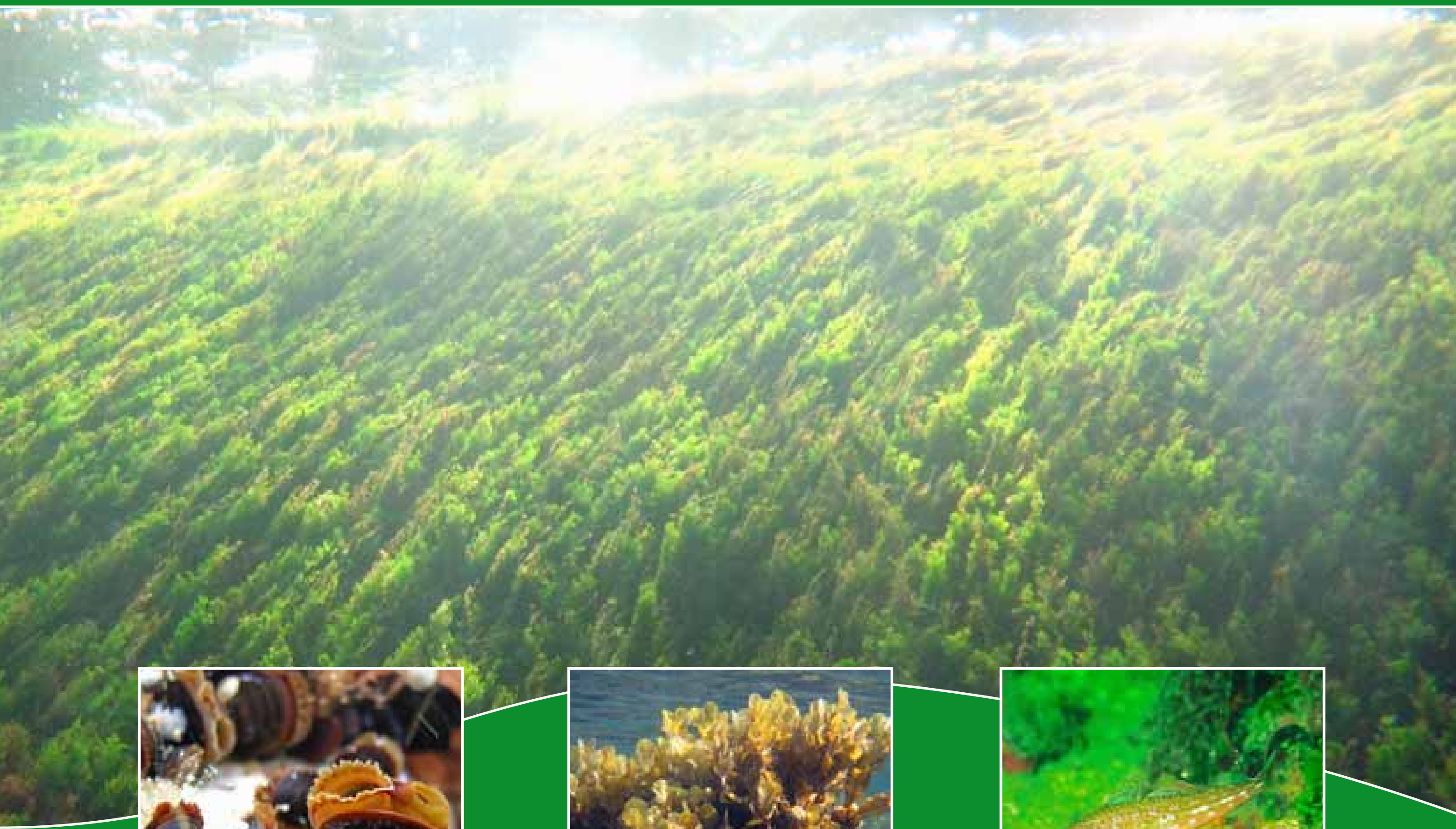
Baltic Sea Environment Proceedings No. 116A

Biodiversity in the Baltic Sea

An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea

Executive Summary



Helsinki Commission

Baltic Marine Environment Protection Commission

Preface

In November 2007, the Ministers of the Environment of Contracting Parties of the Helsinki Commission (HELCOM) adopted the Baltic Sea Action Plan (BSAP), with the target of achieving good ecological status in the Baltic Sea. The biodiversity segment of the Action Plan aims to reach a favourable conservation status of Baltic biodiversity by 2021. This complements other segments of the BSAP aimed at combating eutrophication and decreasing inputs of hazardous substances.

To be able to follow the environmental status of the Baltic Sea in response to actions taken by the HELCOM Contracting Parties, there is a need for regular evaluation of the status of biodiversity and its conservation. This requires the development of a harmonized approach to assessing conservation status, as identified in the BSAP. This Executive Summary presents an overview of the first integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea, covering an assessment of the status of biodiversity and human pressures impacting it, as well as recommendations on how to reach the targets of the Action Plan. The full assessment report (HELCOM 2009a) contains the detailed assessment results and information on the methodology used for the assessment, as well as the citations to the scientific literature that has been used.

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1 Introduction

The Baltic Sea is characterized by a relatively low species diversity compared to most marine and freshwater systems, primarily due to the brackish water and its young geological age. Currently, the number of known species in the Baltic Sea amounts to several thousand, with the majority belonging to the planktonic community. The diversity of the smallest organisms, i.e. bacteria and viruses, is however still largely unknown.

The Baltic Sea has highly varied coastlines, large archipelago areas and a seabed that is shaped into sub-basins with different physical and chemical properties. All these factors have an impact on the distribution of species on a regional and local scale. Salinity has a particularly strong influence on the Baltic biodiversity and determines the distribution limit of many species with more species able to live in the more saline southwestern waters than in the northern areas which are characterized by almost limnic waters (Fig. 1).

The Baltic Sea is a dynamic system that has undergone decadal variations in salinity, oxygen and temperature during the past decades. Changes in the abundance and distribution of pelagic and littoral species and communities in the Baltic Sea have been linked to these climate-driven variations in hydrography. The Baltic Sea region is also home to a population of approximately 85 million people living in the large catchment area of more than 1 700 000 km^2, with a well-developed agricultural sector and other human activities resulting in large inputs of nutrients as well as the release of a number of hazardous substances to the Baltic Sea. Sea-based activities including fishing, maritime transport, extraction of marine aggregates, and construction of offshore wind farms and other installations also influence the environment and distribution of species. Thus, the Baltic Sea is affected by a multitude of natural and anthropogenic factors which have contributed to considerable changes in biodiversity.

What is biodiversity and why is it important?

The concept of biodiversity embraces not only the variety of living organisms but also the genetic diversity within a species and the diversity of habitats and landscapes.

The significance of diversity is emphasized by its role in supporting the capacity of the ecosystem to adapt to changing conditions. There is, for example, ample evidence for a positive relationship between the number of species and ecosystem productivity and stability over time. Maintenance and protection of species diversity is inextricably linked to the preservation of the different environments that serve as a habitat for species and populations. Other fundamental aspects of biodiversity include genetic diversity, which is central for adaptation to changing conditions, and the functional diversity within the ecosystem. Furthermore, large predators have an important structuring role in the ecosystem and the trophic levels can be considered as a vertical diversity of the food web. Reduction of top predators through fishing or hunting has been shown to cause trophic cascades in many aquatic environments. Changes in the environment that result in decreases in any of these aspects of biodiversity

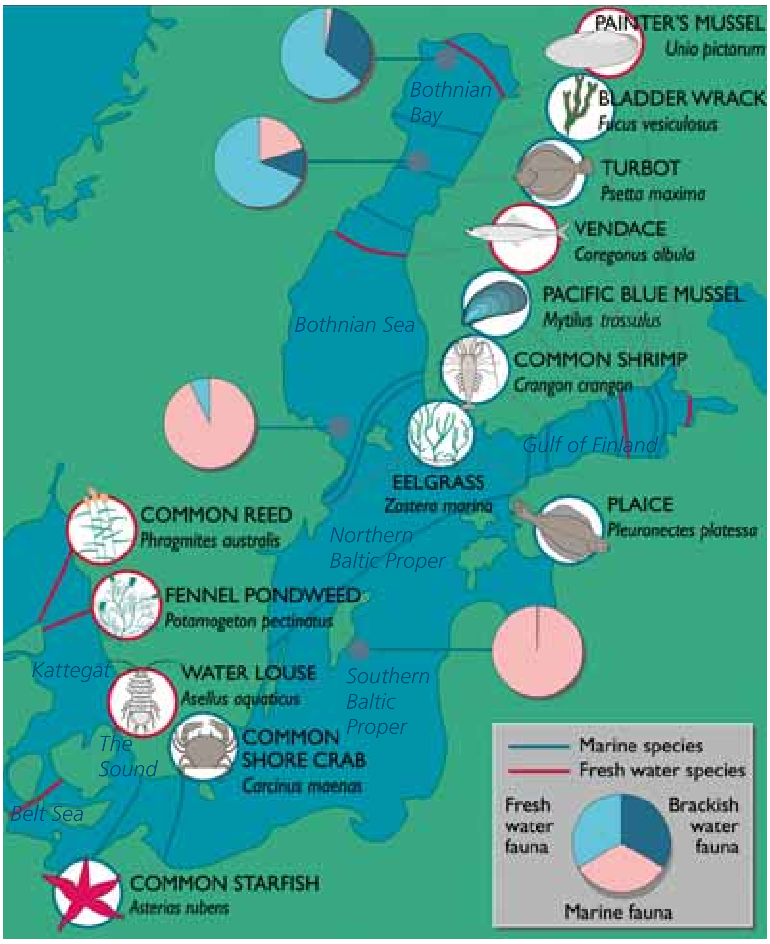

Figure 1. Map with distribution limits of some Baltic Sea marine and freshwater species and the Baltic Sea basins. Source: Furman et al. 1998 in the full assessment report.

Reef community with *Fucus serratus*, Adlergrund

make systems less resilient and more prone to undergo so-called regime shifts. The Baltic Sea is inherently low in species, genetic, and functional diversity, and thus, protection of biodiversity is central to ensuring ecosystem resilience.

How can we measure our progress toward preserving biodiversity?

The strategic goal for biodiversity set forth in the Baltic Sea Action Plan (BSAP) is a 'Favourable conservation status of Baltic Sea biodiversity'. Ecological objectives further define the status that HELCOM Contracting Parties want to achieve, namely:

- Natural marine and coastal landscapes,
- Thriving and balanced communities of plants and animals, as well as
- Viable populations of species.

For each of the ecological objectives, the Action Plan contains a number of more detailed targets, with deadlines for their achievement, to be employed for monitoring the progress towards the strategic goal and ecological objectives.

The integrated thematic assessment of biodiversity (HELCOM 2009a) is intended to provide a baseline for measuring progress towards the goals, objectives, and targets identified in the Action Plan. In accordance with the hierarchy of the biodiversity-related ecological objectives of the BSAP, the assessment has been carried out at the levels of landscapes, communities, and species.

2 Diversity of Baltic marine landscapes and habitats

Marine landscapes provide a simple broad-scale overview of the often complex interactions of the various oceanographic and physical factors constituting the marine environment. Habitats describe the abiotic characteristics of an environment and the associated biological assemblages at high-level resolution. In general, areas with high landscape and habitat diversity can be expected to harbour a higher diversity of species. Sound knowledge of the marine landscapes and habitats is therefore crucial for informed nature conservation and the designation of marine protected areas.

Mapping marine landscapes

A specific target of the Baltic Sea Action Plan (BSAP) is to "By 2021, ensure that 'natural' and near-natural marine landscapes are adequately protected and the degraded areas will be restored". This target requires that the marine landscapes are identified, mapped, and their biological and ecological relevance described.

The EC-funded 'BALANCE' project has provided a first step towards identifying and mapping the marine landscapes of the Baltic Sea. Based on aggregated information on sediment composition, available light and salinity at the seabed, 60 marine landscapes have been identified in the Baltic Sea (Fig. 2). These landscapes provide a coherent, broad-scale, ecologically relevant map for marine areas, although only at a very coarse scale.

In order to make full use of the applications of the approach and to be able to assess the objectives and targets of the BSAP, there are a number of areas where further development of the marine landscape maps is needed. These include, for example, the need to describe benthic biological communities present within individual marine landscapes in more detail, to establish thresholds for the proportion of a marine landscape that can be affected by pressures and still retain the provision of ecological services, and to establish targets that allow an assessment of changes over time.

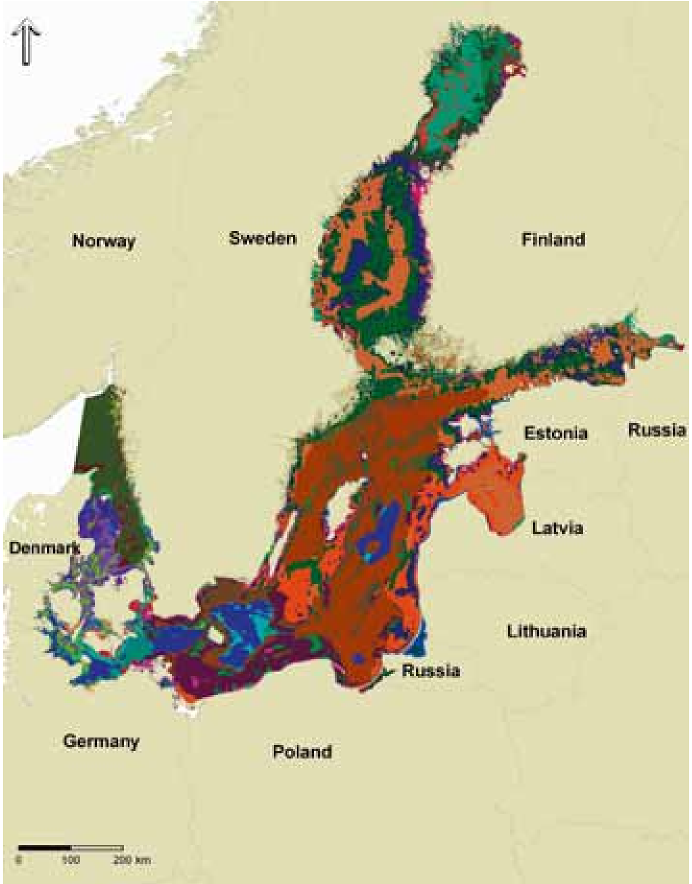

Figure 2. **Benthic marine landscape map of the Baltic Sea. The different colour codes of the marine landscapes reflect different combinations of the three basic maps: marine seabed sediment map, map on photic and non-photic zones and bottom water salinity map (Figures 2.1.1a, b and c in HELCOM 2009a) which were used to produce the marine landscape map by using map algebra software. Source: BALANCE, see Al-Hamdani & Reker 2007 in the full assessment report for details.**

Status of Baltic Sea habitats

A habitat is a particular environment that can be distinguished by its abiotic characteristics and associated biological assemblage, operating at particular but dynamic spatial and temporal scales in a recognizable geographic area. HELCOM commonly uses the term biotope as a synonym to habitat. The BSAP includes the target: "By 2010 to halt the degradation of threatened and/or declining marine biotopes/habitats in the Baltic Sea, and by 2021 to ensure that threatened and/or declining marine biotopes/habitats in the Baltic Sea have largely recovered".

There are no long-term data available allowing an analysis of trends in the status of the Baltic Sea habitats. Therefore, the assessment makes use of the first threat assessment of Baltic Sea habitats published in the HELCOM Red List of Marine and Coastal Biotopes of the Baltic Sea. In addition, the recently prepared HELCOM Lists of Threatened and/or Declining Species and Biotopes/Habitats in the Baltic Sea Area and the 2001–2007 reports on the conservation status of the habitats listed in

	Denmark		Estonia		Finland		Germany		Latvia		Lithuania		Poland		Russia	Sweden	
	N2K	HEL	N2K	HEL	N2K	HEL	N2K	HEL	N2K	HEL	N2K	HEL	N2K	HEL	HEL	N2K	HEL
Sandbanks	Bad	3	Favourable	3	Inadequate	3	XX	2	Favourable				Favourable	3	2-3	Inadequate	3
Estuaries	Favourable	3	Favourable	3	Bad	3	Bad	2		2	Favourable	3	Inadequate	3	2-3	Inadequate	2
Mudflats or sandflats	Bad	3	Favourable	3		3	Inadequate	3		3		P		3	2-3	Inadequate	
Coastal lagoons	Bad	3*	Favourable	3*	Inadequate	2	Bad	2*	Favourable	2*	Favourable	2*	Inadequate	2*	2-3*	Bad	3
Large shallow inlets	Bad	3	Favourable		Inadequate	3	Inadequate	2					Inadequate		3	Inadequate	
Reefs	Bad	3	Favourable	3	Inadequate	3	XX	2	Favourable	3	Favourable		Favourable		Presumably not endangered	Bad	3
Submarine structures	Bad	2-3															
Baltic esker islands		P			Inadequate	2									Presumably not endangered	Favourable	3
Baltic narrow inlets					Inadequate	3										Inadequate	3

* These results represents the assessment of biotope complex Lagoons

N2K: Conservation status of Natura 2000 habitat types. Bad, Inadequate, Favourable

HEL: Threat status according to HELCOM 1998. 0 Completely destroyed, 1 Immediately threatened, 2 Heavily endangered, 3 Endangered, P Potentially endangered, Presumably not endangered

Table 1. Overview of the conservation status of the Baltic Sea marine Natura 2000 habitats in comparison to the HELCOM threat assessment (HELCOM 1998 in the full assessment report). For more detailed assessment, see Annex III of the Biodiversity in the Baltic Sea, An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea (HELCOM 2009a).

the Habitats Directive from Baltic Sea EU Member States to the European Commission (EC) have been used to assess the status of habitats in the full thematic assessment report. Table 1 summarizes the results of the reports of the Baltic Sea EU Member States to the EC in comparison with the threat assessments in the HELCOM Red List. It is clear from the summary table that there are discrepancies between the HELCOM assessment and the reporting by EU Member States to the EC.

As described in more detail in the full assessment report, the biotopes/habitats in the HELCOM Lists are all to some degree threatened and/or declining, although not necessarily in all sub-regions of the Baltic Sea area or in all Baltic maritime areas of HELCOM Contracting Parties. From a Baltic-wide perspective, none of the habitats/biotopes assessed by HELCOM can be considered as being in a favourable conservation status. The situation is troubling in particular for biotope complexes such as offshore deep waters below the halocline, lagoons and estuaries, as well as for some benthic biotope types such as seagrass beds and macrophyte meadows and beds. The poor environmental status of habitats has implications far beyond the local scale because the habitats are important living, feeding, reproduction and nursing environments for associated flora and fauna.

In order to reach the target of the BSAP related to habitats and biotopes, there is an urgent need for actions to protect and restore them. The BSAP also requires the HELCOM Red List of Biotopes to be updated by 2013. Periodic updates of this List in the future will make it possible to assess trends in the threat status and thus to evaluate whether the BSAP target to halt the degradation and ensure the recovery of threatened and/or declining marine biotopes/habitats is being fulfilled.

3 The Baltic Sea communities

Communities are assemblages of species within an ecosystem. The different communities form an intricate web with predatory, competitive, synergistic and commensal interactions. Thus, changes in one community inevitably affect other components of the Baltic biodiversity (Fig. 3).

The Baltic Sea Action Plan (BSAP) includes the ecological objective 'Thriving and balanced communities of plants and animals' and also a number of more specific targets. Owing to their fundamental role in the ecosystem, assessment of the composition of the communities as well as of their key species provides a central component for determining the conservation status of the Baltic Sea.

Signs of change and deterioration in Baltic communities

Phytoplankton communities: A number of changes in the community composition have occurred during the past thirty years, for example, a shift in dominance from diatoms to dinoflagellates during spring bloom periods. Seen over a longer time period, nutrient enrichment has resulted in increased phytoplankton productivity, that is, eutrophication, with more prevalent algal blooms.

Habitat-forming species: Important habitat-forming species such as bladder wrack, eelgrass, and stoneworts have decreased in abundance in many coastal areas especially in the southernmost parts of the Baltic Sea. The decrease is most pronounced in highly polluted and eutrophied areas as well as in areas subject to physical disturbance to the sea bottom. For bladder wrack, a decline has also been observed in areas with low disturbance, indicating that large-scale hydrological and hydrographical changes in the Baltic Sea area may influence the population.

Zooplankton communities: The zooplankton community has also displayed significant changes over recent decades. Climate-driven changes in salinity and temperature are likely important factors behind the observed changes in the offshore copepod communities in the Baltic Proper and the southern Baltic Sea. In addition, eutrophication has contributed to the decreasing volume of oxygenated water below the halocline in offshore areas, thereby reducing the volume of water suitable for the reproduction of zooplankton species that require higher salinities. As copepods are key components of the pelagic food web and important sources of food for planktivorous fish, the observed changes in zooplankton communities have had cascading trophic effects which can be observed as reduced weight at age, general condition, and reproduction of Baltic herring and sprat.

Benthic invertebrate communities: Soft-sediment macrofaunal communities in the open-sea areas of the Baltic Sea are naturally constrained

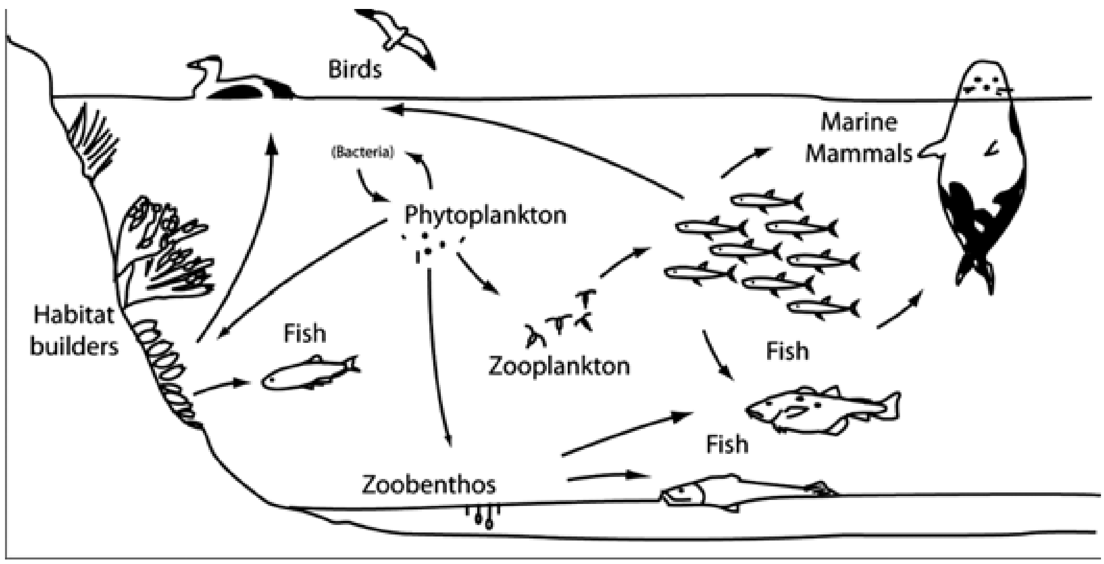

Figure 3. Food web illustration depicting the links among Baltic Sea communities (Hermanni Backer).

Stonewort *Chara* sp., Archipelago Sea, Finland.

by the strong horizontal and vertical gradients in salinity. These conditions result in strong gradients in species and functional diversity throughout the Baltic Sea. Although multiple stressors affect benthic communities in the Baltic, eutrophication and the associated increased prevalence of oxygen-depleted deep water have emerged as the major stressors. Currently, macrobenthic communities are severely degraded and abundances are below a 40-year average in the entire Baltic Sea (Fig. 4).

Fish communities: Fish communities are currently out of balance in several areas of the Baltic Sea. This is evidenced by significant declines in, or in some cases a complete lack of, large predatory fish in the system, a further increase in eutrophication-favouring species in coastal areas, and a decrease in several valuable commercial fish stocks. Since the mid-1980s, the Baltic fish community has undergone a shift from a dominance of demersal communities (e.g., cod) to clupeids (e.g., herring and sprat, Fig. 5). The shift was caused by a combination of natural (i.e., climate variability) and human-mediated factors such as overfishing. Several stocks of migratory fish species are in poor condition because of damming or blocking of migratory pathways.

Overall, eutrophication and fisheries stand out as the two most prominent human pressures behind observed changes in the communities in Baltic

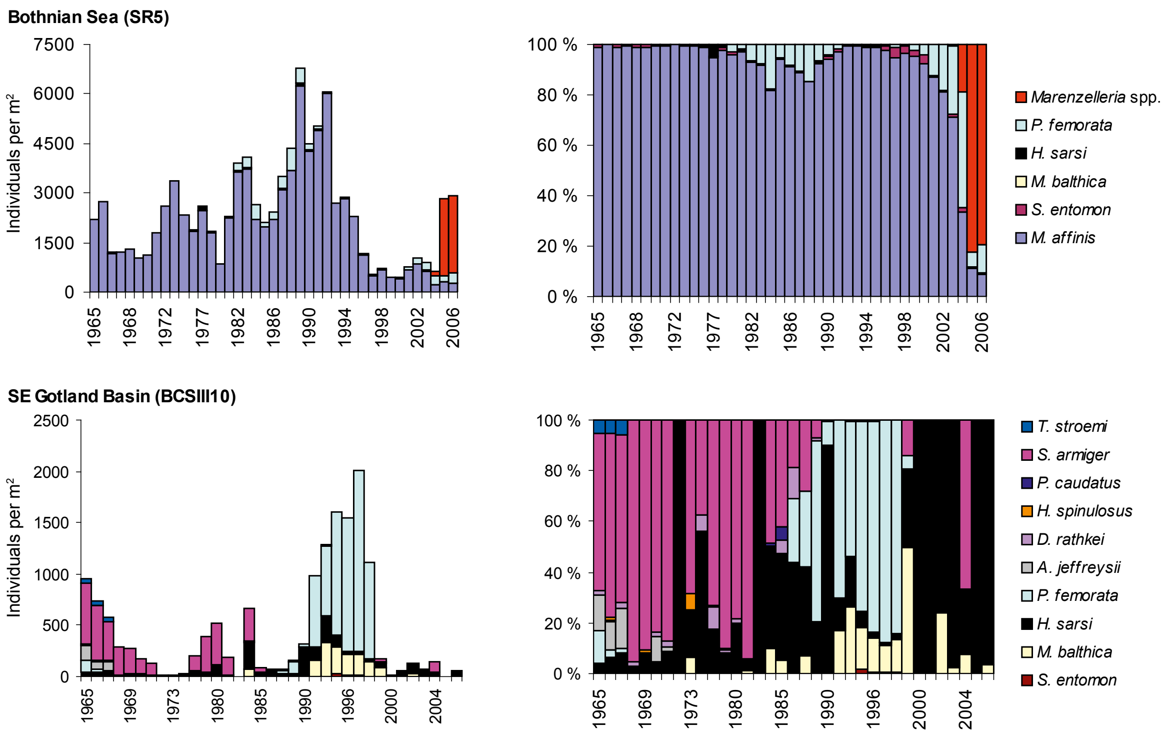

Figure 4. **Long-term changes in benthic community abundances (individuals per m²) and composition (illustrating species turnover) are depicted for two stations: SR5 in the Bothnian Sea and BCSIII10 at Southeast Gotland Basin. Note the different x- and y-axes.**

Sea offshore areas. Climate-driven changes in salinity and sea-surface temperature, as well as deep-bottom oxygen depletion, have enhanced the negative impacts of eutrophication and fisheries during recent decades. In coastal areas, physical disturbance, such as construction works and the almost ubiquitous human impact, add significant stress on the biota. In order to achieve the community-level targets of the BSAP, fishing pressure, eutrophication, pollution, coastal degradation and bioinvasions need to be addressed.

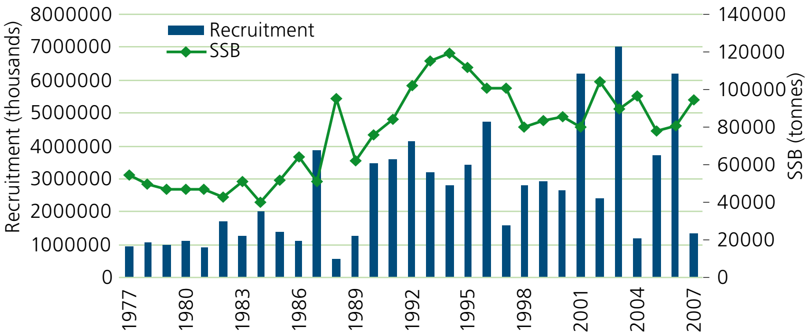

Figure 5. Recruitment (R, age 1 in thousands) and spawning stock biomass (SSB, in tonnes) of the Gulf of Riga herring during 1977–2007 (ICES 2008b in the full assessment report).

Signs of improvement

Aquatic vegetation. In a number of coastal areas of the Baltic Sea, particularly in the northwestern and northeastern Baltic Proper, submerged aquatic vegetation is showing signs of recovery after years of deterioration.

Fish. There have been several positive signs for Baltic fish in recent times. These include, amongst others, an improvement in the natural smolt production of certain salmon populations, improvement of sea trout populations in the western Baltic, significant improvement in the smelt stock in the Gulf of Riga, and an increase in the share of piscivorous fish and the trophic level of fish communities in some coastal areas. These improvements are results of various measures to improve the environment of the Baltic Sea during recent decades.

Baltic herring trawling, Bothnian Bay

4 Assessment of selected Baltic species

The Baltic Sea Action Plan includes (BSAP) the ecological objective 'Viable populations of species'. In the full assessment, species were mainly addressed as representatives of the Baltic Sea communities (see Section 3, above). The assessment of individual species included a special set of species that are either threatened or associated with specific targets in the BSAP. Particular attention has been given to the populations of the harbour porpoise, seals, and a selection of birds.

Some populations of Baltic species are in decline

Threatened and declining species. There are currently 59 species that are considered as threatened or declining in the Baltic Sea (Fig. 6). The only known species extirpated in recent decades is the sturgeon. All marine mammals are under threat or in decline, at least in some parts of the Baltic. The largest single group of threatened or declining species is fish and lampreys, which includes 23 species.

Harbour porpoise. The population of harbour porpoises, especially in the Baltic Proper, is in a precarious state and continues to decline. The most important anthropogenic threats to harbour porpoises are incidental by-catch (Fig. 7), prey depletion, noise pollution and hazardous substances.

Seals. The grey seal population has increased steadily since 1988, but the recovery of grey seals south of 59°N, where they were regularly present before they were hunted to extirpation in the beginning of the 20th century, is still very slow. The status of ringed seals is still unfavorable. As is the case with harbour porpoises, fisheries by-catch and prey depletion are among the most prominent and continuing threats to seal populations, while the impacts of hazardous substances on seals are less severe today (Table 2).

Birds. Among the nine species of birds assessed, a long-term population decline is evident for dunlin, as well as a recent decline for Steller's eider

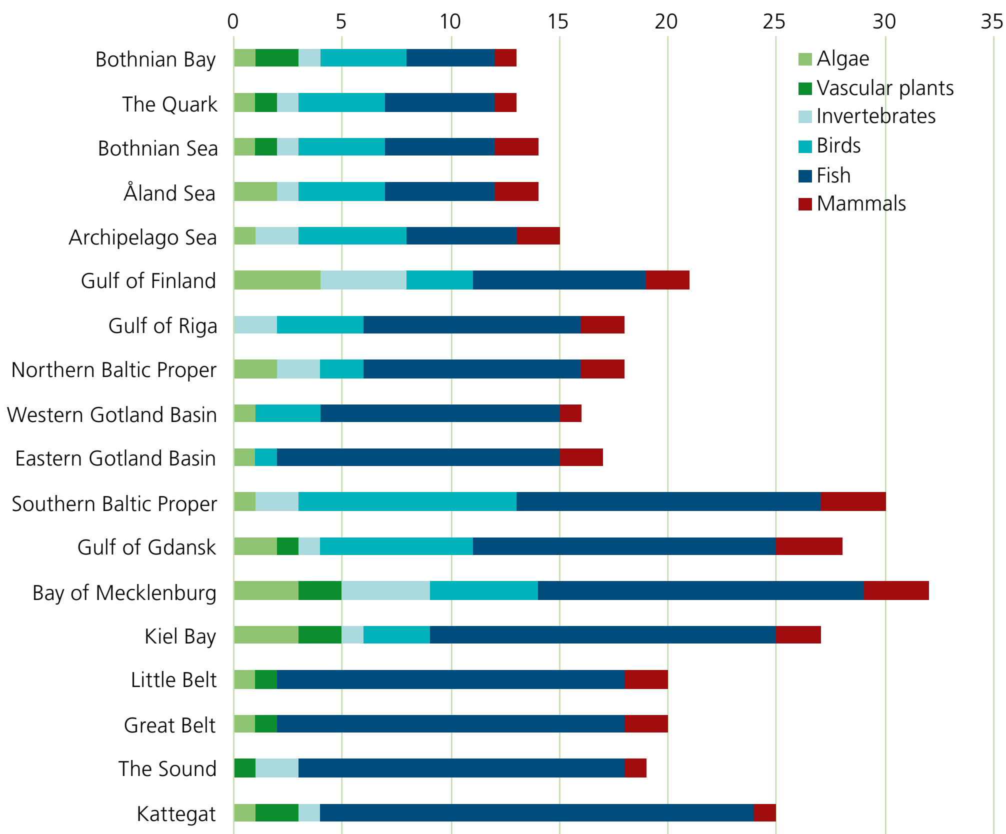

Figure 6. Number of threatened and declining species in the Baltic Sea (based on HELCOM 2007b in the full assessment report).


Long-tailed duck (*Clangula hyemalis*)

(Fig. 8) and long-tailed duck. The causes behind these declines are not well understood, but climate change (in the case of the dunlin), and shipping-induced oil spills, fisheries by-catch and habitat deterioration (in the case of the ducks) may have contributed to the decline.

Non-native species are increasing

About 120 non-native, alien species have been recorded in the Baltic Sea since the early 19th century. Thus far, alien species have mostly had an impact in coastal areas, while only a few alien species have been introduced into the open-sea environment. Certain coastal lagoons, especially in the southern Baltic, have been heavily impacted by introduced species. Most of the observed alien species, however, have not yet become invasive and have, in fact, enriched the species and functional biodiversity of the Baltic Sea. Nevertheless, new introductions pose a threat to the entire ecosystem and its functions, and the risk of new invasions remains high.

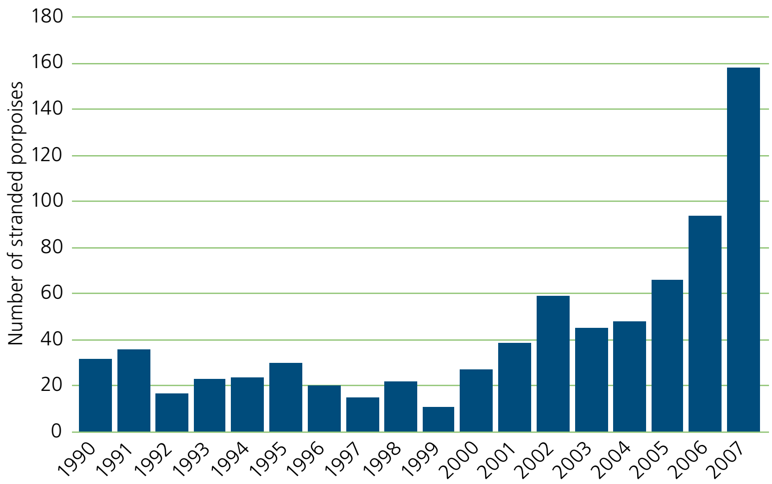

Figure 7. Number of stranded (including by-caught) harbour porpoises recorded at the German Baltic Sea coast for the years 1990 to 2007. Sources: Siebert et al., unpublished report to the Ministry for Agriculture, the Environment and Rural Areas (2008); as well as the database of the German Oceanographic Museum, Stralsund.

Table 2. **Population estimates and threats to the conservation of seals in the Baltic Sea.**

	Population beginning 20th century	Estimated hauled-out population/trend	International protection	Conflict seal/ fishery	Major threats
Harbour seal	5 000 (Baltic Proper)	Baltic Proper: Currently: 630 1970s: 100 Trend +7.9% per yr	Bern/Bonn Conventions	Minor	Contaminants/diseases Entanglement in fishing nets Human disturbances Food limitation
		Kattegat and S. Baltic: Currently:10 100 1976: 2 200 Trend:+3% per yr	Habitats Directive	Moderate	
Grey seal	90 000	North of latitude 59°: Currently: 22 000 1970s: 2 500 Trend: +8.5% per yr	Bern Convention, Habitats Directive	Severe	Entanglement in fishing nets Contaminants/diseases Human disturbances
		South of latitude: 59° Currently: 640 Trend: slightly increasing			
Ringed seal	180 000	Gulf of Bothnia: Currently: 4 800 Trend: +4.3% per yr	Bern Convention	Increasing	Global warming Contaminants/diseases By-catches
		Gulf of Riga: Currently: 1 500 Trend: Zero		Minor	
		Gulf of Finland: Currently: 300 Trend: Zero Archipelago Sea: Currently: 150		Minor	

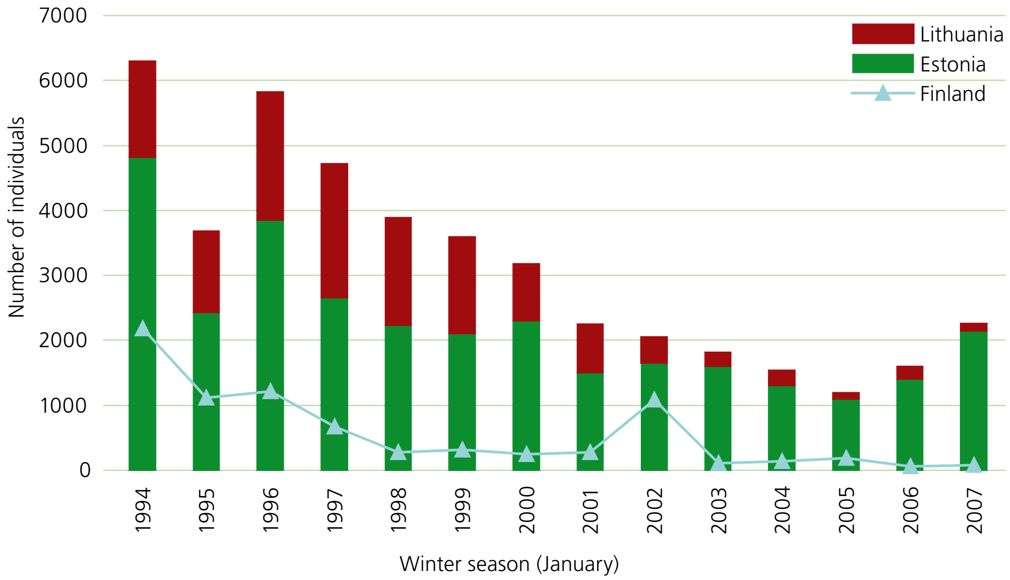

Figure 8.Numbers of wintering Steller's eiders in Estonia and Lithuania, and migrating birds at Hanko-Helsinki, Finland.

Grey seals (*Halichoerus grypus*)

Populations of several Baltic species are recovering

The protection of threatened species has been a central theme in nature conservation in the Baltic Sea area since the 1950s and improvements have been achieved among bird and mammal populations that have been subject to protective measures.

Birds. The previously threatened white-tailed eagle and great cormorant (Fig. 9) have shown considerable increase in their population size, particularly in comparison to the beginning of the 1980s.

Grey seals. The population of grey seals in the northern Baltic Sea is increasing at rates almost maximal for the species (Fig. 10).

Fish. As noted in Section 3, there has been a recent improvement in the status of several species of fish, particularly in some coastal areas.

These improvements are results of restrictions or bans on hunting, reductions in the inputs of certain hazardous substances, the protection of important habitats, biotopes and species and, to some extent, improvements in water quality. The improvements also show that concerted and inter-sectoral management actions have reversed the precarious state of certain species in the Baltic Sea to a better status.

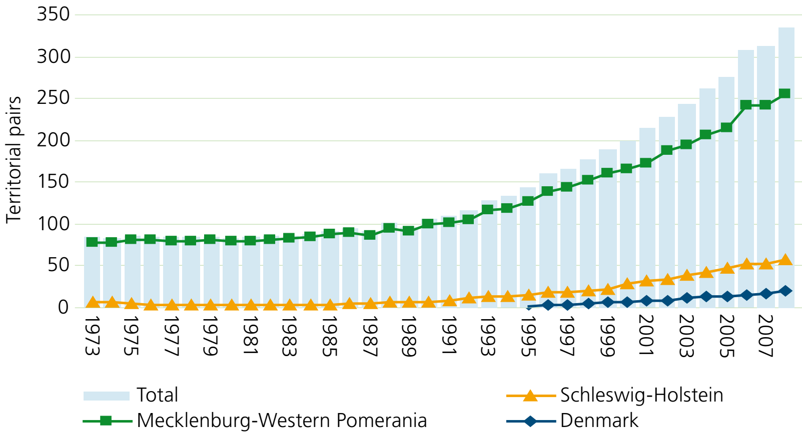

Figure 9. The population development of the white-tailed eagle in the western Baltic (Denmark, Schleswig-Holstein, and Mecklenburg-Western Pomerania), 1973–2008.

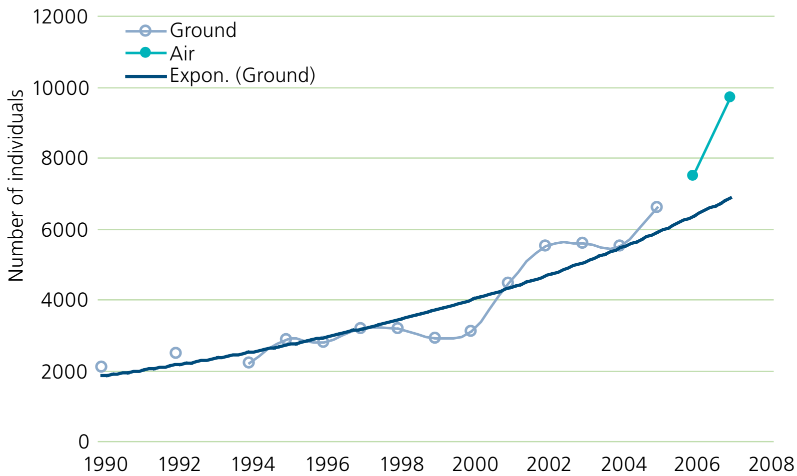

Figure 10. Numbers of grey seals counted from ground level along the Swedish coast. The annual rate of increase was 8% up to 2005. Surveys from air, started in 2006, give higher point estimates.

5 Developing an indicator-based assessment tool of Baltic Sea biodiversity

To be measurable, the HELCOM goals, and especially the three objectives for biodiversity in the Baltic Sea Action Plan (BSAP), must be defined in quantitative terms. With the newly developed approach, the status of a selection of indicators has been evaluated by comparing the desired, or historically observed, situations with the present status. This allows, at least in principle, a more exact definition of goals such as 'favourable conservation status' and a better possibility to monitor the progress towards these goals. This kind of explicit indicator-based approach is already in use in the recently published assessment of eutrophication status in the Baltic Sea (HELCOM 2009b). Compared to the well-defined topic of eutrophication, 'marine biodiversity' is a more complex concept covering a wider range of issues and ecosystem components. Also, fewer data have been available to produce biodiversity indicators, both for defining a desired target level and for assessing the current status.

Using case studies to test the biodiversity assessment tool BEAT

Twenty-two national case studies from all nine HELCOM Member Countries were made available for testing the indicator-based HELCOM Biodiversity

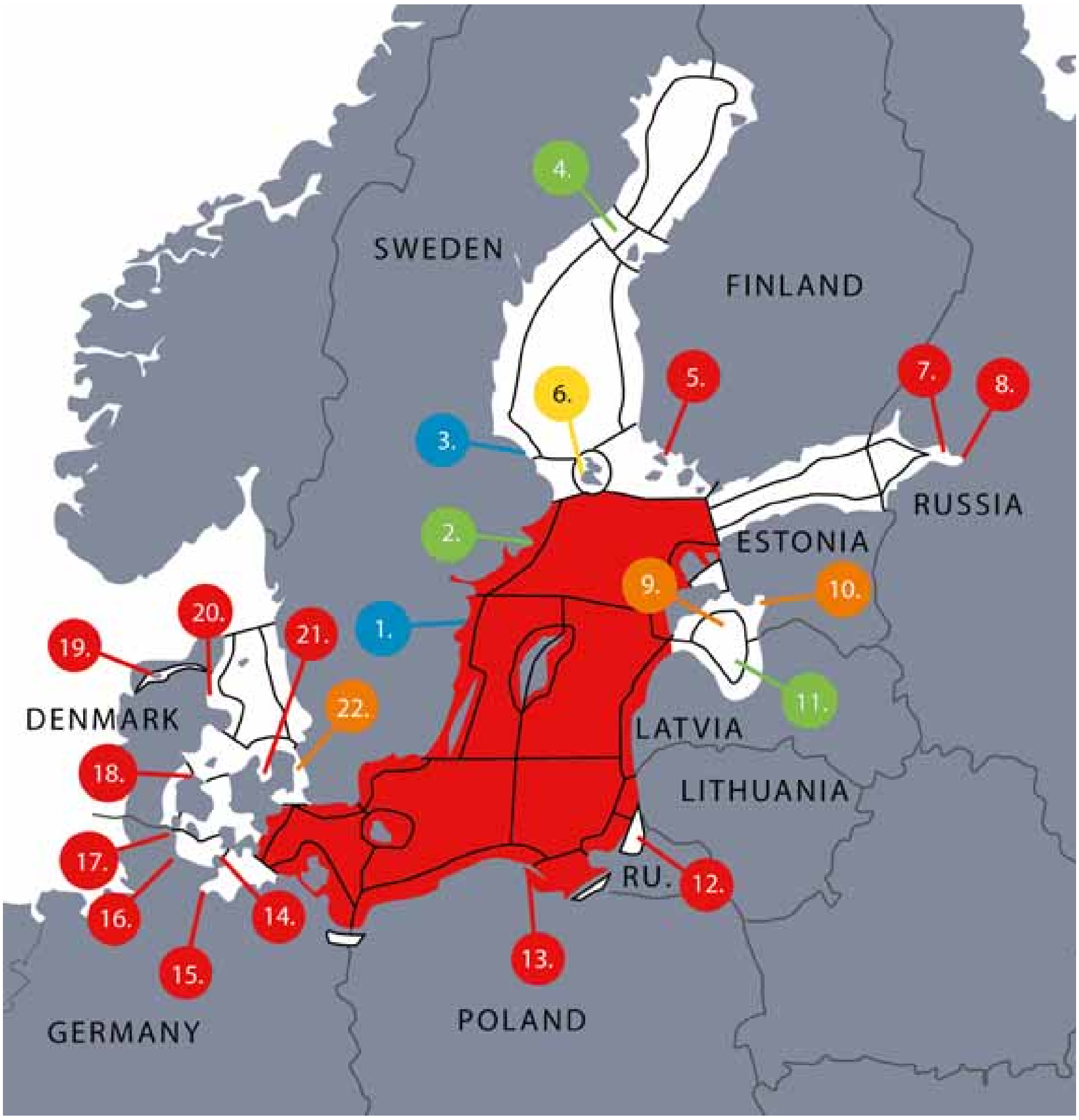

Figure 11. **Approximate location of national case studies. Colours of the pointers refer to assessment results (see Table 4). The Baltic Proper sub-basin was assessed as a whole as indicated with red colour on the map (see Table 5.4 in the full assessment report, HELCOM 2009a).**

Table 3. **Grouping of indicators associated with each category.**

Categories (Ecological Objectives on biodiversity and supporting features)	Indicator topics included within category
Category I: Marine Landscapes	Area-based habitat indicators (all types) and large geographic features
Category II: Communities	Community indicators on structure and function of phytoplankton, zooplankton, zoobenthos, macrophytes, fish community, bird community, endangered habitats and biotopes
Category III: Species	Single-species indicators of high profile species mainly fish, birds and mammals as well as indicators on endangered and alien species
Category IV: Supporting features	Indicators of environmental parameters including e.g., water clarity, water temperature, oxygen concentrations, nutrients

Assessment Tool BEAT. The location and the assessment result of the study sites is shown in Figure 11. In addition, the Baltic Proper as a whole was assessed using a compilation of available indicators to test and illustrate a geographically wider, sub-basin approach.

In order to create an overall assessment of the site, the indicators reported were grouped into the following categories: I – Landscapes, II – Communities, and III – Species, following the structure of the BSAP. In addition, a Category IV for supportive features was included to cover other parameters of interest such as nutrient concentration. The topics included in each of these categories are listed in Table 3. Within Categories I–IV, weighted averages of the ratios between pristine and present status, or Ecological Quality Ratios (EQRs), as well as the acceptable deviations (AcDev) of the individual indicators were calculated. On the basis of the EQR and AcDev values, Categories I-IV were each given a quantitative assessment according to the principles described in the full assessment report for a single indicator, based on five classes ranging from 'high' to 'bad' status.

The overall assessment of the site or geographic unit, combining the results of the four categories, was conducted by applying the so-called 'One out - All out' principle to Categories I–III. This means that the worst-performing category of these three defines the overall status of the site.

Mussel bed reef community, Jasmund, Germany

Table 4. **Assessment results of the national case studies expressed as quality classes. The overall status is based on the use of the 'one out, all out'-principle, i.e., the worst performing category except for the Supporting features (SF) category. Key: ML = marine landscapes, CO = communities, SP = species, and SF = 'supporting features', F = Fish, Z = Zoobenthos, M = Macrophytes, P = Phytoplankton, Zp = Zooplankton, B = Birds, S = Seals, E = Endangered species, C = water Clarity, T = water Temperature, N = Nutrients, O = Oxygen, Sa = Salinity.**

Case study areas	Indicator topics covered within category (see separate background document for details)				Category Status				Over-all
	ML	CO	SP	SF	ML	CO	SP	SF	
1. Kvädöfjärden	-	F(4)	F(2)	C(1), T(1)	-	High	High	Mod.	High
2. Askö-Landsort	-	Z(1), M(1), P(2)	-	C(1), N(6)	-	Good	-	Bad	Good
3. Forsmark (inner)	-	F(4)	F(2)	T(1), C(1)	-	High	High	High	High
4. Holmöarna	-	F(4)	F(2)	T(1), C(1)	-	High	Good	High	Good
5. Archipelago Sea	1	B(1), Z(2), P(2)	-	C(2)	Bad	Mod.	-	Mod.	Bad
6. Finbo	-	F(3)	F(3)	T(1),C(1), Sa(1)	-	Mod.	High	High	Mod.
7. Easten Gulf of Finland	-	Z(2), F(1)	S(1), E(2)	-	-	Bad	Bad	-	Bad
8. Neva Bay (inner)	2	Z(2), F(1)	-	-	Mod.	Bad	-	-	Bad
9. Gulf of Riga, N	1	M(2), Z(1), F(1), P(1)	F(6)	C(1), N(2)	High	Good	Poor	Bad	Poor
10. Pärnu Bay	-	M(2), Zp(3), P(1)	F(4)	C(1)	-	Mod.	Poor	Poor	Poor
11. Gulf of Riga, S	-	P (2), Z(2)	-	C(1), O(1)	-	Good	-	Mod.	Good
12. Curonian lagoon	-	M(2), Z(2), P(2)	-	N(4)	-	Bad	-	Bad	Bad
13. Puck Bay	5	M(3), F(1)	F(2)	-	Poor	Bad	Bad	-	Bad
14. Fehmarn Belt	2	M(6), Z(1), P(1)	-	N(2)	Bad	Poor	-	Bad	Bad
15. Neustadt Bay	2	M(6), Z(1), P(1)	-	N(2)	Bad	Bad	-	Poor	Bad
16. Bülk	2	M(6), Z(1), P(1)	-	N(2)	Good	Bad	-	Mod.	Bad
17. Gelting Bight	2	M(6), Z(1), P(1)	-	N(2)	Bad	Bad	-	Mod.	Bad
18. Odense Fjord	2	M(2), P(3)	-	N(7)	Poor	Bad	-	Bad	Bad
19. Limfjorden	-	Z(12), M(4)	-	C(2), N(2)	-	Bad	-	Mod.	Bad
20. Randers Fjord	-	M(2),Z(3), P(2)	-	N(4)	-	Bad	-	Poor	Bad
21. Ise-Roskilde fj.	-	M(2), Z(2)	-	N(1)	-	Bad	-	Bad	Bad
22. The Sound	1	Z(1), M(1), P(2)	-	C(1)	Poor	Mod.	-	Good	Poor

Category IV covering supporting features was not included in the 'One out - All out' principle. For technical details of the assessment approach and definitions used, see the full assessment.

Using this method, 17 of the 22 national case study areas were classified overall as having a 'moderate', 'poor', or 'bad' biodiversity status, meaning that these areas are in an unfavourable condition in terms of the indicators reported (Table 4, Fig. 11). The exceptions were five sites in the northern Baltic, but they were also limited in terms of the topics covered.

Necessary steps for future assessments of biodiversity in the Baltic Sea

Based on the initial work carried out under the BSAP to identify suitable biodiversity indicators for the Baltic Sea, the thematic assessment employed a number of such indicators in the assessments of communities and species and in the testing of the indicator-based HELCOM Biodiversity Assessment Tool BEAT. The development of indicators, however, needs to be continued in order to arrive at a coherent core set of HELCOM biodiversity indicators for use in future assessments.

When a core set of biodiversity indicators has been established for the Baltic Sea, the revision of monitoring programmes needs to be considered with the specific aim of collecting data that are needed for assessing the conservation status of Baltic biodiversity. Currently, due to lack of data, it is not possible to assess several of the targets set forth in the BSAP.

6 Status of the network of marine and coastal Baltic Sea Protected Areas

The network of Baltic Sea Protected Areas (BSPAs) was the first European regional network of marine protected areas covering a whole regional sea (HELCOM Recommendation 15/5, 1994). Today, many of the BSPAs are also included within the EU Natura 2000 network and these areas are thus now subject to legally binding regulations for Natura 2000 protected features (Fig. 12).

One of the targets of HELCOM is to have, by 2010, an ecologically coherent and well-managed network of marine protected areas. In the thematic assessment on biodiversity, an evaluation based on the data in the HELCOM BSPA database (http://bspa.helcom.fi) and GIS analyses was conducted in order to assess the ecological coherence of the BSPA network. The results of this assessment were combined with the results from a complementary assessment of the ecological coherence of the BSPA and Natura 2000 networks in the Baltic Sea, which was carried out under the EC-funded BALANCE project and was based mainly on benthic marine landscape maps. Currently, according to the database, approximately 6 % of the Baltic Sea marine area is covered by 89 BSPAs, with total area of 22 569 km^2.

Both the HELCOM and BALANCE evaluations indicate that the current BSPA network does not fulfill the criteria for an ecologically coherent network. Therefore, at present, the BSPA network cannot be considered sufficient. Table 5 summarizes the main results of the assessment.

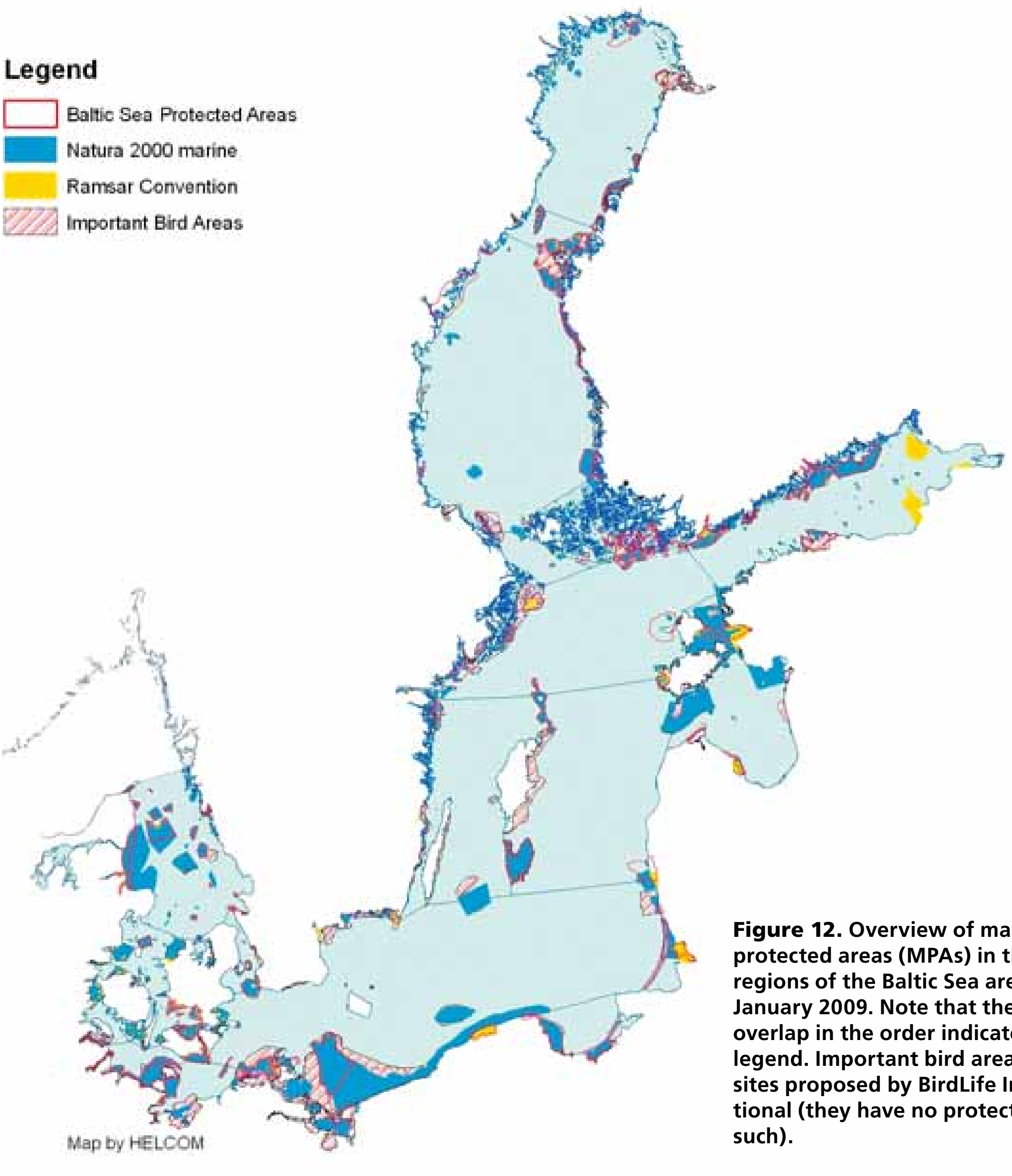

Figure 12. **Overview of marine protected areas (MPAs) in the subregions of the Baltic Sea area, as of January 2009. Note that the sites overlap in the order indicated in the legend. Important bird areas are sites proposed by BirdLife International (they have no protection as such).**

Ecological coherence can only be reached by better protection of all important features of marine biodiversity. An improved understanding of the distribution range and occurrence of biodiversity is therefore imperative. At present, information in the HELCOM BSPA database is patchy and inadequate for a comprehensive assessment and especially needs more comprehensive data on marine landscapes, habitats and species. Naturally, the establishment of an ecologically coherent network of BSPAs also requires relevant legal protection and management measures.

Table 5. Main results of the assessment of the ecological coherence of the BSPA network

Adequacy in terms of size and location	
+	The size of most BSPAs is >3 000 ha
-	The network covers less than 10% of the Baltic Sea
-	The proportionate coverage of sites differs significantly between coastal and offshore areas, sub-regions and countries

Representation of species, habitats and landscapes	
-	According to the data in the BSPA database, 29 of the 59 threatened and/or declining species in the Baltic Sea are not included in the BSPA network
-	Marine landscape types are particularly poorly represented in the deep waters dominated by hard clay and mud
-	Data deficiency especially on habitats made it impossible to carry out proper assessment

Replication of species, habitats and landscapes	
+	Replication of many landscape types is adequate in the current BSPA network
-	Hard clay and bedrock landscapes have relatively few replicates
-	According to the current data many threatened and/or declining species and habitats lack spatial replication

Connectivity between the protected areas	
+	The BSPA network is relatively well connected for species with long dispersal abilities
-	The BSPA network does not sufficiently support connectivity for the short and mid-distance disperses
-	Connectivity is very weak across deeper offshore areas


Chalk cliff, Jasmund, Germany

7 Challenges and opportunities for the protection of Baltic Sea biodiversity

Baltic Sea biodiversity is inherently sensitive to disturbances owing to its relatively limited number of species, low genetic variation, and few species within important functional groups. Deterioration of the status of biodiversity, as manifested by the decline of communities and key species, is critical because it diminishes the resilience or buffering capacity against large-scale shifts in the Baltic Sea ecosystem and increases the risk for escalating deterioration of the environment.

Protection of the marine environment of the Baltic Sea has evolved in HELCOM to embrace a full ecosystem-based approach to the management of human activities, as exemplified by the adoption of the Baltic Sea Action Plan (BSAP). The results of the thematic assessment on biodiversity show that the management of human activities in the Baltic Sea area is still far from satisfactory and does not put into practice the principles of an ecosystem approach to the management of human activities. There are, therefore, numerous challenges ahead before the BSAP goal of a favourable conservation status of Baltic biodiversity by 2021 will be achieved, but there are also numerous opportunities available. The improvements that have already taken place due to changes in management practices show that the potential for recovery of the Baltic ecosystem is in many cases substantial.

Windpark, Nysted

Decoupling economic development and environmental degradation

Economic development generally tends to be coupled to increasing environmental degradation. Despite the current global economic recession, the Baltic Sea region has seen dramatic economic growth during the past decade, resulting in added pressures on the Baltic Sea ecosystem, including an increase in maritime transportation and, in many places of the drainage area, also more intense farming and animal rearing.

In the future mitigation may not only have favourable effects, but could also have negative impacts on Baltic Sea biodiversity. Increased renewable energy production, as required by, e.g., the EU, is likely to result in the construction of offshore wind farms in the Baltic, putting further pressure on the use of the marine space. Likewise, demands for increased bioenergy production may intensify certain agricultural activities, leading to increased use of land and chemical fertilizers and thus also increased nutrient loading to the sea.

To be able to cope with the growing pressures on Baltic Sea biodiversity also in the future, there is an acute need for enhanced policy integration, linking the various human activities to environmental impacts. It is also of utmost importance that development will be sustainable and take into account potential impacts on Baltic Sea biodiversity.

Spatial planning as a practical means for policy integration

An essential component of the ecosystem approach and the implementation of the BSAP is to arrive at in truly integrated management with involvement of all economic sectors and stakeholders and to develop a system in which the environmental targets and objectives are integrated with economic and socio-economic goals.

Coastal fisheries, Greifswald lagoon, Germany

Marine spatial planning is a tool that provides an opportunity for the practical implementation of policy integration. It must be based on good scientific knowledge of the natural features and of the mechanisms by which human activities affect them. Regional spatial controls currently implemented in the Baltic Sea include marine protected areas and Traffic Separation Schemes, but a Baltic-wide coordinated means of addressing spatial issues in the form of marine spatial planning does not yet exist. Fulfilling the task in the BSAP to develop and apply by 2012, in cooperation with other relevant international bodies, 'broad-scale, cross-sectoral, marine spatial planning principles based on the Ecosystem Approach' will be the beginning of a better integration of planning systems.

Attaining a coherent network of well-managed protected areas

The establishment of marine protected areas is an explicit measure of the EU Habitats Directive, Birds Directive and Marine Strategy Framework Directive, as well as of the UN Convention on Biological Diversity. The successful completion of an ecologically coherent network of well-managed Baltic Sea Protected Areas (BSPAs) by 2010 is a fundamental target set forward initially by the 2003 Bremen Ministerial Meeting of HELCOM and OSPAR.

As illustrated by the thematic assessment on biodiversity, the network of BSPAs is not yet ecologically coherent. Detailed recommendations are set forth in the assessment on how to fulfill the 2010 HELCOM commitment, suggesting, e.g., the designation of additional BSPAs, particularly in offshore areas, and the development and implementation of management plans or measures for all BSPAs. Importantly, in order to maximize the benefit of the protected areas, there is a clear need for a multinational perspective in the designation of BSPAs and Natura 2000 sites in the Baltic Sea. The use of appropriate site-selection tools is therefore advocated, in order to apply a systematic Baltic-wide approach that ensures a proper distribution of protected areas to improve the current network.

Reducing pressures from human activities

While protected areas can preserve landscapes and habitats of particular importance and protect against resource extraction and other potentially damaging human activities (Fig. 13), this measure must be complemented with efforts to reduce pressures that are affecting water quality, to protect the ecosystem from invasive species, and to ensure sustainable resource use in areas outside the marine protected areas.

Although we do not currently have adequate knowledge to estimate the relative influence of individual pressures on the status of biodiversity in the Baltic Sea, eutrophication, fisheries, and physical disturbance in the coastal zone are undoubtedly the cause of severe impacts on Baltic biodiversity. Implementation of the agreed provisional country-wise reductions in the nutrient load included in the eutrophication segment of the BSAP is, therefore, a prerequisite also for achieving many of the objectives under the biodiversity segment. The severe impacts of fisheries on the ecosystem structure and the status of birds and mammals, as shown in the full thematic assessment, emphasize the need to implement an ecosystem approach to fisheries management, as agreed in the BSAP, in order to ensure that fisheries are conducted with minimal impact on the ecosystem as a whole. The considerable impacts of physical disturbance in the coastal zone also stress the importance of implementing integrated coastal zone management, as recommended in HELCOM Recommendation 24/10 and EU Recommendation 2002/413/EC.

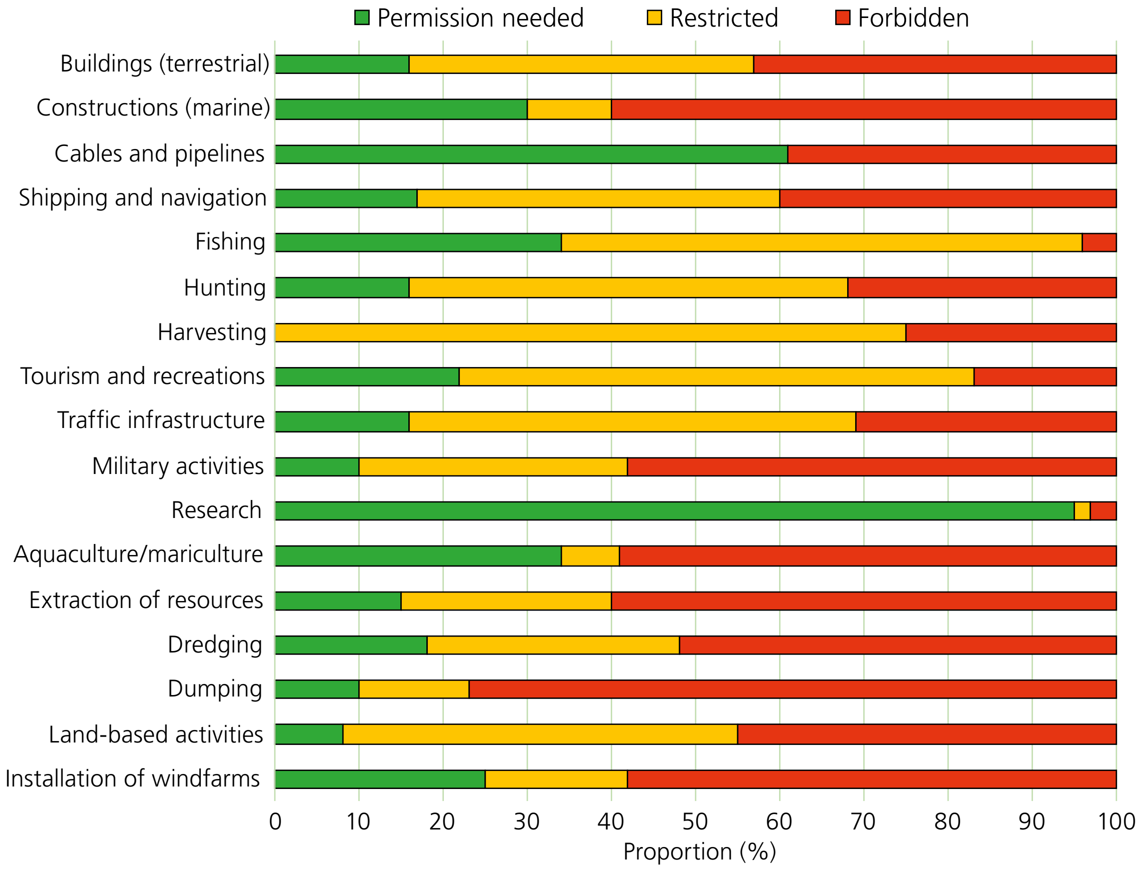

Figure 13. Activities forbidden, restricted or requiring permission within Baltic Sea Protected Areas.

Restoring severely damaged components

In areas where the capacity of the system to recover has been severely reduced, active restoration measures may be necessary in order to reach the conditions that correspond to a favourable conservation status. The BSAP emphasizes the need for research on the possibility of reintroducing valuable phytobenthos species, especially in the southern Baltic Sea. Similarly, the BSAP recommends the development of breeding and restocking practices for salmon and sea trout to safeguard the genetic variability of native stocks. However, transplantation and restocking are only alternatives when the causes behind environmental degradation have been identified and properly mitigated. Moreover, restorations are costly and clearly 'last resort' options. When viewed as such, and when conducted with best available knowledge and precautionary principles, restorations may, however, be a tool to ensure the return to a favourable conservation status of previously damaged components of biodiversity.

Åland Islands, Finland

A good knowledge base to support well-informed and cost-efficient management decisions

The most cost-efficient protection measures can only be chosen based on good knowledge, including both environmental and economic considerations. Effective protection and management measures need to balance among the three pillars of sustainable development: economic, social, and environmental.

There is a wealth of unrevealed small, underwater organisms and genetic diversity in the Baltic Sea. There is also a lack of knowledge on the distribution of many underwater ecological features. In order to fully assess, as well as protect, Baltic biodiversity, it is absolutely necessary to increase our knowledge about this underwater world. In particular, it is important that causal interactions are better comprehended, that is, that the driving forces behind changes in biodiversity are understood and that human impacts can be distinguished from natural variations. Currently, cause-effect relationships have only been established for a limited number of interactions, such as the effect of some hazardous substances on selected biota, such as seals, the relationship between nutrient concentrations and phytoplankton biomass, and the effect of fishing on fish population dynamics. However, cause-effect relationships between multiple pressures and the state of biodiversity are lacking. Although a full understanding of all possible interactions is unrealistic, better knowledge can certainly be achieved by dedicated research and modeling directed towards selected components of biodiversity.

Adaptive management is crucial

Adaptive management with regular monitoring of implementation of the Baltic Sea Action Plan, complemented with necessary review and adjustments, is an inherent feature of the BSAP. This approach includes recognition of the dynamic nature of ecosystems and the use of the most up-to-date environmental targets, data and information.

In the light of anthropogenic climate change, the need for an adaptive management framework will be increasingly important. If the climate will change as projected, the potential abundance and distribution limits of specific species and communities will also change. The highly likely acceleration of eutrophication resulting from higher runoff and changes in hydrography will also affect biodiversity. This means that management measures to protect Baltic Sea biodiversity will also need to be adjusted and in some cases reinforced. This will require effective and continuous feedback between different activities such as monitoring programmes and management measures and, importantly, the results of assessments and analyses must serve as the basis for decisions and implementation.

References

HELCOM (2009a). Integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea. Baltic Sea Environment Proceedings 116B, Helsinki Commission, 188 pp.

HELCOM (2009b). Eutrophication in the Baltic sea: An integrated thematic assessment of the effects of nutrient enrichment in the Baltic Sea region. Baltic Sea Environment Proceedings 115B, Helsinki Commission, 148 pp.

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