or areas”. The favourable condition is considered preferable to all other conditions. Generally, setting conservation objectives can be considered the most difficult phase of the monitoring process (Hurford & Perry, 2000). In this paragraph the information gathered on some aspects of setting conservation objectives is briefly discussed and commented on. For a more detailed discussion see for example: Dankers & Vlas (1994), Höpner (1994), Höpner & Kellner (1998), De Jong (1998), Dittmann (1999) and Müller & Leupelt (1998).

The specification of the targets is not only required to derive monitoring parameters, but also to enable assessments. Although the specification necessary to derive monitoring parameters and the specification necessary for assessments are strongly related, these are not necessarily identical. For example, specifying "stable" for "stable mussel beds" by indicating a mussel bed should be present in more than a certain number of years per e.g. seven years is sufficient to derive a monitoring parameter. For an assessment, however, it should be indicated more than how many years it should be present before stability of a mussel bed can be assumed (e.g. five or six of the seven years). Nevertheless, the kind of specification of "stable" is important for both monitoring and assessment. Specifying "stable" as above, i.e. the frequency of occurrence, or, for example, as a certain vertical height profile of a mussel bed, determines the monitoring parameters needed and the way "stable" will be assessed. The differences in specification needed for monitoring and for assessment depend on the important characteristics identified for a (sub-)feature and the kind of specification applied. Therefore, for a general discussion about setting conservation objectives, i.e. not discussing specific characteristics to set conservation objectives for, aspects only relating to assessments cannot be identified. The topics discussed in this paragraph can thus be applied for the specification needed for assessments and, depending on the characteristics and kind of specification used, for the specification needed to enable the deduction of monitoring parameters.

The setting of conservation objectives for the assessment procedure for one feature corresponds with defining the Favourable Conservation Status for that feature as all these conservation objectives together should represent the Favourable Conservation Status. Defining the Favourable Conservation Status is not discussed in detail in this report. The specification of the targets, in this report, is therefore mostly discussed in relation to the derivation of monitoring parameters.

The process of setting conservation objectives for characteristics of a feature can be thought of as consisting of two elements (Davies *et al.*, 2000):

- Identifying the most important characteristics of the feature that define its status.
  Depending on the feature concerned, this will usually include some combination of:
  quantity of the feature, for example the extent of the habitat and related characteristics such as range of distribution;
  quality of the feature, for example, the presence or abundance of characteristic species of an Annex I habitat or the quality of inorganic components such as substrata; and,
  processes supporting the feature, such as physical environmental factors like water quality, water movement (levels and flows), or sediment processes, where they are of overriding importance to the condition of a habitat or species.
- Identifying the state or value, or range of values, for the selected characteristics which the feature needs to have if it is to be considered as being in a favourable condition. These values need to recognise, as far as possible, the fluctuations that are part of the feature's natural dynamics.

To set conservation objectives, Davies *et al.* (2000) recommend to re-analyse data from existing monitoring programs. Long-term programs, for example, can contribute data on e.g.

the variability of the characteristics of a feature, which can help to set realistic conservation objectives for these characteristics.

3.3.1 Sub-features

For the setting of conservation objectives it is useful to divide the feature into sub-features. The advantages of this division are (Earll, 1999):

- It helps to clarify the conservation importance of the feature and describe this more effectively.
- It enables a more effective and meaningful selection of attributes.

For example in Hurford & Perry (2000) this was done for humid dune slacks. The humid dune slack vegetation was divided into different sub-features based on the successional stage of the vegetation. For the different sub-features specific conservation objective where derived. Such division of a feature and setting conservation objectives for these divisions can make management activities more efficient. For example, instead of setting the conservation objective to increase the area of the whole feature, it can be set to increase only the area of a specific sub-feature that is threatened.

3.3.2 Management and science

For setting conservation objectives that can be used in practice, the management applicability of the objectives should be taken into account. A conservation objective should be easy translatable into appropriate management plans. An important criterion for judging the management suitability of conservation objectives is whether they can be assessed and, by this, enable the evaluation of policies (De Jong, in press).

Next to the applicability in management, the scientific basis of the conservation objectives is important. Conservation objectives on area size, for example, are mainly applied in the management of terrestrial ecosystems. They are very useful from a management point of view because the objective can be precisely specified: the number of hectares of a certain habitat type to be reached within a certain time period (De Jong, 1998). From an ecological point of view, if the overall goal is to achieve natural development, the fixing of a specified area size is questionable. If, on the other hand, the overall goal is, for example, to increase the population size of a certain species, the ecological support for achieving a certain area size, may be appropriate (De Jong, 1998).

As described in De Jong (in press), one of the main demands of conservation objectives for ecosystems, expressed by both scientists and policy makers, is that they should be based on sound science. Uncertainty and lack of consensus within the scientific community are the two main factors that reduce scientific credibility and, consequently, its political impact (De Jong, in press). However, in the process of setting conservation objectives, the dilemma of ‘which nature to protect’ becomes obvious and with this the notion that conservation objectives for ecosystems can never be solely based upon science but have a substantial political and social component (De Jong, in press). Within the Dutch shellfish policy for example, an area of 2000-4000 ha of eulittoral beds has been adopted as an objective. This range is based upon the situation as it was in the 1970s. There is no ecological rationale for the given range, since knowledge to relate a certain area of eulittoral beds to the functioning of the ecosystem is lacking. The choice for 2000-4000 ha must therefore first of all be judged as a political one (De Jong, in press).

3.3.3 Application of the precautionary principle

The setting of conservation objectives can be based on the precautionary principle. This principle means to take action to avoid activities which are assumed to have a significant damaging impact on the environment, even where there is no sufficient evidence to prove a causal link between activities and their impact (De Jong *et al.*, 1993). This principle can for example be used for the setting of conservation objectives for pollutants. The objective could be set that these substances should not occur in the ecosystem. There is no scientific prove that very low concentrations can cause harm as the ecotoxicological criteria are always concentrations higher than zero. When a conservation objective for pollutant is based upon scientific prove, like on ecotoxicological assessment criteria, this can be interpreted as

allowing the continuation of the input of pollutants into the ecosystem as long as the concentration of pollutants is lower than the maximum allowed concentration. Management is in this case, more aimed at the consequences than at the source of the pollution.

The general view of nature conservation does not seem to be in favour of the precautionary approach as argued in De Jong (1998): "History has shown that the conservation of nature for the sake of Man is the predominant option. Since the Brundtland Report (1987) and the Earth Summit (1992), the awareness of the need for preserving natural resources for future generations has increased. The main rationale is an anthropocentric one: the interests of the natural resource capital must satisfy the needs of future generations. In the development of natural resource management strategies there will be an ongoing and probably increasing demand for indicators of what nature can cope with." As a result, conservation objectives might have to be based more on a maximum level of disturbance from man the system can deal with than on a precautionary approach.

The Favourable Conservation Status could be defined as a range of conditions for which the status is assumed favourable. This range should be set bearing in mind the natural changes likely in the feature (Earll, 1999). When the status was favourable but is crossing the limits of the range to an unfavourable status, management will change from measures aiming at conserving the status to measures aiming at restoring the status of the feature (Rückriem & Roscher, 1999). Hurford & Perry (2000) state that it is always easier and more cost effective to maintain the conservation interest of the habitat than it is to carry out restoration management. Therefore, they advise to set the limits in the conservation objective at a precautionary level: at the point that the site managers would become concerned for the habitat and not at the point that the habitat would be damaged.

3.3.4 Quantitative and qualitative objectives

Elliot (2000) states that the more quantified a conservation objective, the better its implementation can be evaluated. Therefore he argues to consider whether monitoring can be carried out against pre-determined and agreed numerical standards and objectives.

Assessments based on quantified conservation objectives might be more objective than assessments based on qualitative conservation objectives. It has therefore since long been the aim to quantify ecological goals (De Jong, in press). When the objective is measurable you can (Hurford & Perry, 2000):

- apply management which is aimed specifically at achieving a well-defined habitat state;
- manage consistently towards a clearly defined habitat state, regardless of discontinuities caused by changes in personnel; and,
- design and conduct efficient monitoring.

However, quantitative conservation objectives are associated with a lot of problems as those mentioned in Earll (1999):

- They require very rigorous statistical design – with many replicates to secure the statistical power one would need to produce valid results.
- When quantitative limits, between which the status is assumed favourable, are set, these limits could be used as an argument to developers for allowing development within an area as long as it remained within the limits set.
- In general, there is also not enough knowledge about the natural fluctuations and dynamics of a feature to set quantitative conservation objectives.

Hurford & Perry (2000) mention another problem for the example of setting values for area size: unless the boundary of the habitat is clearly demarcated or clearly visible by remote sensing, precise measurements of habitat area will rarely be possible. Therefore, they state that setting limits for extent in the form of hectare measures should be avoided unless it can be easily measured.

Although the qualitative conservation objectives might not be as objective as quantitative ones, qualitative descriptive conservation objectives based on ‘expert’ knowledge could be used because there are ‘experts’ who know particular sites well and can assess their status quickly (Earll, 1999). Furthermore, there is sufficient knowledge of natural cycles for trained

staff to use simple assessment techniques to check rapidly on the status of particular habitats and species (Earll, 1999).

Conservation objectives in dynamic ecosystems

There is a shift from the idea that nature is a well behaved, deterministic system, towards the view that equilibrium states are the exception to the rule. There is no fixed balance in populations and communities, the balance is continuously shifting due to natural fluctuations and dynamics (Woudstra, 1994). Therefore, the concept of dynamic instead of fixed ecological conservation objectives could be used (see e.g. Dankers & Vlas, 1994). In this concept natural development is the Guiding Principle. Physical and biological processes should act, as far as possible, undisturbed. The background level of disturbances (physical, biological etc.) should be kept below certain threshold values. Based on historical, geographical and scientific information, a reference can be described for the most important physical and biological processes and for a number of ecosystem types or species groups (Dankers & Vlas, 1994). This approach corresponds with the aim of protecting the stability of ecosystems instead of the stability of structure or function (Höpner, 1994). Protection aiming at the stability of structure uses criteria such as the protection of populations and species, scarcity, variety, concentrations and abundances. Protection aiming at the stability of function uses biological criteria such as productivity, consumption and production capacity. Nature conservation with the aim of protecting the stability of ecosystems uses criteria such as regeneration power, succession, inhomogeneity and variability. Höpner (1994) hypothesises that inhomogeneity and variability are the basis of the stability of the ecosystem in its entirety: impacts meet only sensitive parts and unaffected areas provide germ material. The conservation goal concerning inhomogeneity and variability is therefore the regeneration capacity after local extinctions. Variables and inhomogeneities which are compatible and system typical and which are not, should be distinguished (Höpner, 1994). Protection aiming at the stability of ecosystems uses ecological stability properties like resilience, elasticity and persistence (see glossary). Inhomogeneity and variability are determined on the basis of the resilience[4] that the ecosystem shows in responding to utilisation, loads, and variations of the meteorological conditions. As long as it possesses such a resilience, it is considered ‘stable’, even if its components change continuously and rapidly (Höpner, 1994).

An approach to specify and quantify ecological conservation objectives is the inference of conservation objectives from basic ecosystem properties (e.g. stability, resilience, biodiversity, ecosystem health, ecosystem integrity, sustainability, exergy[5] and keystone species) (De Jong, in press). However, as discussed in De Jong (in press), generally the basic ecosystem properties are ill defined, hard to specify, and scientifically controversial. Detailed knowledge of even the key processes is usually limited and in most cases includes generalisations instead of detailed case studies from the areas involved (Dierßen, 1998). For these reasons the application of basic ecosystem properties in management is problematic (De Jong, in press).

Dynamics do not always lead to a favourable condition for all nature conservation objectives. Succession is, for example, an integral part of the natural dynamics of sand dunes. It is complicated to assess whether the effects of succession are positive, negative or neutral. The general opinion is that development from one natural habitat type into another is considered to be negative if it causes a significantly deterioration in the conservation status of the disappearing natural habitat type at the national level, which may particularly happen to already rare and fragmented natural habitat types. These issues need to be discussed in detail when establishing conservation objectives. In each instance, it must be considered whether the successional development is consistent with the conservation of biological diversity and protected natural habitat types at the national level (Pihl *et al.*, 2001).

[4] Höpner uses the term elasticity, but using the definition given in Dittmann & Grimm, 1999, resilience ('Elastizität' in German) is meant (see also the glossary).
[5] Exergy is defined in the glossary

Reference situations

Another approach to specify and quantify ecological conservation objectives is the use of reference situations (historical or comparable ecosystems elsewhere) as discussed in De Jong (in press). If it is assumed that ecosystems are dynamic and changing, choosing some historical state as an ideal situation is not possible (Woudstra, 1994).

Ideal reference areas might be hard to find. In many areas anthropocentric influences, especially of chemicals, cannot be excluded (see e.g. De Jong (1988)). Dankers & De Vlas, (1994) state that as the main function of the reference should be to provide the *direction* of the conservation objective, a qualitative reference can be considered sufficient. This means that the function of quantifying conservation objectives by reference areas might be difficult, and that references can be used for setting qualitative rather than quantitative conservation objectives.

3.3.5 Objectives based on the current situation

For many terrestrial European sites, the knowledge about the preferred condition of habitats designated in frame of the Habitat Directive is sufficient to be able to define conservation objectives for specific characteristics of a feature. Assessment as to whether features are in a favourable condition can be made using these conservation objectives. However, far less is known about habitat conditions in European marine sites (English Nature: Murray, pers. comm.). Predicting what the Favourable Conservation Status in marine sites may look like is therefore difficult. As a guide, and in the absence of information on which to base a different conclusion, the 'value' of the characteristics at the time when the site was selected can be assumed representative of the favourable condition. Thus, the status of features in European marine sites can be assessed using conservation objectives based on the existing conditions, which may need to be established through baseline surveys in many cases. For the marine SACs in the UK, English Nature plans to use the 2000-2006 reporting period to execute a baseline survey. The assumption that the existing features of European marine sites are in favourable condition will be tested in this period and the results subsequently fed back into the advice and site management (Davies *et al.*, 2000). Where there is more than one year's observations on the condition of marine habitats, all information available will need to be used to set the site within long-term trends in order to form a view on the favourable condition. Where it may become clear that certain characteristics are a cause for concern, and when detailed studies prove this is correct, restorative management actions will need to be taken to return the interest feature from an unfavourable to a favourable condition (English Nature: Murray, pers. comm.).

The UK approach of setting conservation objectives based on the current situation assumes that the site has a certain conservation value and was therefore designated as a SAC. The current condition is interpreted as when the site was put forward to Europe. It is assumed that the site was put forward because it has a certain conservation value. This conservation value is assumed to be the Favourable Conservation Status.

The setting of conservation objectives for characteristics of a feature can also be based on the current unfavourable condition of certain characteristics of a feature. It should be specified which characteristics are unfavourable. For example, it could be found that the number of individuals of a certain species is too low because only a small area with a suitable habitat is present. In this case a conservation objective can be set by indicating that the area of a feature should increase. Setting a desired end value is not necessary, and the difficulties involved with setting quantitative conservation objectives are avoided. The conservation objective is met when there is no desire to increase the area anymore. Setting conservation objectives based on the current status of the site ensures that reaching them is realistic (Rückriem & Roscher, 1999).

3.3.6 Conservation objectives for the Wadden Sea

The basis for the trilateral target concept was laid at the 6th Trilateral Governmental Conference (TGC) in 1991, at which the so-called Guiding Principle of a "Wadden Sea which should develop, as far as possible, in a natural and sustainable way" was adopted. At the same time it was agreed that the Guiding Principle must be specified by means of ecological targets. The Eco-Target Group (ETG) developed a draft catalogue of ecological targets (ecotargets) in 1993. The main element in the Ecotarget concept is the presence of all typical Wadden Sea habitats in their natural state (De Jong, 1998).

Common Ecological Targets were adopted at the 7th TGC in 1994. The targets (see appendix 2), which are the focal point of the Wadden Sea Plan (WSP) of 1997, reflect both the need for a recovery of the natural values of the Wadden Sea ecosystem and the necessity that human activities in the area must be possible in the future. The targets make clear that an increase of natural and undisturbed habitats all over the Wadden Sea is a condition for the restoration of the ecosystem (WSP, 1997; §11).

In the Wadden Sea there is a relatively extensive experience with setting conservation objectives in practice. Therefore, it can provide a good basis for the study of the applicability of the theoretical concepts for setting conservation objectives. In for example De Jong (in press) the first six years of experience with the implementation of the trilateral targets in the Wadden Sea are evaluated.

Quantitative objectives

For the Wadden Sea, Dankers & Vlas (1994) mention a number of problems associated with assigning values to ecological conservation objectives:

- The Wadden Sea is an evolutionary young ecosystem that is still developing.
- The Wadden Sea is a dynamic ecosystem, subject to strong physical, chemical and biological fluctuations acting at time scales ranging from days to months and years. Also erratic catastrophic event like heavy storms or ice winters can have effects on the ecosystem (TMEG 1993).
- The heterogeneous character of the Wadden Sea makes it hard to set equal standards for the whole area.

Dynamic objectives

Because of the problems with assigning quantitative values for conservation objectives in the Wadden Sea, Dankers & Vlas (1994) propose to use the concept of dynamic instead of fixed ecological conservation objectives. This approach corresponds with the aim of protecting the stability of ecosystems and according to Höpner (1994) only the protection of the stability of ecosystems is suitable for the Wadden Sea. Stability of ecosystems is associated with basic ecosystem properties as persistence and resilience. Dittmann & Grimm, (1999) state that despite of short term, seasonal annual and historical changes, a certain persistence remains to be seen in the Wadden Sea. Further, it is stated that the Wadden Sea has a high resilience to changes (Coastal Protection and Sea Level rise Group (CPSL, 2001). Because the application in management of basic ecosystem properties is problematic, the trilateral targets are not based on these properties (De Jong, in press).

The guiding principle for the Wadden Sea, a "Wadden Sea which should develop, as far as possible, in a natural and sustainable way", also relates to ecosystem stability and can be seen as a dynamic conservation objective. In the Wadden Sea Plan (1997) it is stated that the Guiding Principle is more important than special conservation measures for certain species. For example, bird conservation and management, at the general trilateral policy level, is subordinated to the Guiding Principle even when natural dynamics may lead to less favourable conditions for some bird species or populations (WSP, 1997). Dittmann & Grimm (1999) state that the guiding principle relates to the protection of processes. This approach means that all natural processes and dynamic developments are allowed to happen in an ecosystem in an undisturbed way: "let nature be nature". To ensure resilience in the future, the abiotic frame and especially all processes driven by the tides, have to be undisturbed (Dittmann, 1999).

The term sustainable used in the Guiding Principle means a use of resources in such a way that no long-term decline of biological diversity results and the needs and aspirations of present and future generations are maintained (Dittmann & Grimm, 1999). While the protection of processes gives priority to natural development undisturbed by any human impact (zero-use), sustainable development always implies the use of natural resources by man. The protection of processes can only be safeguarded if the area for protection of processes is large enough and coherent and if a true sustainable use is accomplished in the remaining areas (Dittmann & Grimm, 1999). The concept of sustainability seems of little value in nature management without further specification. It is very unclear what it means in ecological terms. Therefore, the concept of sustainability was not further considered in the elaboration of the Guiding Principle (De Jong, 1998).

The aim of the Wadden Sea Plan targets is to achieve the full scale of habitat types that belong to a natural and dynamic Wadden Sea (Bakker *et al.*, 1998). The targets stating a natural or dynamic situation of habitats could be interpreted to take variability and inhomogeinity into account.

Precautionary principle

The Wadden Sea Plan target of a concentration of man-made pollutants based on zero discharge, as described in Annex 5, for example, is based on a precautionary approach. The ultimate goal of the target is a situation in which no xenobiotic substances are present in the system. As there is no scientific prove that very low concentrations of these substances have negative effects, a precautionary approach is applied for this target.

Reference situations

On the 6th TGC (1991) the principle of restoration was agreed on: "where possible parts of the Wadden Sea should be restored if it can be demonstrated by reference studies that the actual situation is not optimal and that the original is likely to be re-established". An option could be to select undisturbed reference areas in the Wadden Sea itself (De Jong, 1998). At the 6th TGC (1991) it was also decided to designate “sufficient large areas, spread over the Wadden Sea, where all exploitation and disturbing factors are banned and which can serve as a reference area [...]”. The zero-use zones in the North of Denmark and in Schleswig-Holstein could be used as reference areas (Marencic, pers. comm.). In the Wadden Sea Area there are many areas that all differ in the way they are used. Therefore, different areas may be used as a reference area for different (sub-)features.

Areas in the Wadden Sea are not ideal references because many anthropogenic influences, especially input of chemicals, cannot be excluded. But for the evaluation of developments with regard to species numbers and diversity such reference areas are possibly the closest one can get (De Jong, 1998). However, as the main function of the reference should be to provide the *direction* of the conservation objective, a qualitative reference can be considered sufficient (Dankers & De Vlas, 1994). Even reference values from regions in other climatic zones could be used as they often indicate processes (Dankers & De Vlas, 1994). The intertidal area Khowr-e Mussa in Iran, for example, is mentioned by Höpner (1999) to offer aspects of a reference system for the monitoring of the Wadden Sea.

Open end formulation

For all habitats in the Wadden Sea, targets were adopted along the line of “increase the area which is natural, undisturbed or dynamic” (see appendix 2). The open-end character of the targets was criticised because it would not allow precise assessments (De Jong, in press). The rationale for this open-end type of formulation was treefold (De Jong, 1998):

0. The substantive evidence for drastic declines in the past in the quality status and area size of most of the habitats.
0. The lack of clear ecological arguments for the optimum size and quality of the different habitats.
0. The social and economic claims on the area.

Furthermore, although the management applicability of these open-end formulated targets is less than for example an ‘area size’ target, the ecological credibility is higher (De Jong, 1998).

The trilateral targets are neither based on emergent ecosystem properties nor on specific reference situations and have not been quantified (De Jong, in press). They are, therefore, hardly vulnerable to scientific critique. It was shown that is the general character of the targets which makes them more suitable for communication with a broad range of interested parties (De Jong, in press). The open-end way formulation of the targets means that there is room for negotiation, both from the user and the nature protection sides (WSP, 1997).

3.4 Case study: "mudflats and sandflats not covered by seawater at low tide"

In appendix 5 one Annex I habitat, "mudflats and sandflats not covered at low tide" (1140), is analysed in more detail. This analysis is intended as an example of how to derive monitoring parameters from the Wadden Sea Plan targets, and to analyse to what extent the monitoring requirements of the Habitat Directive are met and what is missing in the current monitoring activities. The monitoring strategy for this feature should be established by experts at the different (sub-)features. For example in the case of mussel beds, mussel experts have to develop the monitoring strategy. The conclusions stated for this feature can be used as a basis for the experts to further specify the targets and to derive monitoring parameters.

3.4.1 Water and sediment

For the sub-feature water and sediment the monitoring and assessment procedures for man-made substances and natural micropollutants should be established in co-operation with the Joint Assessment and Monitoring Program (JAMP) of the OSPAR Convention to avoid double work. Also the connections between the monitoring for the Habitat Directive and the Water Framework Directive should be investigated.

For man-made substances using the zero discharge target instead of targets based on specific concentrations, might be the best option. For natural micropollutants Wadden Sea specific background concentration to be used in the assessment should be specified. Such values could be derived on the basis of a literature study supplemented with field studies of sediment historical records (De Jong *et al.*, 1999). To assess the eutrophication status, the ammonium and nitrite concentrations in the water could be measured (De Jong, 2001).

As the Wadden Sea is an open system, management measures and the associated evaluation for pollutant and nutrients will have to take place especially outside the Wadden Sea Area. However, monitoring these substances in the Wadden Sea remains essential in order to assess the status of these substances.

3.4.2 Tidal flats

Depending on the definition of 'natural' many monitoring parameters can be deduced from the target "a natural dynamic situation in the tidal flats" including for example the area of the tidal flats and the area of the different sediment types.

For the target "an increased area of geomorphologically and biologically undisturbed tidal flats", for example, the penetrability, tidal elevation and shore slope can be used as parameters additional to the Common Package parameters in order to determine the stability of the sediment. Geomorphological disturbances may lead to biological disturbances and biological disturbances to geomorphological disturbances. Therefore, parameters derived from the target biologically undisturbed can also be used to assess geomorphologically undisturbed and the other way around. Further specifications can increase the number of monitoring parameters largely. Especially the target 'biological undisturbed' can lead to a lot of additional characteristics to be monitored. The selection of which characteristics to assess could depend on priority characteristics like the most important disturbances, threats, priority species and/or important processes. For example, additional parameters for the assessment of the effect of fishing on the cockle population might be necessary. Based on additional

specifications of the targets and the selection of priority characteristics, the Common Package should be optimised.

3.4.3 Mussel beds, *Sabellaria* reefs and *Zostera* fields

For the target "an increased area and a more natural distribution and development of natural mussel beds, *Sabellaria* reefs and *Zostera* fields" it should be specified how the term “natural” should be interpreted. From this specification attributes and related monitoring parameters can be deduced and to what extent the Common Package is sufficient can be determined. Comparing the monitoring results with data of where the sub-features used to occur or where they could occur may help to assess whether the distribution is natural. Using references from (relatively) undisturbed mussel beds and *Zostera* fields could help to assess the “natural development” target. More research on mussel recruitment might be needed to monitor and assess this important characteristic. For mussels often "stable" mussel beds are mentioned. However, when a bed can be considered "stable" is not yet defined. If this term is used, it should be defined.

More information on *Sabellaria* reefs is required to assess the targets related to this sub-feature. As soon as the locations of the *Sabellaria* reefs are known, a method should be developed to measure their area, location and natural development. It might be doubted if targets for *Sabellaria* reefs can be set at all as long as there is not enough knowledge.

3.4.4 Measures, status and conservation objectives

The effect of management measures, which are related with the targets discussed for this example, on the status of the sub-features, could be assessed by using the monitoring results derived from the specifications of the targets. For example, a measure aiming at the reduction of geographical disturbances can be assessed using the results of the measured monitoring parameters derived for the target 'geographically undisturbed tidal flats'.

To assess the status of this feature additional monitoring and assessment procedures might be required. For all additional characteristics proposed to be monitored, conservation objectives should be set in order to be able to assess whether these represent (or to what extent they represent) the Favourable Conservation Status. These conservation objectives should, as far as possible, be related to the Wadden Sea Plan targets or their specifications. For example, as the macrozoobenthic community is an important sub-feature, a monitoring and assessment program for this sub-feature and/or individual species might be necessary. This could be related to the WSP target for a biologically undisturbed tidal area. For macrozoobenthos and/or individual species, specifications, attributes and parameters could be derived from this target. Further, additional attributes to assess the structure and function of the feature might be needed. Because of the many interactions between the offshore zone and tidal area, it is recommended that the monitoring, management and protection of these two habitats be closely tuned (De Jong *et al.*, 1999).

Overall, this example shows that specification of the targets for the sub-features and for the entire feature is essential for the development of a monitoring strategy that meets the Habitat Directive requirements.

4. Reporting for the Habitat Directive

In this chapter a format of the report to the European Commission is proposed. This proposal is based on the requirements of the Habitat Directive. A way to present to what extent the Favourable Conservation Status has been reached is proposed as well.

Many characteristic national species and habitats are not listed in the Habitat Directive. It should therefore be stated clearly that the report is only a status report in relation to the Habitat Directive and not an assessment of the overall nature conservation status of the different countries (Pihl *et al.*, 2001).

4.1 Reporting requirements of the Habitat Directive

In table 5 the reporting requirements of the Habitat Directive are given. Next to the status of the habitats mentioned in Annex I and the species mentioned in Annex II, IV and V of the Habitat Directive, the Member States should also report the implementation of different kinds of measures:

- Measure related to the coherence of the NATURA 2000 network. This concerns the management of features of the landscape which, “by virtue of their linear and continues structure or their function as stepping stones, are essential for the migration, dispersal and genetic exchange of wild species” (Habitat Directive: Article 10). For the Wadden Sea this will be related to measures taken in the Wadden Sea Area to improve or conserve the connection between habitats within the Wadden Sea Area and the connection between Wadden Sea habitats and habitats outside the Wadden Sea Area.
- Other measures taken in the context of the Habitat Directive, including general statutory and administrative regulations related to the implementation of the Habitat Directive. These are, for example, all national nature protection measures that are also valid for Annex I habitats. It includes also all national regulations concerning the assessment of “plans and projects not directly connected with or necessary for the management of the habitats but likely to have a significant effect thereon” in accordance with Article 6 of the Habitat Directive (Rückriem & Roscher, 1999). For the Wadden Sea these are all measures and regulations effecting (a part of) the Wadden Sea Area.
- Conservation measures in accordance with Article 6(1) of the Habitat Directive: “for special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites”. Article 17 explicitly states that the effectiveness of these measures should be assessed. Conservation measures are defined in Article 1 of the Directive as: "a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status”. These measures include those initially undertaken during the procedure of the designation of the sites and those measures designed to improve poor conservation status as well as regular measures to maintain a Favourable Conservation Status.
- Measures taken to prevent further deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated (Habitat Directive: Article 6(2)).
- Measures taken in relation with the assessments of the implications and the implementation of “plans and projects not directly connected with or necessary for the management of the habitats but likely to have a significant effect thereon” in accordance with Article 6(3,4). This Article states that those plans and projects shall be subject to appropriate assessments of their implications for the site, in view of the site’s conservation objectives. This assessment is directly related to the conservation objectives of a site and not to the more general objectives in case of an Environmental Impact Assessment (EIA). These plans and projects shall be agreed upon only if not adversely effecting site integrity, except for imperative reasons of overriding public

interest. “If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of NATURA 2000 is protected. It shall inform the Commission of the compensatory measures adopted” (Habitat Directive: Article 6 (4)). Therefore, reporting the compensation measures taken is necessary as well. For the Wadden Sea all plans and projects conducted in this area should be assessed in the report. In the Stade Declaration (1997) the Ministers *recommend* that in the assessment of plans and projects in the Wadden Sea Area, alternatives should be considered following the EC Habitat Directive.

The reporting requirements stated in Article 17 of the Habitat Directive are also aimed for the European Commission to assess the implementation and effects of the measures that are subsidised or financed by the EU in accordance with Article 8 of the Directive.

Table 5. *Reporting requirements of the Habitat Directive (based on table 1.1 of Rückriem & Roscher, 1999). H.D. = Habitat Directive*

Performed by	Contents	H.D. Article
Member states	Measures taken to improve and conserve the coherence of NATURA 2000	17(1); 10
	Other measures taken in the context of the Habitat Directive	17(1)
	Conservation status of the Annex I habitat types	17(1); 11
	Conservation status of the Annex II, IV and V species (species of common interest)	17(1); 11
	Conservation measures taken and their effect on the conservation status	17(1); 6(1)
	Measures to prevent further deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated	17(1); 6(2)
	Measures taken in relation with the assessments of the implications and the implementation of plans and projects including compensation measures	17(1); 6(3,4)
EU	Evaluation of the progress achieved	17(2); 3
	Evaluation of the contribution of NATURA 2000 to the conservation or, when appropriate, restoration of habitat types and species of common interest - Conservation status of habitat types - Conservation status of species - Coherence of the NATURA 2000 network	17(2); 3

4.2 Report format

It is very important that the report is understandable and easy to read for the general public and politicians (Bischoff *et al.*, 2000). Therefore, the lay out should be clear and surveyable, the different sections understandable without having to read to whole report and the use of scientific or politic jargon avoided. Furthermore, the main results should be presented in clear and easy to read tables to enable quick reading of the report. The information presented in these tables should also be explained clearly in the text. However, one should make sure that this simplicity and clarity are not at the expense of the contents. The presentation of the monitoring results should be based on a sound interpretation and assessment of the monitoring results (Bischoff *et al.*, 2000).

The proposed format of the report is summarised in table 13 (p51). The report could be structured by discussing the different habitats listed in Annex I of the Habitat Directive occurring in the Wadden Sea in different sections ordered by their Annex I number. The different Annex II, IV and V species occurring in the Wadden Sea could be discussed in separate chapters as well. Next to the assessment of the status and the effects of measures, the report should contain some general information about the habitats and species and about

the monitoring and reporting procedures. For one Annex I habitat the following structure is proposed:

4.2.1 General information

General information should be provided first. This should include the name and number of the feature described and the different authorities or institutions responsible for the administration, monitoring and reporting of the area concerned. Next to the numbering of Annex I habitats in the Habitat Directive, the EUNIS (European Nature Information System) habitat classification should, as far as possible, be used in the description of (sub-)features. In the future the EUNIS classification has to be used in EU reports about a.o. the Habitat Directive (EEA, 2001). Using it before it is compulsory makes it easier to compare the different report in time and between countries.

The time between monitoring and reporting and between reporting and publishing of the report can be considerable. The Quality Status Reports (QSRs) of the Wadden Sea show that monitoring, data compilation, scientific analysis, expert assessment and publication of the results for the whole Wadden Sea, can require two – three years of preparation (Marencic & Lüerßen, 2001). Therefore the year of reporting and the monitoring period should be mentioned.

4.2.2 Habitat Description

The description of the feature could include a map showing the location of the different Annex I habitats for one area and indicating their extent (e.g. in hectares) (Rückriem & Roscher, 1999). For some features, like the nine different Annex I beach and dune habitats, it might be difficult and not very useful to indicate their location on a map of the whole Wadden Sea. They might be present along the whole coast in only a small stripe. The location of these habitats could be described in words using a general map or on detailed maps on a regional scale.

The same Annex I habitat can differ considerably between different geographical areas in Europe (Rückriem & Roscher, 1999). This is caused by differences in climate, succession stage and abiotic factors. A good description of the habitat characteristics is therefore essential. For example, the structure and function of the habitat should be described, and its typical, rare and endangered species mentioned. Annex II, IV and V species, especially the priority species, occurring in the habitat should be mentioned as well and the section about the species referred to. Also the use of the habitat, like fishing or recreation, and factors threatening the habitats should be mentioned.

Other, closely connected, areas should be taken into account in the assessment activities. These close connections should be reported as well. These areas may not entail Annex I habitats or they may not be designated as a SAC.

Some Annex I habitats include other Annex I features (see chapter 1, e.g. estuaries). These features should also be mentioned. For a more detailed description of these features one can refer to the section about these Annex I habitats.

4.2.3 Methods

The report should describe, in general terms, the methods used to monitor and assess the status of the feature and the effect of management measures (Rückriem & Roscher, 1999). It should include the monitoring parameters, the monitoring methods used (e.g. aerial photographs), frequency and time of monitoring (e.g. once per year in June) and the area monitored (e.g. whole Wadden Sea or a sample area). The same methods might be used for different habitats. Describing the methods in an appendix and numbering them makes it easy to refer to in the sections about the different habitats (Rückriem & Roscher, 1999).

Often not the whole (sub-)feature, but only a sample, can be monitored. For example, to determine the biomass distribution of mussels within a mussel bed only a sample of the mussels can be measured. Conclusions based on samples are always subject to statistical uncertainties. These uncertainties and their extent should be indicated clearly.

4.2.4 Conservation objectives

A description of the conservation objectives should be given (Rückriem & Roscher, 1999). Linking the conservation objectives with the monitoring parameters (methods) can give a better insight in why different parameters are measured. To present the connection between the Wadden Sea targets and the monitoring parameters table 6 could be used. It gives an overview of what is being monitored for the assessment of which target or its specifications. Also the parameters that can be used for assessing the status of the feature are given. Other monitoring programs than the Trilateral Monitoring and Assessment Program (TMAP), e.g. national monitoring programs, can provide information that can be used in the assessments as well. For specific measures, the management plans should provide information on the effects of the specific measures taken in frame of these plans (see chapter 3). These measures are related to the targets or their specifications, and the assessment of their effect is related to the assessment of the targets. This assessment could also provide information that can be used for assessing the status of a (sub-)feature.

Table 6. *An overview of which monitoring parameters (P) are measured to assess which Wadden Sea target and for which specification of that target (Spec.) for one Annex I habitat. Parameters that can be used to assess the status are also indicated. Also other monitoring programs (Program) could provide usable information. Specific management plans (MP) should provide information on the specific measures, which are related to the targets or their specifications, taken.*

		P 1	P 2	P 3	P 4	...	Program X	Program Y	...	MP I	MP II	...
Target 1	Spec. a	X	X								X	
	Spec. b	X										
Target 2	Spec. a									X		
	Spec. b		X				X					
	Spec. c				X			X				
...	...											
Status		X	X	X	X		X	X		X	X	

4.2.5 Conservation status

The conservation status of the feature should be reported. The assessment of the conservation status of a feature has to be based on the assessments of the status for all its sub-features and the attributes monitored specifically to determine the status of the feature. The monitoring parameters used to assess the status could be indicated as given in table 6. Probably all parameters measured to monitor the targets can also be used for assessing the status. Some additional parameters could be necessary as well (see table 6 "P3"). The results of other monitoring programs and specific management plans can also be used to assess the status of a feature.

Presentation of the Favourable Conservation Status

The presentation of the extent to which the Favourable Conservation Status has been reached should be clear, straightforward and consistent for all features (Rückriem & Roscher, 1999; Davies *et al.*, 2001). This could be achieved by using a limited number of categories indicating in words if the status is favourable or unfavourable and if the status is improving, declining or did not change since the previous report. The chance of reaching the Favourable Conservation Status should also be indicated as well. In the UK Marine SACs Project seven categories are used to indicate the condition of the (sub-) features. These categories are given in table 7.

Table 7. *The seven categories used in the UK Marine SACs Project to indicate the condition of (sub-) features (based on Davies et al., 2000):*

	category	abbreviation	remark
1	Favourable – maintained	f-m	
2	Favourable – recovered	f-r	
3	Unfavourable – recovered	u-r	
4	Unfavourable – no change	u-n	
5	Unfavourable – declining	u-d	recovery possible either spontaneously or due to management input
6	Partially destroyed	p-d	
7	Destroyed	d	no hope of recovery

Only the first two categories of table 7 meet the requirements of a Favourable Conservation Status. A (sub-)feature is in a Favourable Conservation Status when the targets for that (sub-)feature are reached. Depending on the status of the previous reporting event, the status can be indicated favourable-maintained or favourable-recovered. When the status is unfavourable, depending on the previous result it can be indicated that it has not changed, is recovering or is declining. When there is no chance that the Favourable Conservation Status will be reached for (some parts of) the feature it can be indicated by (partly) destroyed. This approach of using a limited number of descriptive categories, enables judgements to be made which are within the capability to make i.e. they are not defined in an over-prescriptive way (Earll, 1999). In this report the UK approach will be used for the proposed format of the report to the European Commission.

Insufficient data

Additional categories might be added to the seven mentioned above. Pihl *et al.* (2001) for example, use the category ‘uncertain’ when conditions suggest that the status is or might be unfavourable but where this status cannot be definitely verified on the basis of existing data. They also use the category ‘unknown’ when the data available are insufficient to make an assessment of the conservation status. In theory, the monitoring results should provide all the data necessary to assess the status. However, in practice there will always be some data missing. For example, bad weather conditions could hamper a proper data collection. Including the categories ‘uncertain’ and ‘unknown’ might therefore be useful.

Sometimes the status can be assessed even if the data are insufficient. When there is no indication whatsoever that the status in unfavourable, it might be assumed favourable. Equally, there may be many indicators that the status is unfavourable even though no sufficient information is present. The status of such features might be stated unfavourable (based on Pihl *et al.*, 2001). However, these kinds of assessments should be applied with care and should be based on good, reliable information. There should be no doubt about the result of such an assessment.

Future conditions

The favourable Conservation Status of the Habitat Directive asks that the structure and functioning of the habitat (and its typical species) are secured for the foreseeable future. To be able to report on this, it must be possible to evaluate what can be predicted about the future condition from the present condition (Brown, 2000). A habitat that is in a Favourable Conservation Status at the moment of monitoring, but which is likely to become unfavourable due to factors that, for example, make the continuation of maintenance management impossible could be judged “unfavourable”. On the other hand, when a site, which is currently in a unfavourable condition, has a high change of becoming favourable in the near future due to the application of management measures, might be considered "favourable” (Hurford & Perry, 2000).

Status of (sub-)features

Assessing the status of the whole feature might be very difficult. Rückriem & Roscher (1999) and Davies *et al.* (2000) state that the status of a feature can only be considered favourable if the status of *all* sub-features is favourable. Averaging the status of the different sub-features is rejected (Rückriem & Roscher, 1999). It is not possible to average for example the favourable-maintained status of one sub-feature with the unfavourable-recovered status of another sub-feature to a favourable-recovered average status. Therefore, the assessment of the overall status will have to be based on expert judgements. In this judgement procedure a lot of information is lost, therefore it is proposed to include information about the status of the sub-features as well. As the result of assessments based on expert judgement are not indisputable, a clear motivation of the status category chosen should be given for the feature as well as for the sub-features. For one feature the extent to which the Favourable Conservation Status is reach could be presented for all sub-features and for the feature in a table like table 8.

Table 8. *An example of how the extent to which the Favourable Conservation Status has been reached can be presented for all sub-features and the feature itself. f-m= favourable-maintained; f-r = favourable-recovered; u-r = unfavourable-recovered; u-n = unfavourable-no change; u-d = unfavourable-declining: p-d = partially destroyed; d = destroyed.*

	f-m	f-r	u-r	u-n	u-d	p-d	d
Sub-feature 1	X						
Sub-feature 2			X				
Sub-feature 3		X					
...							
Feature			X				

Time trends

The actual status can be compared with the desired (favourable) conservation status and with the status assessed in the previous reports. If the assessments of more reporting periods are known, the assessed status throughout the years, relative to the Favourable Conservation Status can be presented diagrammatically as illustrated in the hypothetical example given in figure 3. Note that this figure is not based on values but based on subjective assessments of the status of the sub-features and the feature in the different reporting years. Time trends could also be indicated with arrows as done in Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer (2000a, b) and indicated in table 9.

Table 9. *Indication of the time trends using arrows (based on Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer (2000a, b))*

	Trend stable, at this moment no reasons for concern
	Trend negative, attention needed
	Trend positive, favourable development
?	no trend (yet) or unknown trend

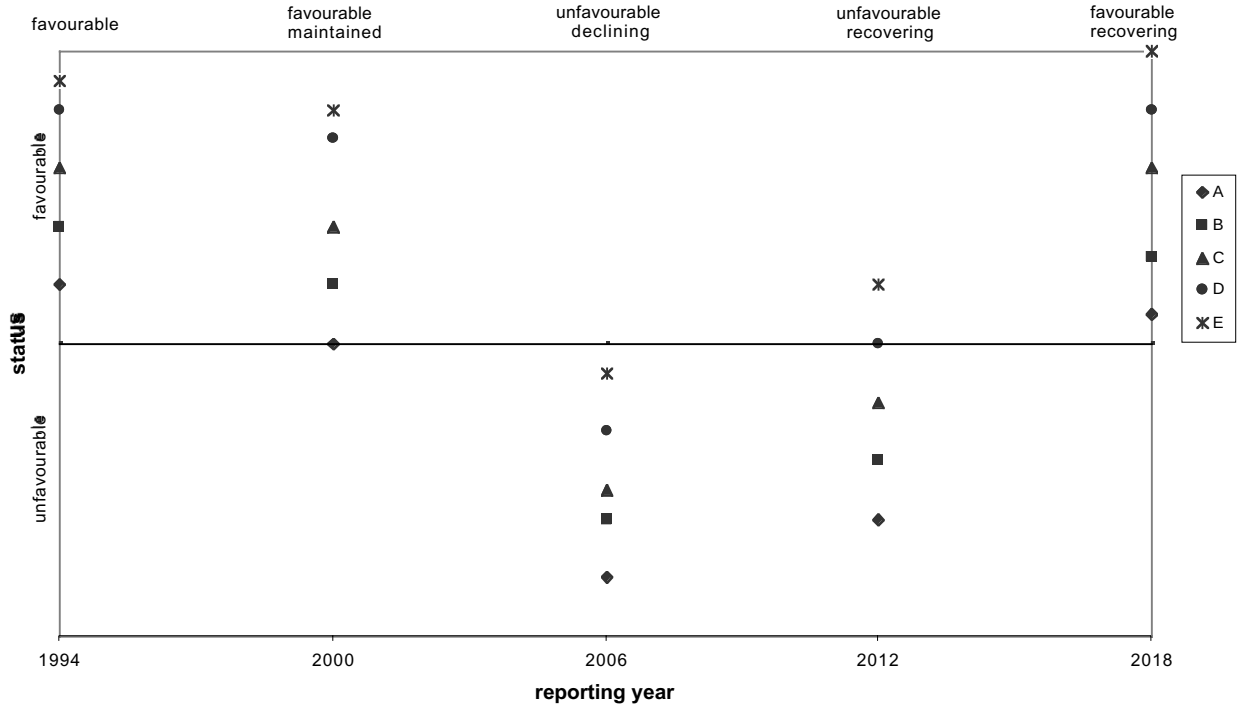


Figure 3. *A hypothetical example of presenting the status of a feature throughout the years, relative to the Favourable Conservation Status. The vertical axis shows the status of the feature over the period shown on the horizontal axis. The horizontal line defines the border between a favourable and unfavourable conservation status. The symbols represent different sub-features (A, B, C, D and E) (source: Davies et al., 2000). Note that this figure is not based on values but based on subjective assessments of the status of the sub-features and the feature in the different reporting years.*

Annex I habitats within a feature

When a feature contains more Annex I habitats, the results of the assessment of these habitats can be used for the assessment of the status of the feature. For clarity the section about one feature should be complete. Therefore the results for the Annex I habitats occurring in this feature, should be repeated. This could be done by incorporating the table with the status assessment of these habitats (table 8) into the status table of the feature. For more details the sections describing the Annex I habitats occurring in the feature can be referred to. For Annex II, IV and V species present in the feature, the same procedure can be followed.

4.2.6 Management measures

The measures indicated in table 5 should be reported. As discussed in chapter 3, the Common Package cannot assess the effectiveness of management measures in detail. Specific management plans should include an evaluation procedure to assess the implementation and effectiveness of the measures taken (Rückriem & Roscher, 1999). The monitoring and assessment of these individual management plans can be used to report to the European Commission about the management measures. These management plans and the responsible authorities should be mentioned in the report. This should include information on the implementation: is it implemented and when is it implemented (date or period). For details, the available information on these plans can be referred.

The effect of general statutory and administrative regulations related to the implementation of the Habitat Directive should be assessed. However, also other general measures could have an effect on the status of features in the Wadden Sea. For example, a measure to reduce the atmospheric deposition of nitrogen that aims to reduce deposition on

a regional or (inter)national scale also effects the Wadden Sea Area. The effect of these measures should also be mentioned in the report.

Measures can be related to the Wadden Sea targets or, in case of general regulations, national targets (e.g. the reduction of atmospheric deposition). This relation could be indicated, for example as proposed in table 10.

Table 10. *An overview of which management measures are applied for which target and for which specification of that target (Spec.) for one Annex I habitat.*

		Management measure
Target 1	Spec. A	
	Spec. B	
Target 2	Spec. A	
	Spec. B	
	Spec. C	
Target 3		
...	...	

Conserving or changing the initial situation

The assessment of measures aiming at conserving and measures aiming at changing the initial status requires different procedures. The assessment of measures aiming at conserving the initial status requires determining if the Favourable Conservation Status is conserved. Assessing measures aiming at changing the initial status should determine to what extent the Favourable Conservation Status has been reached. Because of the different procedures required, these two types of measures could be reported separately (Rückriem & Roscher, 1999). For one feature both types of measures could be present: for the part of the habitat that is has an unfavourable status measures aiming at changes are used, while in the favourable part measures aiming at conserving the initial situation are applied.

An aim of the reports should be to give other countries and organisations (new) ideas for management measures. Only scoring the effect of the measures, in terms of negative or positive, will not be sufficient for this. Next to indicating whether the status is conserved or to what extent the Favourable Conservation Status has been reached, some information about the efficiency of the measures and the causes of negative or positive effects should be given.

Assessment of the effect of measures aiming at changing the current status to the desired status, can be done by comparing the assessed with the desired status or by looking at the time series of the measurement done at the successive monitoring intervals. The direction of the change indicates if the status is improving or not. The implementation, effect and efficiency of these measures could be presented as in table 11a. For clarity, the status of the sub-feature could be repeated here. Also a short description of the causes for not having implemented the measure or the causes of the observed effects and efficiency of the measure should be given.

Table 11a. *The implementation, effect, efficiency of management measures aiming at changing the (initial) status and their causes. The status is abbreviated as follows: f-m= favourable-maintained; f-r = favourable-recovered; u-r = unfavourable-recovered; u-n = unfavourable-no change; u-d = unfavourable-declining: p-d = partially destroyed; d = destroyed. The effect of a measure can be very positive (++), positive (+), neutral (+/-), negative (-) or very negative (- -). The efficiency can be very high (++), high (+), intermediate (+/-), low (-) or very low (--).*

Sub-feature	Measure	Implemented?	Assessment			
		No/when (month + year)	Status	Effect measure	Effi-ciency	Cause
A	1	No	u-n			No money
B	2	From 11 '99	u-r	+	-	Difficult to apply with rel. Small effect
	3	From 06 '00	u-r	+	++	No extra efforts needed
C	4	02 until 05 '99	f-r	++	++	Small effort, large effect
D	5	02 '97 until 01 '00	u-d	+/-	--	Expensive, no effect
...	...	...	...	...	...	...

For measures aiming at the conservation of the initial status, the effect, efficiency and implementation can be presented as in table 11b. Also a short description of the causes for not having implemented the measure or the causes of the observed effects and efficiency of the measure should be given. If it is assessed that the status is unfavourable, the same or other measures related to the same sub-feature will be assessed in table 11a (measures to change the status) in the next report.

Table 11b. *The implementation, effect and efficiency of management measures aiming at the conservation of the initial status and their causes. The signs used are explained in table 11a. FCS= Favourable Conservation Status.*

Sub-feature	Measure	Implemented?	FCS conserved?	effect	Effi-ciency	Cause
E	11	No	No			Legal problems
	12	From 05 '00	No	+/-	--	Not effective for aim
F	13	From 04 '89	Yes	+	-	Very expensive
	14	01 '00 until 05 '00	Yes	++	+	Easy to apply
	15	05 '98 until 05 '99	Yes	+/-	-	No effects observed

Plans and projects

The assessment of “plans and projects not directly connected with or necessary for the management of the habitats but likely to have a significant effect thereon” should be reported (table 5). These include plans and projects inside as well as outside the Wadden Sea that might have an effect on features in the Wadden Sea. These plans and projects should be described in general terms and the institutions involved mentioned. It should be clearly indicated which sub-features might be effected, what the overall effects might be and why approval is given. This assessment should be a part of the implementation of the plans and projects. The results of this assessment can be used for the report to the European Commission. It could be presented as indicated in table 12. The “effect on sub-feature” column should represent the overall effect, taking all negative and positive effects acting on one sub-feature into account. The "effect on feature" should indicate the total effect of the plan or project on the whole feature. The exact effect of plans and projects can not be predicted. Approved plan and projects, which effects were predicted not to alter the status negatively, should still be monitored by the responsible authorities in order to assess whether the prediction was right.

Table 12. *Presentation on the effects of plans and project not directly connected with or necessary for the management of the habitats but likely to have a significant effect thereon. The title of the plan or project, the sub-features it effects, the overall effect on these sub-features and the overall effect of the plan or project on the whole feature should be indicated. The overall effect can be very positive (++), positive (+), neutral (+/-), negative (-) or very negative (- -).*

Plan or Project	effects sub-feature	Effect on sub-feature	Effect on feature
title	A	++	+
	B	+	
	C	+/-	
title	B	-	--
	E	--	
...	...	...	

The compensation measures taken for plans or projects carried out in spite of a negative assessment of the implications for the site and in the absence of alternative solutions for imperative reasons of overriding public interest, should also be reported (Rückriem & Roscher, 1999). It should be indicated if the compensation measures are taken inside or outside the feature effected by the plan or project, the kind of compensation measures taken, their implementation status and the effect on the status of a habitat.

All measures

The total effect of all measures for one feature should be indicated as well. Depending on the current status relative to the status previously assessed and the effect of individual management measures, a general statement about the effect of management can be made.

Many measures, plans and projects will effect different features. A description of these activities could be restricted to one feature. This description can be referred to for the other features. However, their effect should be presented for each sub-feature.

4.2.7 Additional topics to report

The report can form the basis for an evaluation of a part of the national nature conservation policy (Rückriem & Roscher, 1999). Therefore, it should include all elements of an evaluation. An evaluation consists of four elements (based a.o. on Rückriem & Roscher, 1999):

1. Implementation and procedure assessment.

Assesses if the available resources were usefully spend and if the measures were implemented as planned at all.

2. Assessment of the achievement of the conservation objectives.

Assesses to what extent the conservation objectives of the measures are reached. The actual situation is compared with the desired situation. The assessment can be based on expert judgement, using when available, information from reference situations or theoretical concepts. The desired situation should be defined (conservation objectives set) during the management formulation, i.e. before implementing the measures. When a conservation objectives is focussed on the conservation of the initial situation it is easier to deduct management measure and as a consequence it is easier to evaluate the measure (Rückriem & Roscher, 1999). When a target is focussed on the change of a site to the desired situation, e.g. restoration of a certain situation, it is more difficult to deduct the proper measures and to set up an evaluation plan (Rückriem & Roscher, 1999). In how far alternative explanations of the achievement of the observed situation can be refuted, or to what extent the observed situation is caused by the management measures, has to be assessed as well. The efficiency of the measures can be deducted from this information.

3. Analysis of the monitoring and assessment procedures and results.

Assess a.o. whether:

- The methods are adequate to monitor and assess the status and measures.
- The management measures applied are adequate to reach the targets efficiently.
- The targets, for which to measures were taken, are realistic, meaningful and useful.

- There are conflicts between different targets. Conflicts might occur when a more favourable status for one (sub-)feature leads to a more unfavourable status for another (sub-)feature.

4. Advises/implications for further policy and management.

Based on the analysis, the necessary or advisable changes and additions in policy and monitoring, assessment and management activities can be described.

The first two elements are dealt with in the sections about the status and the measures. The last two elements can be based on the assessment results and could be reported in a separate section. This section should contain the conclusions and discussion of the assessment procedures and results. Based on this, necessary or advisable additions and changes in monitoring, assessment and management activities should be given. For example, Rückriem & Roscher (1999) state that the monitoring and assessment for the Habitat Directive should lead to adjustments in monitoring and reporting activities, measures and/or policy. This implies that the last two elements of an evaluation, as described above, should be included in the report. As stated by Rückriem & Roscher (1999), for conservation measures the whole management cycle (problem definition, problem analysis, option analysis, planning, implementation, monitoring and evaluation) has to become routine and repeated through time.

Table 13. *The proposed set up for the report to the European Commission for one habitat of Annex I of the Habitat Directive. The different species listed in Annex II, IV and V of the Habitat Directive should be dealt with in separate sections in a format comparable with the one for Annex I habitats using only the relevant sections.*

General	Name + number Annex I habitat
	Authorities/institutions responsible for administration, monitoring and reporting
	Reporting year
	Monitoring period
Habitat description	Location
	Area
	If present: Other Annex I habitats Annex II, IV and V species Typical, rare, endangered species
	Structure and function
	Use
	Threats
	Connection with other areas
Methods	Monitoring parameters
	Frequency and time of monitoring
	Area monitored
Conservation objectives	Relations with: Monitoring parameters Other programs Management plans
Status	Status of sub-features and feature
	Status compared to previous assessments
	If present: Status of Annex I habitats within feature Status Annex II, IV and V species within feature
Management measures	Measures related to the coherence of NATURA 2000
	General statutory and administrative regulations/measures
	Measures related to plans and projects incl. compensation measures
	Conservation measures taken and their effect: Measures aiming at conserving the initial status Measures aiming at changing the initial status
	Relation measures - targets
	Management plans: Reference Authorities involved
	Implemented? When/why not?
	Effect + causes
	Efficiency + causes
	Plans & Projects: Reference Authorities involved Approval given? Effects
Additional topics	Analysis of: Monitoring and assessment procedures Results
	Advises/implication for further: Policy and management Monitoring and assessment procedures

4.2.8 Total report

The report could also include one table in which the results of all Annex I habitats are summarised. Such a table could for example look like table 14. The status of the different habitats in one area could also be indicated on a map as proposed by Rückriem & Roscher (1999).

Table 14. *Assessment results for all Annex I habitats. The status is abbreviated as follows: f-m= favourable-maintained; f-r = favourable-recovered; u-r = unfavourable-recovered; u-n = unfavourable-no change; u-d = unfavourable-declining: p-d = partially destroyed; d = destroyed.*

Habitat code	Total area (ha)	Status
1140	1400	f-m
1240	1600	u-d
...	...	...

Based on table 14 and the assessments of all species subject to the Habitat Directive occurring in the Wadden Sea, an assessment of the overall status of all Wadden Sea features together can be made in general terms. In this general discussion, changes in the overall status over successive monitoring and reporting periods and the habitats and species that need the most attention could be indicated.

4.3 First national report for the Habitat Directive

The proposals done in this chapter especially focus on the first report. In all further reports, the description of the methods, targets and the habitats can be limited to reporting the changes, the reasons for these changes and additional information about these subjects. For the basic information the first report can be referred to.

The effects of long term development measures and measures aiming at conserving the status that have to be applied continuously, only have to be assessed and reported in detail once (Rückriem & Roscher, 1999). In the following reports they should be mentioned but a detailed assessment is not necessary. As long as these measures have not been changed, it can be assumed that the effect will still be the same. However, the effects should still be monitored in at least a general way. As dynamic processes are a part of the natural development, the effects of measures can never be predicted exactly. The same measures can have different effects in different areas, successional stages and time periods. Measures that were effective once might become less effective or may even have an opposite effect in later time periods. Monitoring the effects of these measures should therefore be continued as long as they are applied.

The larger extent of the first report, combined with the efforts needed to set up a monitoring and reporting procedure, will make the resources needed for the first reporting period much larger than for the following (Rückriem & Roscher, 1999).

4.4 Reporting about species

The report should contain an assessment of the status of Annex II species, the status of their habitats and the implementation and effect of measures related to these species. Because of the limited number of Annex II species in the Wadden Sea, the reporting (and monitoring) procedures for these species are not discussed in detail here.

In the Wadden Sea Plan only targets are set for the Seal species and the Harbour Porpoise and the Common Package only includes the Common Seal. There is a lack of information concerning the development of fish communities especially the status of priority species like the houting (*Coregonus oxyrhynchus*) (TMAG, 2001a). The root vole and the Annex II fish species are only abundant in a few regions of the Wadden Sea. Because of the lack of information and/or the restricted distribution they are not included in the TMAP (TMAG, 2001a).

4.4.1 Seals

For the Seals the ‘Agreement on the Conservation of Seals in the Wadden Sea’ (Seal Agreement) was enacted in 1991. The agreement between the Wadden Sea states aims to co-operate closely in achieving and maintaining a Favourable Conservation Status for the Common Seal population of the Wadden Sea Area. The Seal Agreement contains provisions, a.o. on monitoring and on the protection of habitats, which have been specified in the ‘Conservation and Management Plan for the Wadden Sea Seal Population 1991 - 1995 (Seal Management Plan) and the revised Seal Management Plan 1996 - 2001. These plans include measures for the implementation of the targets on Common Seals. The revised Seal Management Plan 1996 - 2001 also includes additional measures for the protection of the Grey Seal. A new Seal Management Plan for the period 2002-2006 will be adopted on the Trilateral Governmental Conference in 2001.

Here it is assumed that the monitoring activities for the Common Seal provide sufficient information for the reporting requirements of the Habitat Directive. For the Grey Seal there is a lack of information for the development of a comprehensive monitoring and assessment program.

4.4.2 Harbour Porpoise

In the framework of the Conservation of Small Cetaceans of the Baltic and North Sea (ASCOBANS), the harbour Porpoise was included for the first time in the decisions of the 8th Trilateral Governmental Conference of Stade (1997). At this time, too little is known about the population dynamics to be able to evaluate the target for this species (De Jong *et al.*, 1999).

4.4.3 Birds

The EC Bird Directive also requires monitoring and reporting. Therefore, reporting about birds, and areas that are only included in the NATURA 2000 network according the Bird Directive (Special Protected Areas (SPAs)), is not required for the report concerning the Habitat Directive (Rückriem & Roscher, 1999). However, in the Wadden Sea many SPAs are also SACs. Breeding and/or migrating birds are important sub-features in those areas. The targets on birds, stated in the Wadden Sea Plan (1997), are also valid in these areas. Although reporting about measures on birds is not required, management measures related to the habitat itself should be reported in the report for the Habitat Directive. For example, measures related to the target "a favourable food availability" for birds could aim at changing sub-features of a habitat like the macrozoobenthos community which forms a food source for birds. To be able to assess the status of a (sub-)feature like the macrozoobenthic community, factors like the food availability for birds should be taken into account. As these measures aim at protecting birds, their effect could be reported in terms of the changed situations for birds.

In the Wadden Sea, special monitoring programs for breeding birds (Joint Monitoring Program of Breeding Birds in the Wadden Sea (JMBB)) and migratory birds (Joint Monitoring Program on Migratory Birds (JMMB)) exist (see Reineking, 1994). These programs are part of the TMAP. Some species mentioned in the Bird Directive occurring in the Wadden Sea are measured in these two programs. However, 10 of the 24 bird species listed concerning Annex I of the Bird Directive in CWSS (1993) are not included in the monitoring programs[6]. In this report it is assumed that the current monitoring and reporting activities (JMMB, JMBB and other activities in frame of the Bird Directive) provide sufficient information for the reporting for the Habitat Directive.

4.4.4 Species listed in Annex IV and V of the Habitat Directive

The main objective of the reporting for the Habitat Directive is providing information on the Habitats of Annex I and the species of Annex II of this Directive, however, the species of Annex IV and V should also be included in the report. These species are referred to in Article 17 and 11 of the Habitat Directive:

> Article 11: "Member States shall undertake surveillance of the conservation status of the [...] species referred to in Article 2 [...]"
>
> Article 17: "[...] Member States shall draw up a report on the implementation of the measures taken under this directive"

Annexes IV and V do not explicitly require the protection of habitats, so only the status of these species and the related management measures should be reported.

4.4.5 Alien Invasive Species

As the NATURA 2000 network aims at protecting biodiversity, reporting about the Habitat Directive features should also include information on Alien Invasive Species (AIS). An alien species is defined as a species, subspecies, or a lower taxon occurring outside of its natural range and dispersal potential and includes any part or gametes of such species that might survive and subsequently reproduce. An alien species can be called invasive when it becomes established in the natural or semi-natural ecosystems or habitats outside of its natural range (Turlings, 2001). The Species Survival Commission of the World Conservation Union (IUCN) considers AIS as the second largest threat to indigenous species, only after habitat destruction. AIS establish themselves often at the cost of indigenous biodiversity and

[6] The species missing are: *Botaurus strellaris*, *Cygnus bewickii*, *Cygnus cygnus*, *Circus pygargus*, *Porzana porzana*, *Crex crex*, *Tringa glareola*, *Chlidonias niger*, *Luscinia svecica* and *Lanius collurio*.

sometimes at very considerable costs (Bergmans & Blom, 2001). On a global scale, the Convention on Biological Diversity (CBD) recognises the importance of the global problem of invasive species and calls in contracting Parties to 'prevent the introduction of, control or eradicate those alien species which threat ecosystems, habitats and species' (Article 8(h) (SCBD, 1992)). As the NATURA 2000 network is a part of the European implementation of the CBD, it should take the AIS problem into account. Therefore, the reports on the NATURA 2000 sites should address this issue.

In the Wadden Sea Area several AIS might form or already form a threat. An example is the moss species *Campylopus introflexus* that is an introduction from the Southern Hemisphere (Botanical Electronic News (BEN), 1997). Mosses generally have an efficient dispersal rate and are highly competitive. In the Netherlands an increase in the dominance of mosses has been observed in dry sand heaths. The AIS moss species *Campylopus introflexus* is one of several moss species said to colonise dune systems at the expense of lichens because of the intensified eutrophication. *Campylopus introflexus* is considered to present a threat to the grey dunes (2130) (Pihl *et al.*, 2001). Another example, Nehring & Leuchs (1999) describe an analysis of information about the establishment of anthropogenically introduced macrozoobenthic species at the German North Sea coast. 26 recently established species could be identified but no relevant ecological or economic effects could be shown. It is presumed that many possibilities exist for the establishment of further non-indigenous species (Nehring & Leuchs, 1999) which may include species that can invade and cause significant effects. Furthermore, the AIS *Rosa rugosa* and mountain pine represent by far the greatest management problems for the "decalcified fixed dunes with *Empetrum nigrum*" (2140) (Pihl *et al.*, 2001). *Rosa rugosa* is a dense, vigorous species whose hardiness reflects its north-eastern Russia and China origins. It is common in the Northwest as an 'escaped' species (Plant Oregon Catalog, 2001). This rose species was originally brought to many of the Wadden Sea islands for decorative purposes. This species, however, does not integrate in the local plant community but superimposes by covering large areas (De Jong *et al.*, 1999). The mountain pine (*Pinus montana*) is native in the mountains of Central and Eastern Europe (University of Exeter, 2001) and not in the Wadden Sea Area. In De Jong *et al.* (1999) it is stated that the suppression of *Pinus* spp. and *Rosa rugosa* may be forced, as these species act as main competitors for the autochthonous species. Another example: the Pacific oyster (*Crassostrea gigas*) was first found in the Wadden Sea at the beginning of the 1980s. It is likely that this introduced species will expand in the coming years (De Jong *et al.*, 1999).

5. Discussion

In this chapter, the topics described in the previous chapters are discussed and conclusions drawn. Furthermore, proposals are made and suggestions for concomitant research are given.

Member States are obligated to implement the Habitat Directive. The designated areas and species have to be monitored and the results assessed and reported. The three Wadden Sea countries have decided to co-ordinate their activities and measures a.o. to implement international legal instruments in the field of nature conservation (CWSS, 2001a). This means that the monitoring and reporting for the Habitat Directive in the Wadden Sea Area should be co-ordinated trilaterally. This also concerns adjustments of the existing common monitoring and reporting activities (TMAP and e.g. QSR) which are necessary to meet the requirements of the Habitat Directive. The TMAP is only in its first phase of implementation and, with regard to the target requirements, not yet sufficiently elaborated (De Jong *et al.*, 1999). Furthermore, the Common Package does, for example, not entail important functional and process related parameters. Therefore, a comprehensive scientific assessment of the ecological status is limited (Marencic & Lüerßen, 2001). Thus, optimisations of the current activities are necessary.

5.1 National/Wadden Sea report

The Habitat Directive requires a report from every Member State. The results of the monitoring and reporting activities for the Wadden Sea on the trilateral level could be used for the reports of the three countries. If these trilateral activities are in line with the requirements of the Habitat Directive, the results could be used much easier for these national reports. The national and trilateral activities should organised in a way that avoids double work to be done.

As the different habitat types occur in the whole trilateral Wadden Sea Area and do not stick to national borders, it might be easier and more efficient to report for the Wadden Sea as a whole than for each country separately. Furthermore, the results of the same Annex I habitat types of the different Wadden Sea countries are better comparable if they are reported on a trilateral scale. The results of the monitoring and reporting system being set up for the whole trilateral Wadden Sea Area can be used for this. Therefore, it could be proposed to report for the whole Wadden Sea Area in a separate report delivered to the European Commission (EC). In their national report, the three Wadden Sea countries can use the main results of the Wadden Sea report and refer to that report for more detailed information.

The report of the Wadden Sea should take the set up of the national reports into account. The report for the Wadden Sea will have to be used for the national reports even when the Wadden Sea report is a report to the EC in itself. For example, embryonic shifting dunes are also present in areas outside the Wadden Sea. To assess the status of this Annex I habitat at a national level, information from the Wadden Sea report has to be used. It is not yet clear how the different national reporting approaches will look like. Some preliminary proposals are made in some countries (e.g. Rückriem & Roscher, 1999; Phil *et al.*, 2000), but a final set up for the reports is not established yet. Probably the national reports will differ at least to some extent. It should be possible to fit the different national approaches into the trilateral Wadden Sea report.

The present Quality Status Report (QSR) and Policy Assessment Report (PAR) for the Wadden Sea do not contain all information necessary to report for the Habitat Directive. Furthermore, these reports may be too detailed on subjects that also have to be reported for the Habitat Directive, to be used directly for the EC report. However, these reports can provide information useful for the Habitat Directive reporting. The following QSRs and PARs could include specific assessments needed for the Habitat Directive, like the assessment of the status of the Annex I habitats and of the Annex II, IV and V species occurring in the Wadden Sea. In order to avoid double assessment and reporting work, it should be

considered to structure the QSRs and PARs in such a way that it can easily be used for the writing of the EC report.

For the Wadden Sea a monitoring and reporting procedure is already available. Targets are set, many management plans are executed and the status of many habitats and species is known. For other NATURA 2000 sites, in general, until now getting the NATURA 2000 up and running was more important than monitoring. Monitoring is seen as the next step (Evans, pers. comm., 2001). For many of these sites, conservation objectives have to be set, the potential threats have to be investigated, the status at this moment has to be determined and management measures have to be developed, before a suitable monitoring and reporting procedure can be established (Rückriem & Roscher, 1999). Therefore, compared to many other areas, setting up a monitoring and reporting procedure for the Wadden Sea that meets the requirements of the Habitat Directive is easier and requires less efforts. Although the current monitoring and reporting activities in the Wadden Sea might not meet all requirements of the Habitat Directive, the expenditures associated with meeting these requirement will be much lower and less difficulties have to be tackled compared to sites without an existing monitoring and reporting program. Establishing an adequate program for the Wadden Sea as soon as possible is important. As clear guidelines from the European Commission are still lacking (or not even expected (Earll, 1999)), it is very important to have some examples of a monitoring and reporting procedure in Europe. Establishing an adequate program for the Wadden Sea Area can efficiently provide a good example. Having such an example would make it easier to solve all kinds of theoretical, procedural and conceptual difficulties when establishing a program in other sites that have no monitoring and reporting activities yet. Furthermore, a sufficient program for the Wadden Sea makes it clear that it is possible to establish an adequate program. This acts as an incentive for the authorities in charge of other NATURA 2000 sites to set up a monitoring and reporting program.

5.2 Specification of the targets

The description of the Annex I habitats in appendix 3 and table 3 in chapter 2 shows that the habitats listed in the Habitat Directive that occur in the Wadden Sea can be connected with the targets of the Wadden Sea Plan of 1997.

The Habitat Directive states that the conservation objective should be to maintain or restore the habitats and species at a Favourable Conservation Status. The Favourable Conservation Status is only broadly defined for both habitats and species (European Communities, 1998). To be able to assess to what extent this general objective has been reached, a more specified description of the Favourable Conservation Status for each feature is required. As discussed in Earll (1999), for the setting of conservation objectives it is useful to divide a feature into sub-features. The specification of the WSP targets will set specific conservation objectives for characteristics of the (sub-)features. For this specification it should be determined which attributes are the most important to assess to what extent the Favourable Conservation Status has been reached or is conserved. For all additional characteristics proposed to be monitored, new targets should be set and specified or existing targets should be specified in order to be able to assess whether these represent (or to what extent they represent) the Favourable Conservation Status. All conservation objectives related to the assessment of one feature, including its sub-features, together should represent its Favourable Conservation Status.

Dierßen (1998) states that comparing the integration levels from populations to ecosystems, an increasing theoretical and practical complexity of the objectives is obvious. Specifying the general conservation objective of a Favourable Conservation Status of the whole Annex I feature by setting objectives for specific characteristics of the (sub-)features, will therefore simplify the implementation of this general objective.

Setting conservation objectives is a very important part of the monitoring and assessment procedure. Without conservation objectives, a monitoring might be difficult to develop and conclusions about the status of a (sub-)feature cannot be drawn. For example, without having defined what a "stable" mussel bed is, a monitoring parameter cannot be established and assessing "stability" is not possible. Depending on the characteristic and the

kind of specification applied, setting conservation objectives in order to derive monitoring parameters and setting conservation objectives for assessments might differ.

Based on the conservation objectives, management measures can be formulated. For the Wadden Sea, management measures can be based on conservation objectives set by specifying the targets. For example, from the target of a geomorphologically undisturbed tidal flat a conservation objective can be derived stating that the disturbance of the sand balance by human activities should be as low as possible. Based on this objective, a measure can be formulated which limits the sand extraction in the tidal area to the dredging and maintenance of the shipping lanes. Without clear conservation objectives it is impossible to establish the necessary measures. The more specific the desired situation is defined, the easier it is to deduct adequate measures from it and a more specific setting of conservation objectives makes it easier to evaluate the measures (Rückriem & Roscher, 1999).

Also the assessment of the implications of, and (dis)agreement with, plans and projects not directly connected with or necessary for the management of the site, is only possible if specific objectives are set (Rückriem & Roscher, 1999). Without specific objectives, it can not be assessed what kind of effects a plan or projects has on the conservation status of a feature.

It is argued that it may not desirable to make targets too specific (see De Jong, in press). Scientific critique and too specific targets reduce the scientific credibility of the targets and consequently lead to controversial discussions between interested parties, whereas an essential function of conservation objectives is to bring diverging interests together (De Jong, in press). A more general character of the targets makes them more suitable for communication with a broad range of interested parties (De Jong, in press). An open-end formulation of conservation objectives means that there is room for negotiation, both from the user and the nature protection sides (WSP, 1997). However, without specifying the targets by setting conservation objectives for specific characteristics of the (sub-)features, it is not possible to determine the effect of management measures and the status of the features. Not specifying the targets, like 'natural' development, will make it impossible to determine the extent to which the targets have been reached.

5.2.1 Precautionary principle

For nature conservation, using the precautionary principle might be the safest option. However, in general, setting a conservation objective in which no human activities are allowed does not correspond with the anthropocentric rationale. Unless there is no other option possible to conserve or restore the system, setting such objectives should be considered with care if a general support to meet the objective is necessary.

5.2.2 Quantitative conservation objectives

The Guiding Principle and the targets for the Wadden Sea can be considered to be based on an ecosystem stability approach which aims at the protection of processes and takes a dynamic, changing situation into account. Because of the dynamic, developing state of the Wadden Sea and its heterogeneous character, it can be concluded that, in general, setting conservation objectives using a fixed value is not advisable. Conservation objectives should be set by indicating which characteristics are most important for determining to what extent the desired situation for a feature has been reached. For example, when stating that mussel beds should be distributed in a natural way, the total area of beds could be an important attribute to assess this. However, setting a specific value of a certain number of hectares for this is not advisable, as a natural distribution could also mean a changing area throughout the years. Based on the monitoring results, experts should judge whether the distribution is natural.

Ranges for the values of the parameters monitored can often be set based on well-excepted (scientific) knowledge. For example, to prevent extinction of seals a minimum number of individuals is needed. If the number of individuals is lower, it can be assumed that there is not a viable stock of seals. Though, these kinds of ranges are very broad and often not very helpful in setting conservation objectives. If the number is lower than the minimum value, there is no discussion that the sub-feature is not in a Favourable Conservation Status.

Some conservation objectives could be specified by setting a certain value. For example, for a conservation objective like 'the background levels of disturbances should be lower than a certain threshold', thresholds might be quantified. In case of natural micropollutants for example, threshold values could be set based on natural background levels of these substances.

5.2.3 Current situation

The management and policy in the Wadden Sea often aims at changing the status of a feature as the current condition of certain characteristics of such a feature is considered to be unfavourable. Therefore, the UK approach of setting conservation objectives based on the assumption that the situation at the moment the site was put forward to the European Commission represents the Favourable Conservation Status, will not be applicable for many features in the Wadden Sea.

However, conservation objectives in the Wadden Sea could be based on the current, unfavourable condition of certain characteristics of a feature. This could be done by indicating which characteristics should change and in which direction, without defining a certain end situation. The Wadden Sea Plan targets are formulated in this way: “increase the area which is natural, undisturbed or dynamic” (see appendix 2). The specification of these targets can be based on an increase of the important characteristics of the features. For example, when it is known that the reduction of the area of mussel beds is due to human influences, one could state that a reduction of the area is not favourable. The conservation objective of an increase in area, relative to the current area, might be set and related management measures to reduce human influence taken. The Favourable Conservation Status is reached when there is no desire anymore to change the situation at that moment.

5.2.4 Changing conservation objectives

For a consistent monitoring and assessment it could be stated that the conservation objectives set should not be altered. For example, Rückriem & Roscher (1999) state that conservation objectives that aim at protecting the initial situation should not be altered. Adjusting conservation objectives every monitoring period to increase the chance that the (changed) objective will be reached at the next assessment procedure should be prevented. However, allowing no flexibility at all can lead to unrealistic situations. For example, a conservation objective stating that the area of seagrass should be conserved becomes useless when all seagrass dies out in the area and recolonisation is impossible. Also changes in (scientific) knowledge and priorities might require a change in the conservation objectives. For example, when it is found that seagrass is more important for the whole Wadden Sea system than previously assumed, the priority of this sub-feature might increase. Changing the conservation objective from conserving to increasing the current area should then be possible. Thus, if there are good reasons, conservation objectives might be changed. These reasons should be reported clearly.

5.3 Monitoring and reporting procedures

The QSRs of the Wadden Sea show that monitoring, data compilation, scientific analysis, expert assessment and publication of the results for the whole Wadden Sea, can require two – three years of preparation, an intensive co-ordination, as well as high personnel and financial efforts. These factors should be taken into account when a reporting cycle of six years has to be planned.

A monitoring and assessment program should consider the whole feature, even where it may contain other Annex I features (Davies *et al.*, 2001). These features should have their own dedicated monitoring program. A monitoring and assessment program for the whole feature may be based on an aggregation of both monitoring for Annex I (sub-)features in their own right, monitoring derived from the targets related to the feature and additional monitoring for the entire feature.

As discussed in Rückriem & Roscher (1999), it should be considered if features that are present in an area, which have a very small, non-significant range or population size, which is not expected to increase, have to be included in the monitoring and reporting programs.

Especially when the same features have significant ranges or population sizes in other European sites, features with a very small range or population size have no significant importance for the NATURA 2000 network. In general, the conservation of features with a small range or a small population size should be carefully examined. It does not make sense to try to achieve a Favourable Conservation Status for marginal features with an enormous amount of efforts at the expense of many features for which a Favourable Conservation Status is easier, and with less efforts, to achieve. This is especially valid for features with have significant ranges or population sizes in other areas.

Other, closely connected, areas should be taken into account in the assessment and reporting activities. These areas may not entail Annex I habitats or they may not be designated as a SAC. For example, when dealing with hydrology and geomorphology, it is essential that the offshore zone, the tidal area and the salt marshes are considered as one system (De Jong *et al.*, 1999). The Habitat Directive does not include any habitat in the offshore area of the Wadden Sea. As this area might contain important ecological features, the EC should consider adding additional offshore habitats to Annex I of the Habitat Directive. Currently, the Joint Nature Conservation Committee (JNCC) in the UK is writing a report about the implementation of the Habitat and Bird Directive in the UK offshore area (JNCC, 2001b). Their results can be used to examine if important offshore habitats should be added to Annex I of the Habitat Directive.

5.3.1 Case study: "mudflats and sandflats not covered by seawater at low tide”

In appendix 5 the concept of deriving monitoring parameters is described using the habitat "mudflats and sandflats not covered by seawater at low tide” as an example. Additional monitoring parameters might be needed for this feature, depending on the interpretation and specification of the different WSP targets. For example, the cockle fishery in the Dutch Wadden Sea might have a high impact on the birds feeding on cockles (Waardenburg, pers. comm.). Additional parameters to assess the effects of cockle fishery might therefore be necessary. Also to assess the status of the whole feature additional monitoring parameters might be required. For example, as the macrozoobenthic community is an important sub-feature, (additional) monitoring and assessments for this sub-feature and/or individual macrozoobenthic species might be necessary. Based on the example it can be stated that specification of the targets for the sub-features and for the entire feature is essential to meet the Habitat Directive requirements.

5.3.2 Monitoring procedures

In frame of the Habitat Directive, monitoring should provide the information necessary for the report to the European Commission. In general, monitoring of habitats and species aims to detect changes in abundance and quality of them to initiate or improve conservation measures or conservation instruments (Dröschmeister, 2000). Monitoring will help to protect the environment, however, monitoring in itself cannot solve any problems. The protection of the environment has to be guaranteed by national and international legislation and the consequent application of the laws (Sixth International Wadden Sea Symposium, 1988).

By specifying the targets and deriving attributes and the related monitoring parameters, a monitoring program for a feature can be established (see figure 1 and 2). The development of monitoring strategies should be done by experts at the different (sub-)features. As management measures are derived from the targets, assessment of the targets includes a general assessment of those measures. The monitoring parameters derived from the targets can also be used to assess the status of the feature. However, additional parameters to assess the status of the entire feature might be necessary. For every parameter it should be clear for what reason it is monitored. Therefore, for all additional characteristics to be monitored, conservation objectives should be set in order to assess to what extent they represent the Favourable Conservation Status. If possible, the conservation objectives should be based on the Wadden Sea Plan targets or their specifications.

Some Wadden Sea Plan targets can be related to many characteristics. For example, as discussed in section 3.4, specification of the target of a biological undisturbed tidal flat can lead a lot of characteristics to be monitored. Probably not all those characteristics can be

monitored because of resource limitations. The selection of which characteristics to monitor should depend on priority characteristics like the most important disturbances, threats, priority species and/or important processes. However, in practice, political factors might also play a major role. Characteristics that can be monitored with relatively few efforts and the monitoring associated with popular species (birds, seals) might be favoured compared to characteristics that might be more important, but which are more expensive to monitor or have a lower public appeal.

In Earll (1999) several factors to consider when selecting attributes and monitoring parameters are stated. Attributes and monitoring parameters should:

- be measurable;
- provide as much information as possible; and,
- be able to be monitored economically and practical.

All attributes and monitoring parameters together should:

- represent biological, chemical and physical characteristics of the feature;
- be able to monitor the feature as efficient as possible; and,
- take existing programs into account.

When the Common Package parameters were selected from the TMAP, these factors were (partly) taken into account. The selection was based on the information requirements of the targets and "Issues of Concern", as well as on the technical effort needed for the implementation, their importance for the targets, the cost-benefit relation, and whether the parameters are already part of a national monitoring program (TMAG, 2001a).

Rückriem & Roscher (1999) state that the monitoring methods established should not be changed during successive monitoring periods. Changing methods would lead to inconsistent data gathered throughout the years, and would hamper a detailed assessment of changes. Although changing methods can lead to difficulties for the assessment of changes, rejecting all changes is not advisable. Often new techniques are capable of measuring the same attribute with less efforts and/or more precisely. When adjustments in the methods are necessary to be able to use a new technique, these adjustments should not be rejected automatically. If, for example, a new technique can determine the area more efficiently, but this would mean that the area will be measured in another season than initially determined, it should be considered if it is worth the change. However, all changes in methods should be considered with care and the reasons for these changes should be reported clearly.

5.3.3 Assessment and evaluation

As in most cases the conservation objectives cannot be quantified, the assessment will have to be based on expert judgement. Although a qualitative way of assessing is not objective and might be subject to discussions, it is pragmatic and the best one can get. The assessed status of habitats and species can be presented in the report using descriptive categories. If available, information from reference situations in the Wadden Sea itself or in other comparable ecosystems elsewhere can be used for the assessment. According to the Ministerial Declaration of the Esbjerg Conference (1991), areas serving as reference areas should (De Jong *et al.*, 1999):

- have a minimum size;
- comprise an ecologically coherent unit;
- cover the whole variety of characteristic habitats;
- be spread evenly over the Wadden Sea; and,
- be free of exploitation and disturbances.

In general, no historic reference situations can be used because the Wadden Sea is a dynamic, changing ecosystem. The application of theoretical concepts based on basic ecosystem properties like stability properties (e.g. resilience) might be problematic. However, theoretical concepts like, for example, potential areas based on abiotic conditions, could be useful.

Next to the assessment of the status of the individual features, the report should include a general discussion about the status of all Wadden Sea habitats and species subject to the

Habitat Directive together. This discussion will have to include changes relative to previous reports, and habitats and species that need most attention in conservation management.

For management measures it has to be assessed if they are implemented and if so, what the effects are and how efficient these measures are. The causes of the observed effects, efficiency and/or not having implemented the measures should be assessed and reported as well.

The assessment results and the monitoring, assessment and reporting procedures should be evaluated, including advises for future activities, policy and management. The report for the Habitat Directive can not be seen as a complete and comprehensive assessment of the habitats because many characteristic national species and habitats are not listed in the Habitat Directive (Pihl *et al.*, 2001). Furthermore, the same Annex I habitat can differ considerably within different geographical areas in Europe (Rückriem & Roscher, 1999). Only if for the national reports the habitats are assessed in a general way, not based on too much details and specific features of these habitats, a composite report can be made. This leads to the exclusion of unique characteristics of some habitats that make these habitats special. Thus, the report to the EC is not an evaluation of the overall nature conservation status of the different countries (Pihl *et al.*, 2001). Nevertheless, it can provide an important part of the information needed for the national nature policy evaluation.

Monitoring and reporting provide useful information for the conservation management. Although the information on (some) species is mostly relatively detailed in many countries, information about the status of their habitats is generally relatively scarce (Rückriem & Roscher, 1999). The Habitat Directive provides an incentive to set up a monitoring and reporting system that will provide more information on the status of the national habitats. As knowledge about the status of the habitats is a prerequisite for nature conservation, implementing the monitoring and reporting requirements of the Habitat Directive can facilitate the improvement of the conservation management of the Member States.

5.3.4 Selection of important characteristics

Probably not all important characteristics of a feature can be monitored because of resource limitations. The selection of which characteristics to include in the monitoring and assessment programs should depend on priority characteristics like the most important disturbances, threats, priority species and/or important processes. However, the scientific information that can be used for the selection of priority characteristics and setting of objectives is often limited and subject to discussion. Especially in international co-operations, like in the Wadden Sea, the different national scientific cultures can lead to controversies (De Jong, pers. comm.).

Although it should be based on scientific information available, the selection of characteristics and especially the setting of objectives largely depend on political factors, the available resources and public opinion and interests. Characteristics that can be monitored with relatively few efforts and the monitoring associated with popular species (birds, seals) might be favoured compared to more important characteristics that are more expensive to monitor or less attractive. For example, process related monitoring parameters, like the nutrient fluxes from sediments to water, can be important for a comprehensive assessment, but monitoring these parameters is relatively expensive and their public appeal is low. Therefore, politicians might not accept including such parameters in a monitoring program.

Furthermore, the objectives set can, for example, depend on the 'popularity' of the certain threats, e.g. it might be expected that there will be a higher public and political support to decrease the amount of shipping near the Wadden Sea considerably after a big accident with an oil tanker.

5.3.5 Management plans and projects

The results from the evaluations done in frame of specific management plans and for plans and projects with a possible effect on the habitats or species listed in the Habitat Directive, should provide the information necessary to report about the specific measures applied and about the plans and projects. The results of these evaluations can also be used for the assessment of the status of (sub-) features. To make efficient use of these plans and

projects, their monitoring, assessment and reporting cycle should, where possible, be planned in line with those for the Habitat Directive.

The responsible authorities should still monitor approved plans and projects for which no effect is assumed, in order to assess if this assumption is (still) valid.

5.3.6 Other nature conservation programs

Other national, European and international nature conservation programs, conventions and directives may include monitoring, assessment and reporting activities. As far as they apply to the Wadden Sea or to habitats comparable to habitats in the Wadden Sea, their results, methods and guidelines can be used and/or the activities can be co-ordinated with the activities for the Wadden Sea. The co-ordination is necessary in order to increase the efficiency of all monitoring and assessment programs and to avoid double work. For example, the target species and the spatial scales of existing monitoring programs can be harmonised.

National programs

Apart from the Common Package parameters, the Wadden Sea countries monitor several other parameters in their national monitoring programs. These programs partly determine different parameters. When additional monitoring parameters are proposed to meet the Habitat Directive requirements, these programs should be taken into account. It is easier to add a parameter that is already measured in at least some areas, than adding one that is new for all areas.

Bird Directive

The Habitat Directive is closely related to the Bird Directive and their requirements are partly the same. Both directives aim at protecting habitats in the European Union. The Article of the Habitat Directive about the avoidance of deterioration of habitats and the disturbance of species (Article 6 (2)) and concerning plans and projects (Article 6 (3,4)) even replaces the Article about the deterioration of habitats and the disturbance of species (Article 4 (4)) of the Bird Directive. The protected habitats of the two Directives together will form the NATURA 2000 network. As both directives require monitoring and reporting, the close connections could be used to propose to the European Commission to compose one report on NATURA 2000 sites, combining the assessments for both Directives. How the reporting and monitoring activities for both Directives can be combined should be studied in more detail.

Water and sediment

Furthermore, the monitoring procedures and guidelines of the JAMP of the OSPAR convention can be used for the assessment of the water and sediment quality in the Wadden Sea. Also the Water Framework Directive requires monitoring and reporting. Relations and possible co-operations between the monitoring and reporting activities of this Directive and the Habitat Directive should be examined in more detail.

Ramsar Convention

Another example is the Ramsar Convention. The *Convention on Wetlands of International Importance especially as Waterfowl Habitat* (Ramsar, Iran, 1971) ("Ramsar Convention") is a world-wide treaty for the conservation of wetlands. Wetlands are shallow open water and any land regularly or intermittently covered or saturated by water. In the framework of the Convention, wetlands of international importance are designated by the contracting parties (Ramsar, 2001). The Convention's mission is the conservation and wise use of wetlands by national action and international co-operation as a means to achieve sustainable development throughout the world (Ramsar, 2001). Major parts of the Wadden Sea have been designated as Ramsar sites. Furthermore, at the 6th Trilateral Governmental Conference on the Protection of the Wadden Sea, Esbjerg (1991), the participants *agreed* “to undertake the necessary steps to establish a coherent special conservation area covered by a co-ordinated management plan for the Wadden Sea, [...], taking into account the

requirements of [..] the Ramsar Convention" (Esbjerg Declaration, §5), indicating the importance of the convention for the Wadden Sea.

In the framework of the Ramsar convention, inventories, assessments and monitoring is carried out. Several initiatives pointing the way to more effective techniques and more logical analysis have evolved in the Ramsar sites (Finlayson & Taylor, 2001). Monitoring and assessment techniques for Ramsar sites and for the Wadden Sea could be exchanged. Furthermore, relation between monitoring and reporting for the Wadden Sea and for Ramsar should be used to increase the effectiveness of both monitoring and assessment programs and to avoid double work.

5.4 Tuning monitoring and reporting in the EU

EC guidelines

The national reports serve as a basis for the composite report the European Commission will prepare. The composite report will report about the contribution of the NATURA 2000 network on the preservation of the biodiversity within the European Union.

As the Communities natural heritage and the threats to them are often of a transboundary nature, it is necessary to take measures at the Community level in order to conserve them. Therefore, the composite report of the European Commission is also needed to determine what measures on a European scale are required and their effects should be assessed in the following reports.

To enable the necessary summarisations for the common report, a unification of contents and a common structure of the reports at the level of the Member States and the European Union are necessary (Rückriem & Roscher, 1999). Using common reporting approaches will also help to distinguish between local and large-scale changes and the potential causes (Earll, 1999). There are some starting problems concerning monitoring, assessment and reporting in many Member States (Rückriem & Roscher, 1999). Furthermore, the Member States have different views of how to implement the Habitat Directive (Evans, pers. comm.). Therefore, the Europe Commission (EC) should provide clear and straightforward guidelines for the monitoring, assessment and reporting procedures related to the Habitat Directive. To unify the contents and structure of the national reports the Directive states: "the report should be in accordance with the format established by the committee" (Article 17(1)). This regulatory committee should be set up to assist the Commission in the implementation of the Directive and in particular when decisions on Community co-financing are taken (Habitat Directive: Preamble). A common format of the reports is being elaborated by the European Commission and, after publishing, will be made obligatory for all Member States. However, the organisation, form and contents of the reporting requirements are until now not exactly determined in a European wide context (Rückriem & Ssymank, 1997) and there are no clear guidelines from the EC yet (Rückriem & Roscher, 1999). Furthermore, as discussed below, the EC has to react immediately to all kinds of alternative interpretations of the Habitat Directive text.

The EC has left many issues unclear with regard how to harmonise monitoring and reporting across Europe, e.g. (Earll, 1999):

- How will reports from different countries be compared by the EC?
- Will the EC require that similar methods be used to enable the assessment of the Favourable Conservation Status on a Europe-wide basis? This implies that there needs to be a stronger European lead on establishing monitoring and reporting approaches.
- Guidance from the EC would be helpful in clarifying what their expectations are and how they intend assessing the Favourable Conservation Status.

Co-operation between Member States

Next to clear guidelines from the EC, co-operation between Member States, as for example in the Wadden Sea Area, is very important. The exchange of information on methods to monitor and the way the reporting will be done can help to tune the different assessment and reporting activities in order to enable and facilitate the writing of a composite report. Moreover, by exchanging information, the countries can optimise their methods and

procedures in order to increase the efficiency of these methods and to improve the quality of the evaluation of their SACs. Furthermore, biogeographical regions do not stop at the borders but cover several member states. Co-operation between the countries can reduce the total amount of efforts needed to monitor and report about the border crossing features like the Wadden Sea (Murmann-Kristen, 2000).

Habitat classification

Tuning approaches on an EU level can solve problems associated with the classification of habitats. Determining which habitats in the field correspond with which habitat described in Annex I of the Habitat Directive might be quite complicated (Pihl *et al.*, 2001). By way of example, the majority of the natural habitat types specified in the Directive are defined by the occurrence of specific plant communities. However, the individual communities grade naturally into each other and the boundary between communities is often rather arbitrary, not least because the transition communities between individual communities are not necessarily identical in the different European biogeographic zones[7]. Further, especially the marine and coastal habitat categories listed in Annex I of the Directive are broad and thereby may be open to interpretation (European Communities, 1998). Also the classification of habitats in different countries might be based on different procedures. The habitats that are already classified within a country do not necessarily correspond with the habitat classification of the Habitat Directive. Therefore, the results presented in the first reports of the Member States to the European Commission should be considered as preliminary and the coming years will undoubtedly lead to improvements in the verification and standardisation of the habitat classification throughout the Member States (Pihl *et al.*, 2001). The EUNIS habitat classification can be a useful help for this. Using, as far as possible, this classification in the reports is a possibility to make the reports better comparable at the EU level and also in time.

Use of terms

The differences in the terms used by the different monitoring and reporting approaches suggested (see e.g. Davies *et al.*, 2001; Rückriem & Roscher, 1999; Pihl *et al.*, 2001) can cause a lot of difficulties. For example, the use of the term 'features' in Davies *et al.* (2001) is used to indicate the habitats mentioned in Annex I and the species mentioned in Annex II of the Habitat Directive. This term can also be used to indicate characteristics of a certain object. For example, one could say that a feature of the Wadden Sea is that it contains tidal flats. This example shows that the use of this term can be confusing. Also the term 'targets' can be interpreted differently. In the Wadden Sea Plan 'targets' are general conservation objectives, but the term 'targets' can also be used to indicate quantified, precise conservation objectives. To be able to interpret all different national reports and to be able to write an EU wide report, a unification of the terms used is required.

[7] The biogeographical regions are mentioned in the glossary

First report

The current problems associated with the monitoring, assessment and reporting procedure should not be an excuse not to report. The first reports to the EC may not meet the Habitat Directive requirements completely and they may not be completely matching. Nevertheless, by reporting the available results, the Member States can acquire information on how other States interpret the requirements and what the European Commission expects. The first reports can facilitate the establishment of clear guidelines by the EC, the co-operation between Member States and the co-operation between Member States and the EC. The monitoring, assessment and reporting activities can be adjusted to the comments of the EC on these reports and by examining the reports of the other Member States. The comments of the EC can be reformulated into guidelines. The first reports can also form the data basis for the assessments in the future reports (see e.g. Davies *et al.*, 2001). Thus, further reports should be adjusted following the suggestions from the European Commission and by examining the reports from the other Member States.

5.5 Budget

The monitoring and reporting activities should take the given budget limits into account. It should be considered if the costs of monitoring and reporting for the Habitat Directive relate reasonably with the total budget available. Only monitoring and reporting will not improve the status of nature. They form a part of the total conservation management and therefore only a part of the total expenses should be allocated to monitoring and reporting. Besides the SACs, Member States have other areas subject to nature policy. These areas also require a fair share of the total budget available. To keep the total monitoring program of one Member State for the Habitat Directive within reasonable costs, the monitoring needed for each site should not be too expensive. On the other hand, the results should have a high confidence level (Rückriem & Ssymank, 1997).

As at least a part of the monitoring and reporting for the Habitat Directive in the Wadden Sea will be done on a trilateral level, the three countries should allocate a part of the total budget reserved for implementing the Habitat Directive to these trilateral activities.

It might be expected that for the first monitoring and reporting cycle more efforts are needed than for further monitoring and reporting cycles. The establishment of monitoring and reporting procedures and finding out what the European Commission requires exactly will require extra efforts. After having established the procedures and knowing what is required the efforts needed can be significantly decreased.

The integration and use of the specific management plans and by using the evaluation of specific plans and projects, the total cost of monitoring and reporting for the Habitat Directive can be restricted (Rückriem & Roscher, 1999). The information collected, and the reports written, for the designation procedure of the SACs also provide much information that can be used for the report (Rückriem & Roscher, 1999). Information from these sources should be used as much as possible.

Scope of interpretation

When the scope of the interpretation that is left open by the Directive is used, the monitoring and reporting expenditures can be reduced (Rückriem & Roscher, 1999). The scope of interpretations left open is for example:

- The expenditure rising from performance of the national reports depends, for example, on the length of the update period of the surveillance of the conservation status. This surveillance is required according to Article 11 of the Directive. According to Article 17, the main results of the surveillance are part of the reports, so that an update period of 6 years is not directly implied for the surveillance.
- The text of Article 17 allows the interpretation that not all measures performed at a particular NATURA 2000 site have to be evaluated with respect to their impact on the conservation status and to be included in the reports.

Using the scope of interpretation left open, Rückriem & Roscher (1999) suggest the following to reduce the reporting expenditures:

- From the surveillance according to Article 11 only those data gained within the reporting period should be part of the national six year reports. From a scientific point of view, an update period of 12 years would be sufficient for the surveillance and, at the same time, easier for the Member States to accomplish.
- The documentation of the measures performed in a particular NATURA 2000 site does not need to include all the measures performed in all NATURA 2000 sites during the reporting period. It would be possible to include only those measures that were performed under financial support by the European Commission according to Article 8 of the Directive. From all other measures, in particular long-term maintenance measures, a representative number could be chosen for the documentation. This suggestion would reduce the expenditure only of the reports, since for an appropriate site management the documentation of the performed conservation measures is an essential part of its work that cannot be omitted.
- The assessment of the impact of the performed conservation measures on the conservation status of the species and habitat could be limited to a selected sample of measures.

Rückriem & Roscher (1999) state that these suggestions have to be approved by the European Commission before applying them. The European Commission should indeed carefully examine these suggestions.

For some habitats with low dynamics a longer monitoring period might be sufficient. However, an extension of the monitoring period, as suggested above, should be carefully examined in order to avoid that Member States steadily increase this period until no monitoring is performed at all.

As discussed in the chapter 4.3, the effects of long term development measures and measures aiming at the conservation of the status that have to be applied continuously, could only be assessed and reported in detail once. However, to provide an overview of all management applied, all measures should be mentioned in the report and measures, other than those described above, should be assessed and reported. As stated in the suggestion, monitoring and reporting have to be done anyway for the assessment of the different management and policy measures and for the general management of the area. The extra efforts needed to include them in the report for the Habitat Directive are therefore limited anyway. Probably the determination of and discussion about which measures are relevant, should be and are included in the report requires more efforts than simply including them in the report to the EC.

The third suggestion corresponds with the second: instead of assessing all conservation measures, assess only some of these measures. Again, all the measures are monitored and reported, so they can easily be included in the report to the EC. The selection made should be clearly documented to be able to judge whether this selection is acceptable. Reporting about why which measures were or were not selected probably requires much more efforts than the two or three sentences per measure in the EC report.

One common way of interpreting the text of the Habitat Directive is necessary. All kinds of “suggestions” and "reading between the lines" need an immediate reaction of the European Commission. This does not mean that all suggestions should be discarded, but these should be subject to a close examination and can only be applied after a formal European wide consensus. Without a European wide consensus and without having formally adopted suggestion made, all countries will perform different kinds of monitoring and reporting on the same habitat types. The goal of the national reports is to use them for an EU report to assess the status of the NATURA 2000 network. Large differences in the provided information between the different national reports will make this goal impossible to reach. This will mean that *all* expenditures on national monitoring and reporting systems for the Habitat Directive will be in vain.

5.6 Concomitant research

For proper monitoring and to take the appropriate measures, a good understanding of the present ecosystem and the impact of human activities is essential (Dankers & De Vlas, 1994). For example, for the Wadden Sea there is in many cases a lack of a proper data basis for an analysis of the present and the past situation, so that it is not possible to evaluate progress or decline (De Jong *et al.*, 1999). In order to cover all important aspects of a system, it is inevitable to conduct research (Kellermann, 2000). One of the foremost tasks of research is to discriminate between natural fluctuations and human impacts. This is essential for two goals of policy and management: the capability of providing evidence for man-made causes, and the capability of interpreting and predicting the reactions of a system correctly (Kellermann, 2000). Therefore, monitoring should be supplemented with concomitant research. This research looks for causes of observed changes, their environmental significance and the need and possibilities for management measures. Furthermore, it gives a foundation for the selection of parameters and measuring strategies of the monitoring part and thus adapting it to current needs and knowledge (Bakker *et al.*, 1998; Kellermann, 2000). As the Wadden Sea is a changing ecosystem, continues concomitant research will be necessary in order to detect new developments in the ecosystem.

For some features basic information about their characteristics is lacking. It is difficult to set targets, to monitor and to report about these features (Rückriem & Roscher, 1999). According to Article 18 of the Habitat Directive "Member States and the Commission shall encourage the necessary research and scientific work [...]. They shall exchange information for the purposes of proper co-ordination of research carried out at Member State and at Community level. [...] and transboundary co-operative research between Member States shall be encouraged". In the framework of the Habitat Directive research should be conducted to obtain the basic information for all features. The Directive explicitly states that research should be initiated in order to fulfil the requirements regarding (Bakker *et al.*, 1998):

- biodiversity (Article 2);
- management measures (Article 2);
- considerations of economic, social and cultural requirements, and regional and local characteristics (Article 2);
- monitoring methods and strategies (Article 11);
- criteria for selecting sites (Article 4); and,
- land-use planning (Article 4).

Additional information might lead to the designation of additional areas that should be included in the monitoring and reporting activities for the Habitat Directive. Although major parts of the Wadden Sea are designated as SACs (see appendix 6), not all areas entail an Annex I habitat. For example, the offshore area of the Wadden Sea entails no Annex I habitats. Areas that entail no Annex I habitat but contain Annex II species should also be included in the monitoring and reporting activities for the Habitat Directive. More information on the Annex II species of the Wadden Sea and their distribution might lead to additional areas that should be included in these activities (e.g. areas in the offshore zone where fish species of Annex II of the Habitat Directive occur). However, according to Article 4 (1) of the Habitat Directive, for aquatic species that range over wide areas only sites should be designated that are clearly identifiable areas representing the physical and biological factors essential to their life and reproduction.

Based on technical and scientific progress the Annexes of the Habitat Directive might be amended (Article 19). These changes can also lead to the additional areas to be included in the monitoring and reporting activities for the Wadden Sea.

Novel insights can also lead to changes in the characteristics to be monitored. Some, previously considered insignificant, characteristic might be added, while others, which importance was previously overestimated, might be deleted from the monitoring program. For example, Waardenburg found that shrimp fishery using trawlers had a severe impact on shell banks. Shell banks provide a substrate for especially 'hard-substrate' organisms like anemones and hydroids. At this moment little attention is paid to shell banks mainly because monitoring from the water surface is not possible and research requires diving (Waardenburg, pers. comm.). When new, more easily applicable, monitoring methods will be

found or when the importance of shell banks will be generally recognised, this feature might be included in the monitoring programs for the Wadden Sea.

5.7 Species

For many Annex II species occurring in the Wadden Sea, information is lacking for a proper assessment. More information about the Annex II fish species, especially about the priority species houting (*Coregonus oxyrhynchus*), is needed. It should also be determined if *Alosa* spp. are present in the Danish Wadden Sea Area. Furthermore, for the Harbour Porpoise and Grey Seal more information is necessary for a proper assessment of the status and the effect of management measures. Based on the information and knowledge available some general remarks can be made about these species. This was for example done in the QSR of 1999 for the Harbour porpoise. However, because of the lack of data, general remarks have a high uncertainty level.

It has to be examine if there are species occurring in the Wadden Sea that are mentioned in Annexes IV and/or V, but not in Annex II of the Habitat Directive. The Annex IV and V species do not necessarily occur in NATURA 2000 areas. The integration of the monitoring of these species with the monitoring of Annex I habitats or Annex II species might therefore be difficult (Rückriem & Roscher, 1999).

In this report, it is assumed that the results of the assessments of the bird monitoring programs within the TMAP and the Bird Directive provide sufficient information for the reporting about bird related subjects for the Habitat Directive. If this really can be assumed should be examined. Further, it should be checked if all Annex I species of the Bird Directive are monitored in the Wadden Sea. This is mainly important to meet the requirements of the Bird Directive, and not so much for the Habitat Directive.

5.7.1 Alien Invasive Species

The Species Survival Commission of the World Conservation Union (IUCN) considers Alien Invasive Species (AIS) as the second largest threat to indigenous species, only after habitat destruction. As the NATURA 2000 network aims at protecting biodiversity, reporting about the Habitat Directive features should also include information on Alien Invasive Species.

In the Wadden Sea Area several AIS might form or already form a threat. The issue of AIS is therefore also relevant for the Wadden Sea. The spreading of alien/introduced species has to be monitored in order to detect signs of strong displacement effects on the local flora and fauna (De Jong *et al.*, 1999). Research on this topic might therefore be necessary and policy and management will have to be established.

5.7.2 Extinction and migration of species

The Habitat Directive states that the habitats of Annex II species should be protected by designating these areas as Special Areas of Conservation (SACs). Some of these habitats are not Annex I habitats. The problem to be solved concerning areas that are only designated as a SAC because of the occurrence of an Annex II species is, what should be done when the species goes extinct in that area. It should be determined if such an area is still a SAC, and if not, if an alternative area should be appointed as a SAC to compensate for the loss of protected area. In the Danish report about a preliminary assessment of the distribution and conservation status of habitats and species covered by the Habitat Directive, some species were found to be extinct. These species are not further discussed and are not expected to be included in the future monitoring program unless the species should re-immigrate into Denmark and create self-reproducing populations (Pihl *et al.*, 2001). It is unclear if the habitats of the eight Annex II species that disappeared are still included in the NATURA 2000 sites. When species have disappeared due to unsuitable habitats, an approach could be to apply management to the habitat in order to get the species back and only to consider the possible exclusion of a locality when it is concluded that there is no possibility for the species to come back.

Except from going extinct, a species can also move it range out of one area and into another. The SAC based on this species could than be moved. This will require a flexible designation of SACs (Rückriem & Roscher, 1999). In practice, this might be very difficult. It

will mean to give up one protected area, where other nature, which is not subject to the Habitat Directive, might have been formed due to the protection, and assigning another area where protection might not be present yet.

Clear guidelines of what to do when a species goes extinct in or emigrates out of a SAC that is only designated because of the occurrence of this species, should be provided by, for example, the European Commission. This should include guidelines of what to do with the area an Annex II species immigrates to.

Migration and the range of dispersal of a species can cause difficulties for assessments. Assessing the status of, and the effects of management on, species might be difficult as some species have a much wider range of dispersal than the Wadden Sea. For many organisms the Wadden Sea is just a temporary home. Species might migrate from and to the Wadden Sea. For example, the Grey seal stock in the Wadden Sea is strongly influences by immigration from Great Britain (De Jong *et al.*, 1999). Assessment might have to include information from the whole dispersal range of the species.

6. Conclusions and recommendations

In this chapter the conclusions and recommendations of this report are summarised.

6.1 Conclusions

It is concluded that:

- Habitats listed in the Habitat Directive that occur in the Wadden Sea can be connected with the targets of the Wadden Sea Plan of 1997.
- The specification of the Wadden Sea Plan targets (setting conservation objectives) is essential to meet the Habitat Directive requirements.
- As in most cases the conservation objectives cannot be quantified, the assessment will have to be based on expert judgement.
- It might be easier and more efficient to report for the Wadden Sea as a whole in a separate report to the European Commission.
- To enable the necessary summarisations, a unification of contents and a common structure of the reports at the level of the Member States and the European Union are necessary.
- Clear and straightforward guideline from the European Commission and co-operation between Member States are necessary to be able to write an EU wide report.
- Implementing the monitoring and reporting requirements of the Habitat Directive can facilitate the improvement of conservation management of Member States.
- For proper monitoring and to take the appropriate measures, a good understanding of the present ecosystem and the impact of human activities are essential. In order to cover all important aspects of a system and to detect new developments, it is inevitable to conduct concomitant research.
- For many species listed in Annex II of the Habitat Directive and occurring in the Wadden Sea, information is lacking for a proper assessment.

6.2 Recommendations

It is recommended that:

- Monitoring and reporting for the Habitat Directive in the Wadden Sea should be co-ordinated trilaterally.
- The existing monitoring and reporting activities in the Wadden Sea should be adjusted to meet the requirements of the Habitat Directive.
- It should be considered to report for the Wadden Sea as a whole in a separate report to the European Commission.
- It should be considered to structure the Quality Status Reports and Policy Assessment Reports for the Wadden Sea in such a way that it could be easily used for the report about the Habitat Directive. They should include specific assessments required for the Habitat Directive.
- The report for the Habitat Directive to the EC should be understandable and easy accessible for the general public and politicians. However, one should make sure this is not at the expense of the contents.
- Instead of a separate report for the Bird and Habitat Directive, a composite report on NATURA 2000 could be made. How the monitoring and reporting activities for both Directives can be combined should be studied in more detail.
- The report should include a general discussion about the status of all habitats and species subject to the Habitat Directive and occurring in the Wadden Sea together.
- The assessment results and the monitoring, assessment and reporting procedures should be evaluated, including advises for future activities, policy and management.
- A monitoring and assessment program should consider the whole feature.
- Other, closely connected, areas should be taken into account in the assessment and reporting activities.
- The results from the evaluations done in frame of specific management plans and for plans and projects with a possible effect on the habitat or species, should provide the

information necessary to report about the specific measures applied and about the plans and projects.
- The results, methods and guidelines of other national, European and international nature conservation programs, conventions and directives should be used and the activities should be co-ordinated with the activities for the Habitat Directive in the Wadden Sea as far as possible.
- For all additional characteristics proposed to be monitored in the Wadden Sea, conservation objectives should be set. If possible, these objectives should be based on the targets of the Wadden Sea Plan of 1997 or their specification.
- Setting conservation objectives should be based, as far as possible, on sound science and it should take the applicability of the objectives in management into account.
- Although some conservation objectives can be specified by setting a certain value, in general, conservation objectives for the Wadden Sea should not be based on fixed values.
- Conservation objectives in the Wadden Sea could be based on the current, unfavourable condition of certain characteristics of a habitat or species.
- Where possible, reference situations and theoretical concepts should be used for the assessment procedure.
- If changes in methods and conservation objectives are necessary, they should be considered with care. The reasons for these changes should be reported clearly.
- The Europe Commission should provide clear and straightforward guidelines for the monitoring, assessment and reporting procedures related to the Habitat Directive.
- Member States should co-operate to implement the reporting and monitoring for the Habitat Directive.
- The terms used in the national reports of the Member States should be unified.
- Policy and management on Alien Invasive Species should be established. Addition research on this subject might be needed.
- Information about the species listed in Annex II of the Habitat Directive that is currently lacking for a proper assessment should be gathered. This includes information about the occurrence and the development of the communities of some of these species.

Appendix 1: Common Package

The parameter groups of the Common Package of the Trilateral Monitoring and Assessment Program (TMAP) (Stade Declaration, 1997).*

Contaminants	1	TBT** in water and sediment
	2	Metals in sediment
Nutrients	3	Inorganic nutrients in water
Salt Marshes	4	Spatial extension
	5	Agricultural utilisation: grazing
Benthos	6	Macroalgae
	7	Eelgrass
	8	Macrozoobenthos communities
	9	Blue Mussel beds
	10	Contaminants in flounder
Plankton	11	Phytoplankton
Fish	12	Contaminants in blue mussels
	13	Mussel/Cockle/Shrimp fishery
Beaches and Dunes	14	Spatial extension
Birds	15	Breeding birds: numbers and distribution
	16	Breeding birds: contaminants in bird eggs
	17	Migratory birds: numbers of waterbirds in counting units
	18	Beached Bird Survey
Seals	19	Population parameters by aerial survey
Recreational	20	Boats at sea
	21	No. of guided tours
	22	Air traffic
General Parameters	23	Coastal protection measures
	24	Geomorphology
	25	Flooding
	26	Land use
	27	Weather conditions
	28	Hydrology

* The parameters in the Common Package will be monitored according to the agreed common TMAP Guidelines (see TMAG, 1997).

** TBT= Tributyl tin: a chemical, used in antifouling paints, that has become an environmental pollutant.

Appendix 2: Trilateral targets

The targets stated in the Trilateral Wadden Sea Plan of 1997 are given in this appendix.

LANDSCAPE AND CULTURE

- Identity - to preserve, restore and develop the elements that contribute to the character, or identity, of the landscape.
- Variety - to maintain the full variety of cultural landscapes, typical for the Wadden Sea landscape.
- History - to conserve the cultural-historic heritage.
- Scenery - to pay special attention to the environmental perception of the landscape and the cultural-historic contributions in the context of management and planning.

WATER AND SEDIMENT

- Background concentrations of natural micropollutants.
- Concentrations of man-made substances as resulting from zero discharges.
- A Wadden Sea which can be regarded as a eutrophication non-problem area.

SALT MARSHES

- An increased area of natural salt marshes.
- An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.
- An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.
- Favourable conditions for migrating and breeding birds.

TIDAL AREA

- A natural dynamic situation in the tidal area.
- An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas.
- An increased area and a more natural distribution and development of natural mussel beds, *Sabellaria* reefs and *Zostera* fields.
- Viable stocks and a natural reproduction capacity, including juvenile survival, of the Common Seal and the Grey Seal.
- Favourable conditions for migrating and breeding birds.

BEACHES AND DUNES

- Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.
- An increased presence of a complete natural vegetation succession.
- Favourable conditions for migratory and breeding birds.

ESTUARIES

- Protection of valuable parts of the estuaries.
- Maintaining and, as far as possible, restoring the river banks in their natural state.

OFFSHORE AREA

- An increased natural morphology, including the outer deltas between the islands.
- A favourable food availability for birds.
- Viable stocks and a natural reproduction capacity of the common seal, Grey Seal and Harbour Porpoise .

RURAL AREA

- Favourable conditions for flora and fauna, especially migrating and breeding birds.

BIRDS

- Favourable conditions for migrating and breeding birds:
  - a favourable food availability;
  - a natural breeding success;
  - sufficiently large undisturbed roosting and moulting areas;
  - natural flight distances.

MARINE MAMMALS

- Viable stocks and a natural reproduction capacity of the Common Seal including juvenile survival.
- Viable stocks and a natural reproduction capacity of the Grey Seal including juvenile survival.
- Viable stocks and a natural reproduction capacity of the Harbour Porpoise.

Appendix 3: Description of the Annex I habitats occurring in the Wadden Sea

1. Coastal and halophytic habitats

11. Open sea and tidal areas

1110. Sandbanks which are slightly covered by sea water all the time

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

> *Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20m below Chart Datum. Non-vegetated sandbanks or sandbanks with vegetation belonging to the Zosteretum marinae and Cymodoceion nodosae.*

In the Wadden Sea this habitat type is described as subtidal or sublittoral areas. These can be found in association with "mudflats and sandflats not covered by seawater at low tide" (1140), which is called the intertidal area. The subtidal and tidal together are called the tidal area. For the tidal area, an artificial line between the tips of the islands determines the border of the North Sea side. The borders to the estuaries are determined by the average 10‰ isohaline at high water in the winter situation (Leeuwarden Declaration, 1994).

Sub-features of this habitat type in the Wadden Sea are *Zostera* fields, mussel beds and *Sabellaria* reefs (Hauke *et al.*, 1998). The Annex II species the Common Seal (*Phoca vitulina*), the Grey Seal (*Halichoerus grypus*) and the Harbour Porpoise (*Phocoena phocoena*) occur in this habitat (Hauke *et al.*, 1998; WSP, 1997). "Sandbanks which are slightly covered by sea water all the time" are a characteristic feeding habitat for resting and migratory birds (Hauke *et al.*, 1998) and an important wintering habitat for many bird species (European commission, 1999).

The targets of the WSP that relate to the (sub-)features of this habitat are (WSP, 1997):

WATER AND SEDIMENT

Background concentrations of natural micropollutants.

Concentrations of man-made substances as resulting from zero discharges.

A Wadden Sea which can be regarded as a eutrophication non-problem area.

TIDAL AREA

An increased area of geomorphologically and biologically undisturbed subtidal areas.

An increased area and a more natural distribution and development of natural mussel beds, Sabellaria reefs and Zostera fields.

BIRDS

Favourable conditions for migrating and breeding birds:

- *a favourable food availability;*
- *sufficiently large undisturbed roosting and moulting areas;*
- *natural flight distances.*

MARINE MAMMALS

Viable stocks and a natural reproduction capacity, including juvenile survival, of the Common Seal and the Grey seal.

Viable stocks and a natural reproduction capacity of the Harbour Porpoise.

1130 Estuaries

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

> *Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sand and mud flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.*

Estuaries are complex ecosystems linking the terrestrial and aquatic environments and are composed of an interdependent mosaic of subtidal, intertidal and surrounding terrestrial

habitats. Many of these habitats, such as "sandbanks which are slightly covered by seawater all the time" (1110), "mudflats and sandflats not covered by seawater at low tide" (1140), "Atlantic salt meadows" (1330) and "reefs" (1170), are identified as habitat types in their own right in Annex I of the Directive. These habitats are sub-features of the feature estuaries. A monitoring program for estuaries must consider the whole estuary, even where it contains other Annex I features; these features should have their own dedicated monitoring program. An estuary monitoring program may therefore, be an aggregation of both the sampling programs for a range Annex I features in their own right, and a dedicated sampling program for additional features of the whole estuary (European Communities, 1998; European Commission, 1999). Similar large geomorphological systems where seawater is not significantly diluted by freshwater are classified within the Annex I habitat "large shallow inlets and bays" (1160).

In the Wadden Sea this Annex I habitat type is also described as estuaries. It includes the river mouths with a natural water exchange with the Wadden Sea. On the landward side, the mean-brackish-water line delimits estuaries. On the seaward side, the border is the average 10‰ isohaline at high water in the winter situation (Bakker *et al.*, 1998). Only six estuaries have remained in the Wadden Sea Area (Ems, Weser, Elbe, Eider, Godel, Varde Å). As a consequence, natural transitions of fresh and salt water hardly exist in the Wadden Sea Area. The Varde Å and Godel are the only estuaries in the Wadden Sea that have retained their natural character (De Jong *et al.*, 1999). The trilateral agreements regarding estuaries are rather vague because estuaries have only been part of the trilateral co-operation since 1994. That is also the reason why the Wadden Sea targets for estuaries have been formulated in a general way (De Jong, in press).

Estuaries include the sub-feature *Zostera* beds and are important feeding areas for many birds (European Commission, 1999). The salt marshes, which occur in estuaries, are important for both breeding and migratory birds (Jong *et al.*, 1999). For example the Mallard (*Anas plathyrhynchos*) breeds in salt marshes (Meltofte *et al.*, 1994). Migratory species like the Barnacle Goose (*Branta leucopsis*) and the Brent Goose stay, amongst other area, in the salt marshes during their stay in the Wadden Sea (Meltofte, 1994).

The targets of the WSP that relate to the (sub-)features of this habitat are (WSP, 1997):

WATER AND SEDIMENT

Background concentrations of natural micropollutants.

Concentrations of man-made substances as resulting from zero discharges.

A Wadden Sea which can be regarded as a eutrophication non-problem area.

ESTUARIES

Protection of valuable parts of estuaries.

Maintaining and, as far as possible, restoring river banks in their natural state.

SALT MARSHES

An increased area of natural salt marshes.

An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.

An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.

TIDAL AREA

A natural dynamic situation in the tidal area.

An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas.

An increased area and a more natural distribution and development of natural Zostera fields.

BIRDS

Favourable conditions for migrating and breeding birds:

- *a favourable food availability;*
- *a natural breeding success;*
- *sufficiently large undisturbed roosting and moulting areas;*
- *natural flight distances.*

1140 Mudflats and sandflats not covered by seawater at low tide

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

> *Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders. The diverse intertidal communities of invertebrates and algae that occupy them can be used to define subdivisions of 11.27, eelgrass communities that may be exposed for a few hours in the course of every tide have been listed under 11.3, brackish water vegetation of permanent pools by use of those of 11.4.*

Where:

11.27 = "part of Soft sediment littoral communities"

11.3 = a.o. "part of Atlantic eelgrass meadows" (11.31), "Atlantic dwarf eelgrass meadows" (11.32) and "Mediterranean *Zostera* beds" (11.332)

11.4 = brackish sea vascular vegetation

In the Wadden Sea Area "mudflats and sandflats not covered by seawater at low tide" is defined as tidal flats or intertidal areas. These areas are periodically submerged due to regular tides. This feature is the only Annex I habitat that includes the tidal flats. Tidal flats are a part of the tidal area. The tidal area covers all tidal flats and subtidal areas. An artificial line between the tips of the islands determines the border of the tidal area to the North Sea side. The borders to the estuaries are determined by the average 10 ‰ isohaline at high water in the winter situation (Leeuwarden Declaration, 1994). The tidal flats cover about two-thirds of the tidal area and are one of the most typical characteristics of the Wadden Sea. With a total length of 500 km it is the largest unbroken stretch of mudflats in the world. They account for 60 percent of all tidal areas in European and North Africa.

Based on the physical structure, this habitat type can be divided into three broad sediment categories: sandy, muddy and mixed. The extent of tidal current velocities results in a spatial differentiation of the sediment grain size. Generally a positive correlation exists between the maximum current velocity and the size of the sediment grains. This way the tidal flats developing in high energy areas have steep slopes and an average grain size of more than 100 micrometer (sands). To the other extreme, muddy sediments (grain size <63 µm) are deposited in low energy areas, exhibiting a flat morphology in the intermediate zone. Mixed sediments (grain size 63-100 µm) are deposited on tidal flats with transitional morphological properties (De Jong *et al.*, 1993). In practice, many sites contain a mixture of the different categories and there is a continuous gradient between the categories. Within this range, the plant and animal communities present vary according to the type of sediment, its stability and the salinity of the over-lying water (Davies *et al.*, 2000).

In contrast to the apparent visual homogeneity, chemical and biological properties of tidal flats show a high degree of inhomogeneity. In addition, there are regular and irregular variations with time, superimposed by a slow and irreversible development. Examples of inhomogeneity are irregular structures such as mussel beds within mussel fields (Höpner, 1994).

Tidal flats are important feeding areas for birds, like for example the Common Redshank (*Tringa totanus*) and the Oystercatcher (*Haematopus ostralegus*) (Hauke *et al.*, 1998; Rasmussen *et al.*, 2000). "Mudflats and sandflats not covered by seawater at low tide" includes sub-features like *Zostera* fields, mussel beds (Bakker *et al.*, 1998) and *Sabellaria* reefs.

The targets of the WSP that relate to the (sub-)features of this habitat are (WSP, 1997):

WATER AND SEDIMENT

> *Background concentrations of natural micropollutants.*
>
> *Concentrations of man-made substances as resulting from zero discharges.*
>
> *A Wadden Sea which can be regarded as a eutrophication non-problem area.*

TIDAL AREA

A natural dynamic situation in the tidal area.
An increased area of geomorphologically and biologically undisturbed tidal flats.
An increased area and a more natural distribution and development of natural mussel beds, Sabellaria reefs and Zostera fields.

BIRDS

Favourable conditions for migrating and breeding birds:
a favourable food availability;
natural flight distances.

1160 Large shallow inlets and bays

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Large indentations of the coast where, in contrast to estuaries, the influence of freshwater is generally limited. These shallow indentations are generally sheltered from wave action and contain a great diversity of sediments and substrates with a well developed zonation of benthic communities. These communities have generally a high biodiversity. The limit of shallow water is sometimes defined by the distribution of the Zosteretea and Potametea associations. Several physiographic types may be included under this category providing the water is shallow over a major part of the area: embayments, fjards, rias and voes.

The physiographical character of “large shallow inlets and bays” is similar to that of the Annex I feature “estuaries” (1130), but the influence of freshwater is reduced by comparison. "Large shallow inlets and bays" are often complex systems composed of an interdependent mosaic of subtidal and intertidal habitats. They may include several other Annex I features like: “reefs” (1170), “sandbanks which are slightly covered by sea water all the time” (1110), “mudflats and sandflats not covered by seawater at low tide” (1140) and "Atlantic salt meadows” (1310). A monitoring program must consider the whole feature, even where it may contain other Annex I features; these features should have their own dedicated monitoring program. A monitoring program for a large shallow inlet and bay may therefore, be an aggregation of both monitoring for Annex I (sub-)features in their own right, and specific sampling of attributes for the entire feature (such as extent).

"Large shallow inlets and bays" vary widely in habitat and species diversity according to their geographic location, size, shape, form and geology, whether they occur on hard (rocky) or soft (sedimentary) coasts and the degree of exposure to wave action. Especially the degree of exposure is a critical factor in determining habitat and species diversity (Davies *et al.*, 2000).

In the Wadden Sea this habitat is described as subtidal or sublittoral habitats and tidal flats. Apart from the mentioned Annex I features other sub-features of this habitat are mussel beds, *Zostera* fields and *Sabellaria* reefs (European Commission, 1999). Shallow inlets and bays are a feeding habitat for birds like for example the Barnacle Goose (*Branta bernicla*). Some migratory birds like the Shelduck (*Tadorna tadorna*), stay in this habitat when visiting the Wadden Sea (Hauke *et al.*, 1998).

The targets of the WSP that relate to the (sub-)features of this habitat are:

WATER AND SEDIMENT

Background concentrations of natural micropollutants.
Concentrations of man-made substances as resulting from zero discharges.
A Wadden Sea which can be regarded as a eutrophication non-problem area.

TIDAL AREA

A natural dynamic situation in the tidal area.
An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas.
An increased area and a more natural distribution and development of natural mussel beds, Sabellaria reefs and Zostera fields.

SALT MARSHES

An increased area of natural salt marshes.
An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.
An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.
Favourable conditions for migrating and breeding birds.

BIRDS

Favourable conditions for migrating and breeding birds:
a favourable food availability;
sufficiently large undisturbed roosting and moulting areas;
natural flight distances.

1170 Reefs

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Submarine, or exposed at low tide, rocky substrates and biogenic concretions, which arise from the seafloor in the sublittoral zone but may extend into the littoral zone where there is an uninterrupted zonation of plant and animal communities. These reefs generally support a zonation of benthic communities of algae and animal species including concretions, encrustations and corallogenic concretions.

Reefs are an extremely variable habitat type. They are generally subtidal but may extend as an unbroken transition to the intertidal zone, where they are exposed to the air at low tide. Two main types of reef can be recognised, those where structure is created by the animals themselves (biogenic reefs) and those where animal and plant communities grow on raised or protruding rock (rocky reefs). Only a few invertebrate species are able to develop biogenic reefs that are therefore restricted in distribution and extent.

In the Wadden Sea mainly biogenic reefs are present such as mussel beds. Mussel beds are feeding sources for birds like the Common Eider (*Somateria mollissima*) and different Gull species (Kohlus & Küpper, 1998). Only on the island Helgoland rocky reefs, with the typical animal and plant communities, occur. However, Helgoland does not belong to the trilateral Co-operation Area and, therefore, rocky reefs will not be discussed here.

The targets of the WSP related to reefs are:

TIDAL AREA

An increased area and a more natural distribution of natural mussel beds and Sabellaria reefs

BIRDS

Favourable conditions for migrating and breeding birds:
a favourable food availability;
natural flight distances.

12. Sea cliffs and shingle or stony beaches

1210 Annual vegetation of drift lines

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Formations of annuals or representatives of annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter (Cakiletea maritimae p.).

In the TMAP classification system for beaches and dune habitats, "annual vegetation of drift lines" is described as Beach driftline. This is the dune area near to or on the shoreline. It is the area of the embryonic dunes (Petersen, 2001). Many birds feed in this habitat (Hauke *et al.*, 1998) and breeding birds are also present (Reineking, pers. comm.).

The related targets in the WSP (1997) are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.
An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds:

a favourable food availability;
a natural breeding success;
natural flight distances.

13. Atlantic and continental salt marshes and salt meadows

For the Wadden Sea all these habitat types are described using the general term "salt marshes". A vegetation classification for "salt marshes" in the Wadden Sea is described in TMAG (2001b). For the Wadden Sea, the habitat type salt marshes includes all mainland and island salt marshes, including the pioneer zone. Also the brackish marshes in the estuaries are considered part of this habitat type. A growing environmental concern has led to a new appreciation of the Wadden Sea salt marshes as areas of high ecological value (CPSL, 2001).

The Wadden Sea salt marshes are highly specialised halophytic ecosystems on alluvial sediments, within the upper reach of tidally fluctuating seawater. They consist of (semi-) natural pioneer-, grassland- and dwarf shrub-communities, including many invertebrate animal species, which are almost always found in a clear zoning. Salt marshes also provide resting, breeding and feeding grounds for substantial numbers of birds (e.g. geese), many of them migratory. In addition, depending upon regional and national circumstances, salt marshes have a function in coastal protection and are used as meadows (grazing and mowing).

1310 *Salicornia* and other annuals colonising mud and sand

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus Salicornia or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes. Thero-Salicornietea pulverulentae, Frankenietea pulverulentae, Saginetea maritimae.

In the pioneer zone of salt marshes in the Wadden Sea, *Salicornia* spp. together with *Spartina anglica* are dominant species (TMAG, 2001b). Some bird species breed in this habitat (Reineking, pers. comm.).

The targets of the WSP (1997) related to this habitat type are:

SALT MARSHES

An increased area of natural salt marshes.
An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.
An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.

BIRDS

Favourable conditions for migrating and breeding birds:

A natural breeding success;
natural flight distances.

1320 *Spartina* swards *(Spartinion maritima*e)

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Perennial pioneer grasslands of coastal salt muds, formed by Spartina or similar grasses. When selecting sites, preference should be given to those areas supporting rare or local Spartina.

The dominant plant species in this habitat type is *Spartina anglica* (Hauke *et al.*, 1998). Both migrating and breeding birds occur in this habitat (Reineking, pers. comm.).

The targets of the WSP (1997) related to this habitat type are:

SALT MARSHES

An increased area of natural salt marshes.

An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.

An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.

BIRDS

Favourable conditions for migrating and breeding birds:

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

1330 Atlantic salt meadows *(Glauco-Puccinellietalia maritima*e)

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Salt meadows of North Sea [...] and Atlantic shores. Aster tripolium can be present or abundant in most subdivisions.

Salt meadows are a (feeding) habitat for migrating and breeding birds (Reineking, pers. comm.). It is for example a breeding area for Shelducks (*tadorna tadorna*) and sterns (*Sterna* sp.) (Hauke *et al.*, 1998).

The targets in the WSP (1997) related to this habitat type are:

SALT MARSHES

An increased area of natural salt marshes.

An increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced.

An improved natural vegetation structure, including the pioneer zone, of artificial salt marshes.

BIRDS

Favourable conditions for migrating and breeding birds:

a favourable food availability;

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

2. Coastal sand dunes and inland dunes

21. Sea dunes of the Atlantic, North Sea and Baltic coasts

Beaches and dunes develop through landward sand transport by wind and water and subsequent sediment sorting by currents. Thus, especially beaches and young dunes are characteristic features of the dynamics of the Wadden Sea ecosystem (De Jong *et al.*, 1999). For the Wadden Sea there is a TMAP classification system for beaches and dune habitats described in Petersen (2001). This classification system is in accordance with the EUNIS (European Nature Information System) habitat classification system. Beaches and dunes include beaches, primary dunes, beach plains, primary and secondary dune slacks, secondary dunes and the heathland behind the dunes. For practical reasons, in Petersen (2001) only habitat units were selected which can be routinely monitored using aerial photography in combination with ground truth surveys. Furthermore, habitat units that only occur in relative small areas and which have a minor importance for management, have not been described as a separate habitat unit in the TMAP classification for beaches and dunes.

2110 Embryonic shifting dunes

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Formations of the coast representing the first stages of dune construction, constituted by ripples or raised sand surfaces of the upper beach or by a seaward fringe at the foot of the tall dunes.

In the TMAP classification system for beaches and dunes, "Embryonic shifting dunes" are described as Embryonic dunes. These are the first small dunes near the shoreline. The Annex II species the Common Seal (*Phoca vitulina*) and the Grey Seal (*Halichoerus grypus*) occur in this habitat (Hauke *et al.*, 1998, Reineking, pers. comm.). Embryonic shifting dunes are a breeding habitat for some birds, for example the Kentish Plover (*Charadrius alexandrinus*) (Hauke *et al.*, 1998). Some migrating bird species stay in this habitat during their stay in the Wadden Sea (Reineking, pers. comm.).

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

MARINE MAMMALS

Viable stocks and a natural reproduction capacity of the Common Seal including juvenile survival.

Viable stocks and a natural reproduction capacity of the Grey Seal including juvenile survival

2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Mobile dunes forming the seaward cordon or cordons of dune systems of the coasts (16.2121, 16.2122 and 16.2123). Ammophiion arenariae, *Zygophyllion fontanesii.*

Where 16.2121, 16.2122 and 16.2123 differ in vegetation type.

In the TMAP classification system for beaches and dunes, this habitat type is described as White dunes. These are the primary dunes, normally the highest dunes of the coastline. In this habitat is breeding colonies of gull species can be present (Hauke *et al.*, 1998). Some migrating bird species stay in this habitat during their stay in the Wadden Sea (Reineking, pers. comm.).

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

2130 Fixed coastal dunes with herbaceous vegetation ('grey dunes')

In Annex I of the Habitat Directive, this habitat is indicated as a priority habitat, meaning that this habitat type is in danger of disappearance and its natural range mainly falls within the territory of the European Union. This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

> *Fixed dunes, stabilised and colonised by more or less closed perennial grasslands and abundant carpets of lichens and mosses, from the Atlantic coasts (and the English Channel) between the Straits of Gibraltar and Cap Blanc Nez, and the shores of the North Sea and the Baltic. [...].*

This habitat type is part of the dynamic processes of coastal ecosystems, which exists because of the natural occurrence of sand-dune blowouts, breaches and sand drift. The dynamics of this is more pronounced than in the decalcified fixed dunes of the *Empetrum nigrum* type (2140) (Pihl *et al.*, 2001). The vegetation may be a closed cover of grassland, sparse annual grassland on sand or dominated by mosses and lichen. Strong gradients typically characterise this habitat type, depending on the salt and calcium content of the soil. The content of limestone (Ca^{2+}) is generally diminishing with age and succession towards brown dune systems (dune heathland). The acidification gradient extents from 'green' to 'grey' dunes, which are both included in this habitat type (Pihl *et al.*, 2001).

In the TMAP classification system for beaches and dunes, this habitat type is described as Dune grasslands. These are stable coastal grey or older second dunes with a low grassland vegetation. This habitat is a breeding habitat for some bird species like the Shelduck (*Tadorna tadorna*) (Hauke *et al.*, 1998). Some migrating bird species stay in this habitat during their stay in the Wadden Sea (Reineking, pers. comm.).

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

2140 Decalcified fixed dunes with *Empetrum nigrum*

In Annex I, this habitat is indicated as a priority habitat. It is defined in the EC interpretation manual (European Commission, 1999) as:

> *Decalcified dunes colonised by Empetrum nigrum heaths of the coasts. Syntaxa associated to this habitat type: Empetrion nigri*, *Calluno Genistrion pilosae p.*, *Erica tetralicis p.*
>
> *- The term "fixed" should be taken to mean the opposite of "shifting". The psychrophilic coastal association Carici trinervis-Callunetum vulgaris de Foucault & Gehu 78 may be included here.*

In the TMAP classification system for beaches and dunes, this habitat type is described together with 2150 ("Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)") as Dune heath. These are stable coastal brown or tertiary dunes with a heath vegetation. In general, coastal heaths are far more varied than inland heathland due to the greater variety of physical factors affecting vegetation processes. The occurrence of decalcified fixed dunes ranges from gravelly, stony beach ridges with more or less superposed shifting sands through wet dune slacks between dunes to dry wind-swept dunes. As this natural habitat type is growing on shifting sands, it represents, as is the case for all near-shore areas, a relatively young ecosystem (Pihl *et al.*, 2001).

"Decalcified fixed dunes with *Empetrum nigrum*" corresponds with “humid dune slacks” (2190), “fixed coastal dunes with herbaceous vegetation" (2130) and “wooded dunes of the Atlantic, Continental and Boreal region” (2180) (European Commission, 1999).

"Decalcified fixed dunes with *Empetrum nigrum*" is a breeding habitat for some birds like the Shelduck (*Tadorna tadorna*) (Hauke *et al.*, 1998).

The heathlands behind the dunes are included in the targets of the WSP (1997) under the heading of “Beaches and dunes”. The targets related to "decalcified fixed dunes with *Empetrum nigrum*" are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

natural flight distances.

2150 Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)

In Annex I, this habitat is indicated as a priority habitat. It is defined in the EC interpretation manual (European Commission, 1999) as:

Decalcified dunes of France, Belgium and Britain, colonised by heaths of the alliances Calluno-Genistion or Ulicioon minoris. [...].

Although the Wadden Sea countries are not mentioned in this definition, this habitat type is included in the TMAP classification of beaches and dunes. It is included because as a result of former grazing management common heather (*Calluna*) occurs in small patches in the Wadden Sea Area. This habitat type is also not mentioned in CWSS (1993) and TMAG (2001a). Following the TMAP classification of Petersen (2001) it is included here.

"Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)" cannot be distinguished as a separate habitat unit on aerial photographs because of the small patches of common heather. Therefore, in the TMAP classification system for beaches and, "Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)” is described together with 2140 ("decalcified fixed dunes with Empetrum nigrumas”) as Dune heath. These are stable coastal brown or tertiary dunes with a heath vegetation.

"Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)" is a breeding habitat for some birds like the Hen Harrier (*Circus cyaneus*) (Hauke *et al.*, 1998).

The heathlands behind the dunes are included in the targets of the WSP (1997) under the heading of “Beaches and dunes”. The targets related to "Atlantic decalcified fixed dunes *(Calluno-Ulicete*a)" are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

natural flight distances.

2160 Dunes with *Hippophaë rhamnoides*

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Sea-buckthorn formations of forest colonisation in both dry and humid dune depressions.

In the TMAP classification system for beaches and dunes, this habitat type is described as Dune scrub. These are older white dunes or secondary dunes with coastal dune scrub. Normally this habitat is situated on the lee side of the older white dunes or on the beginning of younger grey dunes. It is typical for calcareous sand.

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

2170 Dunes with *Salix repens* ssp. *argentea (Salicion arenariae*)

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Salix repens communities (Salix arenariae), colonising wet dune slacks. Following the lowering of the ground water table or accumulation of drift sand, these communities may develop into mesophilous communities as the Pyrolo-Salicetum (with Pyrola rotundifolia, Viola canina, Monotropa hypopitys) or, into xerophilous Salix communities (with Carlina vulgaris, Thalictrum minus) or into Salix repens communities with Mesobromion elements.

This habitat forms mosaics with other dune slack vegetation containing *Salix arenaria* but which is rich in bryophytes and referable to the *Caricion davallianae* (occurring in the subtype Dune slack fens of "humid dune slacks" (2190)), as well as mosaics with dune grasslands and with thickets with *Rosa pimpinellifolia*.

In the TMAP classification system for beaches and dunes, this habitat type is described as Dune willow scrubbery. These are brown or tertiary dunes, however sometimes also second or grey dunes, and dune slacks. It contains coastal dune scrubbery with *Salix repens agg.* vegetation. This habitat is a breeding habitat for some bird species (Reineking, pers. comm.).

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds

a natural breeding success;

natural flight distances.

2180 Wooded dunes of the Atlantic, Continental and Boreal region

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Natural or semi-natural forests (long established) of the Atlantic, Continental and Boreal region coastal dunes with a well developed woodland structure and an assemblage of characteristic woodland species. It corresponds to oak groves and beech-oak groves with birch (Quercion robori-petraeceae) on acid soils, as well as forests of the Quercetalia pubescenti-petraeceae order. Pioneer stages are open forests with Betula spp. and Crataegus monogyna, mixed forests with Fraximus excelsior, Quercus robur, Ulmus minor and Acer pseudoplatanus or, in wet dune slacks, pioneer forests with Salix alba which develop into humid mixed forests or marsh forests. [...].

The plant species occurring in this habitat are highly varied and depend on local site conditions. This habitat type includes semi-natural forests with a typical undergrowth, spontaneously developed from old plantations. These forests are generally associated with dune scrubs (preforest stages), dune moors, grey dunes and wet dune slacks.

In the TMAP classification system for beaches and dunes, this habitat type is described as Dune area forest. These are brown or tertiary dunes and dune slacks with dune bushes or forest and coastal stable dunes with woodland vegetation. The main coastal dune woods can be characterised as Coastal brown dunes covered with deciduous forest.

This habitat type is not mentioned in CWSS (1993) and in TMAG (2001a). Following the TMAP classification of Petersen (2001) it is included here.

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

2190 Humid dune slacks

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Humid depressions of dunal systems. Humid dune-slacks are extremely rich and specialised habitats very threatened by the lowering of water tables.

In the TMAP classification system for beaches and dunes, this habitat type is divided into four sub-features:

1. Pioneer dune slacks: a pioneer vegetation in open mostly younger dune slacks with high dynamic. These are pioneer formations of humid sands and dune pools fringes, on soils with low salinity.
2. Dune slack fens: fens with grass and small sedges vegetation in mostly older dune slacks. These are calcareous and, occasionally aid fen formations, often invaded by creeping willow, occupying the wettest parts of dune slacks.
3. Dune slack heath: moist or wet heath vegetation in older dunes. These are humid grasslands and rushbeds of dune slacks, also often with creeping willows (*Salix rosmarinifolia*, *S. arenaria*) .
4. Dune slack reedbed: dune slack vegetation – beds – with big sedges and/or reed. These are reedbeds, tall-sedge communities and canebeds of dune-slacks.

Breeding birds like the Short-eared Owl (*Asio flammeus*) occur in this habitat (Hauke *et al.*, 1998). The breeding and migratory Eurasian Curlew (*Numenius arquata*) can also be present in this habitat (Hauke *et al.*, 1998). Humid dune slacks are also a habitat for the fen orchid (*Liparis loeselii*) which is an Annex II species (UK Biodiversity website, 2001).

Targets of the WSP (1997) related to this habitat are:

BEACHES AND DUNES

Increased natural dynamics of beaches, primary dunes, beach planes and primary dune valleys in connection with the offshore area.

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migratory and breeding birds.

a favourable food availability;

a natural breeding success;

sufficiently large undisturbed roosting and moulting areas;

natural flight distances.

4. Temperate heath and scrub

The heathlands behind the dunes are included in the targets of the WSP (1997) under the heading of “Beaches and dunes”.

4010 Northern Atlantic wet heaths with *Erica tetralix*

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Humid, peaty or semi-peaty heaths, other than blanket bogs, of the Atlantic and sub-Atlantic domains.

In the Wadden Sea this habitat is generally described as heathlands behind the dunes. The Whimbrel (*Numenius arquata*), for example, is a migratory bird occurring on heaths (Meltofte, 1994). Some bird species breed in this habitat (Reineking, pers. comm.).

Related targets of the WSP (1997) are:

BEACHES AND DUNES

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds.

a natural breeding success;
sufficiently large undisturbed roosting and moulting areas;
natural flight distances.

4030 European dry heaths

This habitat is defined in the EC interpretation manual (European Commission, 1999) as:

Mesophile or xerophile heaths on siliceous, podsolic soils in moist Atlantic and sub-Atlantic climates of plains and low mountains of Western, Central and Northern Europe.

In the Wadden Sea this habitat is generally described as heathlands behind the dunes. Some birds, like the migratory Whimbrel (*Numenius arquata*), occur in this habitat (Meltofte, 1994; Hauke *et al.*, 1998). Some bird species breed in this habitat (Reineking, pers. comm.).

Related targets of the WSP (1997) are:

BEACHES AND DUNES

An increased presence of a complete natural vegetation succession.

BIRDS

Favourable conditions for migrating and breeding birds:

a natural breeding success;
sufficiently large undisturbed roosting and moulting areas;
natural flight distances.

Appendix 4: Description of the Annex II species occurring in the Wadden Sea

A4.1 The Common and Grey Seal

The two seal species occur in the Annex I habitats "sandbanks slightly covered by sea water all the time" (1110) and in "Embryonic shifting dunes" (2110) as mentioned in the description of these two habitats in appendix 3.

Grey Seals (*Halichoerus grypus*) are the larger of the two species. Adult males reach a length of up to 2.45 m and weight up to 310 kg. They are predominantly fish feeders. Their dietary composition varies seasonally and is linked to the availability of prey species. Grey Seals depend on the sea for their food but also have a need for safe areas of land to haul out to rest, give birth and moult. They require undisturbed areas, usually uninhabited offshore islands, which afford easy access to the intertidal and adjacent coastal areas above Mean High Water of Spring tides. There is increasing evidence that certain habitat features such as access to shallow freshwater pools are important. The stock in the Netherlands meanly grows because of immigration from the UK (De Jong *et al.*, 1999).

The Common Seal (*Phoca vitulina*), also known as Harbour Seal, reach a length of 1.85 m and weighing up to 130 kg (both measures for adult males). They are predominantly opportunistic fish feeders taking a variety of species that are locally abundant, and also invertebrates such as cephalopods, gastropods and crustaceans. Common Seals are coastal feeders, rarely occurring further than a few kilometres offshore. They require haul out sites throughout their life cycle. These are generally found in shallow, sheltered waters, sea lochs and island archipelagos.

The targets of the WSP (1997) related to both seal species are:

MARINE MAMMALS

Viable stocks and a natural reproduction capacity, including juvenile survival, of the Common Seal and the Grey seal.

A4.2 Harbour Porpoise

About 1960 the Harbour Porpoise disappeared almost completely from the coastal zone of the three Wadden Sea countries, but since 1980 it has returned to this area (CWSS, 1993). It occurs only in the Annex I habitat "sandbanks which are slightly covered with sea water all the time" (1110). According to sightings, the Harbour Porpoise mainly inhabits coastal waters not deeper than 20 m. The offshore zone of the Wadden Sea is an important breeding and nursing ground for this species (De Jong *et al.*, 1999). Monitoring the status of this species should also take this area into account. The area west of the Knobsände off Amrum and the island of Sylt is the most densely populated one within the German Bight. Long-term surveys documented that Harbour Porpoises in this area also occur directly near the beach the whole year round. Compared to other parts of the North Sea, there is an extraordinarily high density of mother calf-groups (the suckling-period of this species lasts approx. 8 months) in this area. It can be concluded that this area is an important rearing area for Harbour Porpoises (WSP, 1997).

The targets of the WSP (1997) related to this species are:

MARINE MAMMALS

Viable stocks and a natural reproduction capacity of the Harbour Porpoise.

A4.3 Fish species

Fish species are present in the Wadden Sea habitats containing seawater. For many fish species there is a lack of information concerning the development of their communities (TMAG, 2001a).

The houting (*Coregonus oxyrhynchus*) is indicated as a priority species in the Habitat Directive. For the conservation of priority species the Community has particular responsibility. At the beginning of the 19th century, it was a common species in the Dutch, German and Danish Wadden Sea. However, the North Sea houting disappeared from the

German and the Dutch Wadden Sea in the 1920s and 30s and was only left in two rivers entering the Danish Wadden Sea in the late 80s (De Jong, 1999). It is not known if this species currently exists in the Dutch Wadden Sea. In the German and Danish Wadden Sea it is currently existing (TMAP, 2001a).

The adult Sea Lamprey *(Petromyzon marinus)* is a parasite of other fish species. It lives at sea and migrates up rivers to spawn. As far as it is known the larvae live for 3-5 years in fresh water before they turn into adults and migrate into the sea, where they may stay for more than 30 years. This species only exists in the German Wadden Sea Area.

The River Lamprey is a migratory fish that lives at sea and enters the rivers to spawn. The larvae live 3-5 years in fresh water before they turn into the adult form and migrate to the sea. This species is only present in the Wadden Sea Area of Schleswig-Holstein.

Alosa spp. belong to the family of the Clupeidae (the herring family). Although in TMAG (2001a) it is stated that *Alosa* spp. are not present in Denmark, a Danish report (Pihl *et al.*, 2001) mentions captures of *Alosa fallax* (Twaite Shad) in the Danish Wadden Sea area. For the other Wadden Sea areas it is not known if this species is present.

A4.4 Root vole

The mammal *Microtus oeconomus arenicola* (Root vole; 'Nederlandse noordse woelmuis' in Dutch) is indicated as a priority species in the Habitat Directive. It only occurs in the Netherlands. This mammal normally occurs in wet, swampy areas, probably because competing vole species do not occur in these habitats (Katjeskelder, 2001). In the Wadden Sea Area this species is only present on the island Texel where it lives in roadsides, dike banks, and in dry meadows. Probably because of the absence of competitors, the mammal lives in these dry habitats instead of the wet habitats it normally occupies. The root vole feeds mainly on plants, but sometimes insects are eaten as well (Interwad, 2001).

A4.5 Fen orchid

The fen orchid (*Liparis loeselii*) is a small flowering plant typically found growing in a variety of moist habitats like old sandpits, moist meadows and humid dune slacks. It favours a calcareous bottom. In common with many other orchids, the fen orchid appears to rely on regular disturbance for its long-term survival at any one site, and dune system over-stabilisation has been a major causal element in its decline. In for example dune slacks, the plants rely on the early successional phases of dune slack development where some open soil remains (UK Biodiversity website, 2001; JNCC, 2001a).

Generally speaking, the fen orchid has decreased dramatically during the 1900s (Pihl *et al.*, 2001). In Europe the fen orchid appears on the IUCN threatened list for every country in its range.

Appendix 5: Mudflats and sandflats not covered by seawater at low tide

In this appendix it is analysed how the targets of the Wadden Sea Plan can be specified to derive monitoring parameters and how to analyse to what extent the current trilateral monitoring activities meet the requirements of the Habitat Directive for the Annex I habitat "mudflats and sandflats not covered by seawater at low tide". This analysis includes discussions and conclusions about the monitoring proposed and about the characteristics to be monitored.

The sub-features and targets related to "mudflats and sandflats not covered by seawater at low tide", as described in appendix 3, are summarised in table A5.1.

Table A5.1. *The sub-features and targets related to "mudflats and sandflats not covered by seawater at low tide" (called tidal flats in the Wadden Sea).*

Sub-features	*Zostera* fields		
	Mussel beds		
	Sabellaria reefs		
	Feeding areas for birds		
Related WSP targets	WATER AND SEDIMENT	Background concentrations of natural micropollutants.	
		Concentrations of man-made substances as resulting from zero discharges.	
		A Wadden Sea which can be regarded as a eutrophication non-problem area.	
	TIDAL AREA	A natural dynamic situation in the tidal area.	
		An increased area of geomorphologically and biologically undisturbed tidal flats.	
		An increased area and a more natural distribution and development of natural mussel beds, *Sabellaria* reefs and *Zostera* fields.	
	BIRDS	Favourable conditions for migrating and breeding birds	a favourable food availability
			natural flight distances

A5.1 Water and sediment

The chemistry of the sediments and the water column is affected by the input of pollutants. Pollutants are for example nutrients, heavy metals and organic micropollutants. The input of pollutants can lead to changes of geochemical processes like oxidation, reduction, precipitation and chemical complex formation, resuspension and solution. The changed chemistry and the pollutants themselves can affect the natural biological processes, the individual species and the communities of the ecosystem Wadden Sea (TMEG, 1993). The loads of heavy metal from the Elbe are a major source of inputs to the Wadden Sea (De Jong *et al.*, 1999). The river Rhine is an important source of pollutants for mainly the Dutch part of the Wadden Sea.

A5.1.1 Natural micropollutants

Natural micropollutants are substances like heavy metals, which are not only produced by man but also occur naturally in the environment, be it in low concentrations (WSP, 1997). The target of a background level of these substances can be specified for the different natural micropollutants based on comparable reference areas or model studies.

Besides the TMAP, natural micropollutants are part of the monitoring program of the OSPAR Convention. The OSPAR Convention for the Protection of the Marine Environment of the north-east Atlantic (1992) requires that Contracting Parties shall "take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the

maritime area against the adverse effects of human activities so as to safeguard health and to conserve marine ecosystems and, if practicable, restore marine areas which have been adversely affected" (OSPAR Commission, 2000a). To provide a basis for such measures, Contracting Parties are required to undertake and publish joint assessments of the quality status of the marine environment and of its development, for the maritime area covered by the Convention, at regular intervals. These assessments should also evaluate the effectiveness of measures taken or planned for the protection of the marine environment, and identify priorities for action (OSPAR Convention: Article 6 and Annex IV (OSPAR Convention, 1992)). To monitor environmental quality throughout the northeast Atlantic, the OSPAR Commission adopted a Joint Assessment and Monitoring Program (JAMP). The JAMP is, comparable with the Common Package, a selected list of priority monitoring parameters. Like in the TMAP, the JAMP tries to harmonise the monitoring strategies of its Member States in order to assess the results on an international scale. In the OSPAR there is still a lot of discussion going on about the monitoring procedures and the list of parameters to be monitored. Based on the results of the JAMP, the status of the marine environment and the effectiveness of measures are assessed, discussed and evaluated in the Quality Status Reports (e.g. OSPAR Commission, 2000a and b). Also managerial and scientific actions needed are proposed in the Quality Status Reports. The three Wadden Sea countries are Member States of the OSPAR convention. The harmonisation activities and procedures of the OSPAR parameters, including natural micropollutants, are useful for the TMAP. Instead of developing new approaches in the TMAP, the JAMP approaches and guidelines should be used in order to avoid double harmonisation work. In 1997, the OSPAR commission adopted a set of background concentrations of natural micropollutants in the sediment to be used as assessment tools. It is stressed that these values are not Wadden Sea specific (De Jong *et al.*, 1999). Wadden Sea specific background concentration to be used in the assessment should be specified. The concentration of selected priority substances should be monitored. The concentration of natural micropollutants in the water is highly variable. Therefore, the concentration in the water is not part of monitoring programs. It is assumed that the quality of the sediment is a reflection of the water quality (De Jong *et al.*, 1999). The metal concentrations in the sediment is a parameter included in the Common Package. Table A5.2 summarises the deduction of the monitoring parameter from the target.

Table A5.2. *The deduction of the monitoring parameter 'Concentrations of the specified priority natural micropollutants in the sediment' from the target 'Background level of natural micropollutants'.*

Target	**Background level of natural micropollutants**
Specification	Wadden Sea specific background concentrations of specific natural micropollutants in the sediment
Attribute	Specified priority natural micropollutants
Monitoring parameter	Concentrations of the specified priority natural micropollutants in the sediment

A5.1.2 Man-made substances

Of the different categories of pollutants, man-made substances or xenobiotics, like for example PCBs and synthetic pesticides, must be judged as the ones that may be most dangerous to the ecosystem. In several surveys in the Wadden Sea, relatively high concentrations of xenobiotics have been detected. There is increasing evidence that certain pesticides hamper the grazing ability of zooplankton. Pesticides of the herbicide type interfere with the photosynthesis of phytoplankton and may be a factor in the decline of littoral eelgrass (De Jong *et al.*, 1999).

The Wadden Sea target for man-made substances is based on zero discharges. The ultimate policy goal for xenobiotics is to have zero concentrations in the environment. In practice, this would be almost impossible to achieve, even if all inputs would be zero. The reason is that large amounts of xenobiotics have already been introduced into the environment and, in many cases, their breakdown is a very slow process (De Jong *et al.*, 1999). To set a value to specify ‘zero discharges’, one should be able to determine for each substance what the concentration in the Wadden Sea will be in case of no discharges.

Models might be used for this, but it will be difficult and time consuming to model every substance. Therefore, the zero-discharge target, instead of targets based on specific concentrations, has been set. The evaluation of the target can be done on the basis of developments in inputs and concentrations. An indication of the potential danger of xenobiotics present in the Wadden Sea ecosystem is possible through the application of Eco-toxicological Assessment Criteria. The reduction of discharges of substances with a higher concentration than an ecotoxicological criterion should have the highest priority. This is the reason why the tributyl tin (TBT) concentration is included in the Common Package. TBT is toxic in very low concentrations. Compared to the provisional ecotoxicological criteria for sediment, TBT is posing a huge problem to the Wadden Sea environment, because even in the open Wadden Sea TBT concentrations in sediment are exceeding the criteria over a 1000-fold (De Jong, *et al.*, 1999).

The monitoring and assessment requirements for the OSPAR also include man-made substances. The ultimate target for these substances is, like in the Wadden Sea target, the fading out of these substances in the environment. The JAMP developed ecotoxicological criteria for a.o. a list of man-made substances. This list could also be used to specify the substances to monitor in the Wadden Sea. To avoid double work, the substances and ecotoxicological criteria of the JAMP should be used in the monitoring and assessment activities in the Wadden Sea as well. Table A5.3 summarises the deduction of the monitoring parameter from the target.

Table A5.3. *The deduction of the monitoring parameter ' Concentrations and input of specified man-made substances in the Wadden Sea' from the target 'Concentrations of man-made substances as resulting from zero discharges'.*

Target	**Concentrations of man-made substances as resulting from zero discharges**
Specification	Selection of priority substances
Attribute	Concentrations and load of selected priority substances
Monitoring parameter	Concentrations + input of specified man-made substances in the Wadden Sea

A5.1.3 Eutrophication non-problem area

Eutrophication problems are caused by an excess in the concentrations and quantities of nutrients. This excess may lead to increased seasonal primary production which, in turn, can cause negative effects like oxygen depletion as a result of decaying algal material, shifts in species composition and remobilization of micropollutants.

At the 7th Wadden Sea Conference (1994) the trilateral target with regard to eutrophication was agreed upon which formulation was consistent with the development of a procedure regarding the strategy to combat eutrophication within the framework of the OSPAR Convention. Part of the OSPAR strategy is to classify the Convention Area in terms of Eutrophication Problem Areas, Non-Problem Areas and Potential Problem Areas. It was recognised that criteria for the classification would differ between the different sea areas of the Convention Areas, given the large hydrological differences. This was the reason why it was decided that Wadden Sea specific criteria should be developed within the trilateral framework (De Jong, 2001).

In the period 1998-2000 a trilateral study was carried out to specify the Wadden Sea eutrophication criteria. It is assumed that the Wadden Sea is a system that imports organic material from the adjacent North Sea. This material is broken down (remineralized) in the Wadden Sea and the resulting products, amongst which nutrients, are used again for primary production in the Wadden Sea itself and in the adjacent coastal zone (De Jong, 2001). An important implication of this concept is that changes in the growth of phytoplankton (primary production) in the coastal zone will result in changes in the remineralization rate in the Wadden Sea. Consequently, remineralization products in the Wadden Sea can be used as an indicator of the eutrophication status of the Wadden Sea and the North Sea coastal zone. The main proposal from the study is to use the autumn ammonium and nitrite concentrations in the water as such indicators. These concentrations can be used as the monitoring

parameters for the eutrophication target. Based on the concentrations of these nutrients after 1980, that is, after the large-scale introduction of sewage plants, the ranges of the concentrations in the different classes is determined. In table A5.4 this classification is given. All ranges were developed for the western Dutch Wadden Sea and adapted for five different sub-regions of the Wadden Sea on the basis of recent differences in autumn concentrations of ammonium and nitrite. Table A5.5 summarises the deduction of the monitoring parameter from the target.

Table A5.4. *Classification of the Wadden Sea into Non-Problem, Potential Problem and Problem areas based on autumn concentrations of NH_4 + NO_2 (µM). The division in subregions is based on the availability of seasonal data. The present autumn values refer to values during the 1990s (source: De Jong, 2001).*

Area	Non-Problem conditions	Potential Problem conditions	Problem conditions	"Present" values (1990s)
Western Dutch Wadden Sea	< 3.0 µM	3.0 µM <> 8.3 µM	> 8.3 µM	12.3 µM
Eastern Dutch Wadden Sea	< 4.0 µM	4.0 µM <>10.2 µM	>10.2 µM	16.7 µM
Lower Saxony Wadden Sea	< 3.2 µM	3.2 µM <> 8.2 µM	> 8.2 µM	13.0 µM
Sylt Rømø Bight	< 3.1 µM	3.1 µM <> 7.4 µM	> 7.4 µM	11.8 µM
Danish Wadden Sea	< 2.5 µM	2.5 µM <> 6.5 µM	> 6.5 µM	10.3 µM

Table A5.5. *The deduction of the monitoring parameter 'Concentrations of NH_4 + NO_2 (µM)' from the target 'A Wadden Sea which can be regarded as an eutrophication non-problem area'.*

Target	**Eutrophication non-problem area**
Specification	Classification into Non-Problem, Potential Problem and Problem areas in different subregions
Attribute	Remineralization products
Monitoring parameter	Concentrations of NH_4 + NO_2 (µM)

In the Common Package the concentration of inorganic nutrients, including total nitrogen, in the water is included. Ammonium and nitrite concentrations are not measured separately. Based on the proposal in the study on Wadden Sea specific eutrophication criteria, including the ammonium and nitrite concentration in the TMAP would be sufficient to determine the eutrophication condition. The concentrations of these substances are measured on national scales and international agreed monitoring guidelines are available (TMEG, 1993). The inclusion of these substances in the Common Package might therefore be relatively easy.

A5.1.4 Areas outside the Wadden Sea

The Wadden Sea is an open system and strongly influenced by other systems (Dankers & Vlas, 1994). Sources of pollutants are mainly located outside the Wadden Sea. Discharges of man-made substances may, for example, originate from the river Rhine. The areas outside the Wadden Sea also influence the eutrophication status of the Wadden Sea. For example, there is increasing evidence of the important role of the adjacent North Sea in primary production, which is transported to the Wadden Sea (De Jong *et al.*, 1999). Therefore management measures for pollutant and nutrients will have to take place especially outside the Wadden Sea Area. The effect of these management activities is difficult to assess in the Wadden Sea. Authorities in charge of areas outside the Wadden Sea who take the specific measures also have to monitor the effect of these measures. However, monitoring these substances in the Wadden Sea remains essential in order to assess the status of these substances. This gives an indication of the overall effect of the measures and indicates the most important threats for the Wadden Sea.

A5.1.5 Water Framework Directive

Next to the Habitat Directive, the Bird Directive and the OSPAR Convention, the Wadden Sea is subject to the Water Framework Directive. The overall environmental target is to achieve a good water status by 2015 in all categories. In the case of surface waters, this status is the sum of both their 'ecological status' and the 'chemical status'. The Water Framework Directive also requires monitoring and evaluation of management plans. Therefore, these requirements should be studied in relation to the monitoring and reporting for the Habitat Directive. It should be investigated how the monitoring and reporting procedures for the Habitat Directive can be used for the Water Framework Directive and the other way around.

A5.2 Tidal area

A5.2.1 A natural dynamic situation in the tidal area

To be able to assess this target, it should be specified what is meant with a 'natural dynamic situation' of the tidal flats. This could include, for example, the sand balance. The sand balance is an important characteristic of the tidal area. The tidal area and the offshore zone can, from the perspective of hydrology and sedimentology, be considered as one system (De Jong *et al.*, 1999). As water, loaded with sand, is passing through the tidal inlet during ebbing or flooding tide, sand is respectively exported and imported from the tidal area to the offshore zone. When this balance is negative, that is, when more sand leaves the system than enters, the area of the tidal flats will decrease. Since the end of the last glaciation sea level rise is a natural process. The natural response was a landward shift of the tidal basins (De Jong *et al.*, 1999). This landward shift resulted in a more or less equal area of the tidal flats. Based on this, a natural dynamic situation might be described as a situation in which the sand transport takes place (dynamic) and in which the area of the tidal flats is not reduced. In this case the sand balance should be positive as the sea level is still rising and a landward shift of the tidal flats is prevented by coastal protect measures. Sand transport is an intrinsic character of the tidal flats, so concerning the sand balance, a dynamic situation can be assumed to be present. The area of the tidal flats could be monitored to assess whether the sand transport results in an equal area of tidal flats. Table A5.6, specification 1, summarises the deduction of this monitoring parameter from the target. The Common Package includes the parameter 'total area of the tidal flats'.

Tidal flats are a habitat for several species that require a broad spectrum of sediment types. Due to changes in sea level and human activities like fishing, the sediment composition of the tidal flats may change and could influence the benthic composition of the tidal flats and consequently the forging animals (TMAG, 1997; CPSL, 2001). The extent of the different sediment types can give an indication of a 'natural' situation. Reference situations could be used for the assessment to what extent the sediment composition is natural. The related monitoring parameter could be the extent of the three sediment types, mud, mixed (muddy sand) and sand (in km^2) per sub-area of tidal basin as included in the Common Package under the heading Geomorphology. Table A5.6, specification 2, summarises the deduction of this monitoring parameter from the target.

Next to these parameters, many others can be deduced depending on the definition of a 'natural dynamic situation'. Table A5.6 can be extended by many more specifications, attributes and monitoring parameters. For example, parameters to assess the sediment budget more precisely might be considered necessary. The sand balance can, for example, be determined by the comparison of high-resolution topographic maps for different epochs (CPSL, 2001).

Table A5.6. *The deduction of two monitoring parameters from the target 'A natural dynamic situation in the tidal area'. Many other parameters might be deduced depending on the definition of a 'natural dynamic situation'.*

Target	**A natural dynamic situation in the tidal area**
Specification 1	No reduction in total tidal flat area
Attribute	Total area of tidal flats
Monitoring parameter	Area of tidal flats
Specification 2	A natural spectrum of sediment types per tidal area
Attribute	Area of the sediment types per tidal area
Monitoring parameter	Area of the sediment types mud, mixed and sand (km^2)
...	...

A5.2.2 An increased area of geomorphologically and biologically undisturbed tidal flats

This target can be reached by making existent disturbed tidal flats undisturbed, or by increasing the total area of tidal flats and to assure that the increased area is (partly) undisturbed. Increasing the total area, when possible, would require a lot of efforts. Therefore, it might be more realistic to focus on the reduction of disturbances in existing disturbed tidal flats.

Potential geomorphological disturbances are for example sand extraction and dredging of shipping lanes, which influence the sediment export directly. Also gas extraction can be a geomorphological disturbance. Gas extraction could result in subsidence of the sea floor which aggravates the effects of sea level rise (WSP, 1997). Geomorphologically undisturbed could be defined to include a positive sand balance in which the total area of the tidal flats is not reduced. Again, the total area of tidal flats could provide information for a part of the assessment of the target (table A5.7, specification 1).

The extent of the different sediment types can change due to human activities and sea level rise. It has, for example, been hypothesised that disturbance of benthic communities by shellfish fisheries may lead to higher sediment mobility and erosion and, consequently, unfavourable conditions for the settlement of fine sediment (De Jong, *et al.*, 1999). Using information on the sediment composition can thus also be used for the assessment of geomorphologically undisturbed tidal flats. As mentioned above, the extent of the sediment types can provide information about the sediment composition (table A5.7, specification 2).

A geological undisturbed tidal flat will result in a (certain percentage of) stable sediment. Stability of the sediment is key to the structure of the feature. Penetrability is an indicator of sediment stability. It measures the degree of compaction, which indicates the shear strength of the sediment and thus the susceptibility of that sediment type to erosion (Murray, pers. comm.) (table A5.7, specification 3). The stability of the sediment is also reflected by the topography (English Nature: Murray, pers. comm.). Topography can be determined by measuring the tidal elevation and shore slope (table A5.7, specification 4). Besides stability, the topography also reflects the energy conditions and indicates the position of channels through the feature, which is another important indicator of the processes influencing the feature. Topography is also a major influence on the distribution of communities throughout the feature (English Nature: Murray, pers. comm.). Therefore, this attribute can be used to assess a range of characteristics of the tidal flats. Penetrability and topography are not parameters of the Common Package. Only the elevation is stated as a non-mandatory parameter in the TMAP manual. Penetrability tidal elevation and shore slope are examples of monitoring parameters that can be proposed as additional parameters for the Common Package.

Many other parameters might be deduced depending on the disturbances to assess and/or to gain more information, for example, about the sand balance.

Table A5.7. *The deduction of monitoring parameters from the target 'An increased area of geomorphologically and biologically undisturbed tidal flats'. Many other parameters might be deduced depending on, for example, the disturbances to be assessed.*

Target	**An increased area of geomorphologically and biologically undisturbed tidal flats**
Specification 1	No reduction in total tidal flat area
Attribute	Total area of tidal flats
Monitoring parameter	Area of tidal flats
Specification 2	A natural spectrum of sediment types
Attribute	Area of the sediment types
Monitoring parameter	Area of the sediment types mud, mixed and sand (km^2)
Specification 3	A (certain percentage of) stable sediment
Attribute	Susceptibility of sediment to erosion
Monitoring parameter	Penetrability
Specification 4	A (certain percentage of) stable sediment
Attribute	Topography
Monitoring parameter	Tidal elevation; shore slope
Specification 5	Specific (characteristic) species to be monitored
Attributes	occurrence, abundance, pollutants in tissue
Monitoring parameters	number of individuals, concentration of specific man-made substances (like PCBs) in the tissue
...	...

The organisms living on or in the sediment may influence the geomorphology of the sediment considerably. Wadden Sea organisms living on or in the sediment actively contribute to sedimentation by deposition (biodeposition) or by stabilisation (biostabilisation) of the sediment (CPSL, 2001). For example, very high deposition rates are common in mussel beds. More passively, epibenthic biogenic structures affect the local hydrodynamic conditions, enhancing sedimentation or preventing erosion. The loss of sublittoral seagrass in the 1930s, for example, increased the erosion in areas where it occurred. On the other hand biota are also able to increase the erodibility of the sediment or to destruct the surface by bioturbation, burrowing activities and resuspension of particles (CPSL, 2001). Considering the effects organisms might have on the sediment, the parameters to be deduced from the target of biological undisturbed tidal flats can also be used to assess the target of geomorphologically undisturbed tidal flats.

Geomorphological disturbance may lead to biological disturbance. A decreased area of the tidal flats caused by a negative or weakly positive sand balance will also decrease the habitat of tidal area species. Also changes in sediment type and stability can influence the benthic composition of the tidal flats (TMAG, 1997). So biologically undisturbed also means geomorphologically undisturbed. The parameters deducted for geomorphologically undisturbed tidal flats can therefore also be used to assess the target 'biological undisturbed tidal flats' (table A5.7, specification 1-4).

Disturbances might also effect species and natural biological processes directly. For example, the input of pollutant may lead to changes in key processes such as primary production, secondary production in the different food web levels, decomposition, and also in changes in reproduction, recruitment, growth and natural mortality of species. Another example, fishing can effect the abundance of commercial species (e.g. brown shrimps, cockles, blue mussels) and also the bottom fauna species and the food availability for birds. The effect of these disturbances could be determined by monitoring the species occurring on the tidal flats. Monitoring all species will not be feasible, but monitoring some species can

give an indication of the condition of the total biological community and of the quality of the biotopes of a tidal flat. The selection of species depends on their relevance for processes in the ecosystem, i.e. on their position in the food web, abundance and occurrence, but also on human utilisation (TMEG, 1993). The presence and relative abundance of characteristic species gives an indication of the quality of the biotopes (English Nature: Murray, pers. comm.). Birds, for example, feed on the tidal flats. A decrease in the number of birds feeding on the tidal flats could be an indication that the population of their preys has decreased.

Larger fauna of the sea bottom, called macrozoobenthos, is an important sub-feature of the "mudflats and sandflats not covered by seawater at low tide". Conservation objectives might be set for the composition of the total macrozoobenthos community and the distribution, biomass and abundance of individual species. For the Common Package the macrozoobenthos are monitored in the tidal flats with the objective to assess changes in the natural processes, species abundance and community structure over time and to assess these changes due to changes in input of nutrients, heavy metals and organic micropollutants. Other anthropogenic influences have to be taken into account when assessing the changes in macrozoobenthos. Important influences can be recognised, for example, by establishing reference areas where human influences are kept to a minimum. These areas can also be used for the assessments. For mussels and *Sabellaria* reefs specific targets and monitoring activities are developed (see below). Special attention might be given to the cockle population, as these as being fished in the Dutch part of the Wadden Sea. Cockles are of a major importance for the bird species feeding on them (Waardenburg, pers. comm.). The cockle fishery is included in the Common Package, but additional attributes for this sub-feature might be necessary to assess the effect of this fishery on the cockle population. Table A5.7, specification 5 gives an indication of the deduction of monitoring parameters for species from the target. The monitoring of the biological sub-features *Zostera* fields, mussel beds, *Sabellaria* reefs and birds are discussed below.

Further specifications can increase the number of monitoring parameters largely. Almost every characteristic of the tidal flats can be connected to some biological component, leading to a large number of monitoring parameters related to the target of a biologically undisturbed tidal flat. The selection of which characteristics to assess could depend, for example, on the most important disturbances, priority species and/or important processes.

The effect of management measures, which are related with the targets discussed in this paragraph, on the status of the sub-features could be assessed by using the monitoring results derived from the specifications of the targets. For example, a measure aiming at the reduction of geographical disturbances can be assessed using the results of the measured monitoring parameters derived for the target 'geographically undisturbed tidal flats'.

A5.3 Mussel beds, *Sabellaria* reefs and *Zostera* fields

Eelgrasses, mussels and reef building *Sabellaria* colonies are examples of habitat forming species. By 'mussel beds', the beds of the blue mussel (*Mytilus edulis*) are meant. These beds play an important role in the ecology of the Wadden Sea. They play a role in sediment dynamics, hydrology, nutrient dynamics, biodiversity, as a food source for birds (De Jong *et al.*, 1999) and they may host a diverse invertebrate fauna (CPSL, 2001). Eelgrass beds are particularly important in being an internationally scarce and declining habitat (English Nature: Murray, pers. comm.). The Wadden Sea is inhabited by two species of eelgrass, the common eelgrass (*Zostera marina*) and the dwarf eelgrass (*Zostera noltii*). Eelgrass beds play a multifunctional role in the ecosystem as they supply a habitat for an abundant epibenthic flora and fauna, form a food source for numerous grazers and deposit feeders, moderate water currents, and stabilise sediments (De Jong *et al.*, 1999).

The targets of the WSP (1997) for these sub-features are threefold:

- an increased area;
- a more natural distribution; and,
- a more natural development.

A5.3.1 An increased area

Monitoring the area of the different sub-features will indicate if the area is increasing. The related monitoring parameter is the area of the sub-features (table A5.8).

Table A5.8. *The deduction of the monitoring parameter 'Area of sub-feature' from the target 'An increased area of mussel beds, Sabellaria reefs and Zostera fields'.*

Target	**An increased area of mussel beds, *Sabellaria* reefs and *Zostera* fields**
Specification	
Attribute	Trend in time of the total area of the sub-feature
Monitoring parameter	Area of the sub-feature

For mussel beds, there is a broad consensus about the fact that mussel beds are an intrinsic part of the Wadden Sea system and should be protected (De Jong, in press). There is also a broad support for increasing the area of mussel beds, considering the decline in the last decades. Controversy emerges when it comes to fixing a certain area of beds to achieve (De Jong, in press; see also the discussion about 'target specification' in chapter 3 and 5). For the tidal flats the parameter 'area of the mussel beds' is included in the Common Package.

The reef building polychaete *Sabellaria* sp. is not a part of the Common Package. Recent data on the locations of these reefs are not available. It is therefore not possible to monitor the area of the *Sabellaria* reefs yet.

The area of the *Zostera* fields is measured in all intertidal flats in the Wadden Sea and is a parameter of the Common Package (TMAG, 1997). The extent of the *Zostera* beds is also a key structural component of the sediments and provides a long-term integrated measure of environmental conditions across the feature (English Nature: Murray, pers. comm.).

A5.3.2 A more natural distribution

The assessment of this target requires information on the distribution of the sub-features. This information could be provided for example, by making a map of the Wadden Sea in which all spots where the sub-feature occurs are indicated. To do this, the area (see above) and the location of the sub-feature should be known. For the blue mussel beds on the tidal area the location is measured in the Common Package. The location of all *Sabellaria* reefs in the Wadden Sea is not known yet. Appropriate methods to monitor the location have still to be developed (TMAG, 1997). To assess the ‘natural distribution’ target for *Sabellaria* reefs, knowing the location will be a prerequisite. The location of the *Zostera* fields is measured in all intertidal flats in the Wadden Sea and is part of the Common Package. Difficulties arise when it has to be specified what the *natural* distribution of these sub-features is. Specifying targets for the distribution of these features could be based on where the feature used to occur in former times or on the sediment type where they could occur. For mussel beds, new beds seem to settle where old beds used to occur or where remnants are left (De Jong *et al.*, 1999). *Sabellaria* larvae are strongly stimulated to metamorphose and settle by cement excretions of adult or newly settled young *Sabellaria*. The larvae are also able to detect biochemically, old worm tubes that have been built by the same species. Therefore, several potential settling grounds for a spontaneous regeneration of this characteristic type of Wadden Sea biotope exist. The occurrence of *Sabellaria* reefs also depends on the hydrological conditions. The species requires suspended sand grains to build its tubes. Reef communities, therefore, only occur in very dynamic areas where sand is placed into suspension by water movement (De Jong *et al.*, 1999). The specified target can indicate that the feature should occur in (some of) the areas where it used to occur or where it can occur based on the sediment type and hydrological conditions. The criteria for the potential areas should be defined. Table A5.9 summarises the deduction of monitoring parameters from the target.

In the QSR for the Wadden Sea of 1999, it is stated that *Sabellaria* is probably still occurring on two locations in the German Wadden Sea. Extensive reefs can be considered extinct, although it is not clear whether they have ever occurred in the Dutch part of the

Wadden Sea. In Germany, most of the reefs have disappeared possibly because of fishing activities with sediment disturbing trawls and dredges. Regeneration may be possible in areas that are closed for fishery with bottom gear. However, it is not known whether these reefs will redevelop when fishery is stopped (De Jong *et al.*, 1999). Because of this lack of information, it might be doubted if it is wise to set targets for this sub-feature. Specifying targets is very hard if there is not enough knowledge about a sub-feature.

Table A5.9. *The deduction of the monitoring parameters 'Area of sub-feature' and 'location' from the target 'A more natural distribution of mussel beds, Sabellaria reefs and Zostera fields'.*

Target	**A more natural distribution of mussel beds, *Sabellaria* reefs and *Zostera* fields**
Specification	Should occur in (some of) the areas where it used to occur or where it can occur
Attribute	Distribution
Monitoring parameters	Area of the sub-feature; location

A5.3.3 A more natural development

A more natural development can include many characteristics of the sub-features. A more natural distribution of the sub-features as discussed above, can also be seen as a part of a more natural development. Many development characteristics are sub-feature specific. Therefore, the natural development will be discussed separately for each sub-feature.

Mussel beds

When mussel beds can develop in a natural way, the population of the mussels will have a certain length and biomass distribution. Assessment of a more natural development of mussel beds could therefore include the length frequency distribution and biomass of individual mussels (table A5.10, specification 1).

A natural development could also include the recruitment of the mussels. Recruitment of blue mussels has not been fully understood. More research is needed to be able to develop a sufficient monitoring procedure for the recruitment. However, a natural recruitment includes a regular spatfall and a certain recruitment potential. The primary settlement abundance could provide information about the spatfall and recruitment potential for the blue mussel population (TMAG, 1997). The primary settlement abundance is the abundance of the first migrating stage of *Mytilus*. Based on information on the primary settlement abundance, the extent to which the recruitment is natural can, to a certain extent, be assessed (table A5.10, specification 2).

Pollutants can effect the natural development of mussel beds by effecting, for example, their reproduction, recruitment and physiological functioning (TMAG, 1997). In the Common Package parameters for pollutants in mussels are included. A natural development could be defined as a situation in which the concentration of pollutants in mussels is lower than the lowest concentration that effects the natural mussel development. To assess this, heavy metals and organic contaminants in blue mussels could be monitored (table A5.10, specification 3) in accordance with the JAMP guidelines for monitoring contaminants in biota. Background concentrations and ecotoxicological assessment developed in the JAMP can also be used for the assessment in the TMAP. It has to be checked regularly if additional compounds have to be included in the list of measured substances (TMAG, 1997).

Many other characteristics of mussels can indicate something about the development of mussel beds. For example, the size of the mussels can also be used as an indicator of the age of the mussels (Marencic *et al.*, 1996). A range of age classes is an important indicator of mussel recruitment and growth (English Nature: Murray, pers. comm.). The condition of the mussels also provides information about the development of the mussels. The condition of the mussels can be determined by measuring the condition index, i.e. the ratio of cooked meat vs. shell length, of the sample of the mussels (TMAG, 1997).

Table A5.10. *The deduction of monitoring parameters from the target 'A more natural development of mussel beds'. Many other parameters can be deduced from the target depending on the definition of 'natural development'.*

Target	**A more natural development of mussel beds**
Specification 1	Certain size frequency and biomass distribution
Attribute	Length and biomass
Monitoring parameter	Length frequency distribution and biomass of a sample of mussels of the mussel beds
Specification 2	Natural recruitment
Attribute	Spatfall and recruitment potential
Monitoring parameter	Primary settlement abundance
Specification 3	Lower concentration of pollutants in mussels than the lowest concentration that effects the natural mussel development
Attribute	Concentration of pollutants in mussels
Monitoring parameter	Concentration of specified pollutants in mussels
Specification 4	A certain abundance of mussels within a mussel bed
Attribute	Abundance
Monitoring parameter	The number of individuals per unit area in a sample of all mussel beds
...	...

Next to characteristics of mussels, also characteristics of mussel beds can be used to assess the development of mussel beds. A more natural development of the beds could include a certain abundance of mussels within a bed, i.e. the number of individuals per unit area (table A5.10, specification 4). The abundance could be measured in a sample of all mussel beds. The age of the beds can also be used as an attribute indicating something about a natural development. It should be specified what is natural: many old beds, many young beds or a mixture of old and young beds. The structure of the mussel beds is another characteristic that can be used to assess whether the mussel beds develop in a natural way. In TMAG (1997) it is indicated that parameters have to be classified for:

- area covered by mussels within one mussel bed;
- area of enclosed pools;
- size of mussel patches;
- vertical height profile;
- thickness of accumulated sediment; and,
- coverage by macroalgae.

The stability of a mussel bed might be an important attribute to determine whether there are enough beds in the Wadden Sea that can survive. In order to assess stability, a clear definition of this term should be given. Other parameters mentioned above could indicate stability. Stability could, for example, be indicated by the size of the bed, the abundance of mussels, the vertical height profile etc. Stability could also be indicated by the frequency of occurrence. For example, if a bed is present in at least 6 of every 7 years it can be considered stable. The area of stable beds could be used to assess “natural development”. The TMAP interpretation manual suggests measuring the locations and sizes of individual mussel beds in order to record changes in the distribution pattern of stable and unstable beds. However, a definition of stable or unstable is not given in this manual. De Jong *et al.* (1999) state that there are some indications that the individual size of the patches[8] is an important parameter of their stability. This indicates that the individual size of the patches could be used as a parameter to determine the stability of mussel beds.

[8] A mature mussel bed consists of a spatially well defined, irregular, collection of more or less protruding small beds, called patches (De Jong *et al.*, 1999).

Apart from the above-mentioned parameters, every mussel expert can probably mention many other parameters that also indicate something about the natural development of mussel beds.

Sabellaria reefs
It is not known where *Sabellaria* reefs occur in the Wadden Sea, not all locations have been located yet (TMAG, 1997). Information on the location of existing *Sabellaria* reefs and their development is not available yet. Appropriate methods to monitor these reefs still have to be developed (TMAG, 1997). Therefore, further research is necessary before a monitoring and assessment program for *Sabellaria* reefs can be developed.

Zostera fields.
For this sub-feature the term “natural” should be specified as well. A natural development could include a certain biomass of the *Zostera* fields (table A5.11). Depending on the specification of “natural”, other parameters might be deduced.

Table A5.11. *The deduction of the monitoring parameters 'Biomass of Zostera fields in selected areas' from the target 'A more natural development of Zostera fields'. Other parameters can be deduced from the target depending on the definition of 'natural development'.*

Target	**A more natural development of *Zostera* fields**
Specification 1	Certain biomass of *Zostera* fields
Attribute	Biomass
Monitoring parameter	Biomass of *Zostera* fields in selected areas
...	...

A5.4 Birds

"Mudflats and sandflats not covered by seawater at low tide" is an important feeding habitat for birds like the Shelduck (*Tadorna tadorna*) (Hauke *et al.*, 1998; Meltofte *et al.*, 1994). In the Wadden Sea special monitoring programs for breeding birds (Joint Monitoring Group of Breeding Birds in the Wadden Sea (JMBB)) and for migratory birds (Joint Monitoring Program on Migratory Birds (JMMB)) are conducted in frame of the TMAP. In this report it is assumed that these two monitoring programs together with the reporting activities for the Bird Directive provide sufficient information for reporting for the Habitat Directive.

A5.5 Entire feature

Management measures and plans in the Wadden Sea are related to the targets of the WSP (1997). Therefore, the monitoring activities derived from the targets, as described above, can provide information to assess the effect of management plans. Monitoring parameters related to the targets for “mudflats and sandflats not covered by seawater at low tide” discussed in this appendix are given in table A5.12. Based on the definitions and specifications of the targets by the experts, many other parameters might be deduced. The assessment of the targets also provides information about the status of the sub-features. For the assessment of the status of the entire feature, the assessments of the sub-features can be used. However, this information may not be sufficient and additional monitoring parameters to assess the status might be needed. For all additional characteristics proposed to be monitored, conservation objectives should be set in order to be able to assess whether these represent (or to what extent they represent) the Favourable Conservation Status. These conservation objectives should, as far as possible, be related to the Wadden Sea Plan targets or their specifications.

Table A5.12. *Monitoring parameters discussed in this chapter related to the targets for "mudflats and sandflats not covered by seawater at low tide" (called tidal flats in the Wadden Sea). For the monitoring of the targets for birds, it is assumed that the bird monitoring programs for migratory and breeding birds provide sufficient information. The crosses indicate which parameter can be used for the assessment of which target. *=included in the Common Package; [1]= not for Sabellaria.*

Targets			Metals in sediment*	TBT in water and sediment*	Ammonium + nitrite in water	Area tidal flats*	Area of sediment types*	Penetrability	Tidal elevation	Shore slope	Area of sub-feature*[1]	Location of sub-feature*[1]	Mussel length + biomass + condition	No. mussels/unit area	Pollutants in mussels*	Primary settlement abundance of mussels	Structure of mussel beds	Biomass of *Zostera* fields	Bird monitoring*
Water + sediment	Background level natural micropollutants		X																
	Concentrations of man-made substances as resulting from zero discharges.			X															
	A Wadden Sea which can be regarded as an eutrophication non-problem area.				X														
Tidal area	Natural dynamic situation in tidal area.					X	X												
	Increased area of geomorphologically + biologically undisturbed tidal flats and subtidal areas.					X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Increased area + more natural distribution + development of natural:	Mussel beds									X	X	X	X	X		X		
		Sabellaria reefs									X	X							
		Zostera fields									X	X							
Birds	Favourable conditions for migrating and breeding birds:	A favourable food availability																	X
		Natural flight distances																	X

The aspects on which the criteria, mentioned in the Habitat Directive, for a Favourable Conservation Status of habitats are based are listed table A5.13. The monitoring of the characteristic species composition and the sub-features based on these, are discussed above in the monitoring based on the targets. For example, monitoring the macrozoobenthic community might be important.

Table A5.13. *Aspects on which the criteria, mentioned in the Habitat Directive, for a Favourable Conservation Status of habitats are based (based on table 2.2 and 2.4 in Rückriem & Roscher, 1999).*

Range	Natural range
	Area it covers within that range
Structure and functions	Abiotic factors
	Maintenance and use
Characteristic species composition	Characteristic species composition
	Use of sub-features based on these characteristic species
Threats	Large scale threats
	Local threats

To determine the natural range of a feature information is required about the location and area of the feature. As discussed for the target 'A natural dynamic situation in the tidal area' and 'an increased area of [...] tidal flats', the area and location of the tidal flats are included as parameters in the Common Package.

The physical structure of the feature, for example, can be monitored to assess the 'structure and functions' of the feature (Earll, 1999). The monitoring proposed for the target 'geomorphologically undisturbed tidal flats' can be used for this. Also additional attributes might be proposed to assess 'structure and functions'. For example, information on water and sediment might be required. Next to the polluting substances and nutrients assessed for the targets, other attributes could be important for this. For example the average temperature and salinity of the water might be meaningful. Temperature and salinity are characteristic of the overall hydrography of the area. Changes in temperature and salinity influences the presence and distribution of species (along with recruitment processes and spawning behaviour), including those at the edge of their geographical ranges and non-natives (English Nature: Murray, pers. comm.). Both parameters are part of the Common Package: the temperature is measured under “weather conditions” and salinity under “phytoplankton” as a co-variable (TMAG, 1997).

For specific threats, monitoring parameters can be established. For example, to monitor the possible negative effect (possible threat) of the cockle fishery, additional parameters might to be established, as discussed in A5.2.2.

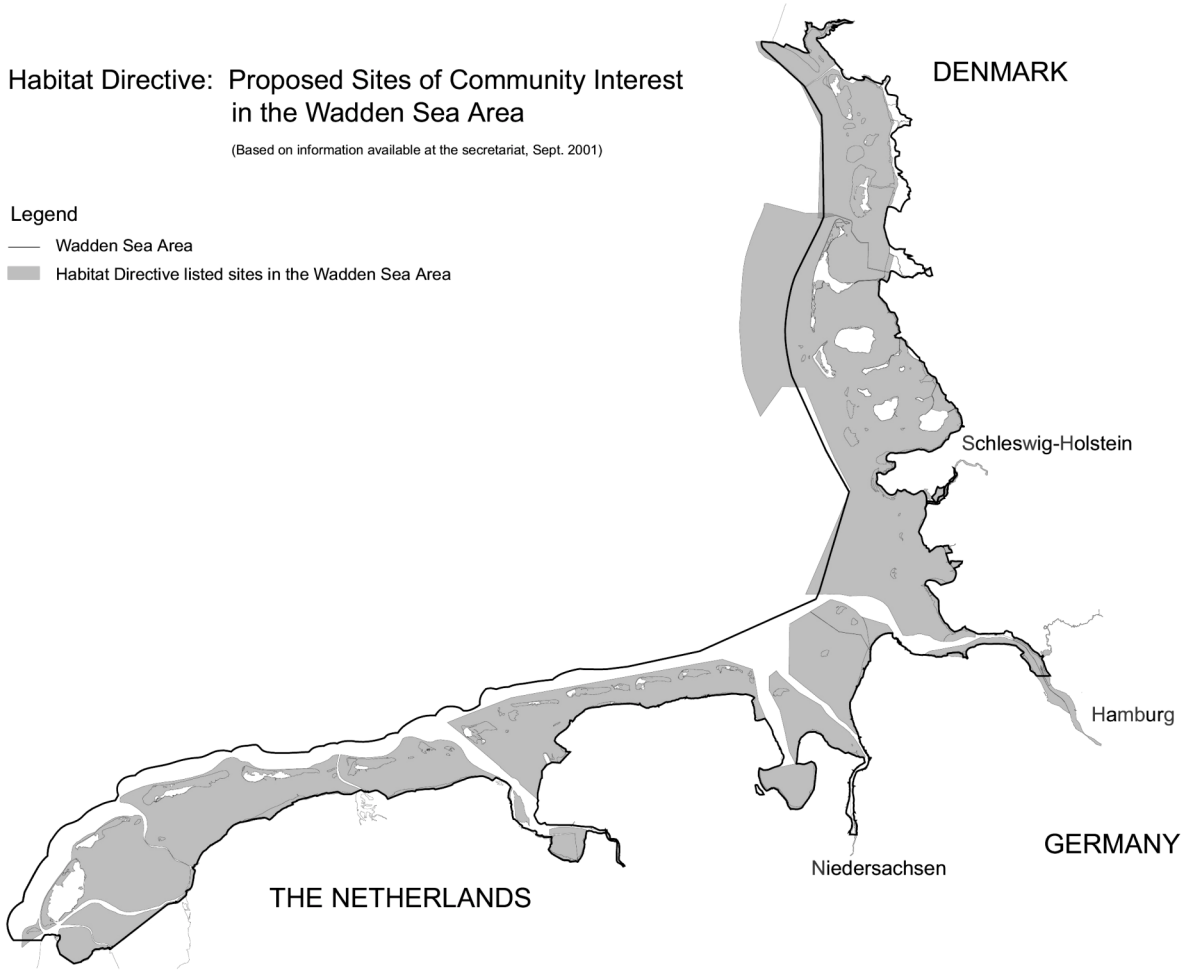
The offshore zone has a large effect on the tidal areas (De Jong *et al.*, 1999):

- Both from physical and biological perspectives, the Offshore Zone and Tidal Area are closely connected.
- From a geomorphological point of view, the Offshore Zone and Tidal Area can be considered as one system.
- The Offshore Zone is an important source of organic material for the Tidal Area.

Because of the many interactions between the offshore zone and tidal area, it is recommended that the monitoring, management and protection of these two areas are closely tuned. The evaluation of impacts in the tidal area should also take into consideration effects in the offshore zone and vice versa (De Jong *et al.*, 1999).

Appendix 6: Habitat Directive listed sites in the Wadden Sea Area

This map in this appendix shows the proposed sites of Community interest for the Habitat Directive in the Wadden Sea Area. The indicated "Wadden Sea Area" is the Trilateral Co-operation Area. This map is drawn based on the information available at the Common Wadden Sea Secretariat in September 2001.



Glossary

AIS
: Alien Invasive Species

Attribute
: Selected characteristic of a feature or sub-feature which provides an indication of the condition of the (sub-)feature to which it applies.

Biogeographical regions (Czybulka, 2001)
: The area of the EU is divided into six (in the future nine) biogeographical regions: Atlantic, Continental, Alpine (Alps, Pyrenean, also parts of Sweden), Mediterranean, Boreal (Sweden and Finland) and Macronesian (Azores, Canaries, Madeira) region. In frame of the future Eastern extension of the EU, the Steppic, Pannonian and Black Sea regions will be added (for a map of these biogeographical regions see European Communities, 2001).

Biological diversity
: Secretariat on the Convention on Biological Diversity (SCBD) (1992): "The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".
: The diversity within species is also called 'genetic diversity', the diversity between species 'species diversity' and the diversity of ecosystems 'ecosystem diversity'.

CBD
: Convention on Biological Diversity

Conservation objective
: A statement of the nature conservation aspirations for features or areas, expressed in terms of the favourable conditions that we which to attain for the features or areas.

Disturbance (Dittmann & Grimm, 1999)
: Any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

EC
: European Commission

EU
: European Union

Elasticity (Dittmann & Grimm, 1999)
: Stability property in ecology; meaning: speed of return to the reference state (or dynamic) after a temporary disturbance.

Exergy (Jørgensen & Nielsen, 1998)
: The amount of work (entropy-free energy) a system can perform, when it is brought into thermodynamic equilibrium with its environment.

Feature
: The habitat or species for which the site has been selected.

Favourable Conservation Status (Earll, 1999)
: A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely effecting its distribution, abundance, structure or function throughout the EU in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.

Habitat (EEA, 2001)
: Plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors (soil, climate, water availability and quality, and others), operating together at a particular scale.

JAMP
: Joint Assessment and Monitoring Program (of the OSPAR convention)

JMBB
: Joint Monitoring Program for Breeding Birds

JMMB
: Joint Monitoring Program for Migratory Birds

PAR
: Policy Assessment Report

Persistence (Dittmann & Grimm, 1999)
: Stability property in ecology; meaning: persistence over time of an ecological system.

Reference situation (Dankers & De Vlas, 1994)
: A description of an undisturbed ecosystem taking the present geographical and hydraulic situation as the only starting conditions.

Resilience (Dittmann & Grimm, 1999)
: Stability property in ecology; meaning: returning to the reference state (or dynamic) after a temporary disturbance.

SAC(s)
: Special Area(s) of Conservation

Sand balance (Coastal Protection and Sea Level rise Group (CPSL), 2001)
: The net amount of material carried into or out of a specific area over a certain time interval.

SO
: Senior Officials

SPA(s)
: Special Protection Area(s)

Sub-feature (Murray, pers. comm.)
: An ecological important sub-division of the feature

TDG
: Trilateral Data handling Group

TGC
: Trilateral Governmental Conference

TMAG
: Trilateral Monitoring and Assessment Group

TMAP
: Trilateral Monitoring and Assessment Program

TMEG
: Trilateral Monitoring Expert Group

TWG
: Trilateral Working Group

WSP
: Wadden Sea Plan

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