

TMAP and QSR 2004 supporting conservation and management of the Wadden Sea

By Karel Essink

National Institute for Coastal and Marine Management (RIKZ)
PO Box 207, 9750 AE Haren
The Netherlands

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Abstract

For any monitoring and assessment program the questions Why?, What?, Where? and How? are essential. It should be clear why monitoring is needed, or which purpose(s) should be served by monitoring. For the Trilateral Monitoring and Assessment Program (TMAP), such purpose is to periodically evaluate the agreed trilateral Targets as laid down in the Wadden Sea Plan of 1997. What had to be monitored to be able to evaluate these Targets, was agreed upon by Denmark, Germany and The Netherlands by accepting the TMAP Common Package of parameters as suitable to provide the information necessary. The questions Where? and How? pertain to the sampling strategy and the analytical and statistical methods. In the case of TMAP, with different institutes and specialist groups performing in different subareas of the Wadden Sea, quality assurance and harmonization are other essential issues. An operational data exchange system completes the TMAP.

Periodic evaluation may or even should result in new or intensified management measures aimed at complying with the Targets set. If necessary, Targets need to be amended in response of advancing insight or changed policy priorities. As such, monitoring and assessment play an essential role in the so called policy cycle.

In this contribution elements of the TMAP and evaluation results from the Quality Status Report Wadden Sea 2004 will be presented against the background of this policy cycle.

1. Introduction

For the Trilateral Monitoring and Assessment Programme (TMAP) for the Wadden Sea as well as for any other monitoring programme the questions Why?, What?, Where? and How? are essential. It must be clear why monitoring is needed, or which purpose(s) is to be served by monitoring. For the TMAP, such purpose is the periodic evaluation of the trilaterally – between Denmark, Germany and The Netherlands - agreed Targets as laid down in the Wadden Sea Plan (WSP 1997). What needs to be monitored to be able to evaluate these Targets, was agreed upon trilaterally by accepting the so called TMAP Common Package being a set of parameters suitable to provide the information necessary (Stade Declaration 1997). The questions Where? and How? pertain to the sampling strategy and the analytical and statistical methods. Sampling effort and observations need to be made in representative subsystems of the Wadden Sea ecosystem such as salt marshes, dunes, intertidal flats and subtidal habitats, and spread over its geographical range. Moreover, areas with known or expected human influence as well as reference areas with no or minimal human impact should be included (Colijn et al. 1995). In the case of TMAP, different institutes and specialist groups carry out the monitoring in the different subareas of the Wadden Sea. This makes harmonisation of methods and quality assurance essential issues. An operational data exchange system completes the TMAP without which the periodic assessment process would be seriously hampered.

2. The “Policy Cycle”

Periodic evaluation may or even should result in new or intensified management measures aimed at complying with the Targets set. If necessary, Targets need to be amended in response of advancing insight or changed policy priorities. As such, monitoring and assessment are essential in the so called “Policy Cycle” (cf. Winsemius 1986). Generally, in the Policy Cycle the following phases are distinguished: 1) problem identification and acceptance, 2) policy formulation, 3) policy implementation, 4) management, and 5) evaluation (Figure 1).

“Policy cycle”

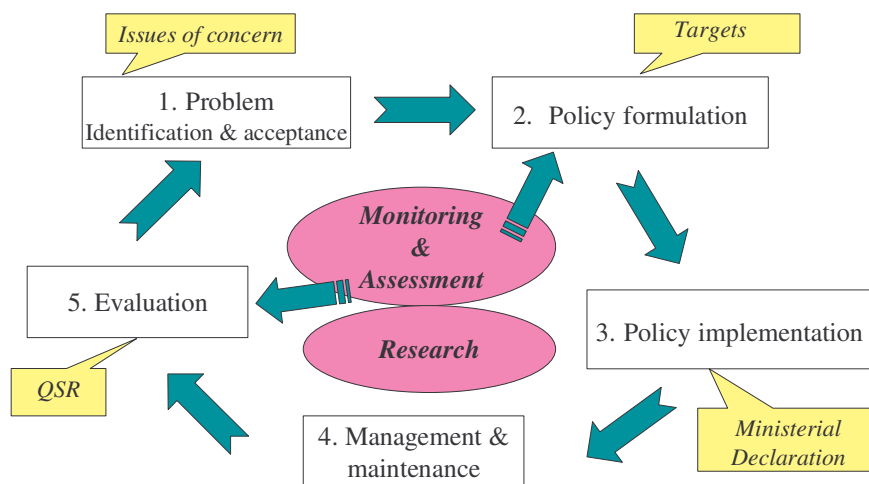


Figure 1 The ‘Policy cycle’ with the role of monitoring and assessment and of research in the trilateral Wadden Sea Cooperation.

2.1. Problem identification and acceptance

This first phase in the Policy Cycle usually starts with an analysis of developments and trends which in the case of the international Wadden Sea may have consequences for e.g. its natural values, its attractiveness as living and recreational area for the human population, and its role as a turntable in large-scale ecological processes such as bird migration. Signals regarding developments and trends may come from society in general or from existing monitoring programmes. The accepted guiding principle for the trilateral Wadden Sea policy “to achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way” dates back to 1991 (Esbjerg Declaration 1991, § 1).

2.2. Policy formulation

Once problems have been identified and accepted, ideas have to be developed - first of all on the political level - on what directions could be taken towards problem resolution. Essential is to properly define what goal should be reached and within what time frame. After preparation of a

policy proposal – mostly by one or more directly involved ministries – the final decision is taken by the parliament. In the case of the Wadden Sea Cooperation, the current policy and its goals have been specified in the form of the Targets as laid down in the Wadden Sea Plan of 1997. This Wadden Sea Plan was agreed upon by the 8th Trilateral Governmental Conference on the Protection of the Wadden Sea held in Stade, Germany, 1997.

2.3. Policy implementation

In the national arena, the implementation of fixed policy usually is a co-production of central (government bodies) and decentralized authorities. This usually implies the formulation of management plans which go into more detail. Examples of these are the Beheersplan Waddenzee 1996-2001 (Rijkswaterstaat 1996) for the Dutch Wadden Sea, and the recent blue mussel management plan for the Wadden Sea of Lower Saxony (Staatskanzlei 1998). For the Wadden Sea the implementation of the agreed trilateral policy is laid down in the Ministerial Declarations of the periodically held Governmental Conferences. The Esbjerg Declaration of 2001 entails a listing of agreed actions and priorities for the trilateral cooperation in the period 2002-2005. The Schiermonnikoog Declaration (2005) will describe the actions and priorities for the next period.

2.4 Management

The factual implementation of the Ministerial Declarations becomes the responsibility of a great variety of higher and lower authorities and agencies, responsible for management as well as for maintenance of relevant legislation and regulations. Management usually has a strong sectoral approach; sometimes authorities work together, e.g. in the Dutch Wadden Sea (RCW 2004). Management activities may range from closure to the public of birds breeding and roosting areas in the relevant season to the execution of nature restoration works in dunes and salt marshes.

2.5 Evaluation.

The coping-stone and most essential phase of the policy cycle is the evaluation, in which is being checked to what extent the set targets have been met. Evaluation may also involve an assessment of the effective use of financial resources related to the reaching of the target. A prerequisite for a good evaluation is the availability of relevant monitoring data. For the trilateral Wadden Sea cooperation this prerequisite is largely fulfilled by the Trilateral Monitoring and Assessment Programme (TMAP) and the institution of periodic Quality Status Reports. Evaluation may lead to reconsidering of policy priorities and management measures, and even to re-defining of targets.

3. Targets for the Wadden Sea

The trilateral conservation policy with respect to the Wadden Sea is directed towards achieving all those habitat types that belong to a natural and dynamic Wadden Sea. For each of these habitat types a certain quality is envisaged to be reached by proper conservation and management measures.

Targets have been formulated for six habitat types, viz. salt marshes, tidal area, beaches and dunes, estuaries, offshore area and rural area, within which a number of subhabitats were defined. Targets related to the chemical quality of water and sediment relate to all these habitat types. Supplementary targets have been agreed for birds (breeding as well as migratory species) and marine mammals (seals and harbour porpoise). The targets as included in the Wadden Sea Plan of 1997 (WSP 1997), together with periodic assessment, play a central role in directing the trilateral conservation policy and related management.

4. The Trilateral Monitoring and Assessment Programme (TMAP)

A trilateral program, in short TMAP, is running to monitor the Wadden Sea, mainly aiming at providing data to be used for periodic assessment of the quality of the ecosystem of the Wadden Sea. Recognized "issues of concern" (climate change, input of pollutants, commercial fisheries, recreation and agricultural practice) were used as a guiding principle for parameter selection. Parameters were selected based on hypotheses regarding the various anthropogenic

impacts on the ecosystem, and grouped to represent important habitats, organism groups and distinct species (TMAP 2000).

In 1997 a Common Package of parameters to be monitored in the TMAP was agreed upon (Stade Declaration 1997). An overview of the TMAP Common Package is presented in Table 1. The Trilateral Monitoring and Assessment Group (TMAG) has the task to implement the TMAP, which in essence is composed of several pieces of national monitoring programs.

Table 1 The Common Package of TMAP parameters.

<p>Chemical Parameters</p> <ul style="list-style-type: none"> • Nutrients • Metals in sediment • Contaminants in blue mussel, flounder and bird eggs • TBT in water and sediment • Beached Birds (oil rate) 	<p>Habitat Parameters</p> <ul style="list-style-type: none"> • Blue Mussel beds • Salt marshes • Beaches and Dunes
<p>Biological Parameters</p> <ul style="list-style-type: none"> • Phytoplankton • Macroalgae • Eelgrass • Macrozoobenthos • Breeding & migratory birds • Harbour (= Common) Seals 	<p>Human Use Parameters</p> <ul style="list-style-type: none"> • Fishery • Recreational activities • Agriculture • Coastal protection <p>General (supporting) Parameters</p>

An essential role within the TMAP, and more specifically the assessment process, is played by the TMAP data handling system. Four data units are being operated, viz. in Denmark, Schleswig-Holstein, Niedersachsen and The Netherlands. Structural, functional and organisational aspects as well as cost-effectiveness have recently been evaluated (Orbis 2004). The Trilateral Data handling Group (TDG), a subgroup under the TMAG, coordinates the necessary updates and amendments of the data units.

A process to optimise the TMAP and to further tune it to the requirements of EC Directives such as Birds Directive, Habitats Directive and Water Framework Directive, is presently ongoing.

5. Outcome of Evaluation (QSR 2004)

In the Quality Status Report Wadden Sea Update 2004 (Essink et al. 2005) a detailed account is given of the developments of various human activities in the Wadden Sea area and of the development of various ecosystem components (species, habitat forming species, habitats). An assessment of these developments provides an evaluation of the different targets as formulated

in the Wadden Sea Plan (1997). In this chapter the main outcome of the target evaluation will be reviewed, and reference will be made to the policy cycle when appropriate. For detailed information the reader is referred to the actual 2004 Wadden Sea QSR. A review regarding hazardous substances (natural micropollutants and xenobiotics) is presented elsewhere in this volume (Bakker 2005). More, and more detailed information on trends and developments is given in other papers of this volume.

5.1 Nutrients and eutrophication

Large inputs of nutrients such as phosphorus and nitrogen compounds was considered the cause of earlier eutrophication phenomena such as local oxygen deficiencies and blooms of the nuisance alga *Phaeocystis* sp. and green macroalgae (De Jong et al. 1999) or kills of fish and benthos such as occurred in the German Bight (Dethlefsen & Von Westernhagen 1982). Such phenomena were considered unacceptable for the Wadden Sea, which led to target that the Wadden Sea “can be regarded as a eutrophication non-problem area”. The prime action needed for development towards that target has since long been accepted as policy and regulations aimed at a considerable decrease of nutrient discharge through rivers debouching in the Wadden Sea (OSPAR 1997). The 2004 Wadden Sea QSR, with data up to 2002, shows that riverine discharges of nutrients have continued to decrease. The decrease in discharge of nitrogen, however, did not keep pace with that of phosphorus. Also in the water of the Wadden Sea nutrients concentrations have decreased, as have phytoplankton chlorophyll levels.

How to evaluate the target? How do we know that eutrophication problems do not occur in the Wadden Sea any more? On the basis of the Comprehensive Procedure, developed for the OSPAR Convention Area (OSPAR 1997), Wadden Sea specific evaluation criteria were developed in a trilateral project (Van Beusekom et al. 2001). Autumn concentrations of ammonia and nitrite were considered suitable indicators of the eutrophication status of the Wadden Sea. Mainly based on these criteria, it is concluded that the target is not yet met. The Wadden Sea may still be a eutrophication problem area, with a higher degree of eutrophication in the southern than in the northern part, notwithstanding the observed declines in green macroalgal cover and in duration of spring blooms of *Phaeocystis*

5.2. Oil pollution and sea birds

Oil pollution at sea mainly originates from ships, and to a lesser extent from oil drilling rigs in the North Sea. The Wadden Sea Plan does not have a specific target regarding oil pollution. For the OSPAR Convention Area, however, an Ecological Quality Objective (EcoQO) regarding the effect of oil pollution on the marine ecosystem was developed as an operational tool and target (Bergen Declaration 2002). And thanks to the so-called Trilateral Beached Birds Survey, now incorporated in the TMAP, data are available to evaluate this EcoQO, which reads “The proportion of oiled common guillemots among those found dead or dying on beaches should be 10% or less”.

Although reported oil spills off the Dutch and German coasts have declined since the 1990s, and oil rates among beached birds have generally also decreased, the OSPAR EcoQO has not been met. Oil rates among birds found dead inside the Wadden Sea are lower than on the North Sea beaches of the Wadden Sea, indicating that oil pollution is mainly an external threat. Hopefully, the designation in 2002 of major areas of the Dutch, German and Danish Wadden Sea as Particular Sensitive Sea Area (PSSA) will contribute to a further decrease of oil pollution (Reineking 2002).

5.3 Salt marshes

These habitats can be found on the Wadden Sea islands and along the mainland shore. The vegetation of salt marshes is strongly determined by the duration of submergence by sea water per tide, and therefore by their elevation as result of natural or man-influenced sedimentation. As a consequence, different vegetation types can be discerned, intersected by meandering creeks or brushwood groynes and man-made drainage systems.

For Wadden Sea salt marshes three targets were formulated. Due to land reclamation and endikement the area of salt marshes in the Wadden Sea had decreased considerably (e.g. Dijkema 1987). Therefore, trilateral policy agreed on aiming at an increased area of natural salt marshes. Realising that a considerable part of the salt marshes were artificial due to land reclamation and their geomorphology and vegetation strongly influenced by man-made drainage systems, an additional target was formulated, aiming for increased natural morphology

and dynamics, including natural drainage patterns, of artificial salt marshes. Finally, for artificial salt marshes an objective was set of obtaining a more natural vegetation structure.

Monitoring and evaluating changes in salt-marsh area or extent of artificial drainage do not seem too difficult a task. Practice, however, is less cooperative. In salt marshes processes of change take many years, changes becoming noticeable only after quite some years. Artificial drainage systems (ditches), when not maintained any more, have proven rather persistent, making it difficult to decide, for example, when an artificial ditch has developed to a naturally meandering creek. Proper evaluation can only be done when these changes are monitored with full coverage of all salt marshes, and a consistent time series of GIS data is available. In practice, good data are available for only a part of the salt marshes. These data show a general increase of area of (semi-)natural salt marshes and a decrease of maintenance of artificial drainage, thus indicating a development according to the target.

The target of an improved natural vegetation structure of artificial salt marshes poses a problem. Firstly, the vegetation structure is very much dependent on local geomorphological conditions. Secondly, it was not possible to give a precise description of the vegetation that can develop and serve as an evaluation criterion. Thirdly, as mentioned before, long-term data are limited, and not all older data can be translated to the recently within the TMAP developed common typology for salt-marsh zones and vegetation types. A precise evaluation of the third salt-marsh target can therefore not be given. In areas, however, where human use of salt marshes (e.g., livestock grazing) was reduced, a more natural vegetation structure did develop.

5.4 Tidal area

The Tidal area includes the intertidal flats and subtidal areas as well as the organisms living in its waters and sediments. Characteristic for these areas is the dynamics of hydrology and geomorphology, especially in the tidal inlets and their outer delta's.

5.4.1 Natural dynamics, no disturbance

A natural dynamic situation in the Tidal Area, and an increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas are the formulations for the relevant targets of the Wadden Sea Plan. As a consequence, policy implementation and management, phase 2

and 3 of the 'Policy cycle', could simply (?) focus on human activities reducing or disturbing this natural dynamics.

Natural dynamics of the sea shore is limited by coastal defence constructions. In the last five years there was no significant increase of these constructions.

Dredging of shipping channels, sometimes adjacent to intertidal flats, causes disturbance of natural sedimentation-erosion processes, and can therefore be judged as deviation from the target. Effects on the ecosystem, if of any significance at all, have not been documented, neither through monitoring nor research.

Intertidal flats are important as habitat for bivalves and other benthos. Bivalves prefer high flats of fine grained sediment for the settlement of their juveniles. Research by Delafontaine et al. (2002) has shown that as a result of progressive endikement, making the Wadden Sea narrower, wave energy increased causing a depletion of fine grained material. It has been made plausible that in the Dutch Wadden Sea intensive fishery for cockles and seed mussels has contributed to a reduction of such high intertidal mud flats (Ens et al. 2004). Consequently, it can be concluded that no increase has occurred of the area of geomorphologically and biologically undisturbed tidal flats.

Land reclamation and shellfish fisheries can to some extent be blamed for the loss of preferred settling habitat of bivalves, but not completely. Climatic factors do also play a role. Analysis of long-term data sets for the westernmost part of the Dutch Wadden Sea shows that the more frequent occurrence of mild winters causes an enhancement of predation on newly settled bivalve post-larvae by shrimps and shore crabs (Beukema & Dekker 2005). This illustrates the importance of being able, through wise monitoring and research, to discriminate between anthropogenic impact and natural causes.

5.4.2 Biogenic structures

In the Tidal Area, a few species occur that form specific biogenic structures. Examples are subtidal reefs of the polychaetous worm *Sabellaria spinulosa*, sea grass fields consisting of *Zostera marina* and *Z. noltii*, and beds of the blue mussel (*Mytilus edulis*). For these biogenic structures the Wadden Sea Plan strives for an increased area, and a more natural distribution and development.

Sabellaria reefs are extremely rare. Nowadays, one reef exists south of Amrum, and possibly two in the Jade. In former times, many more existed; it is not known what caused these to disappear. Monitoring of *Sabellaria* reefs is not included in the TMAP Common Package. This means that policy evaluation is completely dependent on fortuitous observations.

The long-term decline, since the 1930s, of sea grasses in the southern and central Wadden Sea seems to have come to a halt. And some slow recovery is evident in The Netherlands and Schleswig-Holstein. Yet, we still cannot speak of an overall increase in area and natural distribution of sea grass fields. The target of an increased area of *Zostera* fields is therefore not yet met in all subareas of the Wadden Sea.

When looking at the “Policy cycle” it must be noted that in The Netherlands, having noted the extremely slow recovery, evaluation resulted in an additional policy formulation viz. to investigate the possibility of re-introduction of sea grasses. This approach may contribute to sea grass recovery, especially in areas poor in natural seed production

Regarding blue mussel beds there are conflicting interests of nature conservation and fisheries. Regulations have been implemented to safeguard the mussel bed habitat and at the same time allow mussel fisheries or mussel farming. Details of this are beyond the scope of this overview. A trilateral achievement was the new protocol for area measurement of intertidal mussel beds, which will enable future harmonized assessment.

As a result of consecutive spatfalls and of large areas having been without fisheries for seed mussels, a natural increase of intertidal mussel beds was observed during the 1990s. Since 1999, however, poor recruitment caused a decline.

Evaluation of data shows that in parts of the Wadden Sea the target of an increased area of natural intertidal mussel beds is met, but not yet so in other parts. Progress has been made with protection of young mussel beds at old or stable sites. At the same time, specialists realised that they do not yet fully understand the crucial spatfall process, nor the cause of regional differences in recruitment success. Such knowledge is indispensable for designing better management measures.

Concerning subtidal mussel beds, which are heavily exploited by mussel farmers, insufficient data is available to allow evaluation of the target.

5.4.3 Fish and shrimps

The occurrence of fish and shrimps, both not included in the TMAP, can be related to two more general Wadden Sea targets, viz. 1) an increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas, and 2) a favourable food availability for migrating and breeding birds.

With regard to the latter target, there is no evidence of food shortage among fish and shrimp eating birds. With respect to the former target it needs to be clarified whether there is any causal relationship between the recorded offshore shift in the distribution of juvenile flatfish, especially dab and plaice, and the area and quality of intertidal flats and subtidal areas. This signal from national monitoring data deserves to be followed up by adequate research.

An evaluation regarding pelagic and migratory (diadromous) fish is hampered by absence of appropriate monitoring. Here a change in the TMAP is necessary with a view to the implementation of the EU Water Framework Directive in transitional waters (=estuaries).

5.5 Beaches and dunes

The Wadden Sea Plan targets regarding beaches and dunes refer to natural dynamics, natural vegetation succession and favourable conditions for birds. The latter target (on birds) will be dealt with in section 5.8.1.

5.5.1 Natural dynamics

Due to the absence of both criteria and of comparable data it is not well possible to evaluate the dynamics of beaches and dunes. In fact, we got stuck already in the beginning of the "Policy cycle". Within the TMAP no parameters have been developed to enable an evaluation of the target. What can be said, however, is that natural dynamics of beaches has increased where coastal defence activities were stopped, for instance at head- and tail ends of islands.

Natural dynamics of dunes has increased only locally. The area with embryonal dunes, white dunes and primary dune slacks has not increased. Remnant coastal defence structures (e.g. sand dikes) still are an impediment to natural dynamics.

5.5.2 Complete natural vegetation succession.

With regard to the target of an increased presence of a complete natural vegetation succession, it must be concluded that target has not been reached. About two-thirds of the dune areas consist of mid-successional dune type and other vegetation types are not present or show further decline. On some islands, species rich dune slack vegetations have degraded due to groundwater extraction, causing an accelerated succession to drier vegetation types. In some areas accelerated succession is remedied by traditional-type management measures restoring successional processes and species rich habitats.

5.5.3 How to proceed?

The Wadden Sea QSR reveals that too little specific data is available to enable a proper evaluation of the first two targets. On the one hand side, the targets have not been elaborated to objective and quantitative parameters to be monitored. The newly developed TMAP classification of dune types certainly will provide a helpful tool in this respect. On the other hand there is a need to reconsider and redefine the trilateral targets against the background of (1) the high recreational pressure on the coastline, (2) the EU Birds- and Habitats Directives, and (3) sea level rise and its concomitant intensification of coastal defence.

5.6 Estuaries

Estuaries have since long attracted human population and its various activities, most of these being related to trading overseas as well as inland. As a consequence, industrial development boosted, and connected with this also shipping. Many estuarine habitats have disappeared or their extent is greatly reduced. As a counterweight to these human pressures the Wadden Sea Plan states as trilateral policy that valuable parts of estuaries will be protected and river banks will remain and, as far as possible, be restored in their natural state.

Few estuaries are present in the Wadden Sea, of which the Varde Å estuary has largely retained its natural characteristics. For reason not well known, not much effort was put into translating this rather broadly formulated target into operational parameters for monitoring. Hydrology of estuaries has been monitored rather intensively, without doubt because of its significance for shipping. So we know that increased deepening of shipping channels has changed high tide and low tide water levels and current velocities. Continuous dredging and dumping of the dredged material elsewhere is necessary.

Speaking of valuable parts, progressive human pressure has resulted in loss of tidal flats and brackish-water habitats. So called 'Red List' species, signalling their endangered status, do still occur in the estuaries of Elbe, Weser and Ems, which indicates that valuable habitats do still exist, but their extent is hardly known (cf. Von Nordheim et al. 1996). The larger estuaries of the Wadden Sea do not meet the target, as is concluded also in the relevant Water Framework Directive Reports of 2005 (EG-WRRL 2004a, b, c, 2005).

In terms of the 'Policy cycle' policy implementation (phase 2) for estuaries has not yet started. Apparently, management plans for the larger Wadden Sea estuaries have not yet been drafted or not well communicated trilaterally. Possibly, there is also a lack of essential information as a basis to design such management plans. The EU Water Framework Directive, urging the design of River Basin Management Plans, may put new life into the implementation of this Wadden Sea target.

5.7 Offshore area

The Offshore Area is positioned seaward of the Wadden Sea island, extending to the 3 mile limit, but including the Conservation Areas beyond this limit. This seaward limit is artificial, not functional. Three targets apply to this area.

5.7.1 Natural morphology

Apart from coastal defence works on the Wadden Sea islands (e.g. sand nourishments on the foreshore, cross-shore dam at Texel) no evidence has become available regarding major negative developments in natural dynamics of the geomorphology of this area.

5.7.2 Food availability for birds.

Important stocks of the bivalves *Spisula subtruncata* and *S. solida* occur in the Offshore Area. These bivalves are a major food resource for diving duck species such as common scoter and eider. For eider they form an escape in case of adverse food conditions inside the Wadden Sea, e.g. due to severe winter or intense shellfish fishery. Therefore, the fishery on *Spisula* should be carefully managed in relation to conservation of these bird species.

5.7.3 Viable stocks of marine mammals.

The Offshore Area constitutes a part of the living range of harbour seal, grey seal and harbour porpoise, which do not only use the Wadden Sea proper but also large parts of the North Sea (see 5.9)

5.8 Birds

5.8.1 Breeding birds

For more than 30 birds species, the Wadden Sea area is important as breeding area. Breeding habitats are present in salt marshes, dunes, pastures and on beaches. Two targets especially apply to breeding birds, viz. 1) a favourable food availability, and 2) a natural breeding success.

Food availability - The breeding populations of common eider (with more than 75% in the Dutch Wadden Sea), oystercatchers and probably also herring gull have declined mainly in the Dutch Wadden Sea. This is considered an effect of intense shellfish fisheries notwithstanding the management measure of having areas closed for fisheries and reserving certain amounts of cockle and blue mussel stocks for birds (Ens et al. 2004).

Breeding success - Measures aimed at protection of breeding sites of the little tern have proven successful. The significance of the beaches as breeding habitat for bird species such as great ringed plover and Kentish plover has further decreased. As this was already concluded in the previous Wadden Sea QSR (De Jong et al. 1999) it must be concluded that management measures have not been effective at all.

Increased predation pressure by mammalian predators, e.g. red fox, on the mainland caused some bird species to shift their breeding numbers from the mainland to the islands. May be, action is needed to protect the island breeding habitats by keeping mammalian predators away.

5.8.2 Migratory birds

In 22 out of 34 water bird species numbers have experienced declines over 1992-2000. This is an alarming and new development since the 1999 Wadden Sea QSR.

Favourable food availability and sufficiently large undisturbed roosting and moulting areas are the two major target relevant for migratory birds.

Food availability - What can be said about food availability? Of the 22 species showing a decreasing trend, 19 were dependent on feeding on benthos, incl bivalves, for 'fast refuelling' during their migration to the breeding and wintering areas. This is an indication of non-favourable food availability, although other risk factors may play a role. For the migratory bird species within this group and specialising in molluscs (e.g. eider, oystercatcher, knot and herring gull), food availability was impaired due to shellfish fishery. In conclusion, the target is not met.

In contrast, for herbivorous species (e.g., dark-bellied brent goose, Eurasian wigeon, barnacle goose) food availability seems not to be limited.

Undisturbed roosting and moulting - For three species important moulting areas exist in the Wadden Sea and offshore zone viz. for shelduck, common scoter and common eider.

Protection of moulting shelduck has been improved through voluntary agreements with different user groups (e.g., fishermen, yachtsmen) aimed at avoidance of disturbance during the moulting season.

Although most high tide roosts are situated in well protected areas, still disturbances occur due to outdoor recreation, and some species prefer high tide roosts on agricultural land, which are not well protected or not protected at all. Therefore, the target is not satisfactorily met.

5.9 Marine mammals

The common target for each of the most important marine mammal species in the Wadden Sea area is to have viable stocks and a natural reproduction capacity. Monitoring of harbour and grey seal in the Wadden Sea is organised in the framework of the Seal Management Plan 2002-2006 (SMP 2002) under the Bonn Convention. The implementation of the Seal Management Plan is done by the trilateral Wadden Sea cooperation.

5.9.1 Harbour (= common) seal

The harbour seal population, that quickly recovered from two successive PDV-epizootics, can be considered viable having a satisfactorily high reproduction capacity.

New knowledge obtained through satellite transmitters mounted onto harbour seals, showing that these animals use the North Sea to a much greater extent than realised before. The reason for this is not well known.

5.9.2 Grey seal

Grey seals have increased in the Dutch and Schleswig-Holstein part of the Wadden Sea. There are signs of expansion of the population to other parts of the Wadden Sea (e.g. Borkum Riff, Norderney). Although reproduction has increased, a major part of the population increase is due to influx from populations elsewhere such as from the east coast of Great Britain.

Protection of grey seals is not yet optimally organised, and the target cannot be evaluated with satisfaction due to insufficient data. Grey seal monitoring is not included in the TMAP Common Package.

5.9.3 Harbour porpoise

The Offshore Area and adjacent North Sea, especially off Schleswig-Holstein, is important for harbour porpoise. Dedicated trilateral (TMAP) surveys with harmonized methods do not exist. As a consequence, the target cannot be evaluated due to insufficient information.

6. Discussion and Conclusions

New information, as made available in the 2004 Wadden Sea QSR, provides answers to questions and allows to evaluate the targets of the Wadden Sea Plan. There are, however, several limitations.

As stated above, not all Wadden Sea Plan targets are operational, meaning that the targets have been translated to well defined parameters to be monitored. In most cases, the TMAP Manual (TMAP 2000.) provides such a parameter definition. In other cases, such as with respect to the natural dynamics of beaches and dunes, operational monitoring objectives have not yet been formulated.

An other aspect to be discussed is the mere absence of quantifiable targets. Most targets refer to an increase (e.g. area of sea grass fields) or a favourable situation (e.g. food availability for birds) without any further specification. Of course, policy makers wanted the targets to be that general, that vaguely formulated, allowing the partners in the Wadden Sea Cooperation some room for manoeuvre. The drawback of this is that when the time has come for evaluation the policy makers see themselves dependent of the opinions of various specialists regarding the targets being met or not. And specialists may not always be fully objective. The consequence would be to reconsider targets in such a way that they can easily be translated in objective and quantifiable monitoring objectives.

Having said that, and assuming that a nice set of well defined monitoring parameters has been agreed, are we then wise to only monitor those parameters that enable to tell us whether a certain quantified target is met? For example, a total area of sea grass fields with more than 10% cover of "X" thousand hectares, with a natural distribution over the different subregions of the Wadden Sea as $x : y : z : \dots$? My answer is "no". It is of utmost importance to be able to discriminate between changes due to human activities, that directly or indirectly influence the target, and changes due to natural processes, e.g. climatic change. Moreover, the Wadden Sea is a wide open system, being influenced from land as well as from the North Sea. So, the policy makers must be prepared to fund monitoring programs that provide both these options.

New information usually also brings new questions to be answered. This is because we are working with a simplified notion of reality, in policy making, in management as well as in research. This Wadden Sea QSR comprises quite a number of recommendations for further

research to fill gaps in our knowledge of the functioning of the Wadden Sea ecosystem. Among these gaps are apparent functional differences between northern and southern parts of the Wadden Sea, such as in the case of nutrient concentrations in relation to decreased discharges from the major rivers. An improved understanding of such regional differences will contribute to a better protection of the Wadden Sea.

The trilateral cooperation is not the only player in the Wadden Sea arena. The policy world around the Wadden Sea is changing. Most important in this respect are the European Directives, such as Birds, Habitats and Water Framework Directives. All these include obligations for nations, and in the case of the Water Framework Directive at the sub-nation scale of River Basin Districts. In comparison, the transnational character and experience of the Wadden Sea Cooperation is of particular added value. The Guiding Principle of the trilateral Wadden Sea policy “to achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way” (Esbjerg Declaration 1991) remains valid.

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