

# HELCOM Red List of Baltic Sea species in danger of becoming extinct

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**Helsinki Commission**

Baltic Marine Environment Protection Commission



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Baltic Marine Environment Protection Commission

Published by:

## Helsinki Commission

Katajanokanlaituri 6 B  
FI-00160 Helsinki  
Finland  
<http://www.helcom.fi>

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For bibliographic purposes this document should be cited as:

HELCOM, 2013

HELCOM Red List of Baltic Sea species in danger of becoming extinct. Balt. Sea Environ. Proc. No. 140.

Information included in this publication or extracts thereof are free for citing on the condition that the complete reference of the publication is given as stated above.

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Language revision: Howard McKee

Design and layout: Bitdesign, Vantaa, Finland

Photo credits: Front cover: Michael Zettler / Northern horse mussel, *Modiolus modiolus*

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Number of pages: 106

ISSN 0357-2994

# Table of contents

Foreword	5
<b>1 Introduction</b>	<b>6</b>
1.1 The Baltic Sea	6
1.1.1 History of the sea	6
1.1.2 Biodiversity	6
1.1.3 Challenges	6
1.2 The Red List	7
1.2.1 Background and relation to earlier HELCOM assessments	7
1.2.2 The assessment project	8
<b>2 Assessment of threatened species</b>	<b>9</b>
2.1 Background of the assessment method	9
2.2 The IUCN Red List categories	9
2.3 The IUCN Red List criteria	11
2.4 Data availability, inference and projection	13
2.5 Application of the IUCN criteria at the regional level	14
2.5.1 Some principles at the regional level	14
2.5.2 Assessment procedure at regional level	14
2.6 Key terms and definitions used	16
2.7 Implementation of the evaluation in the HELCOM area	21
2.7.1 Area under consideration	21
2.7.2 Scope of the evaluation process	21
2.7.3 HELCOM specifications to the IUCN Red List criteria	21
2.7.4 Assessment work	23
2.7.5 Data quality and uncertainty	23
2.7.6 Notations used in the tables and the Red List	23
<b>3 Results</b>	<b>25</b>
3.1 Scope of the assessment and the number of red-listed species	25
3.2 Application of the criteria	26
3.3 Past and current threats and threats in the future	26
3.4 Baltic Sea species on the global and European Red Lists	28
<b>4 Discussion</b>	<b>31</b>
4.1 Previous evaluations of threatened and declining species	31
4.2 Application of the IUCN methods in a regional sea setting	33
<b>5 Conservation and monitoring of threatened species in the 2000s</b>	<b>35</b>
5.1 Conservation	35
5.1.1. International legislation and its relevance to the HELCOM Red List species	35
5.1.2. National legislation and programmes outside international treaties	38
5.1.3. Marine protected areas	41
5.2 Monitoring	42
<b>6 Conclusions and proposals of the HELCOM Red List project</b>	<b>44</b>
<b>7 HELCOM Red List of Baltic Sea species</b>	<b>54</b>
7.1 Red List of macrophytes	54
7.1.1 Introduction to macrophytes	54
7.1.2 Level of knowledge	55
7.1.3 Assessment process	56

7.1.4 Threat status . . . . .	58
7.1.5 Main threats . . . . .	60
7.2 Red List of benthic invertebrates . . . . .	62
7.2.1 Introduction to benthic invertebrates . . . . .	62
7.2.2 Level of knowledge . . . . .	63
7.2.3 Assessment process . . . . .	63
7.2.4 Threat status . . . . .	65
7.2.5 Main threats . . . . .	67
7.3 Red List of fish and lamprey species . . . . .	68
7.3.1 Introduction to Baltic Sea fish and lamprey species . . . . .	68
7.3.2 Level of knowledge . . . . .	68
7.3.3 Assessment process . . . . .	69
7.3.4 Threat status . . . . .	71
7.3.5 Main threats . . . . .	73
7.4 Red List of Baltic breeding and wintering birds . . . . .	74
7.4.1 Introduction to Baltic Sea birds . . . . .	74
7.4.2 Level of knowledge . . . . .	76
7.4.3 Assessment process . . . . .	76
7.4.4 Threat status . . . . .	78
7.4.5 Main threats . . . . .	81
7.5 Red List of marine mammals . . . . .	90
7.5.1 Introduction to Baltic marine mammals . . . . .	90
7.5.2 Level of knowledge . . . . .	90
7.5.3 Assessment process . . . . .	91
7.5.4 Threat status . . . . .	92
7.5.5 Main threats . . . . .	92
<b>8 Species Information Sheets . . . . .</b>	<b>94</b>
<b>Bibliography . . . . .</b>	<b>95</b>
<b>Annex 1: Authors and contributors . . . . .</b>	<b>104</b>

# Foreword

This HELCOM Red List of Baltic Sea Species in danger of becoming extinct is the result of four years of work with contributions from about 80 experts from all coastal countries of the Baltic Sea.

This Red List completes the task contained in the HELCOM Baltic Sea Action Plan (2007) to produce, by 2013, a comprehensive HELCOM Red List of Baltic Sea species.

The work was organised under the HELCOM RED LIST project for elaboration of "HELCOM Red List of Species and Habitats/Biotopes", which was developed by the HELCOM HABITAT meeting in 2008 and agreed on by the 26th meeting of the HELCOM Heads of Delegation (HELCOM HOD 26/2008). The species part of the project was funded by HELCOM as well as the Contracting Parties.

The first meeting of the project was held in May 2009. The project work was organised into five teams, each chaired by a team member, and a project steering group. The teams focused on birds, marine mammals, macrophytes, benthic invertebrates and fish and lamprey species. The steering group met once per year, provided guidance to the teams and reported to HELCOM HABITAT, which had an overall supervisory role. A separate strand of work was devoted to biotopes and habitats.

The development of a Checklist of all macro species in the Baltic Sea was the first step of red-listing. The Checklist was published in 2012 in the Baltic Sea Environment Proceedings (No. 130) and it should be seen as an inherent component of this Red List. In the same manner, the Species Information Sheets that have been developed for each

red-listed species or other assessment units are integral to this Red List. They are also available on the HELCOM website.

This Red List report together with the Checklist of Macro Species in the Baltic Sea and the Species Information Sheets are an achievement which demanded a great magnitude of expert work. Although there are many persons who put in extra hours to contribute to this Red List, this assessment would not have been finalised without the devoted approach of the Project Manager Tytti Kontula and Project Coordinator Jannica Haldin (2011–2012 parental leave of Project Manager), as well as the Chair of the steering group and Chair of the benthic invertebrates team Anna Karlsson, Sweden, Chair of the fish and lamprey team Ann-Britt Florin, Sweden, and Chair of the birds team Christof Herrmann, Germany.

The proposals for conservation measures that are contained in Chapter 6 were initially drafted by the HELCOM Secretariat and reviewed, revised and complemented by HELCOM HABITAT 15/2013.

This report is the first data driven Red List report HELCOM has developed. In the future, the Red List assessments will be made part of HELCOM's regular assessment activities and the data compiled during these processes will be made available as region-wide compilations of biodiversity data on the HELCOM data portal.

I hope that this report will be useful to its readers and that it will help to focus species conservation efforts in the Baltic Sea region in the coming years.

*Maria Laamanen*  
HELCOM Professional Secretary

# 1 Introduction

## 1.1 The Baltic Sea

The Baltic Sea provides a living environment unlike any other on Earth. It is the largest brackish body of water in the world and is also shallow, young and highly dynamic. Some of its most distinguishing characteristics are the fact that it is almost entirely closed off from the neighbouring ocean, it has a very strong salinity gradient and catchment area that is about four times the size of the sea and which contains over 200 rivers. Freshwater inflow from rivers contributes to about 2% of the total water volume every year.

### 1.1.1 History of the sea

From an evolutionary and geological point of view, the Baltic Sea has offered a living environment of turmoil and radical changes. During the last glaciation it was completely covered by ice kilometres thick, which started to melt around 15 000 years ago. The basin of the present Baltic Sea formed a huge freshwater lake, the Baltic Ice Lake. During the following 9 000 years, this water body developed into a truly marine area, then into an enclosed freshwater area once more before reverting into a marine area around 6 000 years ago. That the periods of freshwater and marine water have interchanged can be clearly seen in the fossil record. Since the last glaciation, these records clearly alternate between a dominance of marine or freshwater species.

The Baltic Sea as we see it today is very young. In its current form, it is only about 3 000 years old, which is in its infancy when compared, for example, to the Atlantic Ocean that is assumed to be around 180–200 million years old. This means that the Baltic Sea still offers several ecological niches available for immigration.

### 1.1.2 Biodiversity

Because of its history and its brackish water, the Baltic Sea is characterised by a relatively low number of plant and animal species compared to more saline waters. The brackish water is too salty for most freshwater species and too fresh for most marine species. The salinity gradient goes hand in hand with a climatic gradient with up to six months of ice cover, a productive season of 4–5 months in the northern Gulf of Bothnia, and an 8–9 month

(almost double) productive season in the southern sounds near its entrance. The species that have found their way into brackish waters tend to be slower growing and smaller in size than in their original habitats, irrespective of whether their original habitats are marine or freshwater. This is at least partly a result of the fact that the environment is suboptimal for them. Thus, the Baltic Sea environment and its biological diversity are unique.

### 1.1.3 Challenges

The Baltic Sea has many challenges in regard to the wellbeing of its biodiversity. Many of the challenges are of anthropogenic origin but some are also natural. The Baltic Sea is, for example, characterised by permanent vertical stratification, meaning that the water between the surface and deeper bottom layers do not mix. This is a condition especially prevalent in the main basin and the western Gulf of Finland. This feature is detrimental to all life on deep bottoms – whenever the oxygen is consumed from the bottom water there is no inflow of additional oxygen from the surface.

Life in the deepest bottoms of the Baltic Sea is dependent on the exchange of water between the North Sea and the Baltic. Inflows of saline water along the bottoms from the North Sea to the Baltic Sea bring oxygen-rich water into its deep basins. These so called salt water pulses are, however, unpredictable and have been increasingly infrequent since the 1970s. Currently, oxygen is used up in large areas and dead bottoms cover an area larger than Latvia, and are the greatest on record to date.

Eutrophication, caused by anthropogenic nutrient pollution, exacerbates hypoxia and increases the extent of anoxic bottoms. Higher nutrient levels mean more productivity and a greater quantity of biomass in the water, resulting in more organic particles sinking to the bottom. The decomposition of organic matter increases the biological oxygen demand and decreases the oxygen levels, leading to hypoxia and, in the worst case, to complete anoxia. The excess of nutrients has also other effects in the water. The microscopic algae in the water increase as does turbidity, which means that less light penetrates through the water. With the light being restricted to a shallower water layer, a larger fraction of the bottom is in darkness and devoid of vegetation. The vegetation shrinks as



does the total area of vegetation covered bottoms. Higher nutrient levels also change the species composition of vegetation as more nutrient-rich waters favour opportunist species, i.e. species that are annual and fast growing.

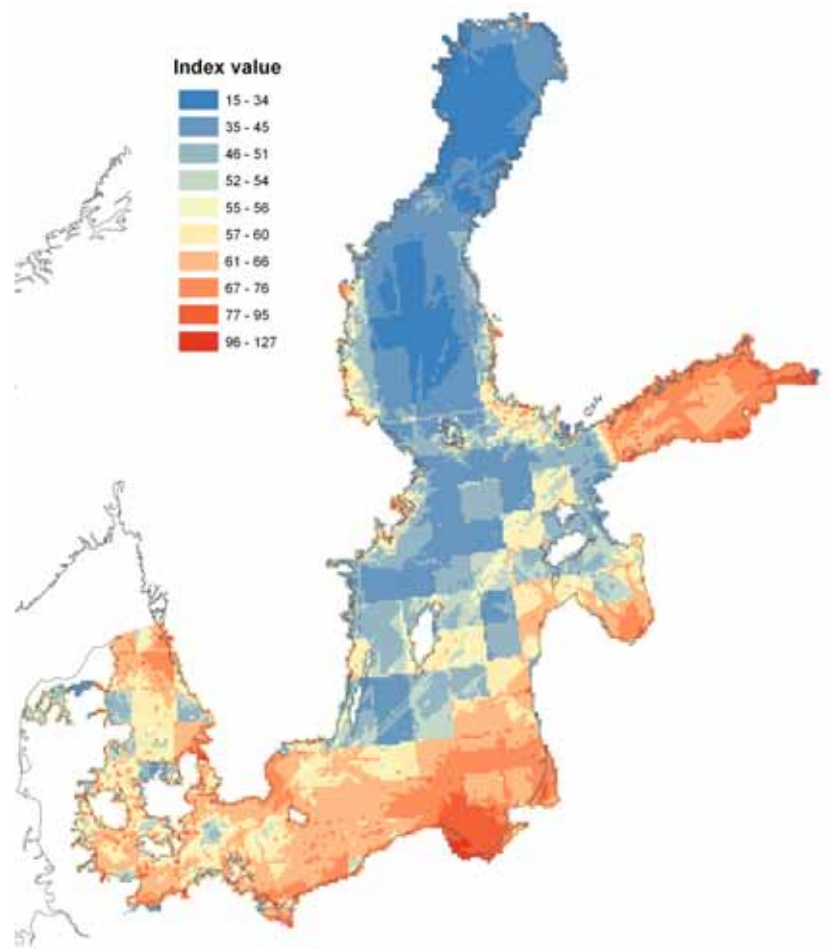
With more than 85 million people living in its catchment area, the Baltic Sea has been exposed to an extensive use of chemicals since the beginning of the industrialisation of the region in the late 19th century. The Baltic Sea has often been referred to as the most polluted sea in the world; its high contamination levels were also confirmed in the latest HELCOM assessment (HELCOM 2010c). Substances that are found to exceed threshold levels in nearly all sub-basins include PCBs, PBDEs, DDT/DDE, PFOS, cadmium, lead, TBT and cesium-137.

In addition to contaminants, various other human pressures from traffic to fisheries and coastal and marine construction works negatively affect the biodiversity of the Baltic Sea by directly killing or destroying animals and plants or by deteriorating their habitats. A summarised view on the human pressures (Figure 1.1) was presented as part of the HELCOM holistic assessment (HELCOM 2010a). According to the Baltic Sea Pressure Index (BSPI), anthropogenic pressures are concentrated in the Gulf of Finland, the southeastern Baltic Proper, and the southern and southwestern sea areas. The high Pressure Index values in the Gulf of Finland and the southeastern Baltic Sea are explained by riverine inputs of nutrients, organic matter and heavy metals, whereas in the south and south-west the high values are mainly caused by heavy fishing pressure and the atmospheric deposition of nitrogen and heavy metals (HELCOM 2010a).

## 1.2 The Red List

### 1.2.1 Background and relation to earlier HELCOM assessments

Article 15 of the Helsinki Convention on nature conservation and biodiversity urges the Contracting Parties to take all appropriate measures with respect to the Baltic Sea area and its coastal ecosystems influenced by the Baltic Sea to conserve natural habitats and biological diversity and to protect ecological processes.



**Figure 1.1** Baltic Sea Pressure Index (BSPI) showing the sum of pressures present in areas of 5 km x 5 km. The index shows the cumulative effect of 52 anthropogenic pressures. For more details on the index, see HELCOM 2010a.

The 2007 HELCOM Baltic Sea Action Plan includes the goal to achieve the favourable status of marine biodiversity as well as ecological objectives such as “thriving and balanced communities of plants and animals” and “viable populations of species”.

Three different lists outlining threatened and declining species and habitats in the Baltic Sea have previously been compiled by HELCOM. The initial assessment covered habitats and biotopes and was published as part of the Baltic Sea Environment Proceedings (BSEP 75) in 1998 (HELCOM 1998). It was followed by the Red List of threatened and declining fish and lamprey species in 2007, also known as BSEP 109 (HELCOM 2007a). This was the first HELCOM Red List to partly use the IUCN criteria. The last list (BSEP 113), also

published in 2007, covered far more species groups than the previous lists and also updated the information on habitats and biotopes found in BSEP 75; however, background information and the assessment procedure was almost entirely left out of the report (HELCOM 2007b).

In 2008, HELCOM took upon itself to compile a more detailed Red List of species, this time assessing all macroscopic species, excluding pelagic invertebrates, found in the Baltic Sea and using the criteria and categories developed by the International Union for Conservation of Nature (IUCN) for species threat assessment.

The earlier HELCOM list of threatened and/or declining species and biotopes/habitats (HELCOM 2007b) presented species and biotopes/habitats that have clearly declined at some point or which are more vulnerable to human pressures due to their rarity. Although the current Red List covers a much larger proportion of all the Baltic Sea biota than the previous list, it does not replace the previous list (HELCOM 2007b); rather, it highlights those species that appear, based on available information, to be still heading towards regional extinction in the HELCOM area. For this reason, the name of the current list is "Red List of Baltic Sea species in danger of becoming extinct". Most of the currently red-listed species are in urgent need of additional protective measures, whereas others may already be under management and will eventually improve their status. Regardless, each of the red-listed species deserves thorough consideration by the Contracting Parties to improve the status of these species in all possible ways.

In regard to the earlier HELCOM Red List of fish and lamprey species, the current Red List is to be seen as an update to the assessments. The previous Red List of fish and lamprey species applied the IUCN criteria and guidelines only partly – it was based more on expert opinions than the current assessments, which explains the majority of the changed categories between assessments.

**The Red List prepared in the current assessment is given in Chapter 6 by Red List categories and in Chapter 7 by species groups.**

## 1.2.2 The assessment project

The assessment project was started in 2009, and by 2010 four expert teams were established to prepare the assessments for macrophytes, benthic invertebrates, fish and lamprey species, and birds. Additionally, the assessments of marine mammals were carried out by an existing group, HELCOM *ad hoc* Seal Expert Group (HELCOM SEAL). The idea was to have a geographical coverage of expertise in each team; however, due to a scarcity of expert resources throughout the project this aim was not completely achieved.

The team of macrophyte experts was chaired by Georg Martin (Estonia), the team of benthic invertebrate experts by Anna Karlsson (Sweden), the team of fish and lamprey species experts by Ann-Britt Florin (Sweden), and the team of bird experts by Christof Herrmann (Germany). The assessment work for marine mammals within the HELCOM SEAL group was chaired by Olle Karlsson (Sweden). The other members of the expert teams are given in Annex 1. The HELCOM Secretariat coordinated the assessments and assisted the teams in data collection and other preparatory work. Anna Karlsson (Sweden) chaired the whole project and also acted as a supervisor concerning the application of the IUCN Red List criteria and guidelines.

As the Baltic Sea region lacked comprehensive checklists of the species groups to be assessed, the project was started with the preparation of up-to-date checklists for each species group. This was a very large task, especially for the macrophytes and benthic invertebrates, and took a considerable proportion of the project time. The Checklist of the Baltic Sea Macro-Species was published in early 2012 as a by-product of the HELCOM Red List project (HELCOM 2012).

In addition to the joint kick-off meeting, held on 21–22 October 2009 in Bonn, Germany, the teams held twelve workshops in order to prepare the checklist and the Red List assessments. A large proportion of the work was carried out intersessionally via email correspondence. The majority of the data collection was carried out and assessments prepared in 2011–2012. All assessments were reviewed by Project Manager Tytti Kontula to ensure a harmonised use of the assessment principles and criteria.

# 2 Assessment of threatened species

## 2.1 Background of the assessment method

This HELCOM Red List assessment of threatened species follows the International Union for Conservation of Nature (IUCN) Red List categories and criteria (IUCN 2001). Text directly from IUCN (2001, 2003 or 2008) is indicated with italics:

*"The general aim of the IUCN system is to provide an explicit and objective framework for the classification of the broadest range of species according to their extinction risk."*

*The IUCN Red List categories and criteria have several specific aims:*

- *to provide a system that can be applied consistently by different people;*
- *to improve objectivity by providing users with clear guidance on how to evaluate different factors which affect the risk of extinction;*
- *to provide a system which will facilitate comparisons across widely different taxa;*
- *to give people using threatened species lists a better understanding of how individual species were classified."* (IUCN 2001)

It should be noted that Red List assessments and setting conservation priorities are two related but different processes (IUCN 2003). The purpose of the Red List categorization is to produce a relative estimate of the likelihood of extinction of the taxon, based on the available information, e.g. on population trends. However, besides the Red List results, planning additional protective measures also takes into account other factors such as the probability of success of conservation actions, availability of funds or personnel to carry out such actions, and legal frameworks for conservation of threatened taxa.

*"The IUCN Red List criteria can be applied to any taxonomic unit at or below the species level. There is sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area. The categorization process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions. The latter are defined in the IUCN Guidelines for Re-introductions (IUCN 1998) as "*

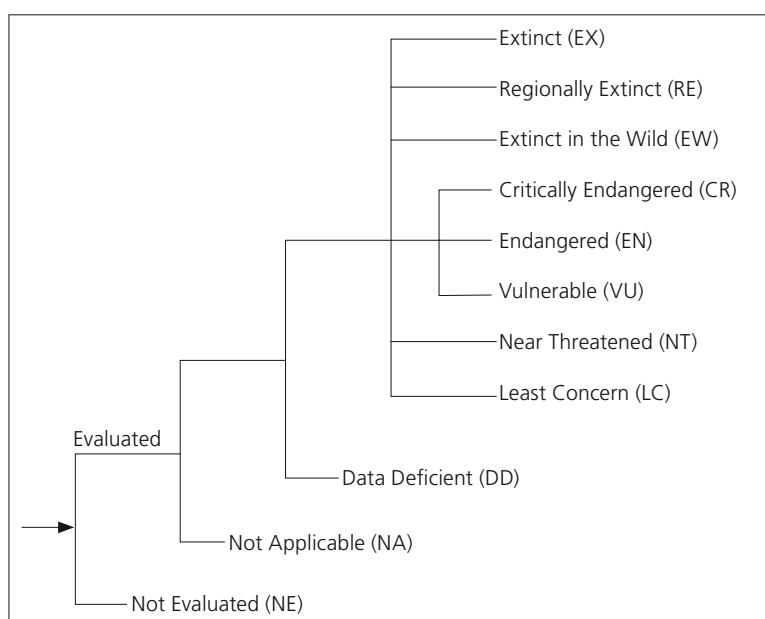
*...an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range'."* (IUCN 2001)

## 2.2 The IUCN Red List categories

*"Extinction is a chance process. Thus a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than those in a lower one (without effective conservation action). However, the persistence of some taxa in high-risk categories does not necessarily mean their initial assessment was inaccurate."*

*All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories."* (IUCN 2001)

Categories are quite commonly referred to by using the abbreviation or code representing each category (see Figure 2.1).



**Figure 2.1. Structure of the IUCN Red List categories at the regional level.**

Each of the categories is defined as follows (IUCN 2001, 2003):

*"EXTINCT (EX)*

*A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycles and life form." (IUCN 2001)*

*"REGIONALLY EXTINCT (RE)*

*A taxon is RE when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or disappeared from the region or, in the case of a former visiting taxon, individuals no longer visit the region. It is not possible to set any general rules for a time period since the last observation before species are classified as RE. This will depend on how much effort has been devoted to searches for the taxon, which in turn will vary, both with organism and region. If the regional authority decides to adopt any time frames for RE assessments, these should be clearly specified.*

*Populations of long-lived individuals that have ceased to reproduce within the region (for example, as a result of a deteriorating environment) should be regarded as potentially capable of reproduction and consequently should not be classified as RE. On the other hand, vagrant individuals of a formerly regionally breeding taxon that reach the region should not be regarded as potentially capable of reproduction." (IUCN 2003)*

*"EXTINCT IN THE WILD (EW)*

*A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.*

*CRITICALLY ENDANGERED (CR)*

*A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.*

*ENDANGERED (EN)*

*A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.*

*VULNERABLE (VU)*

*A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.*

*NEAR THREATENED (NT)*

*A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.*

*LEAST CONCERN (LC)*

*A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.*

*DATA DEFICIENT (DD)*

*A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has*

*elapsed since the last record of the taxon, threatened status may well be justified.*" (IUCN 2001)

*"NOT APPLICABLE (NA)*

*Taxa not eligible for assessment at the regional level (mainly introduced taxa and vagrants) should be assigned the category Not Applicable (NA). A taxon may be NA because it is not a wild population or not within its natural range in the region, or because it is a vagrant to the region. It may also be NA because it occurs at very low numbers in the region (i.e., when the regional Red List authority has decided to use a "filter" to exclude taxa before the assessment procedure) or the taxon may be classified at a lower taxonomic level (e.g., below the level of species or subspecies) than considered eligible by the regional Red List authority. In contrast to other Red List categories, it is not mandatory to use NA for all taxa to which it applies; but is recommended for taxa where its use is informative.*" (IUCN 2003)

*"NOT EVALUATED (NE)*

*A taxon is Not Evaluated when it has not yet been evaluated against the criteria.*" (IUCN 2001)

## 2.3 The IUCN Red List criteria

*"There are five quantitative criteria which are used to determine whether a taxon is threatened or not, and if threatened, which category of threat it belongs in (Critically Endangered, Dangerous or Vulnerable) (Table 2.1). These criteria are based around the biological indicators of populations that are threatened with extinction, such as rapid population decline or very small population size. Most of the criteria also include subcriteria that must be used to justify more specifically the listing of a taxon under a particular category. For example, a taxon listed as "Vulnerable C2a(i)" has been placed in the Vulnerable category because its population is fewer than 10 000 mature individuals (criterion C) and the population is undergoing a continuing decline and all its mature individuals are in one subpopulation (subcriterion a(i) of criterion C2)." (IUCN 2008)*

There are quantitative thresholds either in the form of values or percentages that indicate into which category a species should be placed.

*"The five criteria are:*

- A. Declining population (past, present and/or projected)**
- B. Geographic range size, and fragmentation, decline or fluctuations**
- C. Small population size and fragmentation, decline, or fluctuations**
- D. Very small population or very restricted distribution**
- E. Quantitative analysis of extinction risk (e.g., Population Viability Analysis)**

*To list a particular taxon in any of the categories of threat, only one of the criteria, A, B, C, D, or E needs to be met (IUCN 2001). However, a taxon should be assessed against as many criteria as available data permit, and the listing should be annotated by as many criteria as are applicable for a specific category of threat. For example, Critically Endangered: A2cd; B1+2de; C2a(i). Only the criteria for the highest category of threat that the taxon qualifies for should be listed. For example, if a taxon qualifies for criteria A, B, and C in the Vulnerable and Endangered category and only criterion A in the Critically Endangered category, then only the criterion A met in the Critically Endangered category should be listed (the highest category of threat). Additional criteria that the taxon qualifies for at lower threat categories may be included in the documentation.*" (IUCN 2008)

The Red List criteria also apply to commercially exploited species such as commercial fish species. *"Such listing should not be problematic in the medium to long term because, if the fishery is managed effectively, although it currently exhibits symptoms consistent with endangerment, the population will eventually stabilize at a target level and the decline will end, such that the taxon no longer qualifies for listing. If the declines would continue there would be reasons for concern and the listing would still apply"* (IUCN Guidelines 2011 section 5.5).



**Table 2.1.** Summary of the IUCN criteria according to IUCN (2001), Mannerkoski & Rytteri (2007) and Gärdenfors (2008).

CRITERION A	CRITERION B	CRITERION C	CRITERION D	CRITERION E
<p><b>REDUCTION IN POPULATION SIZE</b>            CR ≥ 90% (A1) or 80% (A2–A4)            EN ≥ 70% (A1) or 50% (A2–A4)            VU ≥ 50% (A1) or 30% (A2–A4)            NT ≥ 25% (A1) or 15% (A2–A4)</p> <p>Based on any of A1–A4:  <b>A1. An observed, estimated, inferred or suspected population size reduction</b> over the last 10 years or three generations, where the causes of the reduction are clearly reversible AND understood AND ceased, based on any of (a) to (e) shown below</p> <p><b>A2. An observed, estimated, inferred or suspected population size reduction</b> over the last 10 years or three generations, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on any of (a) to (e) shown below</p> <p><b>A3. A projected or suspected population size reduction in the future</b> within the next 10 years or three generations, based on any of (b) to (e) shown below</p> <p><b>A4. An observed, estimated, inferred, projected or suspected population size reduction</b> over any 10 year or three generations period, where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on any of (a) to (e) shown below:</p> <p>a) direct observation            b) an index of abundance appropriate to the taxon            c) a decline in area of occupancy, extent of occurrence or quality of habitat            d) actual or potential levels of exploitation            e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>	<p><b>B1. EXTENT OF OCCURRENCE</b>            CR &lt; 100 km<sup>2</sup>            EN &lt; 5 000 km<sup>2</sup>            VU &lt; 20 000 km<sup>2</sup>            NT &lt; 40 000 km<sup>2</sup>            or</p> <p><b>B2. AREA OF OCCUPANCY</b>            CR &lt; 10 km<sup>2</sup>            EN &lt; 500 km<sup>2</sup>            VU &lt; 2 000 km<sup>2</sup>            NT &lt; 4 000 km<sup>2</sup></p> <p>and an indication for at least two of a–c:</p> <p>a) Severely fragmented or the number of known locations is only:            CR: 1            EN: 2–5            VU: 6–10            NT: 11–19</p> <p>b) Continuing decline in any of the following:            i) extent of occurrence            ii) area of occupancy            iii) area, extent or quality of habitat            iv) number of locations or subpopulations            v) number of mature individuals</p> <p>c) Extreme fluctuations in any of the following:            i) extent of occurrence            ii) area of occupancy            iii) number of locations or subpopulations            iv) number of mature individuals</p> <p>Additionally category NT if:            Extent of occurrences &lt; 5000 km<sup>2</sup> or area of occupancy &lt; 500 km<sup>2</sup></p> <p>and one of the above sub-criteria a–c is met.</p>	<p><b>SMALL AND CONTINUOUSLY DECLINING POPULATION</b></p> <p>Number of mature individuals:            CR &lt; 250            EN &lt; 2 500            VU &lt; 10 000</p> <p>and either C1 or C2:</p> <p><b>C1. An estimated continuing decline of at least:</b>            CR: 25% within 3 years or 1 generation            EN: 20% within 5 years or 2 generations            VU: 10% within 10 years or 3 generations</p> <p>or</p> <p><b>C2. A continuing decline in numbers of mature individuals AND at least one of the following (a–b):</b>            a i) number of mature individuals in the largest subpopulation:            CR ≤ 50            EN ≤ 250            VU ≤ 1 000            or            a ii) proportion of the whole population in one subpopulation:            CR: 90–100%            EN: 95–100%            VU: 100%            or            b) extreme fluctuations in number of mature individuals (typically more than tenfold)</p> <p>Additionally category NT if:            Number of mature individuals &lt; 20 000 and continuing decline of at least 10% or            Number of mature individuals &lt; 10 000 and continuing decline of at least 5% or number of the largest population &lt; 2 000.</p>	<p><b>VERY SMALL AND RESTRICTED POPULATION</b></p> <p>If there is an imaginable threat that can make the species capable of becoming CR or RE within a very short time</p> <p>and either D1 or D2:</p> <p><b>D1. Number of mature individuals:</b>            CR &lt; 50            EN &lt; 250            VU &lt; 1 000            NT &lt; 2 000</p> <p>or</p> <p><b>D2. Also VU</b>, if area of occupancy very restricted (typically less than 20 km<sup>2</sup>) or number of locations 1–5</p> <p>and if there is an imaginable threat that can make the species capable of becoming VU or EN within a very short time</p>	<p><b>PROBABILITY OF EXTINCTION ON THE BASIS OF QUANTITATIVE ANALYSIS</b></p> <p>Quantitative analysis showing the probability of extinction is at least:</p> <p>CR: 50% within 10 years or three generations, whichever is the longer (max. 100 years)</p> <p>EN: 20% within 20 years or five generations, whichever is the longer (max. 100 years)</p> <p>VU: 10% within 100 years</p> <p>NT: 5% within 100 years</p>

## 2.4 Data availability, inference and projection

"Although the criteria for each of the categories of threat are based on quantitative thresholds, the system remains relatively flexible to ensure that taxa for which there is very little information can also be assessed. This has been achieved by incorporating inference and projection into the assessment process. Therefore, the person conducting an assessment is expected to use the best available information in combination with inference and projection to test a taxon against the criteria. However, if inference and projection are used, the assumptions made must be documented. If there is any reasonable concern that a taxon is threatened with extinction in the near future, it should qualify for the criteria of one of the categories of threat.

The IUCN criteria use the terms *Observed*, *Estimated*, *Projected*, *Inferred*, and *Suspected* to refer to the quality of the information for specific criteria. For example, criterion A allows inferred or suspected reduction, whereas criterion C1 allows only estimated declines and criterion C2 specifies "observed, projected, or inferred" declines. These terms are defined as follows:

*Observed*: information that is directly based on well-documented observations of all known individuals in the population.

*Estimated*: information that is based on calculations that may include statistical assumptions about sampling, or biological assumptions about the relationship between an observed variable (e.g., an index of abundance) to the variable of interest (e.g., number of mature individuals). These assumptions should be stated and justified in the documentation. Estimation may also involve interpolation in time to calculate the variable of interest for a particular time step (e.g., a 10-year reduction based on observations or estimations of population size 5 and 15 years ago).

*Projected*: same as "estimated", but the variable of interest is extrapolated in time towards the future. Projected variables require a discussion of the method of extrapolation (e.g., justification of the statistical assumptions or the population model used) as well as the extrapolation of current or

potential threats into the future, including their rates of change.

*Inferred*: information that is based on indirect evidence, on variables that are indirectly related to the variable of interest, but in the same general type of units (e.g., number of individuals or area or number of subpopulations). Examples include population reduction (A1d) inferred from a change in catch statistics, continuing decline in number of mature individuals (C2) inferred from trade estimates, or continuing decline in area of occupancy (B1b(ii,iii), B2b(ii,iii)) inferred from rate of habitat loss. Inferred values rely on more assumptions than estimated values.

*Suspected*: information that is based on circumstantial evidence, or on variables in different types of units, for example, % population reduction based on decline in habitat quality (A1c) or on incidence of a disease (A1e). For example, evidence of qualitative habitat loss can be used to infer that there is a qualitative (continuing) decline, whereas evidence of the amount of habitat loss can be used to suspect a population reduction at a particular rate. In general, a suspected population reduction can be based on any factor related to population abundance or distribution, including the effects of (or dependence on) other taxa, so long as the relevance of these factors can be reasonably supported." (IUCN 2008)

### Uncertainty

"The data used to evaluate taxa against the criteria are often estimated with considerable uncertainty. Such uncertainty can arise from any one or all of the following three factors: natural variation, vagueness in the terms and definitions used, and measurement error. The way in which this uncertainty is handled can have a strong influence on the results of an evaluation.

In general, when uncertainty leads to wide variation in the results of assessments, the range of possible outcomes should be specified. A single category must be chosen and the basis for the decision should be documented; it should be both precautionary and credible.

When data are very uncertain, the category of 'Data Deficient' may be assigned. However, in

*this case the assessor must provide documentation showing that this category has been assigned because data are inadequate to determine a threat category. It is important to recognize that taxa that are poorly known can often be assigned a threat category on the basis of background information concerning the deterioration of their habitat and/or other causal factors; therefore the liberal use of 'Data Deficient' is discouraged."* (IUCN 2001)

## 2.5 Application of the IUCN criteria at the regional level

### 2.5.1 Some principles at the regional level

**Scale applicability.** *"Provided that the regional population to be assessed is isolated from conspecific populations outside the region, the IUCN Red List Criteria (IUCN 2001) can be used without modification within any geographically defined area. The extinction risk for such an isolated population is identical to that of an endemic taxon. However, when the criteria are applied to part of a population defined by a geopolitical border, or to a regional population where individuals move to or from other populations beyond the border, the threshold values listed under each criterion may be inappropriate, because the unit being assessed is not the same as the whole population or subpopulation. As a result, the estimate of extinction risk may be inaccurate. These guidelines present methods for adjusting the results from the first step in the assessment process to obtain a Red List Category that adequately reflects a taxon's risk of extinction within the region."* (IUCN 2003)

**Scaling up assessments.** *"Red List assessments from several smaller regions, such as countries on a continent, cannot be combined or scaled-up in any way to provide Red List Categories for the entire larger region. Assessments of extinction risk for the larger region require new evaluations using the pooled data from across the entire region. Data collected from individual smaller regions may be essential for the assessment of the larger region, and are often important for conservation planning."* (IUCN 2003)

**Taxa to be assessed.** *"The categorization process should be applied only to wild populations inside their natural range and to populations resulting from benign introductions (IUCN 1998, 2001). Taxa only marginally within the region should also enter the assessment process (unless excluded by an optional filter, see below). But a taxon that occasionally breeds under favourable circumstances in the region but regularly becomes (regionally) extinct should not be considered. Similarly, a taxon that is currently expanding its distributional range outside the region and appears to be in a colonization phase within the region should not be considered for regional assessment until the taxon has reproduced within the region for several years (typically for at least 10 consecutive years).*

*Taxa formerly considered Regionally Extinct (RE) that naturally re-colonize the region may be assessed after the first year of reproduction. Re-introduced, formerly RE taxa may be assessed as soon as at least a part of the population successfully reproduces without direct support and the offspring are shown to be viable.*

*Visiting taxa may be assessed against the criteria, but vagrant taxa should NOT be assessed."* (IUCN 2003)

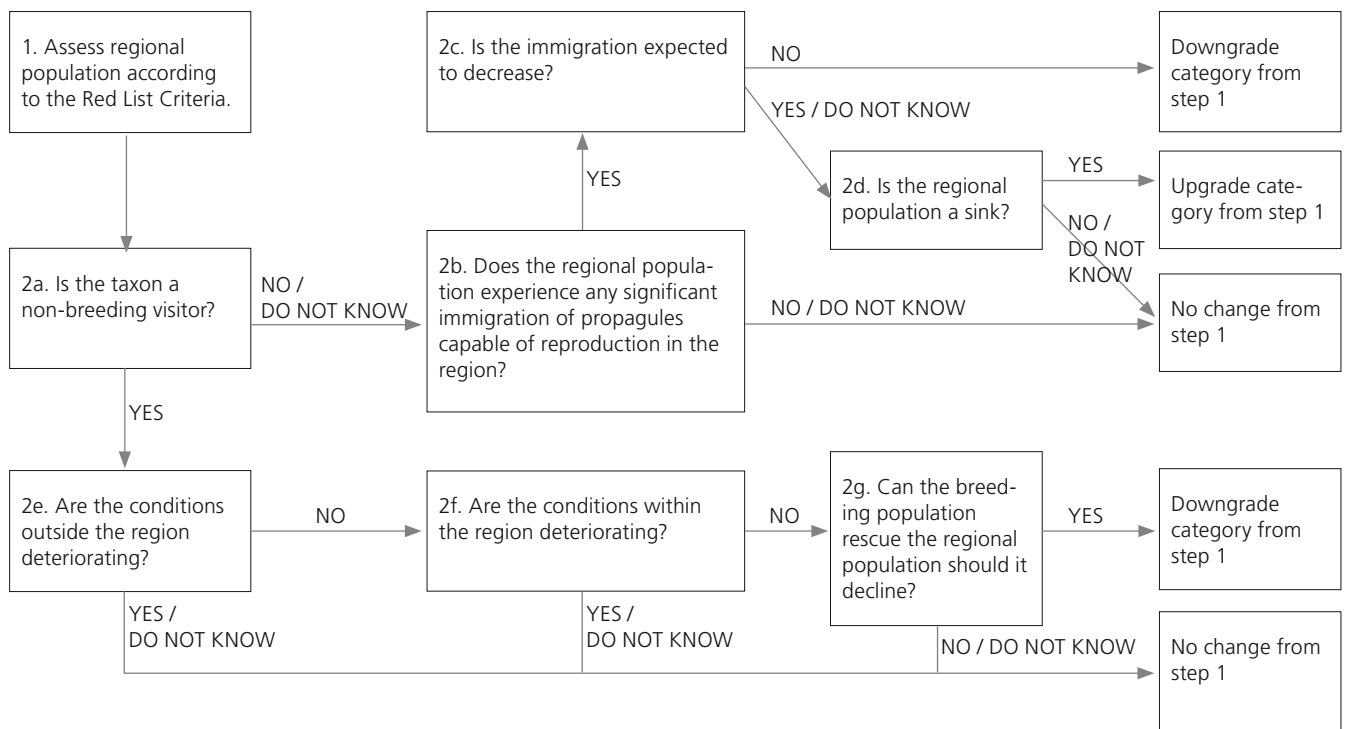
### 2.5.2 Assessment procedure at regional level

*"Regional assessments should be carried out in a two-step process that is slightly different for breeding and non-breeding populations (Figure 2.2).*

#### **Breeding populations**

*In step one, the IUCN Red List Criteria are applied to the regional population of the taxon (as specified by IUCN 2001), resulting in a preliminary categorization. All data used in this initial assessment – such as number of individuals and parameters relating to area, reduction, decline, fluctuations, subpopulations, locations, and fragmentation – should be from the regional population, NOT the global population. However, it must be noted that taxa migrating to other regions during part of the year may be affected by conditions there. It may be essential to take such conditions into account, particularly when applying criteria pertaining to decline and area (A, B and C).*





**Figure 2.2.** Conceptual scheme of the procedure for assigning an IUCN Red List Category at the regional level. In step 1 all data used should be from the regional population, not the global population. The exception is when evaluating a projected reduction or continued decline of a non-breeding population, in such cases conditions outside the region must be taken into account in step 1. Likewise, breeding populations may be affected by events in, e.g., wintering areas, which must be considered in step 1.

In step two, the existence and status of any conspecific populations outside the region that may affect the risk of extinction within the region should be investigated. If the taxon is endemic to the region or the regional population is isolated, the Red List Category defined by the criteria should be adopted unaltered. If, on the other hand, conspecific populations outside the region are judged to affect the regional extinction risk, the regional Red List Category should be changed to a more appropriate level that reflects the extinction risk as defined by criterion E (IUCN 2001). In most cases, this will mean downgrading the category obtained in step one, because populations within the region may experience a “rescue effect” from populations outside the region (Brown and Kodric-Brown 1977, Hanski and Gyllenberg 1993). In other words, immigration from outside the region will tend to decrease extinction risk within the region.

Normally, such a downgrading will involve a one-step change in category, such as changing the category from Endangered (EN) to Vulnerable (VU) or from VU to Near Threatened (NT). For expanding populations, whose global range barely

touches the edge of the region, a downgrading of the category by two or even more steps may be appropriate. Likewise, if the region is very small and not isolated by barriers from surrounding regions, downgrading by two or more steps may be necessary.

Conversely, if the population within the region is a demographic sink (Pulliam 1988) that is unable to sustain itself without immigration from populations outside the region, AND if the extra-regional source is expected to decrease, the extinction risk of the regional population may be underestimated by the criteria. In such exceptional cases, an upgrading of the category may be appropriate. If it is unknown whether or not extra-regional populations influence the extinction risk of the regional population, the category from step one should be kept unaltered.

### Visiting populations

The distinction between a visitor and a vagrant should be noted because the latter cannot be assessed.

As with breeding populations, data used in the initial step (box 1, Figure 2.2) – such as number of individuals and parameters relating to area, reduction, decline, fluctuations, subpopulations, and locations – should be from the regional population, not the global population. To be able to correctly project a population reduction (criteria A3 and A4) or a continued decline (criteria B and C) it may, however, be necessary to examine the conditions outside the region, and particularly in the population's breeding area. It is also essential to distinguish true population changes and fluctuations from transient changes, which may be due to unsuitable weather or other factors and may result in visitors temporarily favouring other regions. Observed population numbers will expectedly fluctuate more in non-breeding than in breeding populations. This must be carefully considered when evaluating the parameters of reduction, continuing decline and extreme fluctuations.

In the second step, the environmental conditions outside (box 2e, Figure 2.2) and inside (box 2f) the region should be examined. Because past or projected population reductions outside the region, as well as deteriorating environmental conditions inside the region, have already been accounted for in the first step, such changes will not lead to any adjustments in the second step. There may be reasons to downgrade the category met in step one only when environmental conditions are stable or improving. Note that taxa which are globally very rare, for example if Red Listed under criterion D, should not be downgraded because a very small global population would not be expected to produce any notable rescue effect within the region." (IUCN 2003)

## 2.6 Key terms and definitions used

### Population and Population Size (Criteria A, C and D)

"The term 'population' is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life forms, population size is measured as numbers of mature individuals only. In the case

of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used." (IUCN 2001)

The interpretation of this definition depends critically on an understanding of the definition of 'mature individuals', which is given and discussed below in the section on mature individuals.

### Subpopulations (Criteria B and C)

"Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less)." (IUCN 2001)

### Mature individuals (Criteria A, B, C and D)

"The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Mature individuals that will never produce new recruits should not be counted (e.g., densities are too low for fertilization).
- In the case of populations with biased adult or breeding sex ratios, it is appropriate to use lower estimates for the number of mature individuals, which take this into account.
- Where the population size fluctuates, use a lower estimate. In most cases this will be much less than the mean.
- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g., corals).
- In the case of taxa that naturally lose all or a subset of mature breeding individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.
- Re-introduced individuals must have produced viable offspring before they are counted as mature individuals." (IUCN 2001)

### Fishes

"In many taxa of marine fish, reproductive potential is commonly closely related to body size. Since exploitation usually reduces the mean age and

size of individuals, assessing declines in numbers of mature individuals may under-estimate the severity of the decline. When evaluating population decline, this factor should be kept in mind. One possible method is to estimate decline in the biomass of mature individuals rather than the number of such individuals when applying criterion A, where biomass is 'an index of abundance appropriate to the taxon'." (IUCN 2008)

### Generation (Criteria A, C1 and E)

"Generation length is defined as the average age of parents of the current cohort (i.e., newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, such as the exploitation of fishes, the more natural, i.e. pre-disturbance, generation length should be used.

Formally, the definition of generation length requires age- and sex-specific information on survival and fecundity, and is best calculated from a life table. Depending on the taxon concerned, other methods may provide a good approximation. Care should be taken to avoid estimates that may bias the generation length estimate in a non-precautionary way, usually by under-estimating it. Generation length may be estimated in a number of ways, e.g:

- the age at which 50% of total reproductive output is achieved
- time taken for most (>50%) individuals to reach maximum reproductive output
- for partially clonal taxa, generation length should be averaged over asexually and sexually reproducing individuals in the population" (IUCN 2001)

### Reduction (Criterion A)

"A reduction is a decline in the number of mature individuals of at least the amount (%) stated under the criterion over the time period (years) specified, although the decline need not be continuing. A reduction should not be interpreted as part of a fluctuation unless there is good evidence for this. The downward phase of a fluctuation will not normally count as a reduction." (IUCN 2001)

"Percentage reductions in the number of mature individuals can be estimated in a number of ways, including 'an index of abundance appropriate to the taxon'. In the case of exploited fishes, the catch per unit effort (CPUE) may be used. This measure should be used with caution because changes in CPUE may underestimate population declines. This may occur, for example, if the population aggregates even at small sizes so that catches remain high with the same level of effort, even if the size of the population is declining. It may also occur if increases in fishing efficiency are not fully taken into account. It is therefore preferable to assess exploited fish taxa using the results of fishery-independent survey techniques." (IUCN 2008)

### Continuing decline (Criteria B and C)

"A continuing decline is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken. Fluctuations will not normally count as continuing declines, but an observed decline should not be considered as a fluctuation unless there is evidence for this." (IUCN 2001)

"Continuing declines are used in two different ways in the criteria. Continuing declines at any rate can be used to qualify taxa under criteria B or C2. This is because taxa under consideration for criteria B and C are already characterised by restricted ranges or small population size. Estimated continuing decline (under criterion C1) has quantitative thresholds, and requires a quantitative estimate. The concept of continuing decline at any rate is not applicable under criterion C1 (or under criterion A)." (IUCN 2008)

Continuing decline can be also irregular or sporadic (Gärdenfors 2008). It may have started recently or it may be on-going or expected to start in the future. In the concept of 'continuing decline' it is essential that after the decline has started, it is not expected to stop without special actions that improve the situation.

### Extreme fluctuations (Criteria B and C2)

"Extreme fluctuations can be said to occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently,

typically with a variation greater than one order of magnitude (i.e., a tenfold increase or decrease)." (IUCN 2001)

"The effect of extreme fluctuations on the extinction risk will depend on both the degree of isolation and the degree of synchrony of the fluctuations between subpopulations. If there is regular or occasional dispersal (of even a small number of individuals, seeds, spores, etc) between all (or nearly all) of the subpopulations, then the degree of fluctuations should be measured over the entire population. In this case, the subcriterion would be met only when the overall degree of fluctuation (in the total population size) is larger than one order of magnitude. If the fluctuations of different subpopulations are independent and asynchronous, they would cancel each other to some extent when fluctuations of the total population size are considered.

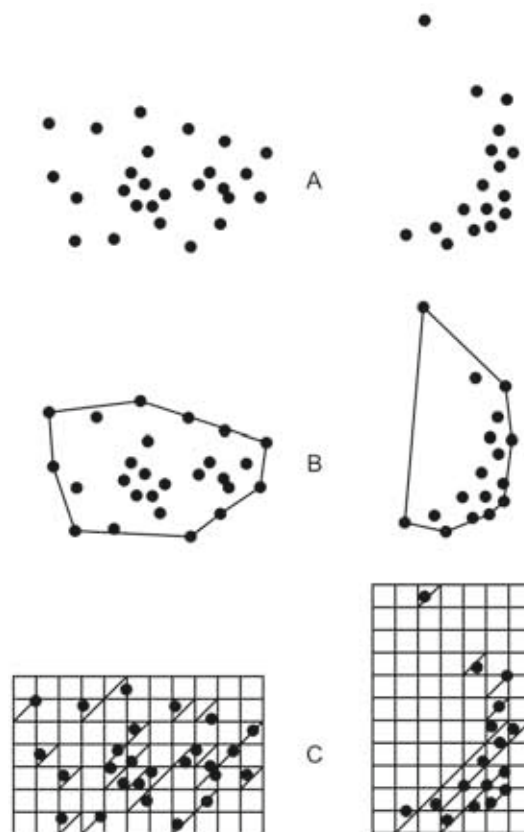
If, on the other hand, the subpopulations are totally isolated, the degree of synchrony between the population is not as important and it is sufficient that a majority of subpopulations each show extreme fluctuation to meet the subcriterion. In this case, if most of the subpopulations show fluctuations of an order of magnitude, then the criterion would be met (regardless of the degree of the fluctuations in total population size). Between these two extremes, if dispersal is only between some of the subpopulations, then the total population size over these connected subpopulations should be considered when assessing fluctuations; each set of connected subpopulations should be considered separately. Population fluctuations may be difficult to distinguish from directional population changes, such as continuing declines, reductions or increases. A reduction should not be interpreted as part of a fluctuation unless there is good evidence for this. Fluctuations must be inferred only where there is reasonable certainty that a population change will be followed by a change in the reverse direction within a generation or two. In contrast, directional changes will not necessarily be followed by a change in the reverse direction." (IUCN 2008)

### Severely fragmented (Criterion B)

"The phrase 'severely fragmented' refers to the situation in which increased extinction risks to the taxon results from the fact that most of its

individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonization." (IUCN 2001)

"Fragmentation must be assessed at a scale that is appropriate to biological isolation in the taxon under consideration. In general, taxa with highly mobile adult life stages or with a large production of small mobile diaspores are considered more widely dispersed, and hence not so vulnerable to isolation through fragmentation of their habitats. Taxa that produce only small numbers of diaspores (or none at all), or only large ones, are less efficient at long distance dispersal and therefore more easily isolated. If natural habitats have been fragmented (e.g., old growth forests and rich fens), this can be



**Figure 2.3** Two examples of the distinction between extent of occurrence and area of occupancy. (A) is the spatial distribution of known, inferred or projected sites of present occurrence. (B) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (C) shows one measure of area of occupancy which can be achieved by the sum of the occupied grid squares.

used as direct evidence for fragmentation for taxa with poor dispersal ability." (IUCN 2008)

Marine organisms (e.g. invertebrates or fish) that have pelagic larval or juvenile stages can seldom be regarded as 'severely fragmented'.

### **Extent of occurrence (Criteria A and B)**

"Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (see Figure 2.3). This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g., large areas of obviously unsuitable habitat) [but see 'area of occupancy' below]. Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence)." (IUCN 2001)

"In the case of migratory species, EOO should be based on the minimum of the breeding or non-breeding (wintering) areas, but not both, because such species are dependent on both areas, and the bulk of the population is found in only one of these areas at any time." (IUCN 2008)

### **Area of occupancy (Criteria A, B and D)**

"Area of occupancy is defined as the area within its 'extent of occurrence', which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases, (e.g., irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data (see below). To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, it may be necessary to standardise estimates by applying a scale-correction factor. It

is difficult to give strict guidance on how standardization should be done because different types of taxa have different scale-area relationships." (IUCN 2001)

### **Problems of scale**

"Classifications based on the area of occupancy (AOO) may be complicated by problems of spatial scale. There is a logical conflict between having fixed range thresholds and the necessity of measuring range at different scales for different taxa. "The finer the scale at which the distributions or habitats of taxa are mapped, the smaller the area will be that they are found to occupy, and the less likely it will be that range estimates ... exceed the thresholds specified in the criteria. Mapping at finer spatial scales reveals more areas in which the taxon is unrecorded. Conversely, coarse-scale mapping reveals fewer unoccupied areas, resulting in range estimates that are more likely to exceed the thresholds for the threatened categories. The choice of scale at which AOO is estimated may thus, itself, influence the outcome of Red List assessments and could be a source of inconsistency and bias." (IUCN 2001)

It is impossible to provide any strict but general rules for mapping taxa or habitats; the most appropriate scale will depend on the taxon in question, and the origin and comprehensiveness of the distribution data. However, we believe that in many cases a grid size of 2 km (a cell area of 4 km<sup>2</sup>) is an appropriate scale. Scales of 3.2 km grid size or coarser (larger) are inappropriate because they do not allow any taxa to be listed as Critically Endangered (where the threshold AOO under criterion B is 10 km<sup>2</sup>). Scales of 1 km grid size or smaller tend to list more taxa at higher threat categories than these categories imply." (IUCN 2008)

### **Estimation of AOO for non-sessile organisms**

Identification of the area of occupancy may not be obvious for species that migrate or otherwise move around. It is recommended that in such cases, AOO is estimated on the basis of areas that are of crucial importance during some part of the lifecycle (e.g. spawning area for a fish species). More generally, AOO could be interpreted as the amount of suitable habitat within the extent of occurrence (EOO).



### **Location (Criteria B and D)**

*"The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat." (IUCN 2001)*

*"Justification for the number of locations used in Red List assessments should include reference to the most serious plausible threat(s). For example, where the most serious plausible threat is habitat loss, a location is an area where a single development project can eliminate or severely reduce the population. Where the most serious plausible threat is volcanic eruption, hurricane, tsunami, frequent flood or fire, locations may be defined by the previous or predicted extent of lava flows, storm paths, inundation, fire paths, etc.*

*Where the most serious plausible threat is collection or harvest, then locations may be defined based on the size of jurisdictions (within which similar regulations apply) or on the level of access (e.g., ease with which collectors may reach different areas), as well as on the factors that determine how the levels of exploitation change (e.g., if collection intensity in two separate areas changes in response to the same market trends in demand, these may be counted as a single location).*

*If two or more subpopulations occur within an area that may be threatened by one such event, they must be counted as a single location. Conversely, if a single subpopulation covers an area larger than may be affected by any single event, it must be counted as more than one location.*

*Where the most serious plausible threat does not affect all of the taxon's distribution, other threats*

*can be used to define and count locations in those areas not affected by the most serious plausible threat.*

*When parts of the distribution are not affected by any threat, the following options will be appropriate under different circumstances: (a) number of locations is not used (i.e., the subcriteria that refer to the number of locations consequently are not met), especially if the unaffected area is more than half the taxon's range; (b) number of locations in the unaffected areas is set to the number of subpopulations in those areas, especially if there are several subpopulations; (c) the number of locations is based on the smallest size of locations in the currently affected areas; (d) the number of locations is based on the most likely threat that may affect the currently-unaffected areas in the future. In any case, the basis of the number of locations should be documented.*

*In the absence of any plausible threat for the taxon, the term "location" cannot be used and the subcriteria that refer to the number of locations will not be met." (IUCN 2008)*

### **Quantitative analysis (Criterion E)**

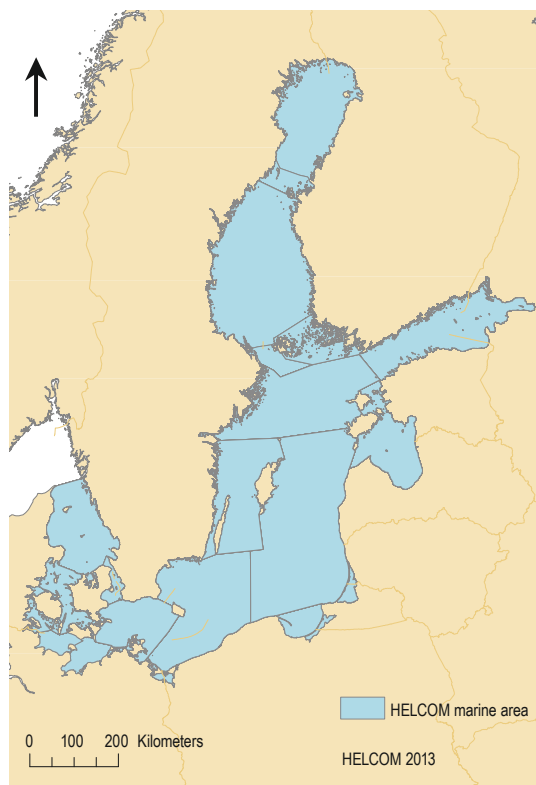
*"A quantitative analysis is defined here as any form of analysis which estimates the extinction probability of a taxon based on known life history, habitat requirements, threats and any specified management options. Population viability analysis (PVA) is one such technique. Quantitative analyses should make full use of all relevant available data. In a situation in which there is limited information, such data as are available can be used to provide an estimate of extinction risk (for instance, estimating the impact of stochastic events on habitat). In presenting the results of quantitative analyses, the assumptions (which must be appropriate and defensible), the data used and the uncertainty in the data or quantitative model must be documented." (IUCN 2001)*

## 2.7 Implementation of the evaluation in the HELCOM area

### 2.7.1 Area under consideration

The area under consideration in this assessment included the HELCOM marine area (Figure 2.4), with the exception of the assessment of breeding birds which used a larger reference area: the entire territories of Sweden, Finland, Estonia, Latvia, Lithuania and Poland, the territory of Denmark with exclusion of the North Sea coast, the German Federal states Schleswig-Holstein and Mecklenburg-Western Pomerania (excluding the North Sea coast of Schleswig-Holstein), and the St Petersburg and Kaliningrad regions in Russia (cf. Chapter 7.4).

In addition to HELCOM-wide assessments, it was agreed that also subregional assessments could have been carried out using the division of sub-basins indicated in Figure 2.4. However, even if



**Figure 2.4.** The HELCOM marine area which was under consideration for most species in the current Red List assessment. The assessments of breeding birds used a larger reference area shown in Figure 7.11.

in some cases subregional assessments would have been justifiable and more informative than HELCOM-wide assessments, they were not prepared due to the general lack of expert resources. In some cases, it was deemed acceptable to also assess subpopulations, even if they do not follow the geographical structuring defined by the HELCOM subregions. It was specified that in order to qualify as assessment units, subpopulations have to be well-defined and preferably genetically differentiated.

### 2.7.2 Scope of the evaluation process

The HELCOM Red List assessments considered five groups of macroscopic species of the Baltic Sea: macrophytes (including algae, aquatic bryophytes, and aquatic vascular plants and excluding shore plants), benthic invertebrates, fish and lamprey species, breeding and wintering bird populations, and marine mammals. Thus, the macroscopic biota of the Baltic Sea was covered entirely with the exception of planktonic species.

It should be noted that the aim of the project was not to assess all species that have ever occurred in the Baltic Sea area, only those that live in or strongly depend on the Baltic Sea marine or coastal area. For example, for the macrophytes and benthic invertebrates this meant excluding the purest freshwater species, i.e. only species that are able to form stable populations in the minimum of 0.5 psu were taken into account in the assessments.

Each of the species groups had more specific rules to include or exclude species from the assessment. These rules are described in detail in Chapter 7.

### 2.7.3 HELCOM specifications to the IUCN Red List criteria

The previous Chapters 2.1–2.6 describe the IUCN criteria and guidelines that were followed in the assessments. In addition to these criteria and guidelines, some additional specifications were made during the project to guide the assessments.

### **Categories**

The Red List categories and their descriptions follow those given by the IUCN (2001) with a partial exception in regard to the category Data Deficient (DD). According to the IUCN guidelines, a species can be assigned to the DD category if data are so uncertain that both CR and LC are plausible categories. However, in the assessments of macrophytes and benthic invertebrates, which both include hundreds of very poorly known species, somewhat different principles have been used. The category DD has been chosen only for such macrophytes and benthic invertebrates for which the uncertainty has been combined with a suspicion of an existing threat.

In regard to the category Least Concern (LC), it was clarified for the expert teams that a marine species that is naturally restricted due to salinity can be evaluated as Least Concern (LC) (regardless of how small EOO or AOO may be) if there is no known or suspected decline within the HELCOM waters, if the species in question is common or at least not rare/threatened in the neighbouring areas in the Skagerrak and North Sea, and the species is relatively easy to identify.

As mentioned in Chapter 2.2, a species is Not Evaluated (NE) when it has not yet been evaluated against the Red List criteria. Already early in the assessment, it became evident that a large proportion of species, especially within the groups of macrophytes and benthic invertebrates, will remain unevaluated due to the fact that they are very poorly known and there is severe lack of data on them. Typical monitoring programs being carried out in the Baltic Sea miss hundreds of species. Many species would need special expertise for identification, special sampling techniques, or a specific timing of the sampling. While some data are being collected for some species, the observational activities are still far too low to evaluate, e.g. the distribution area, potential population trends, or to analyse how common or rare the species actually is at present.

It was also noted that especially in cases where there are only a few observations ever made of a species in the Baltic Sea, difficult borderline cases may exist between the categories Not Evaluated (NE), Data Deficient (DD) and Least Concern (LC). It was therefore recommended that for species

with only few records, the principles below are followed:

- NE: when there is uncertainty about taxonomy and/or identification possibilities.
- DD: when there is suspicion that these records reflect rarity and/or threat and the species is relatively easy to identify.
- LC: when there is no suspicion of threat and/or decline, and information from surrounding waters suggest that the species is doing fine.

### **Criteria**

For all threatened categories, the Red List criteria and the principles for their application have followed the IUCN Red List criteria (IUCN 2001) exactly, and for the Near Threatened (NT) category quantitative thresholds were adopted according to Gärdenfors (2008) because the IUCN guidelines do not specify thresholds for NT (see Table 2.1).

### **Inclusion of species**

As described in Chapter 2.5.1, the IUCN Red List criteria should only be used for wild populations inside their natural range. In the HELCOM assessments, all species that have been intentionally or unintentionally introduced after 1800 were assigned to the category Not Applicable (NA). Irregularly visiting species were also categorised as NA. For example, a number of fish species were regarded vagrants in this assessment, although they were included in the previous HELCOM Red List (HELCOM 2007a).

In regard to the assessment of regularly visiting, non-breeding taxa, it was recommended that a general threshold of 2% of the European population would be followed. However, in the assessments of wintering birds, a lower threshold of 1% was used.

In addition to the taxa that actually breed in the HELCOM marine area, also taxa using resources within the HELCOM area during their breeding time were considered 'breeding' and were thus included in the assessment. This specification concerned some shark species that use resources of the western HELCOM area while pregnant, although they actually give birth to their young in the North Sea.



### Additional specifications for key terms

Some additional specifications or guiding examples were given for the key terms in the HELCOM assessments:

- Individuals that will never reproduce were not counted as **mature individuals** (e.g. bivalves in polluted water or plants that do not produce seeds due to suboptimal conditions).
- **Continuing decline** can be even, irregular or sporadic. It may have started recently or it may be on-going or expected to start in the future. In the concept of 'continuing decline', it is essential that after the decline has started it is not expected to stop without special actions that improve the situation.
- A common guideline was that marine organisms (e.g. invertebrates or fish) that have pelagic larval or juvenile stages can seldom be regarded as '**severely fragmented**'.
- Identifying the **area of occupancy (AOO)** may not be obvious for species that migrate or otherwise move around. It was recommended that in such cases, AOO was estimated on the basis of areas that are of crucial importance during some part of the lifecycle (e.g. spawning area for a fish species). More generally, AOO could be interpreted as the amount of suitable habitat within the extent of occurrence (EOO).
- **Locations** in the marine environment may be quite large. A location can be interpreted, for example, as an area that might be affected by an oil spill.

### 2.7.4 Assessment work

The Red List assessments were prepared by the expert teams that were established for macrophytes, benthic invertebrates, fish and lamprey species, and birds. The assessments of marine mammals were prepared by the existing HELCOM SEAL group. The teams with the largest workloads (macrophytes, benthic invertebrates, and fish and lamprey species) prepared first initial assessments in their first workshops in order to identify clear cases of species that could be categorised as Least Concern, Not Applicable and Not Evaluated. The rest of the species were divided to responsible experts who collected data and prepared the preliminary assessments by themselves or assisted by the Secretariat. The preliminary assessments were reviewed and revised by the expert team, either in workshops or by email correspondence.

All assessments were checked by the Secretariat and, if necessary, returned to the team for further preparation. Final drafts were circulated in the team and the comments collected by the Team Chairs or Secretariat. To ensure harmonised assessment principles among teams, problematic cases were discussed between teams, in the Steering Group and with the IUCN criteria experts such as with the Chair of the Project, Anna Karlsson.

A documentation template was prepared in order to harmonise the assessment procedure and documentation. After the project, all assessment information will be stored in a database, which will facilitate the assessments considerably in the future.

### 2.7.5 Data quality and uncertainty

It should be noted that the quality of data greatly varied between species groups, being on average rather poor for macrophytes and benthic invertebrates, and better for fish, birds and mammals. The level of uncertainty is described in the assessment justifications and given as a range of plausible categories in the assessment documentation.

### 2.7.6 Notations used in the tables and the Red List

Red-listed species are listed in Chapters 7.1–7.5 by taxonomic groups in alphabetical order according to their scientific names. English names are given only for fish and lamprey species, birds and mammals.

#### The Red List categories

RE	Regionally Extinct
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
DD	Data Deficient

The categories are described in more detail in Chapter 2.2. For each threatened species, the criteria on the basis of which the species was assigned to the category in question are given on the species-group-specific Red Lists.

## Past and future threats

The past and current threats, i.e. the reasons behind the species' current situation, were distinguished from the threats that may affect the

population in the future. In many cases, the past and future threats may be the same. Threat codes and their descriptions are given in Table 2.2.

**Table 2.2. Threat codes and descriptions for past, current and future threats that affect the populations of red-listed species.**

Threat code	Description
A	<b>Alien species:</b> competition, predation, hybridization, diseases, ecosystem changes by introduced species
Bc	<b>Bycatch:</b> bycatch by fishing, concerns both non-target species of fish and also other animals, such as waterbirds or marine mammals
AM	<b>Changes in agricultural management:</b> intensification of management, conversion of grassland to cropland etc.
Cc	<b>Climate change:</b> all detrimental effects of climate change
CPr	<b>Competition and predation:</b> competition and predation by native species, especially if promoted by human activities, such as rabies vaccination for foxes, improved food availability for gulls due to fishery and refuse disposal
Co	<b>Construction:</b> all marine construction activities, e.g. wind power farms, gas pipelines, bridges, dredging, ports, coastal defence barriers, also coastal terrestrial construction, if relevant (vacation homes or roads), also noise from construction or operation
Cp	<b>Contaminant pollution:</b> all pollution to waters by hazardous substances, except for oil spills which have their own code (coastal industry, riverine load of heavy metals, discharges of radioactive substances, atmospheric deposition of metals and dioxins, polluting ship accidents excluding oil spills)
Di	<b>Ditching:</b> ditching and draining of mires and coastal meadows
Ep	<b>Epidemics:</b> large-scale epidemics or diseases
E	<b>Eutrophication:</b> detrimental effects of nutrient enrichment that can be defined in more detail, e.g. anoxia and hypoxia, excessive growth of algae, reduction in water transparency, or siltation
ERT	<b>Extra-regional threats:</b> e.g. fishing, hunting or habitat changes affecting migratory species outside the HELCOM marine area
F	<b>Fishing:</b> both commercial and recreational fishing, surface and mid-water fishery, bottom-trawling, coastal stationary fishery, gillnets
H	<b>Hunting:</b> selective extraction of species, including incidental non-target catches
L	<b>Litter:</b> plastic waste, ghost nets etc.
MB	<b>Migration barriers:</b> dams by hydroelectric power plants or other river constructions preventing spawning migrations of fish
Mi	<b>Mining and quarrying:</b> extraction of bottom substrates
O	<b>Oil spills:</b> oil spills from ship accidents, also from oil terminals, refineries, oil rigs
OT	<b>Other threat factors:</b> specific, known threat factors that are not covered by the other threat codes (to be specified)
Ogr	<b>Overgrowth of open areas:</b> e.g. coastal meadows or shallow water areas that become overgrown due to lack of management (related to eutrophication and interfloral competition, incl. expansion of reed)
D	<b>Human disturbance:</b> e.g. disturbance due to people visiting bird islands or passing by too close to bird colonies, hauling-out areas of seals, etc., also disturbance of species due to hunting activities (especially species other than those targeted by hunting)
RTF	<b>Random threat factors:</b> used only for species that are so rare that even random catastrophic events can destroy their populations
To	<b>Tourism:</b> detrimental effects of tourism, e.g. trampling of beaches or cleaning of algal belts from sandy beaches
U	<b>Unknown:</b> threats are not known
T	<b>Water traffic:</b> physical impact due to traffic, e.g. erosion caused by anchoring, boat wakes and other vessel effects, also noise

# 3 Results

## 3.1 Scope of the assessment and the number of red-listed species

The HELCOM checklist for Baltic Sea species (HELCOM 2012) was used as a reference list in the Red List assessments. The checklist contains 2 730 species and the assessment project has considered altogether 2 794 species or other assessment units. In regard to dividing species into assessment units below the species level (i.e. subspecies or distinguishable populations), the approach has varied between species groups in a few cases, and consequently the total number of considered assessment units can be counted in different ways. Table 3.1 gives the numbers of considered and assessed species or other assessment units (subspecies or subpopulations) for the largest assessed units, i.e. excluding separately assessed stocks or subpopulations of one fish and three birds, which have been assessed both on the level of the Baltic Sea and on the level of subregional units. For the other species assessed below species level, no overall Baltic Sea assessments were made. Counted in this manner, the number of considered species or other assessment units is 2 791. Out of these, 1 753 (63%) assessment units were assessed according to the IUCN Red List criteria (Figure 3.1). These numbers include 28 species or subspecies of Baltic Sea birds that have been evaluated both as breeding and wintering populations.

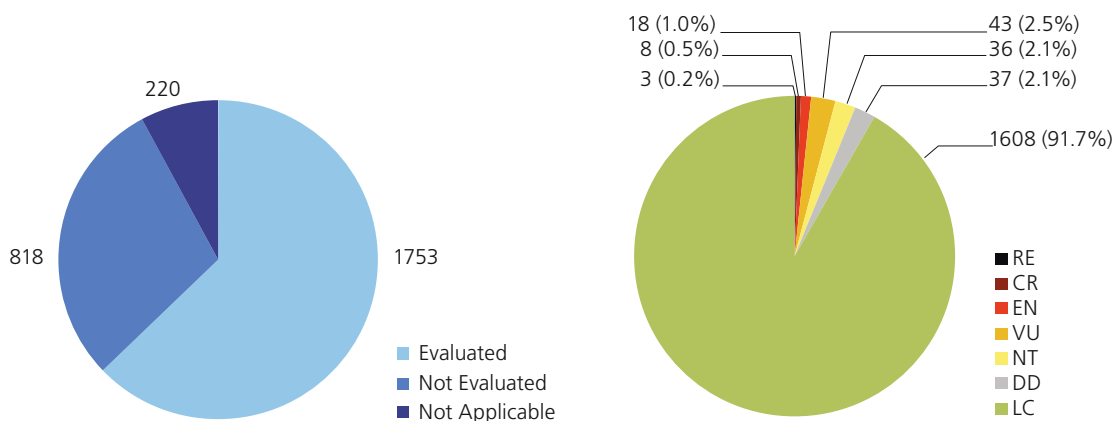
The coverage of the assessment varied considerably between species groups (Table 3.1). For breeding birds and marine mammals, all the taxa listed during the assessment work were also evaluated;

for the macrophytes and benthic invertebrates, however, the proportion of evaluated species was about 60%. This difference reflects the general difference also in the level of knowledge for the species groups. However, the low proportion of the assessed fish and lamprey species (47.3%) is not due to poor knowledge; rather, it is because more than half of the species on the fish reference list are vagrants or otherwise only irregularly occurring species in the Baltic Sea. If only regularly occurring species are considered, all species were evaluated also for fish.

Within the group of assessed species, the benthic invertebrates constitute 69% and macrophytes 18%. The proportion of threatened (VU, EN, CR) species is 3.9% and the proportion of all red-listed species 8.3%. The proportions of threatened and red-listed species vary considerably between species groups, with macrophytes and benthic invertebrates having the lowest percentages, and the vertebrate groups the highest.

Three species are regarded Regionally Extinct in the HELCOM area: two fish, American Atlantic sturgeon (*Acipenser oxyrinchus*) and the common skate (*Dipturus batis*), and one bird, the gull-billed tern (*Gelochelidon nilotica*).

In all eight taxa, all vertebrates were categorised as Critically Endangered (CR) in the HELCOM area. The overall numbers of taxa in the categories Endangered (EN) and Vulnerable (VU) were 18 and 43, respectively. Additionally, 36 taxa were assessed Near Threatened (NT) and 37 as Data Deficient (DD).



**Figure 3.1.** For species and other assessment units, proportions evaluated, Not Evaluated (NE) and Not Applicable (NA) units (left) and proportions of Red List categories within the group of assessed species and other assessment units (right).

**Table 3.1. Total number of species and other assessment units considered in the HELCOM Red List assessment, numbers and proportions of assessed, threatened and red-listed species, subspecies or subpopulations, and numbers by red list category and species group. The table gives the numbers of species or other assessment units only for the largest assessed units, i.e. excluding separately assessed stocks or subpopulations if the species has been assessed also on the level of the whole Baltic Sea.**

Species group	Number of taxa	Number and proportion of assessed taxa	RE	CR	EN	VU	NT	DD	Number and proportion of threatened taxa	Number and proportion of red-listed taxa
Macrophytes	526	317 (60.3%)	0	0	3	4	4	6	7 (2.2%)	17 (5.4%)
Benthic invertebrates	1 898	1 211 (63.8%)	0	0	1	18	9	23	19 (1.6%)	51 (4.2%)
Fish and lamprey species	239	113 (47.3%*)	2	4	3	7	9	8	14 (12.4%)	33 (29.2%)
Breeding birds	58**	58 (100%)	1	1	4	8	9	0	13 (22.4%)	23 (39.7%)
Wintering birds	63	47 (74.6%)	0	2	7	3	4	0	12 (25.5%)	16 (34.0%)
Marine mammals	7***	7 (100%)	0	1	0	3	1	0	4 (57.1%)	5 (71.4%)
<b>All taxa</b>	<b>2 791</b>	<b>1 753 (62.8%)</b>	<b>3</b>	<b>8</b>	<b>18</b>	<b>43</b>	<b>36</b>	<b>37</b>	<b>69 (3.9%)</b>	<b>145 (8.3%)</b>

\* If vagrants and otherwise irregularly occurring species are excluded from the comparison, the proportion of assessed taxa is 100%.

\*\* For the rules of species inclusion see Chapter 7.4. It should also be noted that altogether 28 species or subspecies have been assessed both for their breeding as well as for their wintering population.

\*\*\* Subpopulations assessed separately for two species (i.e. five species and seven assessments).

Within the groups of macrophytes and benthic invertebrates, the Red Lists mainly include species that are rare; in many cases, the rarity in the HELCOM area is related to their salinity requirements (either high or low). However, it should be noted that these species have not been red-listed merely due to their restricted distribution but it has been in combination with the continuing decline in the population, distribution area, or quantity and quality of their habitats.

With regard to vertebrates, the Red Lists do not have such a strong inclination towards geographically restricted populations or towards certain regions. The red-listed fish, birds, and mammals include taxa from different regions rather evenly and also widely distributed taxa that have experienced dramatic overall declines.

## 3.2 Application of the criteria

The HELCOM Red List assessment was based on five criteria (see Chapter 2.3). Four of the criteria, A, B, C and D, were used in the current assessment. Criterion E, which involves a quantitative analysis of extinction risk, was not applied to any species due to its high data requirements.

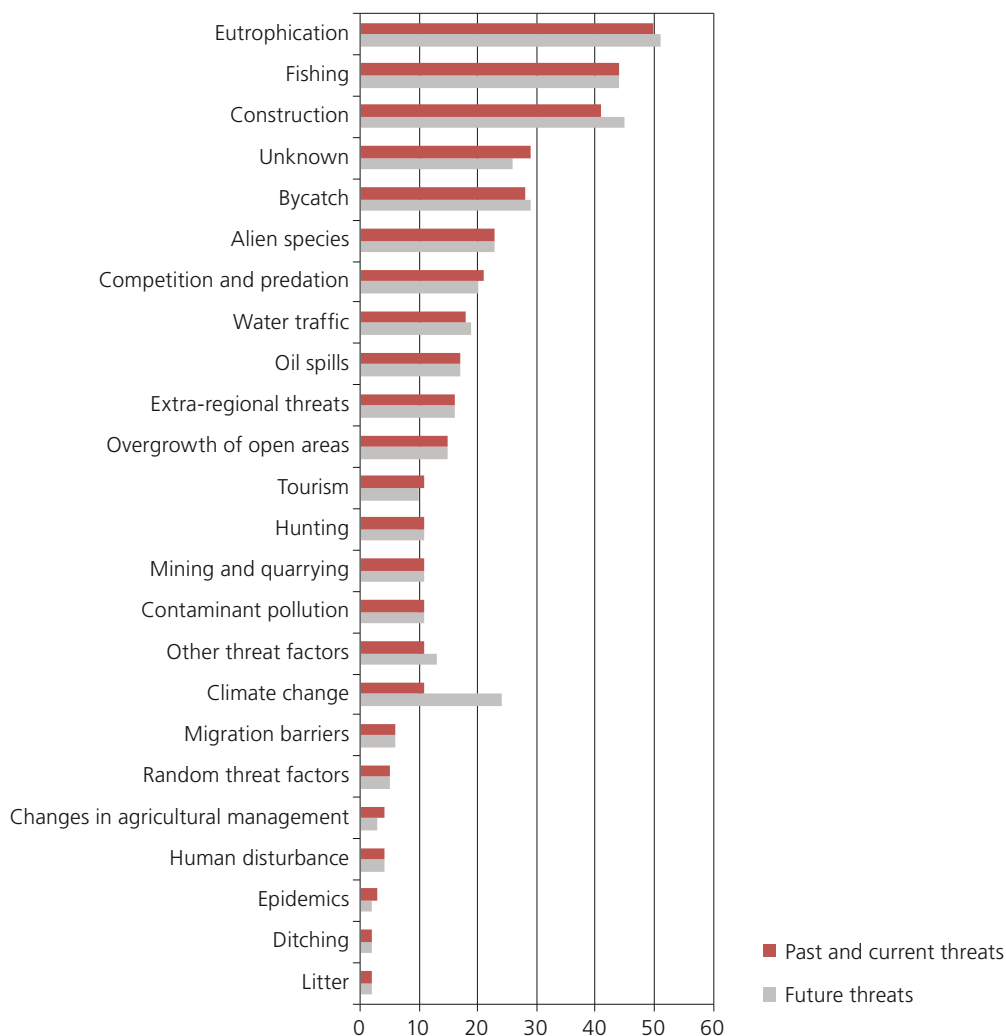
Criterion A, which concerns reduction of population size during a certain timeframe, was applied for most fish and bird species as well as for

mammals and some benthic invertebrates. Especially the vertebrate species are fairly well-known and data to estimate population declines could be found. However, this was not the case for macrophytes and most benthic invertebrates and their assessments had to rely on other criteria. The macrophytes and benthic invertebrates were mainly assessed using criterion B, which relates to geographically restricted populations, fragmentation, the low number of locations, continuing decline and extreme fluctuations. Criterion B was also applied for some fish and birds.

Criteria C and D require estimates on the numbers of mature individuals and concern small, and in the case of criterion C, continuously declining populations. These criteria were applied to fish and lamprey species, birds and mammals.

## 3.3 Past and current threats and threats in the future

If counted over all species groups, eutrophication is the most commonly mentioned past and current threat and also the most commonly mentioned threat in the future for the red-listed species (Figure 3.2). Fishing, construction activities, unknown reasons, and bycatch are the next most important threats, both in the past and in the future.



**Figure 3.2. Past and current threats (reasons for becoming threatened) for the red-listed species and future threats, counted over all species groups. The x-axis shows the number of red-listed species for which the threat was regarded important by the HELCOM Red List experts and reported in the Species Information Sheets.**

Eutrophication is an important threat or reason for becoming threatened, especially among macrophytes and benthic invertebrates. It affects in many ways, e.g. by increasing turbidity and reducing the penetration of light in the water. Increased nutrient levels also benefit opportunistic macrophytes, for example filamentous algae growing on other macrophytes. The colonisation of hard bottoms by macroalgae suffers from increased siltation due to the excessive growth of phytoplankton, which may prevent the attachment of algae spores on substrates. Siltation is assumed to be one of the main reasons for becoming threatened also among benthic invertebrates. In addition to eutrophication, siltation is also caused by bottom trawling, which is very intensive in some areas.

With the enhanced growth of phytoplankton and opportunistic macrophytes, the amount of organic matter ending to the bottom increases, and so does the consumption of oxygen in the decomposition of this biomass. Oxygen deficiency related to eutrophication and in some cases also to the reduced water mass exchange between the North Sea and the Baltic Sea is an important factor for many benthic invertebrates and also some fish.

In many cases, the detrimental effects of eutrophication are indirect, such as in cases where populations of invertebrates or fish are declining together with their habitats, e.g. macrophyte meadows.

Fishing or fisheries is mentioned as an essential threat for many fish species and it includes both commercial and recreational fishing. Fishing also

includes bottom trawling, which is among the most important threats for many red-listed benthic invertebrates. It has both a direct impact on the bottom and its fauna and also increases siltation over larger areas.

Construction includes many coastal and off-shore activities, e.g. wind power farms, gas pipelines, bridges, dredging, ports, coastal defence barriers (Figure 3.3), and also terrestrial construction, such as vacation homes. Construction causes both the direct destruction of habitats and indirect effects, such as increased turbidity and siltation around construction sites. Many macrophytes and benthic invertebrates require near-coast sheltered soft-bottom habitats, such as bays, estuaries and lagoons, which are under great human pressures and have changed dramatically over the past decades. One

of the changes is the restriction of hydrodynamics between the sea and estuaries or lagoons.

The next most important threat class is the unknown reasons behind the threatened status of a species. It is typical for benthic invertebrates and macrophytes that are, in general, more poorly known species groups and have many Data Deficient species. It has also been used for birds and fish.

Bycatch is the fifth most often mentioned threat. It is related to fishing but it is used for non-target species (including fish) that get caught in fishing gear. This mainly concerns sharks and rays, but also the many waterbirds that drown in gillnets, for example. Additionally, bycatch is considered an essential threat for all red-listed marine mammals.

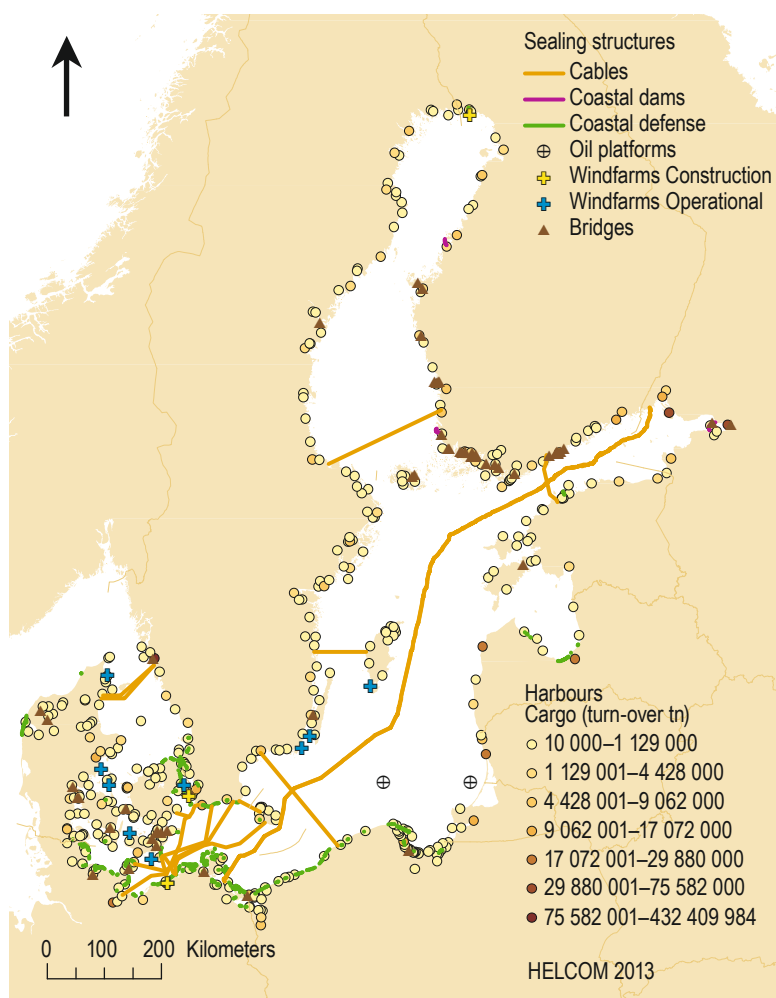
Alien species rank sixth among identified threats and they have been listed as an important reason behind the negative trends, especially for birds. With regard to birds, they particularly concern alien mammal predators such as the mink, raccoon and raccoon dog.

In most cases, the same threat factors that have been considered as reasons for the taxa becoming threatened, i.e. past and current threats, are assumed to be important also in the future (Figure 3.2). Climate change is a special case that has been regarded as an important factor much more often for the future than for the past.

Descriptions for the other identified past and current threats and future threats can be found in Chapter 7 and in the Species Information Sheets that are available on the HELCOM website.

### 3.4 Baltic Sea species on the global and European Red Lists

The IUCN Species Programme has been assessing the conservation status of species for over four decades. The purpose of the classification is to gain knowledge of threatened species of the world and thereby promote their conservation. The programme is committed to providing the world with the most objective, scientifically-based information on the current status of globally threatened biodiversity. The IUCN maintains a Red List of



**Figure 3.3. Structures sealing marine biotopes: harbours, bridges, coastal dams, oil platforms, cables and pipelines, coastal defense structures and wind farms. Data sources: Baltic Port Barometer (2009), HELCOM, EEA, EWA. Redrawn from HELCOM (2010a).**

**Table 3.2.** Baltic Sea species that have been assigned to a category other than Not Evaluated (NE) or Least Concern (LC) in the global or European Red Lists. The Red List categories and criteria are also given.

Species	HELCOM Red List Category 2013	European Red List	Global Red List
<b>Macrophytes</b>			
<i>Alisma wahlenbergii</i>	VU B2ab(ii,iii,iv,v)	VU B2b(iii,iv,v)c(iv)	VU B2b(iii,iv,v)c(iv)
<i>Crassula aquatica</i> , water pygmyweed	NT B2ab (ii,iii,iv,v)c(iv)	DD	NE
<i>Pericaria foliosa</i>	EN B2ab(ii,iii,iv,v)	NT	NE
<b>Benthic invertebrates</b>			
<i>Anisus vorticulus</i> , lesser ramshorn snail	NA	NT	DD
<i>Echinus esculentus</i> , European edible sea urchin	LC	NE	LR/NT *
<i>Myxas glutinosa</i> , glutinous snail	NE	LC	DD *
<i>Pseudanodonta complanata</i> , depressed river mussel	NA	NT	VU A2ace+4ace
<i>Sphaerium rivicola</i> , river orb mussel	LC	LC	VU A2ace
<i>Sphaerium solidum</i> , solid orb mussel	LC	NT	NT
<i>Unio crassus</i> , thick shelled river mussel	NE	VU A2ac+3ce	EN A2ace
<b>Fish and lamprey species</b>			
<i>Acipenser oxyrinchus</i> , American Atlantic sturgeon	RE	NE	NT
<i>Alopias vulpinus</i> , thresher shark	NA	NE	VU A2bd+3bd+4bd (NT in the Northeast Atlantic subpopulation)
<i>Amblyraja radiata</i> , starry ray/thorny skate	LC	NE	VU A2b
<i>Anguilla anguilla</i> , European eel	CR A3bde+4bde	CR A2bd+4bd	CR A2bd+4bd
<i>Cetorhinus maximus</i> , basking shark	NA	NE	VU A2ad+3d (EN in the Northeast Atlantic subpopulation)
<i>Chimaera monstrosa</i> , rabbit-fish	NA	NE	NT
<i>Coregonus maraena</i> , whitefish	EN A2bd	VU A2cd	VU A2cd
<i>Dipturus batis</i> , common skate	RE	NE	CR A2bcd+4bcd
<i>Gadus morhua</i> , cod	VU A2bc+4bc	NE	VU A1bd
<i>Galeorhinus galeus</i> , tope shark	VU A2bd, D1	NE	VU A2bd+3d+4bd
<i>Hippoglossus hippoglossus</i> , halibut	NA	NE	EN A1d
<i>Lamna nasus</i> , porbeagle	CR A2bd	NE	VU A2bd+3d+4bd (CR in Northeast Atlantic subpopulation)
<i>Melanogrammus aeglefinus</i> , haddock	NT B1a+2a	NE	VU A1d+2d *
<i>Raja clavata</i> , thornback ray	VU A2bd	NE	NT
<i>Somniosus microcephalus</i> , Greenland shark	NA	NE	NT
<i>Squalus acanthias</i> , spurdog/spiny dogfish	CR A2bd	NE	VU A2bd+3bd+4bd
<i>Squatina squatina</i> , angel shark/monk fish	NA	NE	CR A2bcd+3d+4bcd
<i>Thunnus thynnus</i> , blue-fin tuna	NA	NE	EN A2bd
<b>Baltic Sea birds (breeding)</b>			
<i>Aythya marila</i> , greater scaup	VU A2bc	EN A2b **	LC
<i>Gelochelidon nilotica</i> , gull-billed tern	RE	VU A2b **	LC
<i>Limosa limosa</i> , black-tailed godwit	NT A2ac	VU A2b **	NT
<i>Vanellus vanellus</i> , lapwing	NT A2bc	VU A2b+3bc **	LC
<b>Marine mammals</b>			
<i>Lutra lutra</i> , Eurasian otter	NT D1	NT	NT
<i>Phocoena phocoena</i> (Baltic Sea subpopulation), harbour porpoise	CR C1+2a(iii)	VU A2cde	LC
<i>Phocoena phocoena</i> (Western Baltic Sea subpopulation), harbour porpoise	VU A2a	VU A2cde	LC

\* in accordance with the old criteria (IUCN 1994), LR (Lower Risk) equates with NT

\*\* done by Bird Life International (2004) according to the IUCN criteria



Threatened Species, which is classified in accordance with the current Red List system (IUCN 1994, IUCN 2001). The species groups that have been comprehensively assessed include amphibians, birds, mammals, freshwater crabs, warm-water reef building corals, conifers and cycads. Nonetheless, there remains many thousands of species that have not been evaluated.

Around 6 000 European species have been assessed according to IUCN regional Red List Guidelines. The IUCN has been working on the initiative together with the European Commission. To date, European regional assessments have been completed for all mammals, reptiles, amphibians, butterflies, dragonflies, freshwater fishes and freshwater molluscs as well as for selected saproxylic beetles (i.e. beetles dependent on decaying wood), terrestrial molluscs and vascular plant species. Assessments for pollinators (all bees and bumblebees), priority medical plants and all marine fishes are expected to be completed by the end of 2014. A re-assessment of all birds is also being funded by the European Commission and is led by BirdLife International.

Of the species found in the Baltic Sea, 34 have been assigned to a category other than Not Evaluated (NE) or Least Concern (LC) in the Global or European Red Lists (Table 3.2). Of the species on the Global Red List, three have been evaluated in accordance with the old criteria (IUCN 1994) and need updating. Three of the fish species have also been evaluated for their Northeastern Atlantic subpopulation. The assessment of the birds on the European level has been carried out by Bird Life International (2004) according to the IUCN criteria.

Taxa classified as Vulnerable, Endangered or Critically Endangered on the basis of their global declines in numbers or range might be Least Concern within a particular region where their populations are stable (IUCN 2001). In these cases, the state of the local population has particular importance in terms of global biodiversity. The purpose of this listing (Table 3.2) is to note the state of the Baltic Sea populations of those species that are threatened on a global or European scale.



# 4 Discussion

## 4.1 Previous evaluations of threatened and declining species

The current Red List is the third evaluation by HELCOM concerning threatened species, but the first to evaluate all species groups using the IUCN Red List criteria. The earlier HELCOM list of threatened and/or declining species and biotopes/habitats (HELCOM 2007b) was based on expert judgment. It listed species and biotopes considered either threatened or declining or both without giving specific criteria or justifications for the decisions. This means that the 2007 and the current assessment are not comparable in such a way that any genuine trends in the status of the Baltic Sea species could be revealed by comparing their results.

The HELCOM list of threatened and/or declining species (HELCOM 2007b) includes 59 Baltic Sea taxa. Thirty-two are also red-listed in the current assessment. The inclusion in the previous HELCOM list (HELCOM 2007b) is separately indicated in the Red List tables in Chapter 7. The rest of the taxa included in the previous HELCOM list were either regarded Least Concern (LC) or, in some cases, Not Applicable (NA). They are listed in Table 4.1.

In addition to the HELCOM list of threatened and/or declining species (HELCOM 2007b), the fish and lamprey species were assessed in 2007, partly by applying the IUCN Red List criteria (HELCOM 2007a). The differences between the current Red List and the Red List partly based on the IUCN criteria (HELCOM 2007a) are described in more detail below. It should be noted that the differences between the lists are mainly due to the different criteria applied. In the current Red List, the IUCN criteria have been strictly applied; in addition, the inclusion of species to the assessment has also followed the IUCN guidelines (see Chapter 2.5.1). For these reasons, 18 species categorised as threatened and one as Near Threatened (NT) in HELCOM (2007a) are categorised Not Applicable (NA) in this assessment since they are only vagrants in the HELCOM area (Table 4.1). The stricter rules for the application of the Data Deficient (DD) category have also resulted in the change of the category from DD to LC for one species.

For 26 fish species, additional information and, in some cases (twaité shad *Alosa fallax* and razor fish *Pelecus cultratus*) positive development, have led to a change in status from threatened to Least Concern (Table 4.1), while the opposite has happened for three species in the comparison between this assessment and that of HELCOM (2007a) (see Chapter 7.3).

For the same reasons, of the species considered threatened in HELCOM (2007b), three are now categorised as Not Applicable and eight as Least Concern, while two species not considered threatened in HELCOM (2007b) are categorised as threatened in the current Red List.

Seven fish species listed as threatened in HELCOM (2007a) have even been excluded from the HELCOM checklist (HELCOM 2012) and are thus not assessed, including the subspecies of autumn spawning herring. These species or subspecies have been excluded either because their occurrence has only been verified outside the HELCOM area or for taxonomic reasons.

In total, HELCOM (2007a) lists 70 fish and lamprey species as threatened and one regionally extinct, HELCOM (2007b) lists 21 threatened species and the current Red List identifies 14 threatened and two regionally extinct species.



***Furcellaria lumbricalis*, a species regarded not threatened in the current assessment.**

**Table 4.1.** Species that were regarded threatened or declining in the previous HELCOM lists (HELCOM 2007a,b) but were categorised Least Concern (LC) or Not Applicable (NA) in this assessment. For fish and lamprey species, the previous Red List category is given according to HELCOM (2007a) and inclusion in the list of HELCOM (2007b) is indicated with \*.

Species group and scientific name	English name	HELCOM lists 2007a,b	Red List category 2013
<b>Macrophytes</b>			
<i>Chara connivens</i>	Convergent stonewort	x	LC
<i>Chara tomentosa</i>	Coral stonewort	x	LC
<i>Furcellaria lumbricalis</i>	Black carageen / Brabs bed	x	LC
<i>Fucus serratus</i>	Serrated or Toothed wrack	x	LC
<i>Fucus vesiculosus</i>	Bladder wrack	x	LC
<i>Zostera marina</i>	Common eelgrass	x	LC
<b>Benthic invertebrates</b>			
<i>Monoporeia affinis</i>	–	x	LC
<i>Pontoporeia femorata</i>	–	x	LC
<i>Saduria entomon</i>	–	x	LC
<i>Macroplea mutica</i>	–	x	LC
<b>Fish and lamprey species</b>			
<i>Alburnus alburnus</i>	Bleak	VU	LC
<i>Alopias vulpinus</i>	Thresher shark	CR	NA
<i>Alosa alosa</i>	Allis shad	CR*	NA
<i>Alosa fallax</i>	Twaite shad	EN*	LC
<i>Amblyraja radiata</i>	Starry ray / Thorny skate	EN*	LC
<i>Ammodytes marinus</i>	Lesser sandeel / Raitts sandeel	DD	LC
<i>Ammodytes tobianus</i>	Sandeel	VU	LC
<i>Ballerus ballerus</i>	Blue bream / Zope	VU	NA
<i>Barbus barbus</i>	Barbel	EN	NA
<i>Cetorhinus maximus</i>	Basking shark	EN	NA
<i>Chimaera monstrosa</i>	Rabbit-fish	VU	NA
<i>Clupea harengus</i>	Herring	LC(EN*) <sup>1</sup>	LC
<i>Cobitis taenia</i>	Spined loach	VU*	LC
<i>Coregonus albula</i>	Vendace	VU	LC
<i>Coryphaenoides rupestris</i>	Roundnose grenadier / Blunt-nose rattail	VU	NA
<i>Cottus gobio</i>	Bullhead	VU*	LC
<i>Cottus poecilopus</i>	Alpine bullhead	VU	NA
<i>Entelurus aequoreus</i>	Snake pipefish	VU	LC
<i>Galeus melastomus</i>	Black mouthed dogfish	EN	NA
<i>Gobio gobio</i>	Gudgeon	NT	NA
<i>Hippoglossus hippoglossus</i>	Halibut	EN	NA
<i>Labrus bergylta</i>	Ballan wrasse	EN	LC
<i>Labrus mixtus</i>	Cuckoo wrasse	EN	LC
<i>Liparis liparis</i>	Sea-snail, striped sea-snail	EN	LC
<i>Liparis montagui</i>	Montagus sea-snail	EN	LC
<i>Lumpenus lampretaeformis</i>	Snake blenny	CR*	LC
<i>Myoxocephalus scorpius</i>	Shorthorn sculpin	VU	LC
<i>Nerophis lumbriciformis</i>	Worm pipefish	VU	LC
<i>Nerophis ophidion</i>	Straight nosed pipefish	VU	LC
<i>Pelecus cultratus</i>	Razor-fish / Sichel	VU	LC
<i>Phoxinus phoxinus</i>	Minnnow	VU	LC
<i>Pollachius pollachius</i>	Pollack	EN*	NA

<i>Scomber scombrus</i>	Mackerel	VU	NA
<i>Scyliorhinus canicula</i>	Lesser spotted dogfish	EN*	LC
<i>Sebastes norvegicus</i>	Red fish / Golden Red fish	EN	NA
<i>Sebastes viviparus</i>	Norway haddock	EN*	NA
<i>Somniosus microcephalus</i>	Greenland shark	VU	NA
<i>Spinachia spinachia</i>	Fifteen-spined stickleback	VU	LC
<i>Squatina squatina</i>	Angel shark / Monk fish	EN	NA
<i>Symphodus melops</i>	Corkwing wrasse	VU	LC
<i>Syngnathus acus</i>	Greater pipefish	EN*	LC
<i>Syngnathus typhle</i>	Broad-nosed pipefish	VU	LC
<i>Taurulus bubalis</i>	Longspined bullhead	VU	LC
<i>Thunnus thynnus</i>	Blue-fin tuna	CR	NA
<i>Trachinus draco</i>	Greater weever	VU	LC
<i>Trigloporus quadricornis</i>	Fourhorn sculpin	VU	LC
<i>Zeus faber</i>	John Dory	EN	NA

#### Baltic Sea birds

<i>Mergus serrator</i> (breeding)	Red-breasted merganser	x	LC
<i>Sterna sandvicensis</i> (breeding)	Sandwich tern	x	LC
<i>Sternula albifrons</i> (breeding)	Little tern	x	LC
<i>Tadorna tadorna</i> (breeding)	Common shelduck	x	LC

#### Marine mammals

<i>Phoca vitulina</i>	Harbour seal (Southern Baltic population)	x	LC
<i>Halichoerus grypus</i>	Grey seal	x	LC

<sup>1</sup> The EN status refers to the autumn spawning herring

## 4.2 Application of the IUCN methods in a regional sea setting

In the current Red List assessment, HELCOM has been doing pioneering work, applying the IUCN Red List criteria for the assessments of almost the entire macrobiota of a regional sea. To our knowledge, no assessments on such a comprehensive scale have been carried out anywhere on the globe in a regional sea setting. In general, the marine realm is poorly covered by the IUCN Red List. Currently, the IUCN Species Programme Marine Biodiversity Unit is conducting the Global Marine Species Assessment project, which is the first global review of the threat of extinction for every marine vertebrate species, plants and selected invertebrates.

In the HELCOM Red List assessment, the proportions of threatened (categories CR, EN, and VU) and all red-listed (threatened and RE, NT, and DD) species are rather low, 3.9% and 8.3%, respectively. In the interpretations of the results, it should first be noted

that in contrast to some other red-listing systems, the IUCN Red List criteria are especially designed to find species with a high risk of (regional) extinction. The IUCN Red List criteria do not highlight populations that have declined, e.g. some decades ago, but are not declining any more, unless they have become threatened merely due to the small size of the remaining population. As shown in the previous Chapter, many species that have been regarded threatened or declining in the previous HELCOM assessments were not considered threatened by regional extinction in this assessment.

The low proportion of threatened species probably also relates to the lack of data and to the composition of the species list considered in the assessment. The majority of the species considered are macrophytes and benthic invertebrates, both of which are much more poorly known than the vertebrate groups. It is impossible to estimate how many threatened species have been left unevaluated due to the severe or complete lack of data. In total, 818 species that were included in the Baltic

Sea checklist (HELCOM 2012) were left out of the assessment (Not Evaluated).

The composition of the considered species list also affects the overall proportion of taxa assessed as threatened in other ways. For example, small animals, which constitute a great majority of the fauna included in the current assessment, tend to have larger population sizes compared to large animals; as a result, they can only seldom be red-listed according to the criteria relating to small population size. Data allowing, smaller animals might become red-listed according to criteria that relate to population declines but the IUCN Red List criteria restrict the time-frame of decline estimation to 10 years or three generations, whichever is the longer period. Small animals also tend to be short-lived, which means that for most of them the time period for population decline estimation is thus only 10 years. However, as such population trend data is virtually non-existent for most of the Baltic Sea invertebrates and macrophytes, these species cannot be red-listed on the basis of potential declines either.

It is also important to note that compared to most other regional seas (e.g. the Mediterranean Sea), the Baltic Sea and especially its western parts have naturally unstable conditions for many environmental factors that control the distribution of species. This favours species assemblages (communities) including a high percentage of generalists that are adapted to variable environmental factors. The proportion of specialists is also low due to the young geological age of the Baltic Sea. As a consequence, the proportion of threatened or red-listed species is lower than would be expected in other regional seas inhabiting higher proportions of specialists.

One other issue should be noted with regard to the overall Red List results: in the HELCOM assessments, it was decided that fairly well-known species can also be assessed within generally poorly known taxonomic groups. This was in contrast to the common practice, e.g. in Sweden, where taxonomic groups were assessed only if there was enough information to assess the majority of the species within them.

Especially in the groups of macrophytes and benthic invertebrates, the opportunity to pick up better known species to the assessment from generally poorly known taxonomic groups may

have led to a situation where species that are common have been assigned to the category Least Concern, whereas species that have always been less common or have become less common (and may thus be more vulnerable to anthropogenic changes) have been left unevaluated (Not Evaluated) due to the severe lack of data. At least for habitat generalists, the lack of data is usually more severe for rare rather than the common species as the accumulation of data depends on sampling that, from the species' point of view, is more or less random in many cases. Therefore, it is possible that when the proportion of evaluated species grows together with accumulating data in the future, the proportion of threatened species may also rise in the forthcoming HELCOM assessments.

At first glance, the percentages of threatened and red-listed species in the HELCOM assessment appear to be considerably lower than those found in similar regional assessments that have been conducted country-wise. The same IUCN Red List criteria have been applied in the Finnish and Swedish national Red List assessments. In Finland, the proportion of threatened species was 10.5% and in Sweden 19.8% over all environments. It is quite likely that the reasons for the apparent difference in the Finnish, Swedish and HELCOM proportions of threatened species lies rather in the taxonomic or distributional differences in the compositions of the groups of assessed species than in genuine differences between environments. Of all the marine species, Finland has assessed only fish, birds and charophytes. Within them, the proportion of threatened species, 11.4%, is even higher than the average over all species. Using a similar delineation in the HELCOM assessment would have resulted in a proportion of threatened species of around 17%. Sweden has covered a much larger proportion of marine species in the national assessment but not nearly as large group as evaluated by HELCOM. However, using the purely marine taxonomic groups of invertebrates, i.e. tunicates, echinoderms, brachiopods and anthozoans, as a reference group gives the proportion of threatened species of 19.5% for Sweden. Within the same taxonomic groups, the proportion in the HELCOM assessment is only 5.2%. The explanation for this difference appears to be related to the Skagerrak species, many of which are regarded threatened in Sweden but were either missing completely or left unevaluated in the HELCOM assessment.

# 5 Conservation and monitoring of threatened species in the 2000s

## 5.1 Conservation

### 5.1.1 International legislation and its relevance to the HELCOM Red List species

Several international nature conservation treaties obligate the countries in the Baltic Sea area.

The most extensive and inclusive convention regarding conservation of species and habitats is the UN Convention on Biological Diversity (CBD) (UNEP 1992). It was initiated by the United Nations Environment Programme (UNEP) in the late 1980s and was opened for signature in the Rio Earth Summit in June 1992. It has been ratified by all the Baltic Sea countries which are committed to its three main goals: the conservation of biological diversity, the sustainable use of components of biodiversity and the fair and equitable sharing of the benefits from the use of genetic resources. During the 10th meeting of the CBD in 2010, a revised and updated Strategic Plan for Biodiversity was adopted. This includes the Aichi Biodiversity Targets for the period 2011–2020. Out of the 20 Aichi targets, seven are relevant to the protection of marine environments and thus the Baltic Sea. These seven targets address:

- 1) the mitigation of the loss of habitats;
- 2) sustainable management and the harvesting of fish, invertebrates and aquatic plants;
- 3) the reduction of pollutants including nutrients;
- 4) the control of invasive species;
- 5) minimising anthropogenic pressures (as climate change or ocean acidification) on vulnerable ecosystems;
- 6) the protection of at least 10% of coastal and marine areas by systems of protected areas by 2020; and
- 7) preventing the extinction and improving the status of threatened species by 2020.

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) regulates the international trade of fauna and flora. The species are listed in the three appendices according to their global or regional extinction status (CITES 2012). It includes and fully obligates all the Baltic Sea countries. Only one of the HELCOM Red List species is listed on the CITES appendices. European eel (*Anguilla anguilla*) is listed under Appendix II, which means that its trade must be controlled in order to

avoid utilisation incompatible with their survival. In the HELCOM Red List, the species is categorised as Critically Endangered.

European Union nature protection legislation includes two directives: the Birds Directive (Council Directive 2009/147/EC on the conservation of wild birds) and the Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) (European Commission 1992, 2009d). These directives are based on the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats), a binding international legal instrument on the conservation of species and habitats for the EU Member States. The two directives are also the basis of the creation of the Natura 2000 network of protected areas. The network is the major EU instrument to fulfil global commitments of the Convention on Biological Diversity (CBD). It is legally enforceable and has strong legal protection. The Natura 2000 network is especially relevant to the wintering and breeding birds on the HELCOM Red List of threatened species since it includes several coastal wetlands and also offshore areas. These offer important breeding, feeding and wintering grounds for many of the threatened bird species of the Baltic Sea. The annexes of the two directives include lists of species of special concern that require special conservation efforts. Species that are common to this list of HELCOM threatened species and either one of the directives include a few aquatic vascular plants, such as *Alisma wahlenbergii*, one invertebrate *Macropylea pubipennis*,



**One of the species included in the HELCOM Red List, European Red List and the annexes of the EU Habitats Directive, *Alisma wahlenbergii*.**



several fish species, such as the sea lamprey (*Petromyzon marinus*), marine mammals including the harbour porpoise (*Phocoena phocoena*), and many birds (Table 5.1).

In addition to the above mentioned nature protection directives, there are also water-related EU directives that support the protection of marine biota and habitats. The Water Framework Directive (WFD) aims at achieving a good ecological and chemical status in the coastal waters. Good ecological status is mainly based on biological quality elements (phytoplankton, macrophytes/macroalgae, macrozoobenthos) which are monitored and assessed at regular intervals. Disturbed habitats will impact the marine biota and thus be reflected in the assessment results. Good ecological and chemical status supports the recovery and health of red-listed species as well as the non-threatened populations of marine biota. The EU Marine Strategy Framework Directive covers the whole Baltic Sea, not only the coastal strip, and has even closer connection to nature protection issues. The Directive requires good environmental status to be achieved by 2020 for several descriptors, including biodiversity (with indicators on species, habitat and community level) and the integrity of the sea-floor.

Part of marine biota has been considered also by the European IUCN, which has prepared European

Red Lists according to the IUCN criteria. HELCOM Red List species that are included either in the directive annexes or the European Red List are presented in Table 5.1.

The Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, CMS) is an intergovernmental treaty focusing on the protection of migratory species. It has been concluded under the United Nations Environmental Programme (CMS 2003). All Baltic Sea countries, except Russia, are parties in the convention. CMS agreements that have direct relevance in the Baltic Sea area are the Agreement on Conservation of Small Cetaceans in Baltic Sea and in North Sea (ASCOBANS) and the African-Eurasian Migratory Water Bird Agreement (AEWA). The ASCOBANS Agreement concerns the harbour porpoise (*Phocoena phocoena*), which has been categorised as Vulnerable for its Western Baltic subpopulation and Critically Endangered for its Baltic Sea subpopulation in the HELCOM Red List. Water bird species to which the AEWA Agreement applies are nearly all listed on the HELCOM Red List of threatened species. These agreements are legally binding treaties which are being executed under Action Plans. For example, the Jastarnia Plan (a Recovery Plan for Baltic harbour porpoises) under the ASCOBANS agreement was adopted by the Contracting Parties in 2009.



Lesser black-backed gull (*Larus fuscus fuscus*), one of the long-distance migrants protected by the African-Eurasian Migratory Water Bird Agreement (AEWA)

**Table 5.1.** HELCOM Red List species that are included either in the directive annexes or the European Red List. The Habitats Directive annex explanations are: Annex II: Animal and plants species of community interest whose conservation requires the designation of special areas of conservation, Annex IV: Animal and plant species of community interest in need of strict protection, Annex V: Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures. The Birds Directive annex explanations are: Annex I: Bird species in danger of extinction, rare, vulnerable to specific changes in their habitat or requiring particular attention for reasons of the specific nature of their habitat, Annex II: Bird species which may be hunted under certain circumstances, Annex III: Bird species which may be traded.

Species	HELCOM Red List 2013	EU Habitats Directive	EU Birds Directive	European Red List
<b>Macrophytes</b>				
<i>Alisma wahlenbergii</i>	VU B2ab(ii,iii,iv,v)	X (Annex II, IV) priority species		VU B2b(iii,iv,v) c(iv)
<i>Hippuris tetraphylla</i>	EN B2ab(i,ii,iii,iv,v)	X (Annex II, IV)		LC
<i>Persicaria foliosa</i>	EN B2ab(ii,iii,iv,v)	X (Annex II, IV)		NT
<b>Benthic invertebrates</b>				
<i>Macrolea pubipennis</i>	DD	X (Annex II)		
<b>Fish and lamprey species</b>				
<i>Anguilla anguilla</i>	CR A3bde+4bde			CR A2bd+4bd
<i>Aspius aspius</i>	NT A3d	X (Annex II, V; except the Finnish populations)		LC
<i>Coregonus maraena</i>	EN A2bd			VU A2cd
<i>Lampetra fluviatilis</i>	NT A2bd	X (Annex II, V; except the Finnish and Swedish populations)		LC
<i>Petromyzon marinus</i>	VU C2a(i)	X (Annex II except the Swedish populations)		LC
<i>Salmo salar</i>	VU A4b	X (Annex II, V; only in fresh water; except the Finnish populations)		
<i>Thymallus thymallus</i>	CR A2bcd	X (Annex V)		LC
<b>Baltic Sea birds</b>				
<i>Anser fabalis</i>	wintering subsp. <i>fabalis</i> EN A2b		X (Annex II)	LC on species level
<i>Branta bernicla</i>	wintering subsp. <i>hrota</i> NT B1ab(iii), D2		X (Annex II)	VU A2b (on species level)
<i>Clangula hyemalis</i>	wintering EN A2b		X (Annex II)	LC
<i>Gavia stellata</i>	wintering CR A2b		X (Annex I)	LC
<i>Gavia arctica</i>	wintering CR A2b		X (Annex I)	VU A2b
<i>Melanitta fusca</i>	breeding VU A2b, wintering EN A2b		X (Annex II)	LC
<i>Melanitta nigra</i>	wintering EN A2b		X (Annex II, III)	LC
<i>Mergus serrator</i>	wintering VU A2b		X (Annex II)	LC
<i>Podiceps auritus</i>	breeding VU A2abce, wintering NT D2		X (Annex I)	LC
<i>Polysticta stelleri</i>	wintering EN A1b, B2ab(ii,iv,v), C1+2a(ii)		X (Annex I)	LC
<i>Somateria mollissima</i>	breeding VU A2abe, wintering EN A2b		X (Annex II, III)	LC
<b>Marine mammals</b>				
<i>Phocoena phocoena</i>	Western Baltic subpopulation VU A2a, Baltic Sea subpopulation CR C1+2(ii)	X (Annex II, IV)		VU A2cde
<i>Phoca vitulina</i>	Kalmarsund population VU D1	X (Annex II, V)		LC
<i>Lutra lutra</i>	NT D1	X (Annex II, IV)		NT

The Ramsar Convention protects wetlands of international importance. All the Baltic Sea countries are Contracting Parties in this intergovernmental treaty for the conservation of wetlands which came into force as early as 1975. The convention plays a role especially in the protection of birds for which the coastal wetlands are important habitats. On a larger scale, the wetlands also contribute to the mitigation of eutrophication of the Baltic Sea as they work as filters of nutrients and organic matter coming from the drainage area. In this sense, the protection of the sites not directly in the sea area but in the drainage basin is also important.

Although the aim of fisheries regulation is to ensure sustainable use of the fish stocks, they nevertheless have the potential to contribute to conservation. Commercially exploited fish and shellfish stocks in the Baltic Sea are regulated under the EU Common Fisheries Policy, as well as through a bilateral agreement between the European Community and the Russian Federation on cooperation in fisheries, and the conservation of living marine resources. For those Contracting Parties that are also EU Member States, there are management plans in place for a number of fish species, including cod, herring, sprat, and under preparation for species such as salmon. Measures for the recovery of European eel populations are regulated by separate EU-wide and national legislation. Fishing in the coastal areas is regulated nationally. The conservation of marine biological resources is the fundamental pillar to achieve the objectives of the EU Common Fisheries Policy, which is currently under revision and expected to enter into force in 2014–2015. It includes the application of ecosystem-based management in fisheries implemented, for example, through the introduction of multi-species management plans, banning discards and reducing unwanted bycatches of mammals, birds and untargeted/undersized fish.

### 5.1.2 National legislation and programmes outside international treaties

National legislation of the Baltic Sea countries is the means to implement the international treaties. In addition, countries can have national conservation legislation that goes beyond the international treaties or the EU Directives.

#### **Denmark**

Danish preservation measures protecting Baltic Sea species can be found in a variety of national legislation and related acts and regulations.

All birds and mammals are protected under the act on hunting and wildlife management. There are several local wildlife preservation areas, in which hunting and disturbances are regulated. Furthermore, wildlife is also regulated through national fisheries laws.

Additional protection occurs under Danish implementations of EU directives such as the Birds and Habitat directives, the Water Framework Directive and the Marine Strategy Framework Directive.

Finally, a series of environmental acts and ordinances protect species indirectly through environmental and nature regulations. Among these are legislation on nature protection and regulations on pollutants and waste.

#### **Estonia**

The Nature Conservation Development Plan (2012) is a strategic basic document for the development of the fields related to the protection and use of nature until 2020. Its goal is to stop the decrease of biodiversity and damaging the nature by 2020, and to restore ecosystems as much as possible, while, at the same time, simultaneously increasing the contribution to the protection of global biodiversity.

The main features of the current management of nature conservation in Estonia were specified in 1994 with the Protected Natural Objects Act and amended in 2004 with the Nature Conservation Act, which takes account of European legislation on nature conservation, first and foremost the Bird Directive and the Habitats Directive. Pursuant to the Nature Conservation Act, nature is protected through regulating the use of valuable areas – the establishment of protected areas, special conservation areas and permanent habitats, the regulation of transactions with individuals of protected species, the promotion of nature education and research and the specification of responsibility for violations. Under the Nature Conservation Act, protected species are divided into three categories based on their threat level:



the most endangered fall into category I and least endangered into category III.

In addition, there is more legislation (the Forest Act, the Water Act, the Planning Act, the Waste Act and the Environmental Monitoring Act) that protects flora and fauna indirectly through restrictions established for another purpose (water protection, shore protection, etc.).

### **Finland**

Finnish national legislation that has an influence on the protection of the Baltic Sea species and habitats includes the Environmental Protection Act, the Water Act, the Act on the Protection of the Sea, the Act on Water Resources Management, the Nitrates Decree, the Hunting Act, the Fishing Act, and the Nature Conservation Act. These laws and regulations include water protection and management, pollution control and the protection of habitats and species. The Finnish Action Plan for the Protection of the Baltic Sea and Inland Watercourses was approved by the Ministry of the Environment in 2005. Its objectives are to reduce eutrophication, to improve the ecological state of the marine environment, to conserve marine and coastal biodiversity and to reduce risks and damage caused by the transportation of oil, chemicals and hazardous substances (Ministry of the Environment 2005). In addition, to implement the Marine Strategy Framework Directive, Finland adopted the legislation on the management of the Baltic Sea in 2011.

### **Germany**

Regulations aiming at the protection of the marine environment are included as an integrated part in all specific legal acts referring to marine resource use in the broadest sense, for example the Federal Spatial Planning Act, the Federal Mining Act, the Act on Federal Waterways, and, for installations within the EEZ, the Decree on Offshore Installations.

However, the most specific regulations are found in the Nature Conservation and Water Resource Management Acts. Due to the federal system of Germany, in both cases, there are Federal Acts which are modified by specific regulations of the Federal States. Important legal nature conservation

instruments that also apply to the marine environment are:

- The establishment of protected areas (Natura 2000 sites, national protection categories like national parks, nature reserves and landscape reserves).
- The protection of certain biotopes, which include the habitats according to the EU Habitats Directive and other biotopes.
- The protection of species (animals and plants).
- The protection of the coastal strip (especially with regard to construction works).

The Federal Nature Conservation Act includes specific paragraphs on marine conservation. These provisions are specified under §24 of the Nature Conservation Implementation Act of Mecklenburg-Western Pomerania, whereas the Nature Conservation Act of Schleswig-Holstein does not include any modifications or additional regulations. The Federal Water Management Act incorporates the regulations of the WFD and the MSFD, which aim at achieving good ecological and environmental status of the Baltic Sea and its marine ecosystems. These laws are also related to the implementation of the EU Nitrate Directive and the Communal Wastewater Treatment Directive which, by reducing nutrient inputs into rivers and the sea, support the protection of the marine flora and fauna. Furthermore, the Federal Surface Water Decree specifies the WFD requirements as well as the water body types, type-specific reference conditions for physico-chemical parameters, environmental quality standards for pollutants and monitoring details.

### **Latvia**

The main Latvian national legislation concerning the protection of biodiversity, including marine biodiversity, are the Law on Specially Protected Nature Territories and the Law on Species and Habitats Conservation. Both laws cover a wide range of regulations and include lists of protected species and habitats, the establishment of marine protected areas as well as general and specific rules on the protection and use of protected areas.

Additional legislation (Fishery Law, Protection Zone Law, Environmental Protection Law, Water Management Act and Spatial Development Planning Law, etc.) protects flora and fauna indirectly

through restrictions and procedures established for another purpose such as water protection and spatial planning.

### **Lithuania**

Regulations on the protection of the marine and coastal environment are included as part in the specific laws and other legal acts referring to marine and coastal resource use and protection:

- Law of the Republic of Lithuania on Protected Species of Animals, Plants and Fungi.
- Law of the Republic of Lithuania on Wild Flora.
- Law of the Republic of Lithuania on Protected Areas.
- Law of the Republic of Lithuania on Fisheries.
- Law of the Republic of Lithuania on Recreational Fishing.
- Law on the Coastline.
- Regulations on Recreational Fishing in inland waters, adopted by the Order of the Minister of Environment.
- Regulations on Commercial Fishing in inland waters, adopted by the Order of the Minister of Environment.
- Regulations on Recreational fishing in the sea waters, adopted by the Order of the Minister of Agriculture.
- Regulations on Commercial fishing in coastal waters, adopted by the Order of the Minister of Agriculture.
- Governmental Decision of the Republic of Lithuania on General Provisions for the Areas on Birds and Habitat Protection.

### **Poland**

The main Polish national legislation act concerning the protection of biodiversity, including marine species, is the Nature Conservation Act of 16 April 2004 (Journal of Laws, 2009, no. 151 item 1220, as amended). Species under strict protection are listed in the Regulation of the Minister of the Environment of 12 October 2011 on wild-life animal species under protection (Journal of Laws, 2011, no. 237 item 1419). All bird species, marine mammals (except otter) and selected fish, lampreys and invertebrates are under strict protection in Poland. This means that deliberate capture or killing, deliberate disturbance, deterioration or destruction of breeding sites or habitats of the species are prohibited

Apart from protection by the Nature Conservation Act, the species are also protected within Natura 2000 sites as well as national protection forms such as national parks or nature reserves.

The species exploited by fisheries (cod, trout, salmon, etc.) have minimum conservation reference sizes and fishing conservation periods specified in the European Union legislation. For Polish territorial waters, as well as other utilised fish species not specified in the EU legislation, such as bream, pike, pikeperch, common roach, minimum conservation reference sizes and fishing conservation periods are regulated in the Regulation of the Minister of Agriculture and Rural Development concerning conservation reference sizes and conservation periods for marine organisms and specific conditions for marine fisheries performance (Journal of Laws, 2011, no. 220 item 1305).

### **Russian Federation**

The Russian Federation is of special interest. As a non-EU HELCOM country the EU Directives do not apply to Russia, in which case the importance of the national legislation is emphasised.

The main legal documents established by the government of the Russian Federation in order to list rare and endangered species of wild animals, plants and fungi, as well as certain subspecies and local populations are the Red Data Book of the Russian Federation and regional Red Data Books. The legislative basis for Red Data Book development and functioning are the Federal Laws 'On Environment Protection' (2001) and 'On Fauna' (1995). These laws regulate the use of biological organisms and their habitats, and determine the rights and responsibilities of the citizens in relation to bioresources and nature areas. It is important to note that the use and management of marine mammals as well as other water organisms are regulated by the Federal Law 'On Fisheries and Water Bioresources Conservation' (2004). Terms and conditions on the use of marine bioresources in the Baltic Sea region as well as quotas for fishermen are set by the fisheries regulations for the western fisheries basin issued by the Fisheries Agency of the Russian Federation. An important federal law that regulates the use and conservation of water objects in the Russian Federation is the 'Water Code' (2006). The establishment, functioning and

main aims of various types of protected areas are regulated by the Federal Law 'On Protected Areas' (1995). There is also a range of federal and regional laws that regulate shipping and its environmental impacts in the Baltic Sea.

### **Sweden**

Swedish national legislation that has an influence on the protection of the Baltic Sea species and habitats includes the Environmental Code and a wide range of related governmental ordinances and regulations issued by authorities under the government. The purpose of the Code is to promote sustainable development to assure a healthy and sound environment for present and future generations. The Code contains provisions aiming at protecting species of animals, plants and habitats as well as on pollution control and waste management. The Water Framework Directive and the Marine Strategy Framework Directive have been implemented by existing provisions in the Environmental code on environmental quality standards and programmes of measures, for example, as well as by the Governmental Ordinance (2004:660) on Water Management and the Marine Environmental Ordinance (2010:1341). Wildlife is also regulated through sectorial laws such as the Swedish Hunting Law (1987:259) and the Swedish National Fisheries Law (1993:787). There are also a range of national laws and ordinances regulating shipping and its environmental impacts.

### **5.1.3 Marine protected areas**

Baltic Sea protected areas include the Natura 2000 network, HELCOM Baltic Sea Protected Areas (BSPAs) as well as some Ramsar sites and sites protected solely under national legislation (Figure 5.1).

The Natura 2000 network is based on the requirements of the Birds Directive and the Habitats Directive. It includes Sites of Community Importance (SCIs) and Special Protection Areas (SPAs), which aim to protect the species listed in the annexes to the directives. In a later step, SCIs can be designated as Special Areas of Conservation (SACs). SCIs are designed to conserve over 200 habitat types and over 700 species of plants and animals. SPAs, in turn, protect the habitats of 194 vulnerable bird species and resting areas of migratory bird

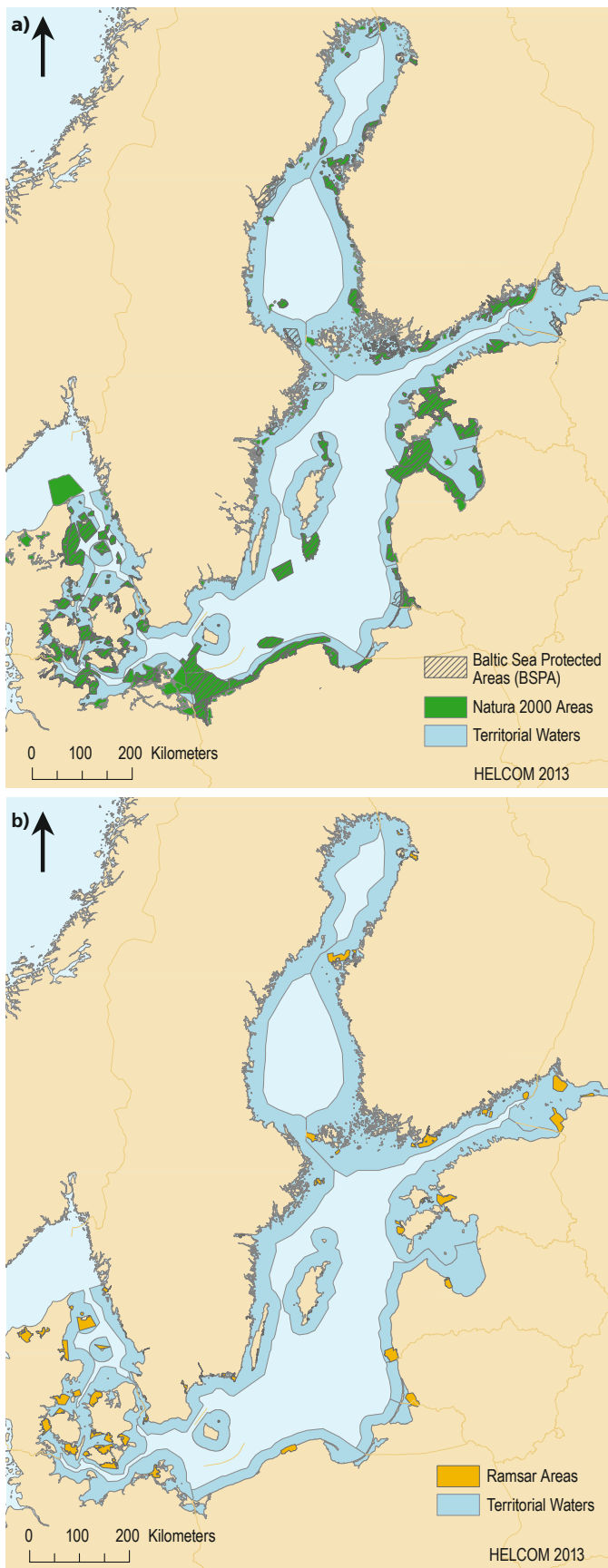


**Protected area, the estuary of River Porvoonjoki, Porvoo, Finland**

species. While human activities are not necessarily prohibited in Natura 2000 areas, they must be sustainable and in accordance with the conservation objectives. Special species and habitat protection measures and management measures must be in place in these areas.

HELCOM Baltic Sea Protected Areas (BSPAs) have their foundation in the HELCOM Recommendation 15/5 issued in 1994. By 2010, 159 BSPAs had been established, including new offshore protected areas and older marine protected areas which have been added to the BSPA network. The Baltic Sea Action Plan, adopted in 2007, accelerated the efforts to create and manage new BSPAs. According to the BSPAs' objectives, they should protect areas with threatened or important species and habitats, areas of high natural biodiversity, unique geological structures and high sensitivity, and areas of ecological significance. Areas of special ecological significance include important feeding, breeding, moulting, wintering, resting and spawning areas (HELCOM 2007c).

The state and functioning of these areas was assessed by HELCOM in 2010 in the 'Assessment on the ecological coherence of Baltic Sea MPA networks' (HELCOM 2010b). The assessment was, to some extent, hampered by missing, incoherent and limited data. Nevertheless, it concluded that HELCOM's objective of an ecologically coherent network of well-managed marine protected areas has not yet been achieved. Natura 2000 network together with HELCOM Baltic Sea Protected Areas (BSPAs) cover about 12% of the Baltic Sea.



**Figure 5.1: a) Natura 2000 network and Baltic Sea Protected Areas, b) Ramsar sites in the Baltic Sea area (map: HELCOM 2013).**

Moreover, the protection of the indicator species chosen for the assessment was, for the most part, insufficient.

A considerable number of Baltic Sea coastal areas have been notified as 'Wetlands of International Importance' according to the treaty text of the Ramsar convention. The wetlands listed in Article II of the treaty are significant in terms of ecology, botany, zoology, limnology or hydrology. The Contracting Parties to the Ramsar Convention are obliged to identify these areas in their territory, designate them to the list and promote their sustainable use. The parties are also committed to establishing nature reserves in wetlands (Ramsar 1987). In the Baltic Sea catchment area, there are 171 Ramsar sites which comprise 142 km<sup>2</sup> of wetlands. Approximately 64% of these are in the actual Baltic Sea area, 27% in shallow marine areas (depth < 6m) and 37% in coastal habitats. The coasts of Lithuania and the Kaliningrad Region of Russia (Curonian Lagoon) and of Poland and Germany are quite poorly represented. For the EU Member States, the Ramsar sites are in general adequately represented in the Natura 2000 network. Thus, there is a legal obligation for the EU Member States to ensure relevant legal protection as well as the management and the allocation of necessary financial resources for these Natura 2000/Ramsar areas (Eriksson 2008).

## 5.2 Monitoring

In its working document 'Overview of the marine environmental monitoring in the Baltic Sea', the HELCOM project for the revision of HELCOM monitoring (HELCOM MORE) presents the latest information on species monitoring in the Baltic Sea area (document 6/7 of HELCOM MONAS 18/2013). As the overview focuses on the reported national monitoring of the state of the marine environment, it only includes a few indicator species in selected locations. Other surveys of the marine fauna and flora are not included in the overview document.

Most macrophyte monitoring in the Baltic Sea is concentrated in the coastal monitoring stations. The southwestern Baltic Sea, the Kattegat and the Danish fjords are the most frequently monitored areas. Less extensively monitored areas are most of the Finnish west coast, most of the central and

northern coasts of Sweden as well as Latvian and Russian coastal waters. Although Russia had not yet presented information on its national monitoring activities, this report contains all monitoring activities reported by the Contracting Parties during the HELCOM MORE project. The most extensive monitoring data exists of few common, large and easily identifiable species, which have been studied over longer periods. Thus, the monitoring of threatened species is overall poor.

Benthic communities are studied as they give information on the overall status of the sea. Much of the regular monitoring carried out in the HELCOM framework, for example, is done for the soft-bottom macrozoobenthos in deep areas. In the coastal zones, the monitoring has recently been improved, for example, due to requirements under the Water Framework Directive in the EU countries. In these coastal surveys, some information on benthic invertebrates is attained; usually, however, this only considers soft-bottom fauna, a small fraction of all species. For most species, only occasional information exists and existing data are scarce and scattered.

Some fish species are exceptionally well monitored since they are commercially important and data are collected and available on their stocks. In addition to the catch data, certain fish species are monitored in different environmental monitoring programmes. However, there is much less data on the non-commercial fish species, many of them occurring in the coastal areas. Recently, some further effort has been established to enhance their monitoring and under the HELCOM FISH-PRO project, for instance, monitoring has been established for non-commercial fish in coastal areas.

Monitoring data on the populations and trends of breeding birds in the Baltic Sea area are extensive. This mainly applies to the near shore areas since offshore areas are much more difficult to monitor and less data are thus available. While extensive monitoring programmes exist for wintering birds in the coastal areas, regional offshore surveys of wintering birds are mostly short term and the data between sites are incoherent. It is worth noting that much of current bird monitoring has not been established in national monitoring programmes; rather, it is based on recreational, albeit well organised, activities.

Mammals are monitored in the Baltic Sea area - regular monitoring exists especially for the three seal species. All the seal species are monitored on an annual basis within national monitoring programmes in all countries with established seal colonies. This monitoring is based on aerial surveys and focuses on seal haul out sites but does not allow for the monitoring of seal movements although they are known to move over large areas. This also renders the estimates less certain. The harbour porpoise and the otter are less studied. The aerial survey methods traditionally used in cetacean monitoring are not optimal for the harbour porpoise. Therefore, a combination of aerial surveys and hydroacoustic monitoring has been carried out by Denmark, Germany and Sweden. Static Acoustic Monitoring (SAM) devices called C-PODs are being used within an international monitoring project, SAMBAH (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise) to detect and log porpoise sonar click activities and gather information about densities and total abundance of the species. The study area of the project reaches from the Darss- and Limhamn ridges in the southwest to the northern border of the Åland archipelago and is being carried out in 2011–2014. Also, dead animals are monitored (all mammals, except the otter) and pathological analyses are used to assess the health of the populations.



Monitoring of threatened species is overall poor.



# 6 Conclusions and proposals of the HELCOM Red List project

Three Baltic Sea species - the American Atlantic sturgeon (*Acipenser oxyrinchus*), the common skate (*Dipturus batis*) and the gull-billed tern

(*Gelochelidon nilotica*) - are regionally extinct from the Baltic Sea. Altogether, 69 species or other assessment units are threatened and

**Table 6.1. List of Regionally Extinct (RE) and threatened (CR; Critically Endangered, EN; Endangered, VU; Vulnerable) species in the Baltic Sea and their threat status.**

	Scientific name	English name	Scientific name	English name
RE	<i>Acipenser oxyrinchus</i>	American Atlantic sturgeon	VU	<i>Atelecyclus rotundatus</i> Circular crab/Old mans face crab
RE	<i>Dipturus batis</i>	Common skate	VU	<i>Clelandella miliaris</i>
RE	<i>Gelochelidon nilotica</i> (breeding)	Gull-billed tern	VU	<i>Cliona celata</i> Yellow boring sponge
CR	<i>Anguilla anguilla</i>	European eel	VU	<i>Deshayesorchestia deshayesii</i>
CR	<i>Lamna nasus</i>	Porbeagle	VU	<i>Epitonium clathrus</i> Common wentletrap/ European wentletrap
CR	<i>Squalus acanthias</i>	Spurdog / Spiny dogfish	VU	<i>Haploops tubicola</i>
CR	<i>Thymallus thymallus</i>	Grayling	VU	<i>Hippasteria phrygiana</i> Rigid cushion star
CR	<i>Charadrius alexandrinus</i> (breeding)	Kentish plover	VU	<i>Hippolyte varians</i> Chamaeleon prawn
CR	<i>Gavia arctica</i> (wintering)	Black-throated diver	VU	<i>Lunatia pallida</i> Pale moonsnail
CR	<i>Gavia stellata</i> (wintering)	Red-throated diver	VU	<i>Macoma calcarea</i> Chalky macoma
CR	<i>Phocoena phocoena</i> (Baltic Sea population)	Harbour porpoise	VU	<i>Modiolus modiolus</i> Northern horsemussel
EN	<i>Hippuris tetraphylla</i>	Fourleaf Mare's Tail	VU	<i>Nucula nucleus</i> Common nut clam
EN	<i>Lamprothamnium papulosum</i>	Foxtail stonewort	VU	<i>Parvicardium hauniense</i> Copenhagen cockle
EN	<i>Persicaria foliosa</i>		VU	<i>Pelonaia corrugata</i>
EN	<i>Haploops tenuis</i>		VU	<i>Scrobicularia plana</i> Peppery furrow shell
EN	<i>Anarhichas lupus</i>	Atlantic wolf-fish	VU	<i>Solaster endeca</i> Purple sun star
EN	<i>Coregonus maraena</i>	Whitefish	VU	<i>Stomphia coccinea</i> Spotted swimming anemone
EN	<i>Molva molva</i>	Ling	VU	<i>Gadus morhua*</i> Atlantic cod
EN	<i>Anser fabalis fabalis</i> (wintering)	Taiga bean goose	VU	<i>Galeorhinus galeus</i> Tope shark
EN	<i>Calidris alpina schinzii</i> (breeding)	Southern dunlin	VU	<i>Merlangius merlangus</i> Whiting
EN	<i>Clangula hyemalis</i> (wintering)	Long-tailed duck	VU	<i>Petromyzon marinus</i> Sea lamprey
EN	<i>Larus melanocephalus</i> (breeding)	Mediterranean gull	VU	<i>Raja clavata</i> Thornback ray
EN	<i>Melanitta fusca</i> (wintering EN, breeding VU)	Velvet scoter	VU	<i>Salmo salar</i> Salmon
EN	<i>Melanitta nigra</i> (wintering)	Common scoter	VU	<i>Salmo trutta</i> Trout
EN	<i>Podiceps grisegena</i> (wintering)	Red-necked grebe	VU	<i>Arenaria interpres</i> (breeding) Ruddy turnstone
EN	<i>Polysticta stelleri</i> (wintering)	Steller's eider	VU	<i>Aythya marila</i> (breeding) Greater scaup
EN	<i>Rissa tridactyla</i> (breeding EN, wintering VU)	Black-legged kittiwake	VU	<i>Cephus grylle arcticus</i> (wintering) Black guillemot
EN	<i>Somateria mollissima</i> (wintering EN, breeding VU)	Common eider	VU	<i>Hydroprogne caspia</i> (breeding) Caspian tern
EN	<i>Xenus cinereus</i> (breeding)	Terek sandpiper	VU	<i>Larus fuscus fuscus</i> (breeding) Lesser black-backed gull
VU	<i>Alisma wahlenbergii</i>		VU	<i>Mergus serrator</i> (wintering) Red-breasted merganser
VU	<i>Chara braunii</i>	Braun's stonewort	VU	<i>Philomachus pugnax</i> (breeding) Ruff
VU	<i>Nitella hyalina</i>	Many-branched stonewort	VU	<i>Podiceps auritus</i> (breeding VU, wintering NT) Slavonian grebe
VU	<i>Zostera noltii</i>	Dwarf eelgrass	VU	<i>Phoca vitulina</i> (Kalmarsund population) Harbour seal
VU	<i>Abra prismatica</i>		VU	<i>Phocoena phocoena</i> (Western Baltic subpopulation) Harbour porpoise
			VU	<i>Phoca hispida botnica</i> Baltic ringed seal

\* There are differences in the concepts and methodologies applied by the IUCN and ICES in assessing harvested fish species.

Some of the differences concern the delineation of assessment units (whether e.g. a species, population or stock is addressed), approaches to defining tolerated risk levels and precaution, time perspectives, as well as the use of data sources and modelling. These can lead to different conclusions about the assessed organisms.

The approach of ICES is using a minimum biomass limit for a stock (called Blim), which is more precautionary than the IUCN criteria. For the cod stocks in the Baltic, ICES in 2013 has identified both the eastern (HELCOM listing VU) and western (HELCOM listing NT) Baltic Sea cod stocks to be above these biomass limits. In addition, ICES projections for these two stocks show a further increase by 2015. For the Kattegat cod stock (here CR) ICES advises that no directed fishery takes place and by-catch and discards should be minimized and the stock has been below biomass limit since year 2000.

Further explanation about the differences in the IUCN and ICES approaches, as well as ICES advice indicating some critical issues regarding the application of the IUCN criteria to Baltic cod has been included in the Species Information Sheet for cod available at [www.helcom.fi](http://www.helcom.fi).



classified either as Critically Endangered (eight species or other assessment units), Endangered (18) or Vulnerable (43). They represent 3.9% of the assessed 1 753 species or other assessment units from the group of more than 2 700 known Baltic Sea macro species, subspecies or populations. These 69 fulfil the IUCN criteria for the risk of regional extinction and are thus in danger of disappearing from the Baltic Sea, or in the case of the harbour porpoise and harbour seal, of certain regions of the Baltic Sea, unless effective conservation measures will be taken.

The species at the risk of extinction in the Baltic Sea include populations of three mammal species, 22 species of birds, 14 species of fish, seven macrophyte plants and 19 invertebrates (Table 6.1). All critically endangered species are vertebrates.

In addition to the species regionally extinct or at the risk of extinction, the HELCOM Red List contains species that are Near Threatened (altogether 36 species) and species that are Data Deficient (37 species). All red-listed species together constitute 8.3% of the assessed species. Of all evaluated 1 753 species or other assessment units, the majority, 1 608 species or other units, were considered to be of Least Concern.

### **Mitigation of anthropogenic threats**

The Species Information Sheets (SISs) have been developed on species that were identified as Regionally Extinct, threatened (Vulnerable, Endangered or Critically Endangered), Near Threatened or Data Deficient in the current assessment, and also species that are not currently red-listed but were included in the previous HELCOM list of threatened and/or declining species and biotopes/habitats (HELCOM 2007b) or the HELCOM list of threatened and declining species of lampreys and fishes of the Baltic Sea (HELCOM 2007a). The SISs contain information on the estimated threats for individual species.

None of the red-listed species seems to be under a pressure from a single specific human activity; rather, it seems that each species faces a multitude of pressures.

### **Eutrophication**

Eutrophication is the most often mentioned threat in the Species Information Sheets. This applies to macrophytes and benthic invertebrates, in particular.

As explained in Chapter 3.3, eutrophication acts both directly and indirectly, through increased turbidity and reduced light penetration, the reduction of photic habitats for macrophytes, overgrowth by opportunistic macrophyte species such as reed and filamentous algae stimulated by excess nutrients, changes in species composition and dominance structure and hypoxia or complete anoxia.

### **Action: Reduce eutrophication**

According to recent HELCOM reports (PLC-5, BSEP 128 and the 'TARGREV report', BSEP 133), nutrient loads to the Baltic Sea have been declining since the 1980s and 1990s. However, the decline is not yet much reflected in the status of the Baltic Sea marine environment and chlorophyll a concentration and Secchi depth which depicts water clarity, for example, are not improving in most areas of the Baltic Sea.

HELCOM addresses eutrophication through the Baltic Sea Action Plan nutrient load reduction scheme and provisional nutrient load reduction targets that have been assigned to each Baltic Sea country. The scheme is under a review which is to be finalised in autumn 2013 by the HELCOM 2013 Ministerial Meeting.

In addition, loads of nitrogen and phosphorus are addressed in various HELCOM recommendations such as Recommendation 28E/5 Municipal wastewater treatment, which sets more ambitious targets for phosphate removal than the EU Wastewater treatment directive. HELCOM



**Eutrophication acts through the reduction of photic habitats for macrophytes, overgrowth by opportunistic species such as filamentous algae, and hypoxia or complete anoxia.**

Recommendation 28E/6 addresses the on-site wastewater treatment of single family homes, small businesses and settlements of up to 300 person equivalents (P.E.) while the revised Annex III of the Helsinki Convention 'Criteria and measures Concerning the Prevention of Pollution from Land-Based Sources' focuses on reducing discharges from land, for example from agriculture.

Those Contracting Parties that are also EU Member States take measures to reduce eutrophication by implementing various directives such as the Water Framework Directive and its River Basin Management Plans, the Marine Strategy Framework Directive, the Nitrate Directive as well as the Urban Wastewater Treatment Directive.

Agriculture is currently the major source of nutrients. For those Contracting Parties that are also EU Member States, the Common Agricultural Policy commands much of the practices in agriculture; it will be decisive for the Baltic Sea and the threatened species to see how the agricultural sector incorporates water protection needs into its practices. The Common Agricultural Policy is currently under review.

In summary, while many of the measures to reduce eutrophication are already in place, it is important to implement these measures as soon as possible and to ensure that also agriculture deals with its share of the measures.

### **Fishing and fisheries**

Fishing and fisheries are mentioned as a substantial threat for many species. Fishing includes both commercial and recreational fishing, and both targeted fishing and bycatch are addressed as a threat.

Excess fishing is overwhelmingly the largest identified threat to the fish species in the Baltic Sea area in general.

Bottom-trawling is the fishing method that is most often mentioned as a threat for different organism groups. It heavily and directly impacts the bottom and the plants and animals living on or in the bottom. It also has indirect effects such as increased turbidity and siltation. Bottom-trawling is the cause for many benthic invertebrates to become threatened and, as a consequence, it

also has an impact on the birds which prey on them. According to the HELCOM Initial Holistic Assessment (HELCOM 2010a), bottom-trawling is especially prevalent in the southern Baltic Sea, the Danish Straits, the Belts and the Kattegat.

Although recreational fisheries seem less regulated than commercial fisheries, they are part of the problem. For example the use of gillnets in recreational fishing is only loosely regulated in some of the countries. However, gillnetting is a great risk for many bird species since tens of thousands of birds die in the nets annually. In the southern Baltic Sea, for example, recreational angling is a problem since there are clearly less restrictions than for commercial fisheries. In the northern Baltic Sea, similar problems exist for grayling and sea trout.

Marine protected areas do not *per se* provide shelter from fishing activities, neither recreational nor commercial, since fishing is not prohibited in any of the Baltic marine protected areas and is



**Fishing and fisheries are mentioned as a substantial threat for many species.**

restricted in only about 20 of them according to the 2010 data (HELCOM 2010b). In addition, management plans of MPAs are still under development for most sites.

The HELCOM Baltic Sea Action Plan contains numerous measures addressing fisheries with the Environment and Fisheries Forum being established to oversee the implementation of these measures. Fisheries are not in the mandate of the environmental sector and cooperation is needed with the competent authorities to reduce this pressure. All the Baltic Sea coastal states, except Russia, are members of the European Union. For the HELCOM Contracting States that are also EU Member States, the fisheries sector is governed by the EU Common Fisheries Policy (CFP), for which the EU has exclusive community competence. The CFP is currently under revision. The HELCOM Contracting States that are also EU Member States are obliged to follow the principles of Community legislation under the CFP in fisheries conservation and management.

**Action: To address the competent authorities in order to ensure the effective monitoring and the reduction of bycatch**

Countries should have an effective monitoring programme for bycatch in place. Bycatch is currently poorly monitored - even a good understanding of its magnitude in the Baltic Sea is lacking. HELCOM has developed the core indicator 'Number of drowned mammals and waterbirds in fishing gears', which is meant for monitoring the levels of bycatch. Although the concept for the core indicator exists, proper monitoring to populate the indicator with data still does not exist.

Better understanding of bycatch would enable targeted measures to protect fish and lamprey species as well as marine mammals and birds by placing restrictions, for example, to gillnet fisheries in the most important staging and wintering areas of birds and/or by developing and using alternative fishing gears.

Contracting Parties should take all necessary actions to implement the BSAP and take measures, including voluntary measures, with the aim of reaching the target: "By 2015, bycatch of harbour porpoise, seals, waterbirds and non-target fish

*species has been significantly reduced with the aim to reach bycatch rates close to zero."*

**Action: To address the competent authorities with the view to ensure reduction of negative direct and indirect effects of bottom trawling**

The distribution, intensity and quality of the effects from bottom trawling in the Baltic Sea are still not well understood. In the Baltic Sea, a further detailed overview of bottom-trawling activities, apart from that based on fish landings, is lacking since the VMS data have not been made openly available even though enforcement of the DCF calls for member states to share their VMS data. Member states should currently be producing a VMS data-based overview of bottom trawling activities and should be openly shared by all end users, including the environment sector. This information should be compared with the information on the distribution of threatened species that are under a pressure from trawling. Finally, measures should be taken to bring bottom-trawling to a level that no longer is a threat to the species at risk of extinction.

The HELCOM Moscow 2010 Ministerial Declaration addresses unsustainable fishing practices: "WE AGREE to further assess the environmentally negative impacts of fishing activities, including unsustainable fishing practices, with the aim as a first step to consider the exclusion of the use of certain techniques in marine protected areas to achieve their conservation objectives." To this end, HELCOM has developed the BALTFIMPA project (HELCOM Managing Fisheries in Baltic Marine Protected Areas). To date, although the project has not achieved sustainable project funding, it should be secured in the future.

**Action: To address the competent authorities with the aim of ensuring that fish management plans should be prepared and/or followed**

For those Contracting Parties that are also EU Member States, there exist management plans for eel and cod; moreover, long-term salmon management plans are currently being finalised.

**Action: To address the competent authorities with the aim of ensuring fishing restrictions, e.g. during spawning and migration**

Restrictions during spawning and migration on endangered species should be applied when relevant. Contracting Parties that are also EU Member States should consider addressing the relevant authorities in order to implement seasonal closures in areas where these events occur as fisheries technical measures within the context of the CFP. For those Contracting Parties that are also EU Member States, a fishing ban exists on the porbeagle *Lamna nasus* (CR), the angel shark *Squatina squatina* (NA) and the common skate *Diptys batis* (RE) in the Kattegat.

**Action: To conserve red-listed migratory fish by constructing fish passes, habitat restoration, preventing habitat fragmentation, and by reducing eutrophication in spawning areas**

Already with the BSAP, the countries committed themselves to developing restoration plans that include the restoration of spawning sites and migration routes in suitable rivers to reinstate migratory fish species by 2010. In addition, they committed to conserving at least ten endangered or threatened wild salmon river populations in the Baltic Sea region as well as to the reintroduction of native Baltic Sea salmon in at least four potential salmon rivers by 2009. Furthermore, they agreed to enhance the restoration of lost biodiversity by joining and/or supporting Poland and Germany in reintroducing Baltic sturgeon to its potential spawning rivers.

The HELCOM SALAR project produced an overview of salmon and sea trout populations and habitats in rivers flowing to the Baltic Sea (HELCOM 2011, BSEP 126A). The report further specifies how the BSAP commitments should be implemented and in which rivers, and provides recommendations to this end. According to the recommendations, the original salmon populations in rivers that have been categorised as 'red-listed' by SALAR, for example, immediate and effective conservation measures should be carried out. An assessment concerning man-made migration hindrances should be made for certain rivers and passage in them should be provided where the results justify it. The report also contains recommendations for targeted measures for specific measures to reach the status defined as good salmonid habitat.

HELCOM Recommendation 32-33/1 Conservation of Baltic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) populations by the restoration of river habitats and the management of river fisheries was adopted in 2011. According to the Recommendation, the Contracting Parties report on the implementation of the Recommendation to the Commission every three years in January, starting in 2012.

For sturgeon, HELCOM has agreed already in 2010 to initiate activities of a project group on sturgeon remediation. Although activities on sturgeon re-establishment in River Odra and Vistula and their tributaries have been carried out bilaterally between Germany and Poland, the intention of this project is to extend these activities to other countries and rivers. Countries should direct information activities towards fisherman to promote catch avoidance as well as the release of unintentionally caught sturgeon.

In summary, HELCOM has agreed on various activities that need to be implemented to improve the status of red-listed migratory fish.

**Action: To address the competent authorities with the aim of ensuring the identification and protection of spawning areas**

As the first step information should be compiled on spawning areas of red-listed fish and lamprey species.

Based on this information, the competent authorities should develop effective conservation measures for red-listed fish and lamprey species.

**Resolving the identification problem on rays**

Only the fins of rays are consumed. The identification of rays is currently a challenge - their fins are cut which does not allow the identification of the species.

**Action: The cutting of rays should be prohibited, i.e., when fishing is allowed rays should be landed only with fins attached**

As the first step, the landing of uncut rays and their identification would facilitate estimating the magnitude of fishing pressure on them.



### **Managing construction activities in the marine area**

Construction activities are the third most often mentioned pressure on threatened species. They include all marine construction activities both coastal and off-shore and they also include dredging and building coastal defence structures. Construction activities are mentioned as a threat for all groups of red-listed organisms.

**Action: Maritime Spatial Planning processes should be used to regulate construction activities; prior to construction, baseline studies and risk assessments should be carried out in accordance with standards for the Environmental Impact Assessment; monitoring should also be carried out during operation phase**

Maritime Spatial Planning (MSP) should be used to direct construction activities to those areas and intensities that allow the recovery of red-listed species.

The HELCOM-VASAB Working Group on Maritime Spatial Planning (MSP) was established in 2010. It has developed common principles for MSP in a transboundary setting. According to these principles, Maritime Spatial Planning is a key tool for sustainable management by balancing economic, environmental, social and other interests in spatial allocations, by managing specific uses and coherently integrating sectoral planning, and by applying the ecosystem approach. When balancing interests and allocating uses in space and time, long-term and sustainable management should take priority.

Data on the distribution and ecology of the red-listed species should be available for planning processes and their conservation needs incorporated in the plans. Whenever relevant, restrictions to coastal construction activities and dredging should be implemented.

**Action: Halt the loss of coastal and off-shore habitats**

This is an action called for by the species experts and it is fully in line with the BSAP target '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



**Maritime Spatial Planning (MSP) should be used to direct activities to those areas and intensities that allow the recovery of red-listed species.**

marine biotopes/habitats in the Baltic Sea have largely recovered' and the UN CBD Aichi Target 5.

Since the understanding on the current status of habitats is not at a good level, it is proposed that as the first step, core indicators with underlying habitat monitoring will be developed that have targets for the rate of loss of the habitats; as the second step, reasons behind habitat loss should be identified; thirdly, measure should be taken to stop the loss.

### **Habitat restoration**

**Action: Restore habitats for red-listed species**

Habitat restoration is called for especially in flooded coastal meadows and coastal lagoons.

In the Baltic Sea Action Plan, the Contracting Parties also committed themselves to developing research on the possibilities to reintroduce valuable phytobenthos species in regions of their historical occurrence, especially in degraded shallow waterbodies in the southern Baltic Sea. However, this is one of the few actions on which no activities have been reported in the countries.

The UN CBD Aichi target 15 also addresses habitat restoration. HELCOM should consider the regional approach to the implementation of this target on habitats in the Baltic Sea setting in general, specifically from the perspective of the red-listed species.

This approach could also support the implementation of the MSFD for those Contracting Parties that are also EU Member States.

### **Working against climate change on international level**

HELCOM has addressed the global level by informing the Conferences of the Parties of the UN Framework Convention on Climate Change on the potential deleterious effects of climate change on the Baltic Sea ecosystem. This work was based on the 2007 HELCOM thematic assessment of climate change in the Baltic Sea Area (HELCOM 2007d, BSEP 111).

An update to the assessment is underway in 2013 and contains proposals for management action to counteract the impacts of climate change on the Baltic Sea that are of relevance from the perspective of conserving red-listed species. Since combatting climate change is beyond HELCOM realm, its work focuses on adapting to the impacts. Adaptation is proposed to include reductions to other human-derived pressures. As an example, other pressures on the ringed seal *Phoca hispida botnica* (VU) ought to be reduced in order to assist its survival in worsening ice conditions that impact its pupping.

### **Action: Strengthen the network of marine protected areas to provide shelter from climate change impacts**

An ecologically coherent network of protected areas is essential to ensure a safe space for species and habitats. There should be a strong and ecologically coherent network of protected areas where species and habitats can develop undisturbed by effects from other anthropogenic impacts.

In the future, it may be necessary to assess the boundaries of marine protected areas (MPAs) to take into account possible changes in the distribution of species and habitats caused by changes in temperature and salinity.

The network of protected areas should be evaluated at regular intervals as it may need to be adjusted to better support species and habitats with special needs.

The management of MPAs should take into account potential impacts of climate change, including

the need to protect species that are red-listed. Future analyses of the necessity to complement the network of protected areas, e.g. with MARXAN analyses, should take climate change into account.

### **Hunting**

Although hunting is not the main reason for the decline of the red-listed Baltic bird species, it must be considered as an additional pressure. Hence, hunting red-listed bird species should be banned not only in the Baltic countries, but also in those countries where the birds are wintering (especially western Europe, and North and West Africa).

Moreover, the general disturbance from hunting to other species than the targeted ones should be addressed.

### **Management of competing species**

#### **Action: Management of predatory mammals**

Predatory mammals should be managed to protect threatened ground-breeding birds. This especially applies to the American mink *Neovison vison*, the raccoon *Procyon lotor* and the raccoon dog *Nyctereutes procyonoides*, which are alien species and present a severe problem for coastal bird conservation.

HELCOM should promote measures that enable protecting especially ground-breeding birds from the predatory mammals.



**The increase of predatory mammals, including the American mink, is one of the most severe problems for coastal birds.**



### **Action: Protection of the otter**

Measures to protect otters include:

- creating small wetlands in or near cultivated habitats to keep otters away from fish farms - this would contribute to reducing the otter-human conflict and the illegal killing of otters in fish farms,
- using technical means to keep otters away from fish farms and thus causing harm (protective netting, fences and their relocation),
- protecting breeding areas against tourism,
- reducing oil pollution,
- protecting feeding habitats against substrate extraction, and
- reducing losses due to road kill by constructing otter-safe road passages (especially along water channels under roads).

The team on mammals was of the opinion that there is a need to improve the monitoring of otters, especially in the coastal areas.

### **Action: Promoting cattle grazing in the coastal areas**

Threatened macrophytes are under a pressure from overgrowth by other plant species such as reed. Overgrowth by reed and other plants is related both to eutrophication and the cessation of cattle grazing, especially in the north. With regard to threatened macrophytes, it seems relevant to promote cattle grazing, in particular in shallow, sheltered bays, lagoons and inlets.

### **Non-indigenous species**

Non-indigenous species are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found.

Non-indigenous species have been identified as one of the key causes of loss of native species and harm to biodiversity. Under Article 8(h) of the Convention on Biological Diversity, each Contracting Party is required to prevent the introduction or control or eradicate those non-indigenous species that threaten ecosystems, habitats or species. Invasive non-indigenous species are commonly regarded as a serious threat according to the UN CBD, the EU Biodiversity Communication, MSFD,

Habitats Directive, the Bern Convention and Baltic Sea Action Plan, among others.

Non-indigenous species can act as vectors for new diseases, alter ecosystem processes, change biodiversity, reduce the value of water for human activities and cause other socio-economic consequences for local communities.

### **Action: Prevent the introduction and mitigation of the negative impacts of non-indigenous species and eradicate existing non-indigenous species**

To this aim, the Contracting Parties:

- should prevent the introduction of all non-indigenous species via different pathways, including aquaculture, and specifically those via shipping by the ratification and harmonised implementation of the 2004 International Convention for Control and Management of Ships' Ballast Water and Sediments (BWM Convention),
- should develop regulations to ensure the adequate protection of aquatic habitats from the risks associated with non-indigenous species,
- minimise the negative impacts from invasive non-indigenous species on biodiversity,
- prohibit the deliberate introduction into the wild of any non-indigenous species without permission and control, and
- collect and disseminate information on invasive non-indigenous species.

### **National seal management plans**

#### **Action: Finalise and implement national seal conservation and management plans, including long-term monitoring, habitat restoration, and the establishment and proper management of seal sanctuaries**

The development of seal management plans has been agreed upon under HELCOM Recommendation 26/1 Protection of Baltic Sea seals and the Baltic Sea Action Plan, which contains the text: "WE AGREE to safeguard the long-term viability of the Baltic seal populations according to HELCOM Recommendation 27-28/2 by following its general management principles, and by 2012, to finalise national management plans and by implementation of non-lethal mitigation measures for seals-fisheries interactions."

In 2013, not all Contracting Parties with seal populations had finalised their management plans. However, by the end of 2013 almost all countries with seal populations are expected to have them finalised.

### **Marine Protected Areas**

**Action: To achieve and maintain an ecologically coherent network of well-managed marine protected areas in the Baltic Sea and provide protection to the red-listed species**

The assessment of ecological coherence of the network of protected areas revealed that while the network covered 12.3% of the marine areas of the Baltic Sea, it was still not ecologically coherent (HELCOM 2010b, BSEP 124B). The adequacy of the network was considered from the point of view of some indicator species, including *Zostera noltii* (VU). The conclusion was that the network did not seem to be adequate or provide sufficient protection for the considered species. In addition, the analyses showed the need for enhanced replication for most indicator species and concluded that special attention should be paid to species such as the eel *Anguilla anguilla* (CR) and cod *Gadus morhua* (VU) that were severely underrepresented.

The Baltic Sea network of marine protected areas should be strengthened to ensure the protection of the red-listed species. According to the MARXAN analysis carried out in 2010, the MPA network should be expanded to at least twice the size of the then existing network to provide protection to the full range of biodiversity. Areas in the northernmost Baltic, in particular, were pointed out as being in need of further protection. The management of the areas should be improved to provide shelter from anthropogenic pressures and to avoid 'paper parks'. According to the 2010 report, activities commonly mentioned as threats to the threatened species, such as fisheries, tourism and recreation, were not at all or only seldom forbidden in the protected areas. Cooperation between the countries and sharing experiences could be useful when further developing the management of these areas.

**Action: Update HELCOM Recommendation 15/5 on Protected Areas**

The process of strengthening the network should include the revision of HELCOM Recommendation 15/5 on Baltic Sea Protected Areas to ensure that the needs of the red-listed species are sufficiently covered in the network of marine protected areas.

See also the text on MPAs under the title 'Work against climate change'.

### **Improving knowledge on Baltic Sea biodiversity**

This assessment clearly demonstrated the poor level of knowledge for a large part of the Baltic Sea species. Altogether, 818 species were Not Evaluated, mainly due to a lack of information on them. It has also become apparent during the HELCOM RED LIST project that there is a lack of data on most species and that regular monitoring activities only concern a small fraction of Baltic Sea biodiversity.

**Action: Improve monitoring and data collection on Baltic Sea species**

The Contracting Parties should enhance their data collection activities and make some level of monitoring of all species in the Baltic Sea area a part of regular activities. These data collection and monitoring activities should be coordinated regionally within HELCOM according to the revised HELCOM Monitoring and Assessment Strategy to ensure, for example, the geographically relevant distribution and coordinated timing of activities to allow and ensure the comparability of data.

Regarding specific data and information needs:

- For macrophytes and benthic invertebrates, there is a general need for information on their distribution, habitat preferences and population trends.
- For the ringed seal, more data are needed on population parameters.
- For harbour porpoises, more data are needed on their distribution and migration patterns, using static acoustic monitoring (C pods), as well as data from sightings, strandings and bycatch. Data stemming from these activities should be included in the HELCOM Harbour porpoise database; moreover, the Contracting Parties should also annually report new observations.
- For fish and lampreys, more information is needed on the reasons behind their declines, species' life history, ecology, distribution, habitat

preferences, population structure and the extent of bycatch.

- For birds, there is a need for proper monitoring programmes and the analysis of pan-Baltic ringing data to pinpoint mortality factors as well as to reveal the main migration routes and wintering areas.

Training new generations of scientists capable of identifying Baltic Sea species is needed. Currently, the lack of expertise may result in a lack of data and false results on the state of populations of macrophytes, for example. The harmonisation of methods is another area where there is a need for improvement in order to ensure the comparability of data. In this respect, taxonomy training and the harmonisation of the use of taxonomic names between the countries should be enhanced. HELCOM could initiate activities to support this.

**Action: Set up a project as the first step to manage biodiversity data within HELCOM**

HELCOM should ensure that the biodiversity data and information on species and biotopes collected during the HELCOM RED LIST project and used for assessments will be made publicly available on the Internet. HELCOM should also develop a biodiversity data portal where regional biodiversity data can be managed and made publicly available to support nature conservation and maritime spatial planning.

This should include making available the species assessment justifications, the distributional data on species (at a 10x10 km grid scale for macrophytes and benthic invertebrates), biotope descriptions, photographs on species and biotopes, as well as check-list data and the Baltic Sea underwater biotope classification HUB. Linking the HELCOM biodiversity data portal to relevant external data portals, such as national portals for retrieval of original data, should be an ultimate long-term aim of HELCOM.

This work should be designed so as to serve nature conservation needs as well as those stemming from maritime spatial planning. This work, especially its spatial data component and database, could be developed in such a way that it could be extended to spatial data on human pressures and activities.

HELCOM should set up a project with a Project Manager in the Secretariat, supported by the



**Meeting of the HELCOM Red List project for macrophyte assessments in Tallinn, Estonia in March 2011.**

HELCOM Data Administrator and the HELCOM RED LIST species and biotopes teams, to develop an efficient regional biodiversity data management system and database which is connected to the HELCOM Map and Data system and, via this, ensure public availability.

**Action: Regularly update the HELCOM Red List assessments**

Regularly updating the threat assessments of species and biotopes, as well as the species check-lists and the biotope classification, if needed, will be made part of HELCOM's regular assessment cycle described in the revised Monitoring and Assessment Strategy.

The first update has been agreed by HELCOM HOD 41/2013 to be carried out by the end of 2019 and it should be done with the aim of further improving data availability on species and biotopes and, through this, the quality of the red list assessments. In the long run, the assessment could be repeated every twelve years. The Contracting Parties should consider producing and updating their national red lists of marine species prior to the HELCOM assessments in order to make data available for the HELCOM assessments.

Bearing in mind that the future work on threatened species will require expert work, HELCOM Contracting Parties should aim to ensure that the RED LIST expert network will be able to continue its work and will be kept active and available.

# 7 HELCOM Red List of Baltic Sea species

## 7.1 Red List of macrophytes



See Annex 1 for authors and contributors for the Red List of macrophytes.

### 7.1.1 Introduction to macrophytes

A macrophyte literally means a 'macroscopic plant'. More commonly, however, macrophytes refer specifically to aquatic macroscopic plants. Macrophytes include macroalgae, aquatic vascular plants and aquatic mosses. As photosynthetic organisms, macrophytes are restricted to the photic zone of water bodies, i.e. to the zone where the light intensity is high enough to enable growth. Although most aquatic macrophytes grow totally submerged, some plants may partly emerge above the water surface in shallow waters (Figure 7.1).

Macrophytes growing on a soft bottom have roots or rhizomes to anchor themselves to the bottom sediment (rooted growth). Other species can attach themselves with certain holdfasts to a hard bottom (referred to as epilithic growth), to other stable surfaces like mussels (epizoic growth) or to other plant bodies (epiphytic growth) (Figure 7.2). Some species, or morphologically distinct ecotypes of species, have also adapted to growing free floating on the water surface or drifting at the bottom.

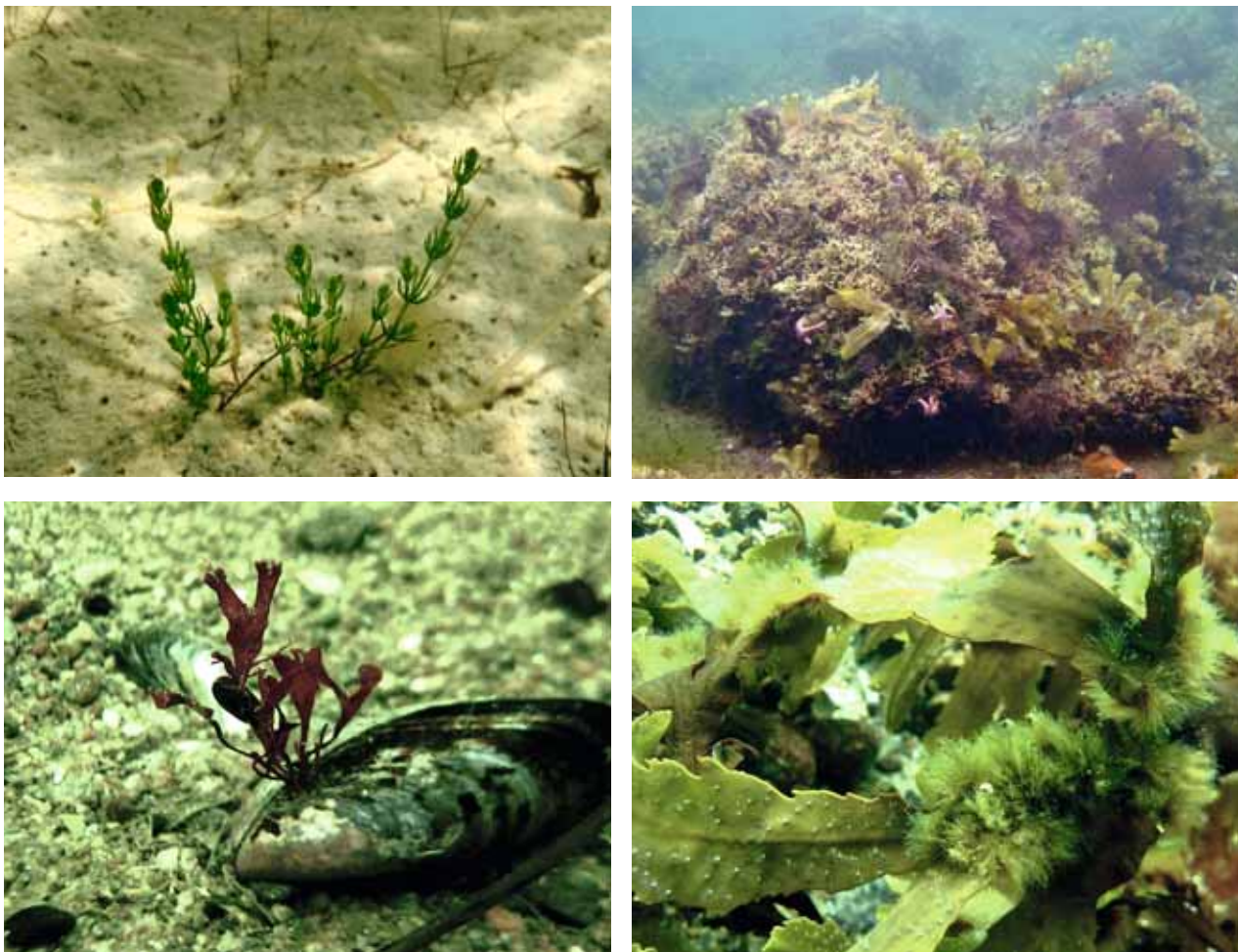
Taxonomically, macrophytes are a diverse group. The majority of species are macroalgae, which is predominantly a marine group, containing red (Rhodophyta), brown (Phaeophyta) and green algae (Chlorophyta), and also some multicellular filamentous or colonial forms of yellow-green algae (Xanthophyta). Stoneworts (Charophyta), which mainly live in freshwaters, are also included in macroalgae. Macroalgae are structurally rather simple plants with stem-like and leaf-like parts; they have no water conducting system or flowers. Macrophytes also include aquatic vascular plants and aquatic mosses. Vascular plants are also called higher plants, which have water-conducting tissues and a structure consisting of roots, stem and leaves. Like algae, mosses also lack water-conducting tissues.

Aquatic macrophytes can be categorised according to their tolerance of salinity. Marine macrophytes live in full marine conditions (35 psu or even higher) while freshwater macrophytes are distributed in pure limnic environments (up to 0.5 psu maximum). The number of true brackish water species, occurring neither in marine waters nor in freshwater, is low in the Baltic Sea due to its young age in geological terms. Some of the marine and freshwater species, however, also grow in brackish conditions. In general, the number of marine species able to sustain themselves in brackish water is much higher than the number of freshwater species. As a result of this and due to the salinity gradient in the Baltic



**Figure 7.1.** Three aquatic vascular plants: *Zostera marina* (left) growing totally submerged, *Ranunculus peltatus* subsp. *baudotii* (centre) growing submerged but with flowers above the water surface, and *Phragmites australis* (right) growing partly above the water surface.





**Figure 7.2.** Four different growth forms of macrophytes: a charophyte (*Chara baltica*) anchoring in soft bottom (top left), several seaweeds attached to a boulder (top right), a red seaweed (*Coccotylus truncatus*) attached to a mussel shell (bottom left) and a tiny brown seaweed (*Elachista* sp.) growing on the fucoid *Fucus serratus* (bottom right).



Sea, the overall number of macrophyte species increases from the northern and eastern Baltic Sea towards south and west.

### 7.1.2 Level of knowledge

In general, the level of knowledge on Baltic Sea macrophytes is poor, with the exception of a handful of common, large and easily identifiable species that have been the subject of research throughout the history of marine research in the Baltic Sea. Macrophytes were part of many regional surveys already at the end of the 19th century. Species compositions were studied from flotsam washed ashore, by direct sampling or by dredging. In the second half of the 20th century, diving and submerged video observations also entered the research field. At the same time, the focus of studies shifted, for example, on the commercial value of macrophytes and on

mapping vegetated areas; however, research on taxonomy and on taxonomically difficult species groups was, nevertheless, an essential part of scientific work. In recent decades, basic research on macrophytes has been greatly reduced, becoming studied only as subjects of eutrophication studies or 'blue biotechnology', for instance. As a result of this and despite the new European legislation that emphasises the value of macrophytes by several directives, taxonomic experts and the skills of species determination have been partly lost.

In the early days, results of macrophyte surveys were stored in herbarium collections or publications. While this information is currently difficult to access, it may get easier in the future as the digitalisation of the old information has begun in many HELCOM countries. Today, macrophyte data are more and more regularly stored in databases;

however, although easily accessible in principle, several problems still exist in utilising this new data. For example, there are often several different databases per country, they are updated with long delays, irregularly or not at all, the ownership of the data is unclear, or the data are not validated by experts and may therefore include many errors.

In all, the distributional information on macroalgae and charophytes is comparatively good due to two extensive Baltic-wide studies: the distributional index of macroalgae by Nielsen et al. (1995) and the study of the Baltic Sea charophytes by Schubert & Blindow (2003). The information on aquatic vascular plants, bryophytes and yellow-green algae of the Baltic Sea had not been gathered before the HELCOM Red List project. All the most essential national databases were checked and extensive literature reviews carried out to update the information for macroalgae and to compile the checklists of vascular plants and bryophytes.

It should be noted that even though the data for the macrophyte checklist may be on a satisfactory level, the data required for the Red List assessments themselves (e.g. data on population trends) are very scattered and scarce.

The data used in this assessment is a combination of monitoring and mapping data from several databases and monitoring programmes in the HELCOM countries. Extensive literature studies were conducted in some areas to fill data gaps for countries without databases and for databases lacking certain time periods.

In addition, national experts would also normally be required to evaluate and check the data in the Red List assessments. The expert participation was rather limited for many countries and was almost completely lacking for Denmark and Latvia. The lack of Danish expertise has been especially unfortunate as the species diversity in Danish waters is high compared to many other areas in the Baltic Sea.

It is also worth noting that previous experience on using the IUCN Red List system has been very limited within the assessment process of macrophytes. Although Red Lists have been prepared in all HELCOM countries, they have usually not considered all macrophyte groups systematically and have been based on national, rather than the IUCN

Red List criteria. The exception is Sweden, where macroalgae and aquatic vascular plants have been systematically considered in national assessments following the IUCN Red List criteria.

### 7.1.3 Assessment process

#### *Preparation of checklist*

The HELCOM Red List project started with the preparation of the Baltic Sea checklist of macrospecies (HELCOM 2012). The checklist of Baltic Sea macrophytes was compiled according to three prerequisites: 1) the species should be taxonomically unambiguous and found in international taxonomic databases, 2) the species should be capable of growing permanently submerged (at least the lower part of the plant) in minimum salinity of 0.5 psu, and 3) the species should be found in the Baltic Sea itself, not just in nearby ponds, rivers or other related water-bodies. Following these criteria, 531 macrophyte taxa were included in the Baltic Sea checklist of macrophytes and considered in the Red List assessment.

#### *Initial assessments*

Using the checklist of Baltic Sea macrophytes (HELCOM 2012) as a starting point, the first step in the Red List assessment work was to identify species that could be directly assigned to one of the following IUCN categories: Not Applicable (NA), Not Evaluated (NE) or Least Concern (LC). The criteria and specifications for this initial assessment are described below.

#### **Not Applicable (NA)**

This category was chosen for all introduced taxa (neophytes) and vagrants. All taxa introduced after 1800 were regarded as neophytes and classified as NA.

Although nearly all macrophytes are somehow attached to the substratum and 'vagrants' are therefore not likely to occur, this term was applied to some taxa. Old literature, in particular, often contains taxa that have only been found as flotsam washed onshore. However, as currents can transport detached specimens over huge distances, it cannot be clearly demonstrated that those specimens have their origin in the Baltic Sea. Taxa that



have only been found detached were therefore regarded as vagrants. Species, which exist partly free-floating such as *Sargassum muticum*, form an exception to this principle; for such species, the 'vagrant' definition is not usable. In the special case of *Sargassum muticum*, the species was anyhow classified as NA as it is a neophyte in the HELCOM area.

### **Not Evaluated (NE)**

This category was chosen for whole taxonomical groups or single taxa if identification difficulties or taxonomical uncertainties exist or if they are very poorly known. In practice, however, it was difficult to make the division between NE and DD (Data Deficient) and even LC (Least Concern) in many cases.

The category NE was used for many taxa that are difficult to determine or to recognise, and consequently rarely found in normal surveys. For some taxonomic groups, the low level of current records actually reflects a decline in the level of expertise in the Baltic Sea area and not in the population of the species.

The category NE was one option also for marine or freshwater species that occur in the Baltic Sea at the edge of their distributional range. To decide whether such species should be categorised as NE, DD or LC, the population outside the Baltic was also taken into account. It was decided that if the species is rare and even threatened outside the Baltic Sea, but the Baltic Sea populations are marginal, perhaps even unstable and have no relevance for the sustainability of the species as a whole in the Baltic Sea region, they should be classified as NE.

Some examples for NE assignments are:

All records of *Chlorochytrium dermatocolax* are from historical surveys. It is very small green algae, which can be seen as a borderline case between a macro- and a micro-species. The presently conducted monitoring programmes are inadequate to detect such species, which explains the lack of recent records.

*Dictyota dichotoma* has only one record in the HELCOM area (Kattegat). It is a typical marine species under threat in its marine environment in at least some countries (e.g. Sweden – Near Threatened). The record gives no evidence of a stable population in the Baltic Sea.

*Nitella syncarpa* has only few records in the HELCOM area (Eastern Gotland Basin and Gulf of Finland). It is a typical freshwater species under threat in its freshwater environment in at least some countries (e.g. Sweden – Endangered). The Baltic Sea findings are marginal and represent sites with very low salinity (suspected to be lower than 0.5 psu).

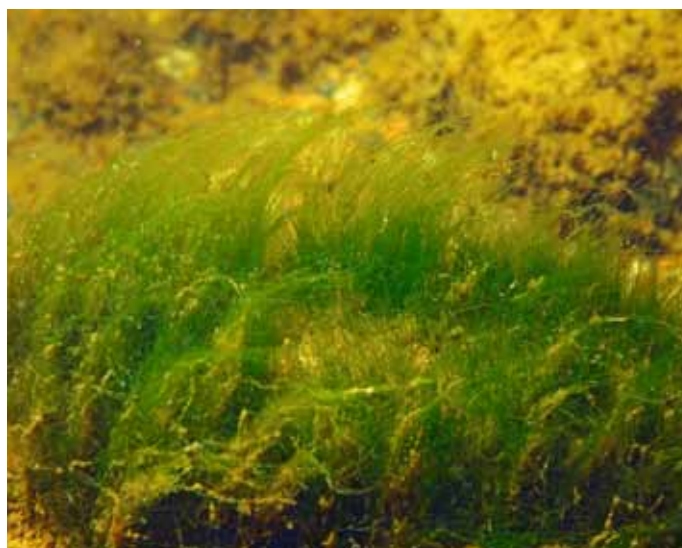
### **Least Concern (LC)**

This category was chosen for widespread and abundant species for which there was no evidence of population declines. If there were any suspicion for negative trends in even one of the countries, direct assignment to LC was not used.

The category LC was also used for species that occur at the edge of their distributional range in the Baltic Sea and thus have only few Baltic Sea records if the species were regarded not threatened in their marine or freshwater environment. For marine species, checklists and record numbers from Skagerrak, Helgoland and the UK were also taken into account. Similarly, the status of freshwater macrophytes was checked for inland waters in the neighbouring countries.

Some examples of LC assignments are:

*Laminaria hyperborea* is a typical marine species that reaches its distributional limit in the western part of the Baltic Sea. There are only few records from the HELCOM area (Kattegat and the Belts). It is



**The category Not Evaluated (NE) was used for many taxa that are difficult to determine or to recognise, and consequently rarely found in normal surveys. All species of *Vaucheria* were left unevaluated.**



widespread in its marine environment and no negative trends are known for the last 10–20 years.

*Callitriche palustris* is a typical freshwater species that reaches its distributional limit in sheltered oligohaline coastal lagoons or bays of the Baltic Sea. Consequently, only few records exist in the northern Baltic Sea. It is widespread in its freshwater environment and no negative trends are known.

#### Data collection for candidate species and the assessment

All species that could not be directly categorised in the initial assessment described above were regarded as 'candidate species' and were subject to a more thorough assessment. Furthermore, all species (twelve in total) that were included in the previous HELCOM list of threatened and/or declining species (HELCOM 2007b) were included in the more detailed assessment. The set of candidate species included 32 taxa, which corresponds to 6% of the taxa included in the checklist. The candidate species were divided among the responsible countries or experts who gathered status and distribution information on the species required for the assessments. A standard format for the data exchange of geographical information was developed, including in minimum data on:

- National code: To define which country has delivered data or which country the geographical information belongs to.
- Coordinates and type: Exact positions of records and the positioning system (e.g. WGS84) if available.



Charophyte *Lamprothamnium papulosum* a species Endangered (EN) in the HELCOM area.

- Location: Historical data sets/records include only locations, e.g. Flensburg Fjord, Kiel Harbour, etc., instead of exact positions.
- Date of record: Date of sampling, if available (exact date, at least the year). If the exact date of the investigation/finding is not clear, the publication date of the reference can be used instead.
- Reference: Publication, report or data base in which the data are represented.
- Comments: Free text.

If possible, additional information was gathered relating to: observed depth, method (diving, raking, etc.), responsible person for determination and data type (point, transect, shape, area, etc.).

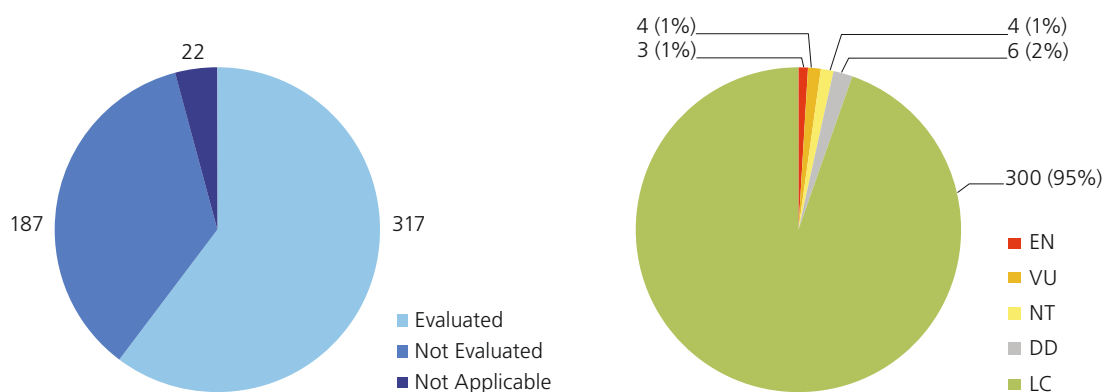
The assessment work was carried out during workshops and separately by the experts. The intersessional work was checked by the expert team at the workshops. Altogether, five workshops were organised during the whole project.

Of the five IUCN Red List criteria, criterion B was most often applied to macrophytes. The other criteria were not as suitable for this organismal group. Criteria C or D would have required data on population sizes - macrophytes are only very rarely, if ever monitored as individuals. On the other hand, the quality, quantity and/or timeliness of the data did not allow the use of criteria A or E, which would have required good data on population trends.

### 7.1.4 Threat status

#### Threat classes and proportions

Altogether, seven macrophyte species were considered threatened in the current HELCOM Red List assessment (Figure 7.3, Table 7.1). Three were assigned to the category Endangered (EN): one charophyte, *Lamprothamnium papulosum*, and two vascular plants *Persicaria foliosa* and *Hippuris tetraphylla*. Four species were categorised as Vulnerable (VU), charophytes *Chara braunii* and *Nitella hyalina* and the vascular plants *Alisma wahlenbergii* and *Zostera noltii*. Four species were assessed Near Threatened (NT): two charophytes *Chara horrida* and *Nitellopsis obtusa* and two vascular plants *Crassula aquatica* and *Potamogeton friesii*. All threatened and Near Threatened species are characteristic for soft bottom, sheltered environments.



**Figure 7.3.** Proportions of species that were assessed, not assessed (Not Evaluated) or Not Applicable (NA) according to the IUCN criteria (left), and proportions of Red List categories within the assessed species (right).

**Table 7.1.** Red List categories for macrophyte species that were evaluated threatened, Near Threatened or Data Deficient in the current HELCOM Red List assessment. For each red-listed species, the past and current threats, future threats and the Red List criteria are given. Descriptions for threat and category codes are given in Chapter 2.7.6.

Species and taxonomic group	Past and current threats	Future threats	HELCOM list 2007b	Red List criteria	Red List category
<b>Green algae (Chlorophyta)</b>					
<i>Rosenvingiella constricta</i>	U	U			DD
<b>Charophytes (Charophyta)</b>					
<i>Chara braunii</i>	E, Co, T, Ogr	E, Co, T, Ogr	x	B2ab(iii)	VU
<i>Chara horrida</i>	E, Co, T	E, Co, T	x	B2b(ii,iii,iv,v)	NT
<i>Lamprothamnium papulosum</i>	E, Co, T, To	E, Co, T, To, OT, Cc	x	B2ab(ii,iii,iv,v)	EN
<i>Nitella hyalina</i>	Ogr, E, T, C	Ogr, E, T, Co		B2ab(iii)	VU
<i>Nitellopsis obtusa</i>	E, T, Co	E, T, Co		B2a	NT
<b>Red algae (Rhodophyta)</b>					
<i>Helminthora divaricata</i>	U	U			DD
<b>Brown algae (Phaeophyceae)</b>					
<i>Botrytella reinboldii</i>	U	U			DD
<i>Delamarea attenuata</i>	U	U			DD
<i>Myriocladia lovenii</i>	U	U			DD
<i>Stypocaulon scoparium</i>	U	U			DD
<b>Vascular plants</b>					
<i>Alisma wahlenbergii</i>	Ogr, E, Co	Ogr, E, Co, Cc	x	B2ab(ii,iii,iv,v)	VU
<i>Crassula aquatica</i>	Ogr, E, Co	Ogr, E, Co, To		B2ab(ii,iii,iv,v)c(iv)	NT
<i>Hippuris tetraphylla</i>	Ogr, E, Co, CPr	Ogr, E, Co, CPr, Cc	x	B2ab(i,ii,iii,iv,v)	EN
<i>Persicaria foliosa</i>	Ogr, E, Co	Ogr, E, Co		B2ab(ii,iii,iv,v)	EN
<i>Potamogeton friesii</i>	E, Co	E, Co		B2a	NT
<i>Zostera noltii</i>	E, Co, T, To	E, Co, T, To, OT, Cc	x	B2ab(iii,iv)	VU

Additionally, six species have been categorised as Data Deficient (DD) (Table 7.1). Two extend their known distribution area to the Gotland Basins or the Baltic Proper, whereas the rest are marine

algae restricted to the westernmost part of the HELCOM area.



The rest of the assessed species, i.e. 300 taxa (95%), represent the category Least Concern (LC). These include also six species that were considered threatened or declining in the previous HELCOM list (HELCOM 2007b): *Chara connivens*, *Chara tomentosa*, *Furcellaria lumbricalis*, *Fucus serratus*, *Fucus vesiculosus* and *Zostera marina*. Most of these species have experienced at least local declines, but as the species are still common in their distribution areas and the declines have taken place usually already decades ago, the IUCN Red List criteria are not fulfilled.

Twenty-two species were categorised as Not Applicable (vagrants and neophytes), and 187 were left unevaluated due to serious or complete lack of data (Not Evaluated). Together, these two categories comprise 40% of the macrophyte taxa listed in the Baltic Sea checklist of macrophytes.

### 7.1.5 Main threats

In the current HELCOM Red List assessment, eutrophication and different construction activities were mentioned most often among the reasons for becoming threatened for the red-listed species. Eutrophication has many negative effects on macrophytes. Increased nutrient levels stimulate the growth of phytoplankton, which increases the

concentration of particles in water and reduces the penetration of light within the water column. As nutrients are available in sufficient amounts for longer times throughout the year, phytoplankton blooms also last longer and occur more often during the season. This shortens the optimal growth periods for macrophytes (De Vries et al. 1996). The reduced light at the bottom causes a decline in the vertical distribution of vegetation communities and a reduction in the overall amount of plants (Duarte 1991, Schramm 1999, Dahl & Carstensen 2008).

Increased nutrient levels also stimulate the growth of opportunistic macrophytes. Their small size with fine, highly branched filamentous habitus give a high surface to volume ratio and therefore a high rate of nutrient uptake. This enables opportunistic macrophytes extremely high growth rates if abiotic conditions (light, temperature) are also favourable. Higher nutrient concentrations therefore result in changed species composition and dominance structure of the vegetation communities (Schramm 1999). The sea bottom can be covered 100% by opportunistic species - such mats of algae may reduce water exchange to the underlying substrate. Decomposition of the biomass may result in oxygen deficiency and sometimes H<sub>2</sub>S release, which may lead to a die off of the bottom organisms (Rosenberg 1985, Norkko & Bonsdorff 1996).



Coastal development may destroy or deteriorate the natural habitats of macrophytes. Kaliningrad, Russia.



The growth of phytoplankton may get too intensive to be consumed totally by the planktonic (zooplankton, fish) or the benthic (bivalves, polychaetes) food web. The consequence is an increased concentration of organic matter in sediments. Such siltation makes the seabed less suitable for vegetation growth. When the hard substrates are covered by organic material, it may prevent the attachment of the algae spores necessary for maintaining the populations. The organic material also covers the leaves of macrophytes, which probably reduces photosynthesis and growth.

Various construction activities also appear to be important threat factors for macrophytes, and include construction projects, such as harbours or offshore wind farms, as well as the dredging of waterways and coastal defence. These activities may destroy substrate of macrophytes, increase turbidity, or change hydrodynamic conditions leading to the destruction of vegetation. Boulder fishing, which is also regarded as a construction activity, has destroyed hard substrates over large areas in the southern Baltic Sea.

The red-listed vascular plants and also some charophytes are threatened by overgrowth of open areas, for example overgrowth by reed, and is related both to eutrophication and, especially in the northern Baltic Sea, to the cessation of cattle grazing in coastal meadows. These species only survive if open patches are continuously produced in their habitat.

Water traffic is regarded as another important threat to macrophytes. In shallow habitats, erosion caused by boat wake may be detrimental to macrophyte populations. Anchoring boats can also impact rooted vegetation, if rhizomes are torn out of the sediment. Since such non-vegetated holes within macrophyte stands cause high physical exposure for the surrounding shoots, anchoring may eventually affect a larger area. Tourism may also have a direct impact on macrophyte communities in shallow waters. Different kinds of aquatic sports cause trampling that can damage vegetation. Tourism may also increase eutrophication if wastewater is not sewage-treated adequately.

Commercial trawl fishery also has an impact on benthic vegetation, especially at its lower depth



Foto: Dr. Lars Tiepolt

**Shallow and sheltered bays and lagoons are important habitats for many red-listed species and heavily affected by human pressures.**

limit where the light already restricts macrophyte growth. Macrophytes can be cut loose from the hard substrate or damaged by the heavy shear trawl doors and forerun chains and are thus unable to form typical, perennial macroalgae assemblages.

Considering the main threats for macrophytes described above, it is no surprise that all of the red-listed species are characteristic components for shallow, sheltered bays, lagoons or inlets. Eutrophication effects are more pronounced in such habitats due to reduced water exchange causing the slow dilution of high nutrient levels or the accumulation of organic matter, for example. These areas are also hot spots for tourism, exposed to several construction activities and commercial use (fishing, aquaculture).

In most cases, the same reasons that are assumed to have caused the declines in the past are also expected to affect the species' populations in the future. Climate change is mentioned as a new threat for some species. In addition to increasing temperatures, it is expected to enhance eutrophication and lower salinity in the Baltic Sea basin. It is also expected to reduce the amount of sea ice and thus also ice erosion, which is an important factor for weak competitors. Ice erosion creates open patches in shallow water and therefore benefits at least some of the currently threatened aquatic vascular plants. With reducing ice, these small shallow water plants are in danger of becoming completely replaced by reed or other strong competitors.



## 7.2 Red List of benthic invertebrates



See Annex 1 for authors and contributors for the Red List of benthic invertebrates.

### 7.2.1 Introduction to benthic invertebrates

Taxonomically speaking, 'invertebrate' is no more than a term of convenience. In fact, the vast majority of animal species are invertebrates, since only about 3% of animals include a vertebral column in their anatomy. Invertebrates thus have representatives from taxonomically very distant groups.

For practical reasons, invertebrates are often divided into ecological groups such as 'benthic invertebrates,' which refer to organisms that live in or on the bottom sediments of rivers, streams, lakes and seas. In the Baltic Sea, invertebrates are by far the most diverse of the groups considered in the HELCOM Red List assessment (Figure 7.5). It includes hundreds of species of segmented worms

(Annelida), molluscs (Mollusca) and arthropods (Arthropoda), such as crustaceans and aquatic insects. Benthic invertebrates play a key role in aquatic ecosystems and thus a diversity of species is needed to maintain the ecological function of the bottom habitats. Through bioturbation, benthic species oxygenate the bottoms and fuel important processes like nitrogen turnover.

In the Baltic Sea, benthic invertebrates of both marine and freshwater origin co-occur, creating a unique ecosystem. The number of species from marine and freshwater origins changes along the salinity gradient of the Baltic Sea. The proportion of marine species is highest in the Kattegat, the Belt Sea and the Sound (Bernes 2011). There are several taxonomic groups that only or predominantly occur in the western and southern HELCOM area, such as sea squirts (Ascidiacea), echinoderms (Echinodermata), sponges (Porifera) and sea anemones and corals (Anthozoa). In the northern Baltic Sea, the overall number of species is lower with the majority being of freshwater origin. In the Gulf of Finland, for example, more



**Figure 7.5.** Examples of Baltic Sea benthic invertebrates: common and widespread blue mussel *Mytilus edulis* and an isopod *Saduria entomon*, and two rare species with more restricted, western distribution: an amphipod *Haploops tenuis* and a sea squirt *Pelonaia corrugata*.



than half of the recorded benthic invertebrate species are aquatic insects (HELCOM 2012).

The diverse group of benthic invertebrates can be divided on the basis of organism size. Macrozoobenthos refers to benthic fauna retained on a sieve with a mesh size of 1 mm x 1 mm. Smaller animals belong to meiobenthos whose taxa have not been considered in the HELCOM Red List project.

### 7.2.2 Level of knowledge

As the status and ecological sustainability of the Baltic Sea is reflected by its bottom communities, several regional and national monitoring programmes for different communities have been conducted. However, this data flow concerns only a small fraction of benthic invertebrate species and in general, the invertebrate fauna is poorly known and existing data scarce and scattered. Much work has thus been carried out on identifying and compiling accessible data from the HELCOM countries. While there are no monitoring programmes specifically targeting invertebrates within the HELCOM area, several programmes and projects address different taxonomic, ecological or geographic subsets of benthic invertebrates on the national and regional levels. The work on the Red List has depended on several major national and regional databases such as the Danish national database for marine data (MADS) (Denmark), the databases of the Leibniz Institute for Baltic Sea Research Warnemünde, IOW (Germany), the Swedish Meteorological and Hydrological Institute (SHARK), the Swedish Species Information Centre (Sweden), the International Council for the Exploration of the Sea (ICES), the Finnish Environment Institute, and the Estonian Marine Institute. In addition to the experts of the Benthic Invertebrate Expert team, some 30 other experts have also contributed with data and knowledge.

Although large amounts of data have been compiled for the Red List work of benthic invertebrates, many gaps still exist. Many invertebrate species belong to groups that are normally excluded from monitoring work; moreover, there are also large differences in sampling efforts within the HELCOM area. In general, coastal areas are better sampled than offshore areas, but there are also large variations at the national level. Thus, some areas within the HELCOM area are relatively well investigated whereas others

remain largely unexplored. From a species point of view, information is often scarce and scattered. Some species are targeted in several monitoring programmes, for which long-time data series can sometimes be obtained. However, for a majority of the invertebrate species only occasional observations exist, often with a discontinuous geographic distribution.

From a Red List perspective, only Sweden and Germany have assessed aquatic invertebrate species on a broader scale (Gärdenfors 2010) whereas in other countries, mostly single species or groups have been subject to assessments. Similarly, the previous HELCOM list of threatened and declining species (HELCOM 2007b) only addressed certain species and groups, most of which were included in national Red Lists or subject to research or monitoring programmes. Thus, the current task of defining and identifying benthic invertebrates within the HELCOM area, collecting data and assessing the status for these has been a major undertaking.

Despite the size and diversity of the target group and the complexity of the assessment work, very few experts have been involved in the work. Several countries - Denmark, Latvia and Lithuania - have not contributed with any expert help. Although some, and in the case of Denmark even large datasets have been analysed to cover also these countries, national expertise would have been required to ensure the correct interpretation of the data.

### 7.2.3 Assessment process

#### Preparation of checklist

In the current Red List project, not all aquatic invertebrates with distribution in the HELCOM area have been included. For practical reasons, an already existing checklist (Zettler 2011) containing more than 1 400 macrozoobenthic species was used as a base for the Red List work. This checklist was checked by the national experts and supplementary species added. Special attention was paid to species occurring in the Kattegat, the Sound and Belt areas, and to freshwater species.

In order to focus the work on species that truly occur in and depend on the HELCOM marine area, several principles were also laid down for



choosing the species, similarly to the preparation of the macrophyte checklist (see 7.1.4). First, the checklist only considers taxa with a valid reference in at least one of the international taxonomic databases used, or in contemporary literature. Second, only species that are believed to form stable populations in brackish waters where the salinity reaches 0.5 most of the time were taken into account. Third, only records that are geographically located within the marine HELCOM area have been included. Thus, records from nearby ponds, rocky pools or rivers have not been taken into account. Furthermore, as species determination must be reliable, species with a very low number of records have been checked by benthic invertebrate experts - doubtful determinations were excluded. The checklist of the HELCOM area macrozoobenthic invertebrates created according to the above principles included 1 898 species (HELCOM 2012). This set of species formed a starting point for the Red List assessment work.



**Non-native species were not evaluated. Chinese mitten crab, *Eriocheir sinensis*.**

#### Initial assessments

An initial assessment was made of the species on the checklist (HELCOM 2012) in order to separate clear cases of species that can be directly categorised as Least Concern (LC), Not Evaluated (NE) or Not Applicable (NA). The rest of the species were regarded as candidate species and thus would require more in-depth evaluation. While most of these initial assessments were made during expert team meetings and discussed in plenum, some species were also subject to individual expert assessments that were communicated via

intersessional work. Once the initial assessment was completed, a list of more than 400 candidate species was established. These species were then divided between the team experts, according to their scope of taxonomic and geographic expertise.

The initial assessment was based on the principles that follow the general guidelines adopted in the Red List project. However, some amendments have been made for the consideration of freshwater species.

#### **Not Applicable (NA)**

Similarly to the other species groups, this category was chosen for vagrants and for species introduced in the HELCOM area after 1800.

#### **Not Evaluated (NE)**

Taxa that are very poorly known or where taxonomic difficulties exist were labelled as Not Evaluated (NE).

The category NE was also used for freshwater species that are rare/threatened in the inland waters and have some occurrences in the Baltic Sea if it was assumed that the Baltic Sea findings do not represent stable populations, or the Baltic Sea occurrences are not important in relation to the population(s) of the whole Baltic Sea catchment area.

#### **Least concern**

Species that are widespread and abundant, and where there is no evidence or suspicion of threat and decline were assigned to the category Least Concern (LC).

Common freshwater species that have some occurrences also in the Baltic Sea were assigned to Least Concern (LC) in the current Red List, despite the fact that the 'Baltic population' might meet some of the Red List criteria if considered alone.

#### Data collection for the candidate species and the assessment

The assessment of the species on the candidate list was mainly conducted as intersessional work by the assigned team of experts, but discussed by all

in two team meetings. Data for candidate species were exchanged between team experts with additional data obtained via the HELCOM secretariat and external experts.

In general, as there is a lack of long-term data series for most benthic invertebrates, criterion A could seldom be applied. Based on geographical data, both present and past, the assessments of benthic invertebrates have instead primarily focused on criterion B and to some extent criterion D. Expert advice has been of significant importance, for example in valuing whether gaps in the geographical data represent a lack of sampling or reflect the species true distribution. A simplified template, concentrating on information on the area of occupancy (AOO), extent of occurrence (EOO) and continuing decline, was prepared to facilitate the application of criterion B and the evaluations of the candidate species. The occurrence and status of species in adjacent waters, such as in the Skagerrak and the North Sea, was also taken into account in the assessment process.

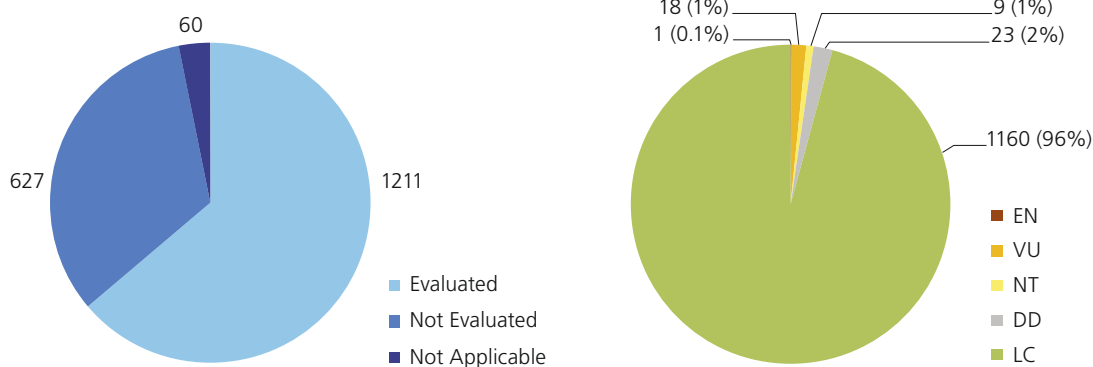
It is important to recognise that the approach of using geographical data and estimating past and present EOO and AOO, for example, does not fully reflect shifts, declines or trends over time. In some cases, the shifts seen in the data are generated by a change in sampling effort whereas in other cases, genuine trends are simply lost due to

a scarcity of data. Due to the lack of proper time series data on population sizes, species that are widespread but experiencing severe declines may also have escaped the IUCN criteria altogether.

#### 7.2.4 Threat status

In all, 19 macrozoobenthic species were considered threatened in the HELCOM Red List assessment. One species, an amphipod *Haploops tenuis*, was categorised as Endangered (EN) and eighteen species as Vulnerable (VU) (Figure 7.6, Table 7.2). Most of the threatened species are restricted to the western part of the HELCOM area with many occurring mainly in the Kattegat. Nine species were classified Near Threatened (NT) and 23 species as Data Deficient (DD). Altogether, 51 species were red-listed in this assessment.

Of the almost 1 900 species included in the checklist, 627 (33%) were left unevaluated (Not Evaluated). The category Not Applicable (NA) was given to 60 species. A total of 1 211 species entered the assessment process; the proportion of the category Least Concern was by far the highest among the assessed species: 1 160 (96%). Four of the species categorised as LC were included in the previous HELCOM list of threatened or declining species (HELCOM 2007): *Monoporeia affinis*, *Pontoporeia femorata*, *Saduria entomon* and *Macrolea mutica*.



**Figure 7.6.** Proportions of species that were assessed, not assessed (Not Evaluated) or Not Applicable (NA) according to the IUCN criteria (left), and proportions of Red List categories within the assessed species (right).



**Table 7.2.** Red List categories for benthic invertebrate species that were evaluated threatened, Near Threatened or Data Deficient in the current HELCOM Red List assessment. For each red-listed species, the past and current threats, future threats and the Red List criteria are given. Descriptions for threat and category codes are given in Chapter 2.7.6.

Species and taxonomic group	Past and current threats	Future threats	HELCOM list 2007b	Red List criteria	Red List category
<b>Sponges (Porifera)</b>					
<i>Cliona celata</i>	E, F	E, F, Co		D2	VU
<b>Sea anemones – Anthozoa (Cnidaria)</b>					
<i>Stomphia coccinea</i>	U	Cc		B1ab(iii)	VU
<b>Snails – Gastropoda (Mollusca)</b>					
<i>Alderia modesta</i>	Co	Co		B2a	NT
<i>Amauropsis islandica</i>	F, E	F, E, Cc		B2ab(ii,iii,iv)	NT
<i>Boreotrophon truncatus</i>	F, E	F, E		B2ab(ii,iii)	NT
<i>Clelandella miliaris</i>	E	E		B1ab(i,iii)	VU
<i>Cryptonatica affinis</i>	U	Cc			DD
<i>Epitonium clathratulum</i>	U	U			DD
<i>Epitonium clathrus</i>	E, F	E, F		B1ab(iii)	VU
<i>Epitonium turtonis</i>	E, F	E, F, Co			DD
<i>Lunatia pallida</i>	E, F	E, F		B1ab(iii)	VU
<i>Myosotella myosotis</i>	Co	Co			DD
<i>Roxania utriculus</i>	U	Cc			DD
<i>Skeneopsis planorbis</i>	U	U			DD
<i>Vitreolina philippi</i>	U	U			DD
<b>Bivalves – Bivalvia (Mollusca)</b>					
<i>Abra prismatica</i>	E, F	E, F, Co		B1ab(iii)+2ab(iii)	VU
<i>Macoma calcarea</i>	E, OT	E, OT		A2c	VU
<i>Modiolus modiolus</i>	F, E, Co	F, E, Co, Cc		A2c	VU
<i>Mya truncata</i>	E, OT, F	E, OT, F	x	A2c	NT
<i>Nucula nucleus</i>	U	U		A2c	VU
<i>Parvicardium hauniense</i>	E, Co	E, Co	x	B2ab(ii,iii)	VU
<i>Scrobicularia plana</i>	U	U		A2c	VU
<b>Crustaceans – Crustacea (Arthropoda)</b>					
<b>Amphipoda</b>					
<i>Corophium multisetosum</i>	E, Co	E, Co		B2b	NT
<i>Deshayesorchestia deshayesii</i>	To, Co	To, Co		B2ab(iii)	VU
<i>Gammarellus angulosus</i>	U	U			DD
<i>Gammarus inaequicauda</i>	E, Co	E, Co			DD
<i>Haploops tenuis</i>	U	U		B1ab(i,iii)+2ab(ii,iii)	EN
<i>Haploops tubicola</i>	U	U		B1ab(i,iii)+2ab(ii,iii)	VU
<i>Orchestia gammarellus</i>	To, Co	To, Co			DD
<i>Talitrus saltator</i>	To	To			DD
<b>Decapoda</b>					
<i>Atelecyclus rotundatus</i>	E, F	E, F		D2	VU
<i>Corystes cassivelaunus</i>	E, F	E, F, Co		D2	NT
<i>Geryon trispinosus</i>	F	F			DD
<i>Hippolyte varians</i>	E	E		B1ab(iii)	VU
<i>Inachus dorsettensis</i>	E	E		B1ab(iii)	NT
<i>Inachus phalangium</i>	F, E	F, E			DD
<i>Palaemonetes varians</i>	E, Co	E, Co			DD
<i>Thia scutellata</i>	E, F	E, F, Co			DD
<i>Upogebia stellata</i>	F	F			DD
<b>Isopoda</b>					
<i>Eurydice pulchra</i>	E, Cp, Co	E, Cp, Co			DD
<i>Lekanesphaera rugicauda</i>	Co	Co			DD
<i>Limnoria lignorum</i>	Co	Co			DD
<i>Pleurogonium rubicundum</i>	U	U			DD
<b>Insects – Insecta (Arthropoda)</b>					
<i>Agrypnètes crassicornis</i>	U, E	U, E			DD
<i>Macroplea pubipennis</i>	E, Co	E, Co	x		DD
<b>Polychaetes (Polychaeta)</b>					
<i>Sabella pavonina</i>	E, F	E, F		B1ab(iii)	NT
<b>Echinoderms (Echinodermata)</b>					
<i>Amphipholis squamata</i>	E	E			DD
<i>Ekmania barthii</i>	F	F, Cc			DD
<i>Hippasteria phrygiana</i>	E, F	E, F, Cc		B1ab(iii)	VU
<i>Solaster endeca</i>	E, F	E, F, Cc		B1ab(iii)	VU
<b>Tunicates – Tunicata (Chordata)</b>					
<i>Pelonaia corrugata</i>	E, F	E, F		D2	VU

## 7.2.5 Main threats

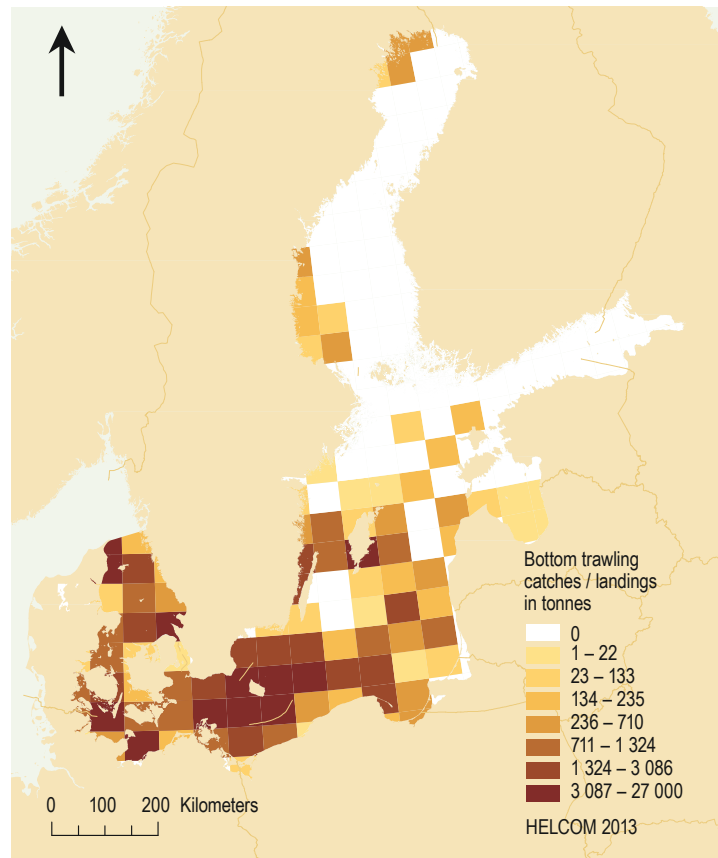
Although hard evidence rarely exists to pinpoint the factors behind the declines for most red-listed benthic invertebrates, it is quite likely that eutrophication has played a significant role in the negative development for many of the red-listed species. In the western HELCOM area, to which most of the red-listed species are restricted, the detrimental changes caused by eutrophication are the same as elsewhere in the Baltic Sea region, for example increased sedimentation and anoxia in bottom habitats. It should be noted that anoxia is not caused by eutrophication alone but also by the reduced water mass exchange from the North Sea. For some species, the effect of eutrophication is indirect: increased turbidity has deteriorated algal belts and the species have thus suffered together with their habitats.

Another important factor behind the declines of many red-listed benthic invertebrates is bottom trawling, which is very intense in some areas (Figure 7.7). Bottom trawling has a direct impact on benthic fauna on the actual site of trawling and causes turbidity and increased sedimentation over much larger areas.

Various construction activities, especially on the coast, have also had detrimental effects on bottom fauna. This includes sea defence or coast protection works, land reclamation, the construction of wind farms and dredging to deepen waterways, for example, as well as boulder fishing, which has decreased the amount of hard bottom habitats considerably in some areas such as in Poland and in the Danish part of the Kattegat in past decades.

Some species have suffered from beach tourism, which affects the shoreline and shallow water habitats in at least two ways: 1) tourism causes physical disturbance on the substrate in the form of trampling and 2) algal belts that serve as a main habitat for many invertebrates are removed to keep the beaches clean for swimmers.

There are more than a dozen species on the current Red List that are so poorly known that no threats or pressures have been identified, even though they have declined or are suspected to be under a threat.



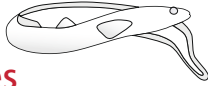
**Figure 7.7. Bottom trawling affects populations of many benthic invertebrates. Catches or landings of fish by bottom trawling (HELCOM 2010a).**

For the majority of species, past and future threats are the same. Some activities have ceased, such as boulder fishing, but most threats or pressures continue to affect the red-listed species negatively. In the future, climate change is a major threat to many of the red-listed species. The marine species that are dependent on high salinities will probably decline even further in the HELCOM area since the salinity of the Baltic Sea is expected to decrease at the same time as precipitation increases. Increasing water temperatures will also hamper arctic species requiring cold and well-oxygenated water.





## 7.3 Red List of fish and lamprey species



See Annex 1 for authors and contributors for the Red List of fish and lamprey species.

### 7.3.1 Introduction to Baltic Sea fish and lamprey species

The Baltic Sea fish fauna is a mixture of marine and freshwater species. More than 70% of the fishes in the HELCOM area are of marine origin, close to 20% of freshwater origin and the rest are diadromous – migrating between freshwater and marine water during their lifespan.

Taxonomically, the group of fish and lampreys consists of five different taxonomic classes within the HELCOM area. Most of the species (208 taxa) belong to the class Actinopterygii, rayfinned fishes, which represent all lifestyles: marine, freshwater and diadromous (Figure 7.8). The class Elasmobranchii, sharks and rays, include 27 species that are purely marine. The two species of anadromous lampreys make up the class Cephalaspidomorphi, jawless fishes, while one species each represents

the marine classes Holocephali, whole heads, and Myxini, hagfishes.

The 239 species found within the HELCOM area are very few compared to those found worldwide: more than 30 000 species of ray-finned fish, more than 1 000 sharks and rays, 43 species of jaw less fishes, 49 species of whole head fish and 77 species of hagfish (Bisby et al 2011). The low numbers of fish species within the HELCOM area compared to adjacent areas are mostly due to the fact that the Baltic Sea, being the largest brackish water area in the world, offers a challenging environment for both marine and freshwater species to live and prosper in. The main limitation for marine species in the Baltic is the decreasing salinity with distance from the Öresund straits, whereas for freshwater species the problem is reversed.

### 7.3.2 Level of knowledge

The level of knowledge is generally good for fish and lamprey species because many species are commercially exploited and hence good data are often available. In some cases, the level of knowledge is even exceptionally good due to the work



**Figure 7.8.** Representative species of different taxonomic classes occurring in the HELCOM area: whiting *Merlangius merlangus* (ray-finned fishes), thornback ray *Raja clavata* (sharks and rays), rabbit fish *Chimaera monstrosa* (wholeheads), and river lamprey *Lampetra fluviatilis* (jawless fishes).

of the International Council for the Exploration of the Sea (ICES), which gives advice on management for fished species within the EU. In addition, many fish species are followed in different environmental monitoring programmes, most notably coastal monitoring net surveys coordinated within HELCOM. For species lacking direct estimate of population trends from exploitation or monitoring surveys, assessments were based on indirect evidence such as the quality and quantity of the main habitat, for example eelgrass meadows. For eight species, however, the level of knowledge was so low that they were categorised as Data Deficient.

### 7.3.3 Assessment process

#### Preparation of checklist

The Red List assessments of fish and lamprey species started with the preparation of the Baltic Sea checklist (HELCOM 2012). The earlier checklist, established in 2007 in the HELCOM Red List of Threatened and Declining Species of Lampreys and Fishes in the Baltic Sea (HELCOM 2007a), was used as a starting point. In addition, information from national experts, including national checklists, museum collection registers, and different fish monitoring programmes, were used to revise the list. All hagfish, lampreys and fish recorded within the HELCOM area (with a salinity of at least 0.5 psu) since 1800 were included in the final checklist (HELCOM 2012). The checklist and the current Red List follow the taxonomy of the Catalogue of Fishes (Eschmeyer & Fricke, 2011) with the exception that only taxa acknowledged as valid species by the whole expert team were included. This meant that the Pallas's houting (*Coregonus pallasii*) and the Baltic houting (*C. balticus*) were merged with whitefish (*C. maraena*) both in the checklist and the current Red List. The vernacular names follow the recommendations of the Journal of Fish Biology using Wheeler (1992) and Wheeler et al. (2004) with a few exceptions.

#### Initial assessments

Using the checklist (HELCOM 2012) with 239 species as a starting point, species qualifying for assessment using the IUCN guidelines were identified. Introduced species were categorised as Not Applicable (NA) so that only species naturally occurring within the HELCOM area with a salinity

of 0.5 psu were considered in the Red List assessments. This corresponds to the Baltic Sea and the Danish straits north to the Kattegat, including fjords, lagoons and sea connected lakes with a salinity of at least 0.5 psu.

The prerequisites for entering the Red List assessment were also considered following the principles below. A species was assessed according to the IUCN criteria if it fulfilled at least one of the following criteria (otherwise categorised as NA):

1. Species reproduces within the HELCOM marine or brackish water area.
2. A significant part of the species population spends a major part of its life cycle in the HELCOM marine or brackish area.
3. Over 2% of the species European population occurs within the HELCOM marine or brackish area.

For live-bearing organisms like viviparous sharks, the occurrence of pregnant females also fulfilled the first principle of reproduction in the HELCOM marine or brackish water area. The second and third principles were applied especially when considering the inclusion of diadromous species such as salmon, which do not reproduce in the HELCOM marine or brackish water but still utilise it to a large extent during other parts of its lifetime. The third principle was applied to eel where more than 2% of the European populations occur within the HELCOM marine or brackish area.

As the first step of the assessment, an attempt was made to classify some of the species directly as Least Concern (LC) on the basis of expert judgment if there were no perceived threats and no indications of decline. In the final results, however, this simplified procedure only concerned nine species; for the rest of the species, a full assessment was made as described below.

#### Data collection and the assessment

Species were divided among experts who compiled the data, filled in the assessment data templates and made the preliminary assessments using the HELCOM guidelines for the IUCN red-listing system. The assessment data template was based on the software red-listing tool EVA used by the Swedish Species Information Centre (SSIC), which required the expert to fill in all available data for



all criteria used in the IUCN Red Listing system. Assessments were later discussed at a workshop or by e-mail correspondence. All assessment data were also put into the EVA tool to generate suggestions for the red-listing category and provide criterion strings presented in the species information sheets.

#### **Calculation of length of assessment period**

The choice of time period for assessing the rate of population reduction follows the IUCN guidelines of three generations or at least ten years for short-lived species. It is important to note that according to IUCN, the generation time is the average age of the individuals contributing the most to the next generation in a pristine situation, i.e. when the age distribution has not changed due to fishing, for example.

In order to get an objective and consistent estimate of generation time across all fish species, the formula for generation time calculation adopted by the Swedish Species Information Center (SSIC) was used. This is based on the formula from IUCN guidelines (2011): age of first reproduction +  $z * (\text{length of the reproductive period})$ . The reproductive period is the time between age of maturity and maximum lifespan and  $z$  is usually  $<0.5$ .  $z$  is lower for higher mortality during reproductive years and higher for relative fecundity skewed towards older age classes. For fish,  $z$  was set to  $1/3$  following SSIC.

#### **Criteria used**

All fish and lamprey species have been tested against criteria A–D. However, for fishes that normally have large population sizes and are widespread, the IUCN criteria B–D are seldom fulfilled. There has been no opportunity to apply criterion E, mainly due to a lack of data and sometimes lack of expertise or expert time; for this reason, criterion A, the reduction in population size, has been the most informative for fish and lamprey species. Criterion A has four subcriteria - A1–A4 - where A1 and A2 utilise data from the past, A3 projects into the future, and A4 uses any combination of past and future time. The subcriterion A1 is used if the causes of reduction are clearly reversible AND understood AND ceased. The subcriteria A2–A4 are used if the reduction or its causes may not have ceased OR may not be understood OR may not

be reversible. Criterion A1 has not been regarded appropriate for any of the declined Baltic Sea fish because: 1) fishery has not been regarded as the sole cause for the observed reductions, or 2) it has not been certain that the change is reversible, or 3) the reduction due to fishery has not been considered ceased.

#### **Calculation of population changes**

As the abundance of fish often fluctuates markedly between years, the choice of years to be compared can have a strong effect on the conclusion. In order to minimise the influence of single extreme years and in order to compare values that are representative for a longer time period, the mean value for the last few years representing the current situation was compared to the mean value for the years at the beginning of the assessment period. A three-year average was used for short-lived species and a five-year average for long-lived species. If data were available for the time before the assessment period, these were also checked in order to detect if the current decrease was part of a natural fluctuation. A downward phase of a natural fluctuation should not be considered a decrease since it is expected to increase again and thus does not directly relate to an increased risk of extinction due to the reduced population size (IUCN 2001).

#### **The DD category**

Compared to previous HELCOM assessments of threatened and declining species (HELCOM 2007a,b), the rules for application of the DD category have been restricted. When using category DD according to the IUCN guidelines adopted in the HELCOM RED LIST process, the uncertainty needs to span from LC to CR in possible threat categories. If the uncertainty is less, for example ranging from NT to CR, the species should be assigned to the most likely threat category.

#### **Problems encountered**

The most significant problem with the assessment work was the limited expert time allocated by the countries, meaning e.g. that not all experts were able to contribute to the final assessments, and adequate information from some regions, especially Estonia and Denmark, was missing.

### 7.3.4 Threat status

Among the species that qualified for assessment (i.e. excluding NA species), 80 were classified as Least Concern, 14 as threatened (Critically Endangered, Endangered or Vulnerable), nine as Near Threatened, eight as Data Deficient and two were regarded Regionally Extinct (Figure 7.9, Table 7.3).

Two species were regarded Regionally Extinct in the HELCOM area: the American Atlantic sturgeon (*Acipenser oxyrinchus*) and the common skate (*Dipturus batis*). The sturgeon occurring in the Baltic after 1800 has most probably been *A. oxyrinchus* and not as previously believed *A. sturio* (Gessner & Ritterhoff 2004). Sturgeon populations have declined to extinction throughout its distribution range in the HELCOM area. The common skate was formerly a common and widespread species occurring in the Kattegat and more rarely south to the northern parts of the Sound; however, after the dramatic decline of the North Sea population mature individuals of the species no longer occur regularly within the HELCOM area.

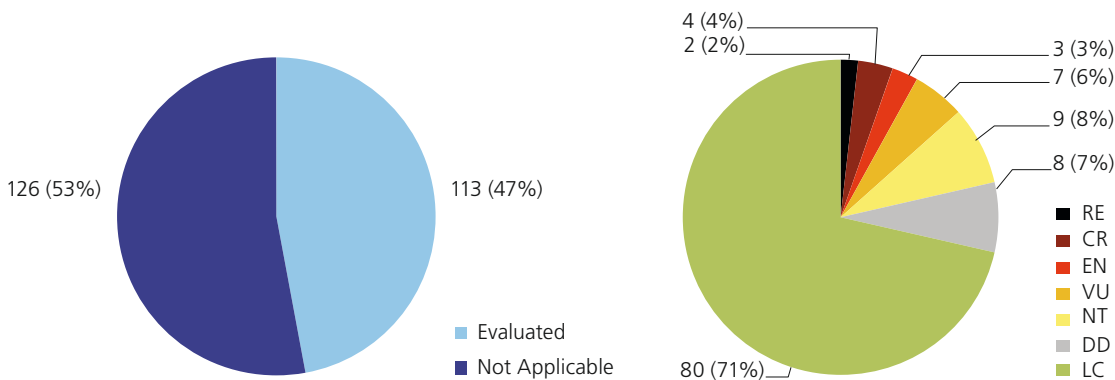
Four species were categorised as Critically Endangered, the Baltic Sea populations of the grayling (*Thymallus thymallus*), the eel (*Anguilla anguilla*) and two sharks, the porbeagle (*Lamna nasus*) and the spurdog (*Squalus acanthias*), all of which have experienced dramatic population declines in the HELCOM area. Three species were assessed Endangered: the Atlantic wolf-fish (*Anarhichas lupus*), the whitefish (*Coregonus maraena*) and the ling (*Molva molva*), and seven as Vulnerable: sea lamprey (*Petromyzon marinus*), the tope shark (*Galeorhinus*



**European eel (*Anguilla anguilla*) was categorized as Critically Endangered (CR).**

*galeus*), the thornback ray (*Raja clavata*), the cod (*Gadus morhua*), the whiting (*Merlangius merlangus*), the salmon (*Salmo salar*) and the trout (*Salmo trutta*). For all except one species, the sea lamprey, the threatened categories were assigned on the basis of estimated past population declines or, in some cases, past declines combined with projected future declines. For the sea lamprey the category assignment was based on the small size and continuously declining population.

Additionally, nine species were evaluated Near Threatened and eight Data Deficient (see Table 7.3).



**Figure 7.9. Proportions of species assessed according to the IUCN criteria, and for which the criteria were not applicable (left), and proportions of Red List categories within the assessed species (right).**



**Table 7.3. Red-listed fish and lamprey species. The table gives scientific and English names, past and current threats, future threats, Red List category in the previous HELCOM Red List assessment (HELCOM 2007a; inclusion in the list of HELCOM 2007b indicated with \*), IUCN criteria and the Red List category for each species. Descriptions for threat and category codes are given in Chapter 2.7.6.**

Species and taxonomic group	English name	Reasons for becoming threatened	Threats in the future	HELCOM lists 2007a,b	Red List criteria	Red List category
<b>Jawless fishes (Cephalaspidomorphi)</b>						
<i>Lampetra fluviatilis</i>	River lamprey	MB, E, F	E, MB, F	EN*	A2bd	NT
<i>Petromyzon marinus</i>	Sea lamprey	MB, E, F	MB, E, F	EN*	C2a(i)	VU
<b>Sharks and rays (Elasmobranchii)</b>						
<i>Dipturus batis</i>	Common skate	F, Bc	F, Bc	CR*	–	RE
<i>Galeorhinus galeus</i>	Tope shark	Bc, F	Bc, F	EN	A2bd, D1	VU
<i>Lamna nasus</i>	Porbeagle	F, Bc	F, Bc	CR*	A2bd	CR
<i>Raja clavata</i>	Thornback ray	F, Bc	F, Bc	EN	A2bd	VU
<i>Squalus acanthias</i>	Spurdog, Spiny dogfish	F, OT	F, OT	CR*	A2bd	CR
<b>Rayfined fishes (Actinopterygii)</b>						
<i>Acipenser oxyrinchus</i>	American Atlantic sturgeon	F, Bc, MB, E	F, Bc, MB, E	RE*	–	RE
<i>Anarhichas lupus</i>	Atlantic wolf-fish	F, Bc	F, Bc	EN	A2d	EN
<i>Anguilla anguilla</i>	European eel	F, A, MB	F, A, MB	CR*	A3bde+4bde	CR
<i>Aspius aspius</i>	Asp	Co, F	Co, F	VU	A3d	NT
<i>Coregonus maraena</i>	Whitefish	Co, E, F, Bc, Cc, A	Co, E, F, Bc, Cc, A	VU*	A2bd	EN
<i>Cyclopterus lumpus</i>	Lumpsucker	F, Bc	F, Bc	VU	A2b	NT
<i>Enchelyopus cimbrius</i>	Four-bearded rockling	U	Bc	RA	A2b	NT
<i>Gadus morhua</i> **	Cod	F, E, Bc	F, E	EN*	A2bc+4bc	VU
<i>Lebetus guilleli</i>	Guillet's goby	U	U	–	–	DD
<i>Lebetus scorpioides</i>	Diminutive goby	U	U	RA	–	DD
<i>Lesueurigobius friesii</i>	Fries's goby	U	U	DD	–	DD
<i>Lota lota</i>	Burbot	E, Cc	E, Cc	LC	A2b	NT
<i>Lycodes gracilis</i>	Checker eelpout	U	U	–	–	DD
<i>Melanogrammus aeglefinus</i>	Haddock	F	F, E	VU	B1a+2a	NT
<i>Merlangius merlangus</i>	Whiting	F	F	RA	A2bd	VU
<i>Merluccius merluccius</i>	European hake	F, RTF	F, RTF	RA	B1a, B2a	NT
<i>Molva molva</i>	Ling	F	F	VU	A2d	EN
<i>Phrynorhombus norvegicus</i>	Norwegian topknot	U	U	RA	–	DD
<i>Pomatoschistus norvegicus</i>	Norway goby	U	U	–	–	DD
<i>Pomatoschistus pictus</i>	Painted goby	U	U	VU	–	DD
<i>Salmo salar</i>	Salmon	F, MB	F, MB	EN*	A4b	VU
<i>Salmo trutta</i>	Trout	F, MB	F, MB	VU	A4b	VU
<i>Scophthalmus maximus</i>	Turbot	F, E	F, E	DD	A2bd	NT
<i>Thymallus thymallus</i>	Grayling	Cc, Co, Cp, E, F	Cc, Co, Cp, E, F	–	A2bcd	CR
<i>Zoarces viviparus</i>	Eelpout, viviparous blenny	Cc, CP, CPr, Bc	Cc, CP, CPr, Bc, A	LC	A2b	NT
<i>Zeugopterus punctatus</i>	Topknot	U	U	RA	–	DD

\*\* For *Gadus morhua*, three stocks have been separately assessed: Kattegat as CR (A2bc), Western Baltic as NT (A2b+4b), and Eastern Baltic as VU (A2bc+4bc).

See also the footnote related to the assessment of the cod in Table 6.1



### 7.3.5 Main threats

Fishing, either as targeted commercial or recreational fishing or as bycatch, are mentioned among the most important reasons for becoming threatened for most of the red-listed fish species (Table 7.3). Many traditional seafood fishes such as Atlantic wolf-fish, ling, whiting, cod and salmon end up on the Red List due to population decreases most likely caused by targeted fishery. For marine fishes in general, overfishing is the overwhelmingly largest identified threat and despite regulations aiming for a sustainable use of the resource, many fish stocks in the world are not currently used sustainably (see e.g. Worm et al. 2009). Bycatch is a serious threat for many sharks and rays since these species are long-lived with a low reproduction capacity meaning that they are highly sensitive to exploitation. In addition, sharks and rays are cartilages fishes that are easily damaged by the fishing gear and may not survive even after being released back into the water.

For anadromous fish species, the main threats are migration barriers due to construction on rivers. Most anadromous fish species were heavily affected by the building of hydropower plants on many of the rivers in the HELCOM drainage area during the 20th century, resulting in serious population decreases in large parts of the distribution areas. Many Baltic rivers, for example, have lost their original wild salmon population due to migration barriers (HELCOM 2011). Since the mid-20th century, many populations have stabilised, although at lower levels than before the river constructions, meaning that the twaite shad (*Alosa fallax*), for example, is considered LC in the current Red List despite being rare compared to before the constructions.

Eutrophication causing the loss of habitats, both directly due to filamentous algae covering and indirectly due to oxygen deficiency, is a serious threat to several fish species. For example, sea spawning whitefish are dependent on clean sand substrate for successful reproduction; however, the increasing amount of drifting filamentous algae in the Gulf of Bothnia has probably negatively affected the species (Veneranta et al. 2013). Another example is the cod where the Gotland deep and the Gulf of Gdansk have both ceased to



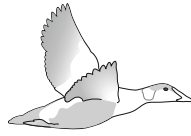
**Fishing is mentioned among the most important reasons for becoming threatened for most of the red-listed fish species.**

function as spawning areas due to oxygen deficiency (ICES 2012).

Climate change (rise in water temperatures) has also been regarded as one of the most important reasons for becoming threatened for a few species requiring cold and well-oxygenated water, such as the eelpout and grayling.



## 7.4 Red List of Baltic breeding and wintering birds



See Annex 1 for authors and contributors for the Red List of Baltic Sea birds.

### 7.4.1 Introduction to Baltic Sea birds

The Baltic Sea is one of the most important areas for seabirds and coastal birds in the Western Palaearctic. Due to the high diversity of coastal habitats, a variety of species groups with different habitat preferences can be found as breeding birds, such as grebes and dabbling ducks breeding on inland lakes and pools or in brackish lagoons, sea ducks favouring rocky and shrubby archipelago areas, waders and terns preferring open sand or gravel habitats or low grass vegetation, gulls occupying roofs of buildings or auks breeding on rocky islands and skerries (Figure 7.10). In winter, the avifauna of the Baltic Sea is dominated by species that breed in (arctic) freshwater habitats but occur in marine or brackish habitats outside the breeding season such as divers, grebes and sea ducks, the most characteristic bird species of the Baltic Sea. Truly marine, pelagic species are only represented by northern

fulmars and black-legged kittiwakes (both only in the Kattegat region) and by auks.

#### Species selection

In the HELCOM Red List assessment of breeding birds, only species with a distinct relationship to the marine or coastal environment of the Baltic Sea have been considered. For the selection of species, the following criteria have been applied:

- 'True' marine or coastal bird species, *i.e.* species that breed exclusively on the coast or only exceptionally inland (e.g. the sandwich tern - *Sterna sandvicensis*, the turnstone - *Arenaria interpres* and the eider - *Somateria mollissima*);
- Species that breed mainly on the coast, or reach higher densities, or form larger colonies on the coast compared to inland (e.g. the cormorant - *Phalacrocorax carbo sinensis* and the white-tailed eagle - *Haliaeetus albicilla*);
- Species that are characteristic inhabitants of typical coastal habitats such as coastal bays, salt meadows, dunes and skerries (e.g. the lapwing - *Vanellus vanellus*, the meadow pipit - *Anthus pratensis*, the northern shoveler - *Anas clypeata* and the osprey - *Pandion haliaetus*).



**Figure 7.10.** Examples of Baltic Sea birds: white-tailed eagle (*Haliaeetus albicilla*), Caspian tern (*Hydroprogne caspia*), common eider (*Somateria mollissima*) and ruddy turnstone (*Arenaria interpres*).

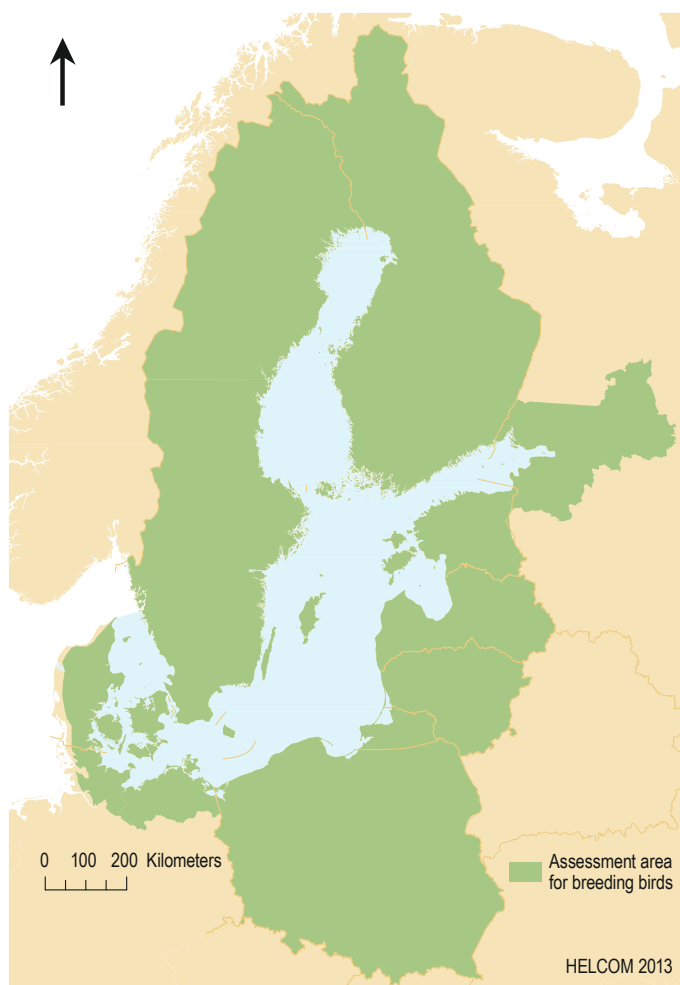
Species for which either criteria b) or c) is true for only some Baltic regions are also included in the assessment. For example, the osprey is a typical breeding bird of coastal habitats in the Swedish and Finnish archipelagos, but in Germany it only breeds in inland lake areas, and the little tern (*Sterna albifrons*) breeds almost exclusively on the coast in most Baltic countries, whereas in Poland it is mainly found on sandy and gravelly river banks.

Different subspecies are separately assessed. This applies to the two subspecies of the lesser black-backed gull (*Larus fuscus fuscus* and *L. fuscus intermedius*) and the black guillemot (*Cephus grylle grylle* and *C. grylle arcticus*) breeding in the Baltic Sea area and also to the dunlin (*Calidris alpina alpina* and *C. alpina schinzii*) and the ringed plover (*Charadrius hiaticula hiaticula* and *Ch. hiaticula tundrae*). In the latter cases, only the subspecies *Calidris alpina schinzii* and *Charadrius hiaticula hiaticula*, respectively, have been included in the assessment since the other subspecies do not breed on the Baltic Sea coast.

The HELCOM Red List assessment of wintering birds includes threat assessments for species that winter in the Baltic Sea area and thus exhibit a distinct relationship to the marine or coastal environment and are supposed to be dependent on the Baltic marine areas as wintering sites. Species that occur in the Baltic Sea area during migration movements only are not considered.

As with breeding birds, the assessment for wintering birds was also made at the subspecies level. This applies to the two subspecies of the great cormorant (*Phalacrocorax carbo carbo* / *P.c. sinensis*), the bean goose (*Anser fabalis fabalis* / *A.f. rossicus*) and of the two auk species the razorbill (*Alca torda torda* / *A.t. islandica*) and the black guillemot (*Cephus grylle grylle* / *C.g. arcticus*).

Common guillemots (*Uria aalge*) wintering in the Baltic Sea originate from birds breeding in the Atlantic area and the Baltic Sea. According to Bauer et al. (2005), they belong to the same subspecies *Uria aalge aalge*, but they are considered as two distinct biogeographic populations (e.g. Mitchell 2004, Bellebaum et al. 2006) since only single birds breeding in the Baltic Sea have been recorded to move as far west as the Kattegat and Skagerrak (Nettleship & Birkhead 1985; Olsson et al. 2000).



**Figure 7.11. Assessment area of the HELCOM Red List of Baltic breeding birds.**



Thus, the North Atlantic and the Baltic biogeographic populations are assessed separately.

A general threshold of 1% was applied to the assessment of wintering birds, i.e. only species whose winter population size in the Baltic Sea equals or exceeds 1% of their respective biogeographic population were considered, otherwise they were classified as Not Applicable (NA). Species that are known to have exceeded the 1%-threshold in the past but winter in lower proportions in the Baltic Sea in present times due to a declining population were included in the Red List assessment. This applies to the black-throated diver (*Gavia arctica*), for example. Taxa that are not a wild population or not within their natural range in the Baltic Sea area, but have been intentionally or unintentionally introduced after 1800, were also assigned NA. This applies to the Canada goose (*Branta canadensis*).

## 7.4.2 Level of knowledge

In many European countries, **breeding** populations of birds have been studied and monitored for a long time. For species breeding in the Baltic Sea region, there are several recent, comprehensive publications of population numbers and trend data that have been used for the assessment (see References). Studying birds at sea is much more difficult and challenging. While nearshore areas are covered by the land-based International Midwinter Waterbird Census (IWC), information from the offshore areas is scarce. Only the implementation of ship-based and aerial surveys in the last decades have enabled scientists to describe the distribution and number of birds wintering at sea. However, there are no comprehensive monitoring programmes for birds **wintering** in the Baltic Sea. Only two publications (Durinck et al. 1994, Skov et al. 2011) provide information on several bird species wintering in the total Baltic Sea area. While there are some regional reports on wintering birds from several Baltic riparian states, they often focus on particular species or locations only and do not provide long-term data series. Furthermore, different investigation periods of local studies make it difficult to derive population information for the total Baltic Sea, given that the winter distribution of many species strongly fluctuates due to winter conditions. Information for wintering gulls and for passerine species wintering in coastal habitats is particularly scarce since no winter surveys for these groups are undertaken by most countries.

The assessments of the Baltic Sea breeding and wintering birds are based on literature and additional unpublished data provided by national experts. A comprehensive list of references used as background data for the Red List assessments is given on the Red List website under the HELCOM website.

## 7.4.3 Assessment process

### **Reference area for the assessment**

The reference area for the assessment of **breeding birds** is the entire territory of the Baltic Sea riparian states. However, for Denmark and Germany / Schleswig-Holstein the coastal zone of the North Sea has been excluded. In the case of Germany, only the Baltic Federal states Schleswig-Holstein

and Mecklenburg-Western Pomerania have been considered, and for Russia only the St Petersburg and Kaliningrad regions (Figure 7.11).

The North Sea border is given by the border of the Helsinki Convention area, i.e. between the Kattegat and Skagerrak.

The arguments why the entire national (or, in case of Germany and Russia, regional) territories have been used for the assessment are:

- Population monitoring data are usually available on a national or regional scale; in most cases, it is difficult or even impossible to separate ‘coastal’ from ‘inland’ numbers of breeding birds.
- Coastal and inland breeders usually form one population, i.e. there is no (genetic) separation.
- A distinction between ‘coastal’ and ‘inland’ breeders for most species would not change the results of the assessment (despite the fact that population trends may differ between coastal and inland areas).

For species with spatially segregated, well-distinguishable populations on the Baltic coast and in the northern tundra areas of Fennoscandia, sub-regional assessments for the Baltic coastal populations are given in addition to the assessment for the total population within the reference area. This is the case for the coastal population of the greater scaup (*Aythya marila*) and the ruff (*Philomachus pugnax*) in the southern Baltic (south of 60° Lat.), and the Bothnian Bay population of Temminck’s stint (*Calidris temminckii*).

The reference area for the assessment of **wintering birds** was defined as the Helsinki Convention area and is thus restricted to the actual Baltic Sea waters, including the Kattegat and the adjacent lagoons. It thus differs from the assessment area used for the Red List of Baltic breeding birds. The first Baltic-wide survey of wintering seabirds and waterbirds was conducted in 1988–1993 (Durinck et al. 1994) and repeated during 2007–2009 (Skov et al. 2011) using the Helsinki Convention area as the reference area. By choosing the identical study area for the present project, data on population sizes and population trends from both studies can be easily used for the Red List assessment. Furthermore, Germany has recently updated its population sizes of wintering birds in the Baltic Sea using the



study area according to the Helsinki Convention area. These current data can thus also be considered for the Red List assessment. However, to account for the fact that some species, especially geese, frequently switch between actual Baltic Sea habitats and more inland habitats, coastal areas up to 50 km inland were included for such species after consulting with experts.

### Assessment criteria

The Red List assessments of Baltic Sea birds were based on the IUCN Red List criteria described in Chapter 2 and on their HELCOM specifications described in Chapter 2.7.3. Similar to the other species groups, the category *Not Applicable* was applied to species that have been introduced in the Baltic Sea region after 1800 and for wintering taxa that occur only in low numbers in the Baltic Sea. The threshold of 1% of the respective biogeographic population (see also *Species selection from Chapter 7.4.1*) was chosen for the inclusion of wintering populations in the assessment.

In the assessment of population declines, **generation length** is an essential variable and can be estimated in a number of ways as described in Chapter 2.6. In the HELCOM Red List assessment of **breeding birds**, generation lengths have been estimated with the following method (IUCN 2010):  $\text{Generation length} = \text{age of first reproduction} + z * (\text{length of the reproductive period})$ , where  $z$  is usually  $<0.5$ , depending on survivorship and the relative fecundity of young vs. old individuals in the population.

For the calculation of the age of first reproduction and the length of the reproductive period, data from Cramp & Simmons (1977, 1983) and Cramp & Brooks (1985) have been used. The value for  $z$  was set to 0.25, which gives a fairly good estimate for most species.

For the assessment of **wintering birds**, values for generation length were chosen according to the Swedish Red List of breeding birds (Tjernberg & Svensson 2007). For the other birds, the generation lengths used were the same as applied in the assessment of breeding birds or they were set by expert opinion.



**For some species, such as the ruff (*Philomachus pugnax*) separate subregional assessments were prepared in addition to the overall assessment within the reference area.**

**Wintering** birds were evaluated against criteria A to D. Criterion E was not used since no quantitative analysis was carried out to calculate the probability of extinction. For all taxa with appropriate available information on population size, population trends over three generations or ten years, whichever is the longer, that are needed to test for a reduction in population size according to criterion A were calculated with the 'Criterion A tool' provided by the IUCN (IUCN 2001). The tool was also used to calculate the population trend over the time periods required by criterion C. Information on the extent of occurrence, the area of occupancy and the number of wintering locations (criteria B and D) was taken from Durinck et al. (1994), Skov et al. (2001) and Petersen et al. (2010). In contrast to the assessment of breeding birds, population size was defined as the total number of individuals rather than mature individuals since it is not feasible to determine the proportion of mature individuals in the Baltic Sea winter population of the different species.

### Data collection and the assessments

The Red List assessments of **Baltic breeding birds** were carried out by the Bird Expert Team chaired by Christof Herrmann (Germany). Several methodological issues, such as criteria for the selection of species to be included in the assessment and the reference area, were agreed on already at the kick-off meeting of the Red List project in 2009.





In 2010, a request for detailed species information (population size and trends) was circulated to the national experts. The information submitted in response to this request together with information from published sources formed the basis for the elaboration of the first draft of the assessment.

The first draft of the Red List of Baltic Breeding Birds was agreed on in principle at the HELCOM HABITAT 13 meeting in 2011, subsequently complemented by the additional information from the Contracting Parties and published as an interim report on the HELCOM website in 2012.

The Red List assessments of **Baltic wintering birds** were prepared by consultant Nicole Sonntag (Germany), supported by the Chair Christof Herrmann. The preliminary species list for the assessment of wintering birds compiled by the expert team added three species to the list in its review (the Caspian gull *Larus cachinnans*, the northern fulmar *Fulmarus glacialis* and the Eurasian rock pipit *Anthus petrosus*), while the common redpoll *Carduelis flammea* was excluded because it does not rely on the coastal environment of the Baltic Sea for wintering. Subsequently, the list was sent via e-mail to seabird and coastal bird experts of all Baltic Sea countries, together with a request to provide available information on population sizes and population trends for species wintering in the Baltic Sea area of their country. Sweden, Finland and Germany submitted the required data while Denmark provided national midwinter survey reports. The information submitted in response to the request, the reports of the two comprehensive Baltic Sea surveys in the early 1990s (Durinck et al. 1994) and in 2007-2009 (Skov et al. 2011), as well as other published information formed the basis for the first draft of the assessment. Experts for certain species were contacted within the assessment process and asked for additional information or advice. In March 2013, the first draft of the Red List classification was submitted to the national experts for their comments and suggestions for improvement.

#### 7.4.4 Threat status

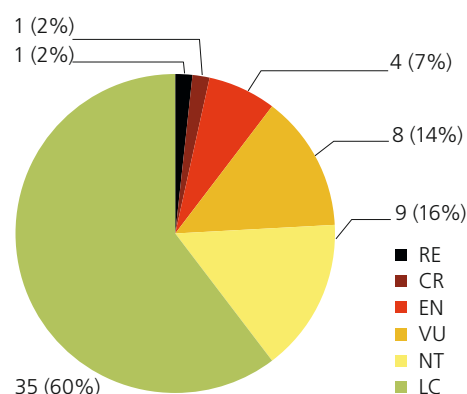
##### Breeding birds

According to the criteria described above, 56 breeding species have been included in the Red List assessment. Two species - the lesser black-backed

gull and the black guillemot - occur with two subspecies in the Baltic Sea area (*Larus fuscus fuscus* & *L. f. intermedius* and *Cephus grylle grylle* & *C. g. arcticus*), which have been assessed separately. Hence, a total of 58 taxa have been analysed in the assessment. In all, 23 taxa were red-listed; their results are given in Table 7.4. The whole list of evaluated species and information on their distribution by HELCOM countries is given on the Red List website under the HELCOM website.

One species, the gull-billed tern, has been a regular breeding bird in the past but is considered as Regionally Extinct (RE) today. The category Critically Endangered (CR) also comprises one species, the Kentish plover, which has formerly been a regular breeder in Denmark, Sweden and Germany, but after 2000 has only bred with single pairs in Sweden and Germany (Mecklenburg-Western Pomerania). The category Endangered (EN) comprises four species (the dunlin, the Terek sandpiper, the Mediterranean gull and the black-legged kittiwake). Eight taxa classify for the category Vulnerable (VU). The category Near Threatened (NT) comprises nine taxa, and the category Least Concern (LC) 35.

Figure 7.12 shows the percentages of the Red List categories. In all, 22.4% of the assessed taxa are threatened (Critically Endangered, Endangered or Vulnerable), 15.5% are Near Threatened and 60.3% are Least Concern.



**Figure 7.12.** Proportions of the Red List categories for the Baltic Sea breeding birds. The sub-regional assessments of the ruff, the greater scaup and Temminck's stint (see Table 7.5) are not included in the sample. All 58 species or subspecific taxa were considered as the Baltic Sea breeding birds were evaluated; no taxa were assigned in the Data Deficient category (DD).

**Table 7.4. Red List categories for Baltic Sea breeding birds that were evaluated Regionally Extinct, threatened, Near Threatened or Data Deficient in the current HELCOM Red List assessment. For each red-listed species, the past and current threats, future threats and the Red List criteria are given. Descriptions for threat and category codes are given in Chapter 2.7.6.**

Species/subspecies	English name	Past and current threats	Future threats	HELCOM list 2007b	Red List criteria	Red List Category
<i>Podiceps auritus</i>	Slavonian grebe	OT, CP, A, CPr, ERT	OT, CP, A, CPr, ERT		A2abce	VU
<i>Aythya fuligula</i>	Tufted duck	OT, To, A, CPr, H, Bc, O	OT, To, A, CPr, H, Bc, O		A2ab	NT
<i>Aythya marila</i>	Greater scaup	Bc, A, CPr, O, ERT, H	Bc, A, CPr, O, ERT, H		A2bcd	VU
<i>Somateria mollissima</i>	Common eider	Ep, A, Cc, CPr	Ep, A, Cc, CPr		A2abe	VU
<i>Melanitta fusca</i>	Velvet scoter	A, CPr, D, OT, E	A, CPr, D, OT, E	x	A2b	VU
<i>Charadrius hiaticula hiaticula</i>	Ringed plover	Ogr, To, A, CPr, AM	Ogr, To, A, CPr, AM		A2bc	NT
<i>Charadrius alexandrinus</i>	Kentish plover	To, A, CPr, U	To, A, CPr, U		D1	CR
<i>Vanellus vanellus</i>	Lapwing	Di, AM, A, CPr, H	Di, AM, A, CPr, H		A2bc	NT
<i>Calidris temminckii</i>	Temminck's stint	A, CPr, To, OT, U	A, CPr, To, OT, U		A2a-c	NT
<i>Calidris alpina schinzii</i>	Southern dunlin	Ogr, A, CPr, Di, Cc, ERT	Ogr, A, CPr, Cc, ERT	x	A2ace, C1	EN
<i>Philomachus pugnax</i>	Ruff	ERT, Ogr, Di, Cc, A, CPr	ERT, Ogr, Cc, A, CPr		A2abcd	VU
<i>Limosa limosa</i>	Black-tailed godwit	Ogr, Co, CPr, A, ERT	Ogr, CPr, A, ERT		A2ac	NT
<i>Tringa totanus</i>	Redshank	Ogr, Co, A, CPr, ERT	Ogr, A, CPr, ERT		A2ac	NT
<i>Xenus cinereus</i>	Terek sandpiper	A, CPr, RTF?, ERT	A, CPr, RTF, ERT		D1	EN
<i>Actitis hypoleucos</i>	Common sandpiper	Ogr, A, To, ERT	Ogr, A, To, ERT		A2ab	NT
<i>Arenaria interpres</i>	Ruddy turnstone	Ogr, A, CPr, ERT	Ogr, A, CPr, ERT		A2abce+3ce+4abce	VU
<i>Larus melanocephalus</i>	Mediterranean gull	RTF?, A, CPr	RTF, A, CPr		D1	EN
<i>Larus fuscus fuscus</i>	Lesser black-backed gull	Ep, ERT, CP, A, CPr, To	Ep, ERT, CP, A, CPr, To	x	A2abce	VU
<i>Rissa tridactyla</i>	Black-legged kittiwake	F, Cc, Mi, O, L, Bc, RTF	F, Cc, Mi, O, L, Bc, RTF		D1	EN
<i>Gelochelidon nilotica</i>	Gull-billed tern	AM, A, CPr	–		–	RE
<i>Hydroprogne caspia</i>	Caspian tern	ERT, A, CPr	ERT, A, CPr, Cc		C1	VU
<i>Cephus grylle grylle</i>	Black guillemot	A, CPr, H, CP	A, CPr, H, CP	x	A2ab	NT
<i>Oenanthe oenanthe</i>	Northern wheatear	AM, ERT	AM, ERT		A2abc	NT

For three species, separate assessments for Baltic coastal sub-populations in addition to the total assessment have been made. These assessments for sub-populations refer to the greater scaup (Baltic coastal population), the ruff (Baltic population south of 60°Lat.) and Temminck's stint (Bothnian Bay population). In all cases, the assessed sub-populations classify for higher threat categories than the total population (Table 7.5).

### Wintering birds

According to the criteria described above, 58 wintering species have been included in the Red List assessment of wintering birds. Four species, the great cormorant, the bean goose, the razorbill and the black guillemot, occur with two subspecies in the Baltic Sea area and have been assessed separately. One species, the common guillemot, occurs with two different biogeographic populations in the Baltic Sea area and have also been assessed separately. Hence, a total of 63 species,

**Table 7.5. Assessment of Baltic coastal sub-populations for the greater scaup, the ruff, and the Temminck's stint.**

Category	Scientific Name	English name	Criteria
EN	<i>Aythya marila</i> (Baltic coastal population)	Greater scaup	A2abcd, C1
EN	<i>Philomachus pugnax</i> (southern Baltic population – south of 60° Lat.)	Ruff	A2abcd, C1
VU	<i>Calidris temminckii</i> (Bothnian Bay population)	Temminck's stint	A2ac, C1, D

subspecies, and populations have been included in the assessment.

In total, 16 wintering species, subspecies, or populations were red-listed in this assessment. The species and their results are given in Table 7.6. Two species, the red-throated diver and the black-throated diver, have dramatically decreased as wintering birds in the Baltic Sea and were classified as Critically Endangered (CR). The category Endangered (EN) comprises seven species, including five

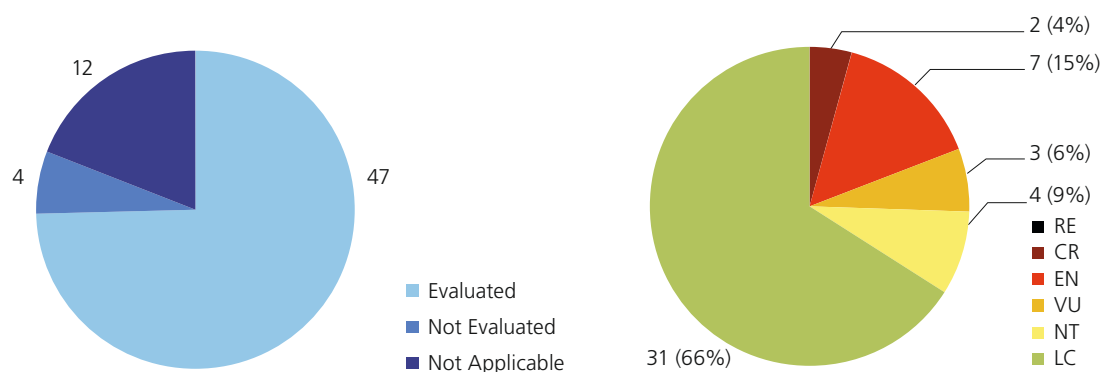


sea duck species. Three taxa classify for the category Vulnerable (VU) and four for the category Near Threatened (NT). The category Least Concern (LC) comprises 31 species. One species, the Canada goose, was assigned Not Applicable (NA) as introduced species, while 12 species were assigned NA because they do not reach the 1% threshold to be considered in the assessment. Two passerine species that were listed as Baltic Sea wintering species were not evaluated against the criteria (NE) since information on the Baltic Sea winter population was too scarce, while the Atlantic populations of the common guillemot and the razorbill were

Not Evaluated (NE) because only a marginal part of the population winters in the Baltic Sea and information is too scarce.

Information on the size of the wintering populations considered in the assessment is given on the Red List website under the HELCOM website.

Figure 7.13 shows the percentages of the Red List categories. In all, 25.5% of the assessed species or subspecies classify for one of the threat categories from Critically Endangered to Vulnerable, 8.5% are Near Threatened, and 66.0% are Least Concern.



**Figure 7.13.** Proportions of the Red List categories for Baltic Sea wintering birds. Proportions of species, subspecies or populations that were assessed, not assessed or Not Applicable according to the IUCN criteria (left), and proportions of Red List categories within the assessed taxa (right).

**Table 7.6.** List of species and subspecies that have been included in the Red List assessment of wintering birds. For each red-listed taxa, the past and current threats, future threats and the Red List criteria are given as well as inclusion in the previous HELCOM list of threatened and/or declining species (HELCOM 2007b, b = breeding population included, w = wintering population included). Descriptions for threat and category codes are given in Chapter 2.7.6.

Species/subspecies	English Name	Past and current threats	Future threats	HELCOM list 2007b	Red List Criteria	Red List Category
<i>Gavia stellata</i>	Red-throated diver	O, Bc, Co, T	O, Bc, Co, T	w	A2b	CR
<i>Gavia arctica</i>	Black-throated diver	O, Bc, Co, T	O, Bc, Co, T	w	A2b	CR
<i>Podiceps grisegena</i>	Red-necked grebe	Bc, O, Mi, Co, T	Bc, O, Mi, Co, T		A2b, C1	EN
<i>Podiceps auritus</i>	Slavonian grebe	Bc, O, Mi, Co, T	Bc, O, Mi, Co, T	w	D2	NT
<i>Anser fabalis fabalis</i>	Taiga bean goose	H, D, Ogr, Mi, Co, OT, CP, ERT	H, D, Ogr, Mi, Co, OT, CP, ERT		A2b	EN
<i>Branta bernicla hrota</i>	Light-bellied brent goose	ERT, Ogr, Cc, E, OT, D, F	ERT, Ogr, Cc, E, OT, D, F, H		B1ab(iii), D2	NT
<i>Somateria mollissima</i>	Common eider	Bc, O, H, ERT, D, Mi, Co, T	Bc, O, H, ERT, D, Mi, Co, T		A2b	EN
<i>Polysticta stelleri</i>	Steller's eider	A, Bc, O, T	A, Bc, O, T	w	A1b, B2ab(ii,iv,v), C1+2a(ii)	EN
<i>Clangula hyemalis</i>	Long-tailed duck	O, Bc, H, Mi, T, Co	O, Bc, H, Mi, T, Co		A2b	EN
<i>Melanitta nigra</i>	Common scoter	O, Bc, H, ERT, Mi, Co, T	O, Bc, H, ERT, Mi, Co, T		A2b	EN
<i>Melanitta fusca</i>	Velvet scoter	O, Bc, H, Mi, Co, T	O, Bc, H, Mi, Co, T	b	A2b	EN
<i>Mergus serrator</i>	Red-breasted merganser	Bc, O, H, Mi, Co, T	Bc, O, H, Mi, Co, T	b	A2b	VU
<i>Hydrocoloeus minutus</i>	Little gull	O	O		D2	NT
<i>Rissa tridactyla</i>	Black-legged kittiwake	F, Cc, Mi, O, L, Bc, RTF	F, Cc, Mi, O, L, Bc, RTF		D2	VU
<i>Cephus grylle grylle</i>	Black guillemot	O, Bc, Mi, Co, T	O, Bc, Mi, Co, T	b+w*	A2ab	NT
<i>Cephus grylle arcticus</i>	Black guillemot	O, Bc, Mi, Co, T	O, Bc, Mi, Co, T	b+w*	D2	VU

\*included only on species level

## 7.4.5 Main threats

### **Habitat destruction**

Habitat destruction or deterioration is an important factor in the decline of species. Both the destruction of breeding habitats and resting or wintering sites may have an impact on bird populations.

### **Ditching of coastal meadows (Di)**

In the Baltic Sea area, coastal meadows, important breeding sites for waders and ducks in particular, were largely destroyed for land reclamation purposes. In Mecklenburg-Western Pomerania, for instance, about 36 800 ha of coastal meadows were dyked and drained during the 20<sup>th</sup> century - only 6 600 ha exposed to a natural flood regime have remained (Holz et al. 1996; Herrmann & Holz 1997). These land reclamation projects already started in the 19<sup>th</sup> century and culminated in the 1950s–1970s. During the last two decades, however, these kinds of activities have almost ceased. More recently, some of the formerly dyked areas have been restored with more restoration projects being planned. Nevertheless, the extension of coastal meadows with a natural flood regime is still much reduced compared to the past, which means reduced habitat availability for many coastal bird species.

### **Overgrowth of open areas (Ogr)**

The abandonment of coastal meadows and short-grazed grasslands has long been a problem in several Baltic regions. In economic terms, the grazing of these meadows is not profitable today; however, with abandonment, these areas lose their habitat suitability for grassland-breeding birds (Haartman 1975, Larsson 1976, Król 1986). Incentive programmes are needed in order to maintain a management regime according to nature conservation requirements.

Overgrowth as a natural process also concerns maritime islands with no history as pastures. Habitats for terns and waders are diminishing due to overgrowth in the outer zones of the S–SW archipelagos where shores are steep and less exposed to land uplift effects.



**If not grazed, Baltic salt meadows are overgrown by reed. Island Kirr, National Park Western Pomeranian Lagoon Area, Germany.**

### **Agricultural intensification / Changes in arable land (AM)**

Agricultural intensification and the conversion of grasslands to arable lands (e.g. for the production of bio-energy crops) cause habitat loss in terms of the quality and extension for those species that breed at high proportions on agricultural land. Agricultural intensification is considered to be the main factor affecting the habitat of the lapwing across most of its range. The consequences are the insufficient production of fledglings due to an increased clutch failure rate, reduced possibilities of re-nesting and poor chick survival.

The intensification of grassland management - increased fertilisation followed by higher cattle densities - has a strong negative impact on breeding birds. In the Netherlands, economically recommended grassland management practices have been shown to have a devastating effect on nest survival (Beintema & Müskens 1981, 1987).

### **Extra-regional threats (ERT)**

In addition to breeding habitats, feeding and resting habitats during migration and wintering periods are also of importance for the population status of a species. Losses of habitat quality in the traditional staging areas in the Netherlands are suggested as the reason for the large-scale





population re-distribution of the ruff towards the east, resulting in a strong population decline in its European and Russian European Arctic breeding range (Rakhimberdiev et al. 2011). Losses of feeding opportunities in some wintering areas are also considered to be a problem for the greater scaup (EU Commission 2009c). The over-harvesting of mussels and cockles in the Dutch Wadden Sea has been shown to have a strong impact on the distribution of eider (Piersma & Camphuysen 2001, Reneerkens et al. 2005) and may also lead to the degradation of feeding opportunities for other benthos-feeding ducks. The over-harvesting of the bivalve *Spisula subtruncata* in the Dutch North Sea may also be significant. Eutrophication causes a decline in the extension of sea grass *Zostera* spp. beds, an important feeding habitat for ducks in spring during the spawning season of herring in the western Baltic Sea.

#### **Mining and quarrying / sediment extraction (Mi)**

Offshore extraction of sand and gravel in the Baltic Sea is usually carried out in shallow waters and thus might result in a temporary or permanent reduction of feeding grounds (EU Commission 2009c). In the Baltic Sea, sea ducks and diving ducks, grebes and black guillemots, in particular, feed on benthic or benthopelagic prey species and depend on areas where such food sources are abundant and accessible to them. Diving physiology limits the range of energetically suitable water depths, which constrains the habitat choice of the

birds. Thus, the reduction or destruction of such bottom habitats by sand extraction or by dredging activities for shipping channels and coastal development, for example, may decrease the food availability for the species. A food shortage can cause mass starvation under unfavourable weather conditions or lead to poor body condition, making birds more susceptible to diseases or parasites; it can also lead to reduced or failed breeding success (Mendel et al. 2008). Mussel fisheries and sediment extraction or dredging can remove large bivalve occurrences within a short time span. Such losses cannot be offset through accelerated mussel regrowth - they must be compensated by recolonisation. This might lead to a food shortage for molluscivorous duck species since many important feeding habitats are affected. Moreover, increasing water temperatures during winter and changes in phytoplankton communities due to decreasing nutrient levels can lead to a lower quality of bivalves.

#### **Bycatch (Bc)**

Several studies from different parts of the Baltic Sea have shown that set net (gillnet) fishery causes the death of tens of thousands of birds every year. A comprehensive overview of the bycatch problem has recently been given by Žydelis et al. (2009), who estimated that at least 73 000 birds die annually in gill nets in the Baltic Sea. The fine monofilament nets are nearly invisible to birds and thus they become entangled while diving for food. The bycatch problem is of special relevance where gillnet fishery is practised in areas with high concentrations of resting, moulting or wintering sea-birds. In the Baltic Sea, gillnet fisheries are mainly operated in shallow coastal areas or on shallow offshore grounds - areas that are also the most important habitats for birds. The overlap of gillnet fishing and high concentrations of birds usually occurs only during certain periods of the year (e.g. wintering, autumn and spring migration or moulting time (Zydelis et al. 2009, Sonntag et al. 2012).

Bycatch studies have been undertaken in German coastal waters off Schleswig-Holstein (Kirchhoff 1982) and in the Pomeranian Bay off Usedom (Schirmeister 1993, 2003, I.L.N. & IfAÖ 2005). A more recent study was carried out on behalf of the German Federal Agency for Nature Conservation (Bellebaum 2011). In Poland, data have been



**Young great crested grebe (*Podiceps cristatus*) drowned in fishing net.**



collected from the Pomeranian Bay (Kowalski & Manikowski 1982), the Gulf of Gdańsk (Stempniewicz 1994) and Puck Bay (Kieś & Tomek 1990). In Lithuania and Latvia, bycatch studies have been published by Dagys & Žydelis (2002) and Urtāns & Priednieks (1999, 2000), respectively. For Finland, Hario (1998) analysed the incidental take of seabirds by fisheries, and from Sweden there are data available from Oldén et al. (1988) and Lunneryd et al. (2004). These studies show that both piscivorous birds (divers, grebes, mergansers, auks, cormorants) and benthophagic ducks may get entangled and die in fishing gear.

The bird losses in fishing gear may be of considerable magnitude. For the territorial waters of the German Federal State Mecklenburg-Western Pomerania and the adjacent German Exclusive Economic Zone, Bellebaum (2011) estimated a bycatch of 17 000–20 000 seabirds per winter season (November–May). His results suggest that for the flyway populations of the long-tailed duck (*Clangula hyemalis*) and the greater scaup, mortality from bycatch and other human impacts (oiling, hunting) may reach a level that might not be sustainable. Hence, bycatch is probably a significant factor that contributes to the current decline of the two species.

At the southern coast of the Baltic Sea (Germany, Poland, Lithuania and Latvia), the long-tailed duck is the most numerous species caught in gillnets, followed by the black scoter (*Melanitta nigra*), the velvet scoter (*Melanitta fusca*) and the red-throated diver (*Gavia stellata*). In some areas, the eider, the greater scaup, the common guillemot (*Uria aalge*) and cormorants (*Phalacrocorax carbo*) are also found in gillnets in high numbers. In the coastal waters of Lithuania, losses of Steller's eiders (*Polysticta stelleri*) need special consideration. In Finland, especially the eider, the black guillemot (*Cepphus grylle*), the razorbill (*Alca torda*) and the red-throated and black-throated divers (*Gavia stellata* and *G. arctica*) are the most affected species. In the Swedish Kattegat, the studies of Oldén et al. (1988) revealed that 90–95% of the birds found in fishing gear were common guillemots. The most recent Swedish bycatch study covering the Swedish fishery as a whole (Lunneryd et al. 2004) showed that the cormorant was the dominating species, followed by the eider, the common guillemot, the

merganser (*Mergus serrator*), and the long-tailed duck. The specific threat to drown in fishing gear is higher for piscivorous species than for benthophagic ducks, even though total numbers of the latter group in most areas are higher because of higher population numbers.

Bycatch of the common guillemot in gillnets appears to be the single most serious threat to the population and may have contributed to the observed decrease in adult survival rates. The highest mortality was caused by gillnets set for cod fishing. The bycatch rates for this species have increased from 1972–1999 due to increased fishing efforts for cod (Österblom et al. 2002).

The list of seabirds with high bycatch rates includes several species that are threatened according to the HELCOM Red List: the Slavonian grebe (*Podiceps auritus*), the tufted duck (*Aythya fuligula*), the greater scaup, the velvet scoter and the eider are quite often found in fishing gear. Several of these species are not only affected by fishing in the Baltic Sea area, but also in the wintering areas along the North Sea/Atlantic coast.

For wintering greater scaups, bycatch is considered an important problem off the Latvian, Lithuanian, Polish and German coasts as well as in Dutch waters (Grimm 1985, Stempniewicz 1994, Van Eerden et al. 1999, Dagys & Žydelis 2002). In Poland, Stempniewicz (1994) estimated that more than 1 300 greater scaups drown in nets annually in the Gulf of Gdańsk, resulting in a mortality of 10.6% of the maximum resting number recorded. On the German Baltic coast, gillnet fishery is practised on important nocturnal feeding sites. Grimm (1985) estimated that up to 8% of the 35 000 greater scaups staging in the Wismar Bight drown in gillnets each winter. In the Dutch IJsselmeer, a similar mortality of 9.4% to 10–20% per year, involving probably 11 600 greater scaups per year was estimated from data from 1978–1990 by Van Eerden et al. (1999). This means that annual bycatch may cause losses of 5–10% of the total population, a proportion that may have a negative impact on the population level.

Bycatch appears to be an important problem also for wintering velvet scoters off the Latvian, Lithuanian and Polish coasts (Stempniewicz 1994, Dagys & Žydelis 2002, Žydelis et al. 2006). The



scale of the problem is not yet fully clear since the available studies usually only cover limited time spans. However, the intensity of gillnet fishery on the main wintering grounds of velvet scoters in these countries suggests that the problem may be of significant magnitude. For instance, Stempniewicz (1994) estimated that more than 3 000 velvet scoters drowned in one winter in the Gulf of Gdańsk. Dagys & Žydėlis (2002) estimated that off Lithuania, 0.15 velvet scoters were entangled per 1 000 m of net per day, and 11% of all birds drowned were velvet scoters. Durinck et al. (1993) reported that in Denmark, several hundred birds may die in one catch.

Mortality due to bycatch in fishing nets is seen as one reason for the decline in the Finnish inland population of velvet scoters after the introduction of monofilament fishing nets in the remote breeding lakes in the north. Fishing still continues in these lakes, possibly constituting the main factor preventing the recovery of this population (Hario 2000).

The available studies mainly investigate bird bycatch in near-coastal waters. Information on the bycatch in fishing grounds further offshore is scarce, although it is known that high densities of birds and seasonal high fishing intensity may also overlap in these areas. The total ban of driftnets within the EU in 2008 has probably contributed to reducing bycatch; however, shifting the effort to long-lining in salmon fishing may be having the opposite effect, especially in the southern Baltic Sea.

#### **Hazardous substances (Contaminant pollution, Cp)**

Among the hazardous substances released to the environment, DDT and PCB, in particular, have had a severe impact on birds. PCB affects birds by direct intoxication (Koeman et al. 1973), whereas DDT, or its metabolite DDE, cause reproductive failures especially in top-predators. DDT was originally used as an insecticide; however, it also affects vertebrates and invertebrates other than those originally targeted. Owing to its persistence, DDT bio-accumulates and biomagnifies in food webs. The decline of the white-tailed eagle (*Haliaeetus albicilla*) and other predatory birds several decades ago was associated with DDT and its metabolites, especially DDE. Piscivo-

rous seabirds and terrestrial predatory birds were especially affected due to their position in the upper levels of the food chain. Following the bans on DDT and PCB during the 1970s around the Baltic Sea, the concentrations of DDE and PCB in biota declined considerably (HELCOM 2010a). The reproduction success of white-tailed eagles started to recover in the 1980s, and since the mid-1990s it has largely recovered back to pre-1950 levels (Helander et al. 2011).

The only African migrant among the Baltic gulls, the nominate subspecies of the lesser black-backed gull (*Larus fuscus fuscus*), has recently shown declining hepatic levels of DDE, HCB,  $\beta$ -HCH and trans-nonachlor (organochlorine pesticides), while the concentrations of PCBs are still comparatively high in the Gulf of Finland (Hario & Nuutinen 2011). The source of the PCBs is supposed to be the staple food of the species, the Baltic herring (*Clupea harengus*). Concurrently, the fledging rate of the lesser black-backed gulls in the Gulf of Finland has increased from 0.02 in the 1990s to 0.52 in the 2000s, a figure probably sufficient to sustain the population (Hario et al. 2004).

Currently, lead contamination from hunting bullets via prey animals poses a severe threat to white-tailed eagles, other birds of prey and scavenging species (Herrmann et al. 2011). Metals and trace elements in eiders have been found to be high in the Gulf of Finland, with levels increasing from west to east along the Gulf (Franson et al. 2000a, 2002). Also, acute lead poisoning due to ingested lead shots has been diagnosed in Finnish eiders; however, the source areas of lead shots are unknown for birds sampled soon upon arrival from spring migration (Hollmén et al. 1998, Franson et al. 2000b). All in all, exposure to lead and selenium should be considered among the potential factors for the current decline of the eider in the Baltic Sea.

#### **Plastic waste (Litter, L)**

Plastic waste is a threat to seabirds since they may use it as nesting material (e.g. plastic remnants of lost fishing gear, plastic threads of packing material), with the consequence that adults and chicks may get entangled and die. Bird species known to integrate plastic in their nests are northern gannets, black-legged kittiwakes and great cormorants. Birds breeding in mixed colonies with

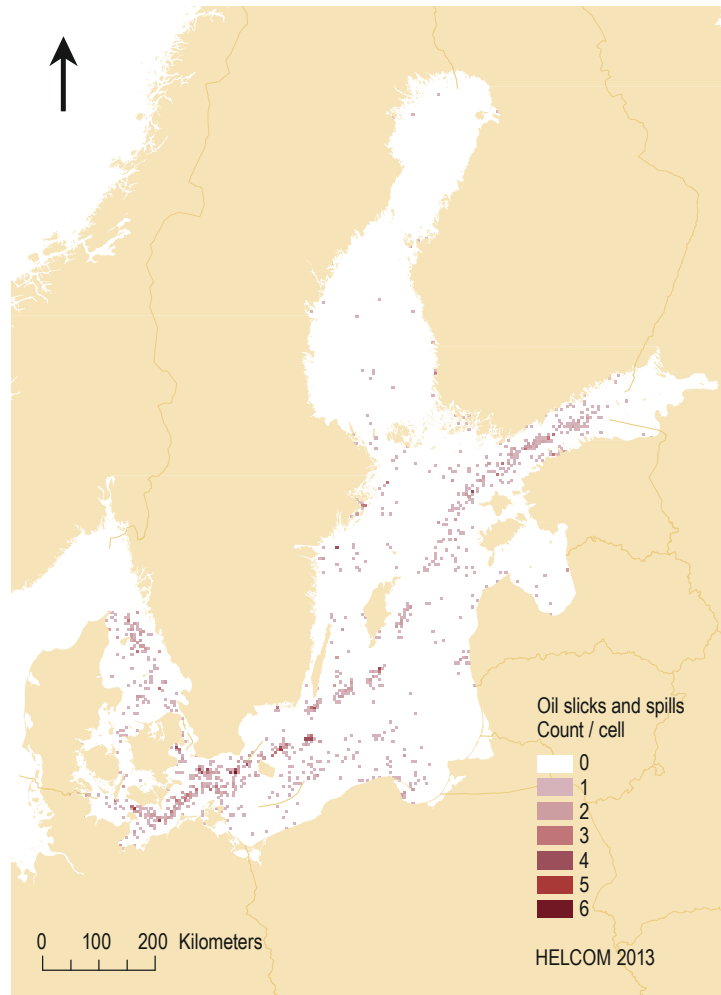
these species, such as common guillemots, can also be affected (Hartwig et al. 1985, Montevecchi 1991, Votier et al. 2010). Furthermore, plastic particles in the water are ingested by several species or fed to the chicks (Heckroth & Hartwig 2005). Especially northern fulmars are known to be seriously threatened by ingested plastic particles. A study of several hundred fulmars found dead along the North Sea coast revealed plastics in the stomachs of 95% of the investigated birds (Guse et al. 2005).

### Oil spills (O)

Surveillance data clearly show that the efforts to reduce oil contamination in the Baltic Sea have been effective and the numbers of oil spills is largely declining. Nevertheless, chronic oiling is still one of the most important mortality factors for seabirds in the Baltic Sea, especially sea ducks, auks and divers. These species spend high amounts of time swimming on the water and often occur in large aggregations. Sea ducks, in particular, often form huge flocks and concentrate in specific areas and are thus among the species most seriously affected by oiling. Figure 7.14 shows oil slicks and spills during the years 2003–2007.

Weekly winter surveys of oiled birds in southern Gotland between 1996/97 and 2006/07 have shown that in the central Baltic Sea, several tens of thousands of long-tailed ducks are killed by oil each year (Larsson & Tydén 2005, Larsson 2007). Furthermore, analyses of 998 long-tailed ducks that had drowned in fishing nets at Hoburgs Bank showed that about 12% of the birds had oil in the plumage (Larsson & Tydén 2005). A study from the Lithuanian coast by Žydelis et al. (2006) on beached birds during the period 1992/93 till 2002/03 also revealed high oiling rates. However, a clear relationship between the volume of the long-tailed duck passage in the Gulf of Finland during 1988–2007 and the numbers of registered oil spills in the Baltic, or any parallel long-term trends, could not be found (Hario et al. 2009).

Oil pollution is considered to be the main threat to the velvet scoter (EU Commission 2009c). The habit of congregating during moult and on wintering sites makes the species extremely vulnerable to oil spills. An estimated 7 200 velvet scoter were killed in an oil spill incident in March 1972 in the Danish



**Figure 7.14.** Oil spills during the years 2003–2007.

Kattegat, which contaminated another 23 000 diving ducks (Joensen & Hansen 1977). Oil transportation is increasing off the Curonian Spit, the main Lithuanian wintering site for velvet scoters, where up to 20 000–50 000 birds - even more than 100 000 during cold spells - gather (Vaitkus 2001).

In addition to the direct mortality caused by heavy plumage contamination from oil spills, it has also been found that bird fatalities occur from haemolytic anaemia caused by oil ingestion from preening or from oil-polluted food or water (Yamoto et al. 1996). In November–December 2007, some 150 sea ducks (mainly velvet scoters) were found dead on the islands Greifswalder Oie and Ruden (Greifswald Lagoon, Mecklenburg-Western Pomerania). Although there was no visible oil contamination of the plumage, laboratory analyses revealed oil ingestion, the apparent reason for their death.



**Predators and invasive species (CPr for native predatory species, A for alien species)**

The presence of predatory mammals may not only have an impact on the reproduction success of ground-breeding birds (such as waders, ducks, gulls and terns), but may also lead directly to the abandonment of breeding places. During the last decades, the presence and densities of predatory mammals have increased in almost all regions of the Baltic due to the following reasons:

- In Germany, rabies has been eliminated during the mid-1990s, with the consequence that the population of red foxes (*Vulpes vulpes*) increased considerably; for some regions, a tenfold increase in fox numbers has been observed (Bellebaum 2003).
- Invasive species, such as the feral American mink (*Neovison vison*) and the raccoon dog (*Nyctereutes procyonoides*), have spread all over the Baltic Sea area. Especially the feral mink seems to cause severe problems for ground-breeding coastal birds (Andersson 1992, Nordström et al. 2003),

The increase of predatory mammals together the invasion of introduced species is currently considered to be one of the most severe problems for coastal bird conservation (Langgemach & Bellebaum 2005, Kube et al. 2005, Herrmann 2010).

In western Poland, grassland waders (lapwing, common snipe *Gallinago gallinago*, black-tailed godwit *Limosa limosa*, curlew *Numenius arquata* and redshank *Tringa totanus*) have declined dramatically during recent years. Low breeding success caused by enhanced predation (particularly the red fox and corvids) is seen as the main reason for this trend (Ławicki et al. 2011).

The presence of feral American minks has caused substantial decreases of breeding bird numbers in those areas where it reaches high densities (e.g. Stockholm archipelago). In a nine-year experimental study, Nordström et al. (2002) removed all minks from two large archipelago areas in south-west Finland, which led to a marked increase in the breeding numbers of smaller waterfowl, gulls and terns, whereas there was no effect on numbers of larger species, such as the mute swan (*Cygnus olor*), the greylag goose (*Anser anser*), the goosander and the common eider. In another study, mink predation was found to be the most

important mortality factor in black guillemots breeding in the Gulf of Finland (Hario 2002).

Other invasive species that cause negative impacts on birds are certain phytoplankton species that are brought into the Baltic via the ballast water of tankers. Among these are toxin-producing dinoflagellates. The toxins accumulate in molluscs and fish, and may end up in seabirds. The periodic blooms of these dinoflagellates are known as 'red tides'. Paralytic Shellfish Poisoning (PSP) via neurotoxins has been implicated as the major cause for large-scale mortalities of breeding common guillemots and razorbills in the Gulf of Finland in four major incidents (in 1992, 2000, 2006 and 2010, Hario et al. 1993).

In the Eurasian tundra zone, predators like the snowy owl, the arctic fox and skuas have always affected ground-breeding bird species. Thus the breeding success of many species correlate with the abundance of lemmings, leading to a high reproductive output every 3–4 years when predators concentrate on peak lemming numbers as prey. However, possibly due to the increase in global temperature, regular lemming cycles have nearly disappeared in the Eurasian tundra over the last 15 years, intensifying predation on breeding birds (Bellebaum et al. 2012). For long-tailed ducks and Steller's eiders, whose reproductive output correlate with lemming numbers, a strong decrease of breeding success has already been reported, leading to low recruitment and eventually population decline (Hario et al 2009).

**Hunting (H)**

The harvesting of migratory waterbirds continues on a large scale in many European countries despite increasing calls in several countries and at the EU level to ensure that the take is 'sustainable'. However, there is neither consensus in Europe concerning an operational definition of 'sustainable harvesting' nor consensus concerning the criteria that should be applied in determining sustainability (Bregnballe et al. 2006). In addition to the direct effect of hunting it also causes mortality through the poisonous lead shot that are used to hunt waterbirds and can be ingested accidentally by birds feeding on benthic prey or by those that eat grit to aid digestion. In the Gulf of Finland, high exposure to lead among nesting females of common eiders

have been documented and could be a reason for the population declines observed in these areas (e.g. Franson et al. 2002). Hunting also disturbs birds, leading to habitat restrictions and reduced time for feeding and resting (Garthe et al. 2003).

According to the EU Birds Directive, hunting may be allowed in the Member States if a species is listed in Annex II. This annex is divided into two sections: species included in section A can be hunted in all EU countries and species of Annex B only in those countries for which they are listed.

Of the bird species included in this Red List assessment, 11 are listed in Annex II A of the Birds Directive (bean goose, greylag goose, Eurasian wigeon, gadwall, common teal, mallard, northern pintail, northern shoveler, common pochard, tufted duck, common coot), and 20 in Annex II B (mute swan, greater white-fronted goose, brent goose, greater scaup, common eider, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser, goosander, lapwing, ruff, black-tailed godwit, common black-headed gull, common gull, herring gull, Caspian gull, greater black-backed gull, lesser black-backed gull).

Bag statistics are available for some species and may illustrate the scale of the problem:

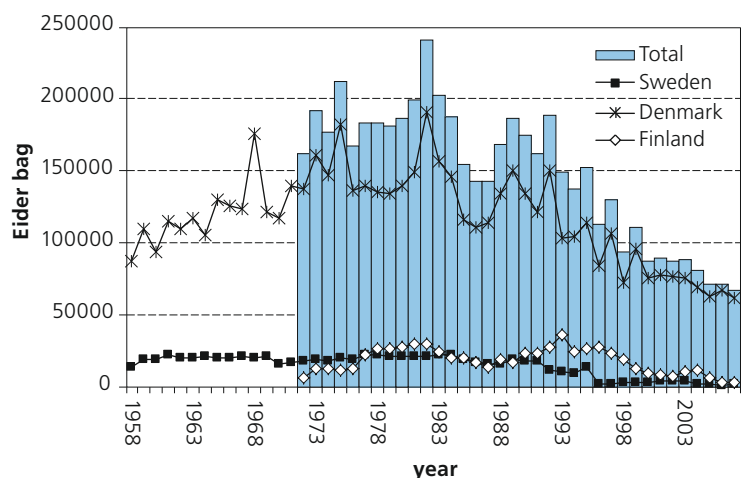
The greater scaup has a population of >120 000 wintering birds and an estimated annual bag of around 2 000 in the EU, or about 2 500 including crippling (Mooij 2005). In Denmark, which used to have one of the largest documented takes, the annual bag has declined significantly. In the late 1960s, the average bag was some 7 000 (with considerable annual variation), while in the second half of the 1990s it was down to less than 1 000 (Bregnballe et al. 2003). In the 2002/2003 hunting season, the take was estimated at less than 300 birds (Clausager 2004). This hunting bag does not constitute a significant threat to the north-western European winter population of the greater scaup. However, for a strongly declining species, mortality from hunting is likely to be a significant additive factor (EU Commission 2009c). This applies especially to the small Baltic breeding population of the greater scaup.

The eider bag in the Baltic Sea area increased during the 1960s and 1970s and reached a maximum of 200 000–250 000 birds during the

mid-1970s and 1980s. Since the beginning of the 1990s, a strong decline is observed to currently 70 000–80 000 birds being shot annually (Figure 7.15). The strong hunting pressure in the 1980s did not prevent the population from growing, though it possibly contributed to the subsequent decline of population growth rates.

Until 2006, spring hunting of male velvet scoters was traditional on the Åland Islands, an autonomous region of Finland with its own hunting legislation. Annual quotas were defined by the Åland Government's hunting administration. In May 2000, the quota was set at 6 700 males, but only 4 275 males were taken (EU Commission 2007a). In 2004, the quota was reduced to 3 000 males and a bag of 1 830 males was taken (Hario, unpubl.). The spring hunting in Åland might have had an impact on the local or even the Baltic breeding population - considering the location and timing of the spring shoot in Åland it is likely that most, if not all, males taken are part of the Baltic breeding population (EU Commission 2007a). In 2006, following EU legislation, the spring shoot on velvet scoter was ceased. In 2011, however, the Åland Islands resumed the spring shoot of common eider males.

There have been recent declines in the annual bags of velvet scoters in Denmark and Sweden. In Denmark, the bag was 10 000 during the mid-1960s and falling to 1 600–1 800 in 2001–2003 (Madsen et al. 1996, Clausager 2004). In Sweden,



**Figure 7.15.** The development of the eider bag in Denmark, Finland and Sweden. The Finnish data do not include the Åland Islands. Data were provided by the Danish National Environmental Research Institute, Finnish Game and Fisheries Research Institute, and the Swedish Association for Hunting and Wildlife Management.





the annual bag reported by Tucker (1996) was 1 500–2 000. It then declined to less than 100 birds (EU Commission 2007a) and was eventually stopped in 2009. With a population of 500 000–1 000 000 birds, an estimated annual bag of 5 000 birds in the EU does not constitute a significant threat to the north-western European/west Siberian population (EU Commission 2007a).

The annual hunting bag of the lapwing in the EU Member States is 480 000, although recent unpublished data give lower figures (EU Commission 2009b). To produce an estimate of the total hunting mortality affecting European lapwings, an unknown number of lapwings harvested in Russia and other East European countries, and probably also a small number of birds shot in northern Africa, must be added to this figure. Most of the hunting occurs in France, Italy, Greece, and probably Spain. However, because of the lapwing's extensive migration movements and populations mixing up at moulting and wintering sites, hunting in these countries is likely to involve birds originating from the whole range of the species (Trolliet 2000).

Within the EU territory, the black-tailed godwit is hunted only in France. The bagged birds are likely predominantly belonging to the western European populations, including the Baltic breeding birds. An annual take of 6 000–8 000 birds of the 215 000 black-tailed godwits migrating or resting in western Europe equals 2.8–3.7%. To this the 'cripple loss' should be added, which has been estimated at 25% of the bag size (Mooij 2005). For a slow reproducing species, such as the black-tailed godwit, this is a relatively small but still significant additional mortality. It specifically affects the western European population, which is already weakened by other factors such as poor reproduction due to deteriorating breeding habitats (EU Commission 2007b).

Within the EU, the redshank is currently hunted only in France with an estimated bag of 5 000–8 000. The impact of hunting on this species is considered to be low. However, there remains an urgent need to quantify the extent of the current hunting bag in France, the effects of crippling, and the numbers and distribution of the birds involved in this hunt (EU Commission 2009a).

A recent Danish study (Bregnballe et al. 2006) assessed the sustainability of the hunting bag of waterfowl in Denmark, where the hunting of migratory waterbirds has a strong tradition with some 700 000 birds killed annually. For most of the 29 species with an open hunting season, the take was assessed as 'sustainable' or 'probably sustainable', but in a few cases as 'uncertain' (the common eider) or even 'not sustainable' (Baltic population of the nominate subspecies of the lesser black-backed gull *Larus f. fuscus*). The authors emphasise the difficulty to give a reliable assessment for the whole flyway since bag statistics are not available for all countries. Furthermore, while vulnerability to hunting may differ between sub-populations of a species, bag statistics do not allow the assessments of the impacts at the sub-population level.

#### **Offshore constructions, especially wind farms (Co)**

In the Baltic Sea area, offshore wind farms have already been built in Denmark, Sweden and Germany. More projects are under development in these three countries as well as in Finnish waters in the Bothnian Bay. Over the entire Baltic Sea region, there are plans for 29 new offshore wind farms to be completed by 2020, and another 25 between 2020–2030. Offshore wind farms and associated ship movements are likely to scare away birds, and many seabird species are known to avoid wind farm areas. These constructions may thus result in habitat fragmentation and habitat losses (e.g. Fox et al. 2006). The displacement from favourable feeding habitats, however, may have marked effects on seabird fecundity, especially in the Bothnian Bay, an important reproduction area. The installations may also act as a barrier during migration movements, forcing birds to deviate to avoid collision and thus leading to higher energy consumption and reduced physical condition. Further, wind rotors pose a mortality risk to birds. Of the species assessed in the Red List, the white-tailed eagle is known to be vulnerable to wind farm mortality since this species obviously does not avoid wind rotors. According to the investigations of the Leibniz Institute Berlin (Herrmann et al. 2011), wind power collisions are responsible for about 4% of the mortality of the species in Germany. For various seabird species, Garthe & Hüppop (2006) provide a wind farm sensitivity index that scales possible adverse effects of marine wind farms on seabirds.

It is based on the different factors regarding flight and general behaviour and on the conservation status of the different species - all taking into account the risks of seabirds colliding with wind turbines and/or being disturbed by wind farms. Of the species assessed in the Red List, the two diver species, followed by the velvet scoter, the sandwich tern, the great cormorant and the common eider are most sensitive towards marine wind farms, while most gull species and northern fulmars ranged lowest in the sensitivity index (Garthe & Hüppop 2006). Both possible impacts of wind farms – habitat loss and collision risk – depend much on the specific site and can be reduced by appropriate site selection. The same precaution applies to other man-made constructions, such as energy cables and pipelines that may cut off the shoreline from preferred feeding habitats of many archipelago bird species.

#### **Epidemics / Diseases (Ep)**

The outbreak of epidemic diseases is a factor that may have an impact on animal populations. In the Baltic Sea, outbreaks of Avian Cholera (caused by the bacteria *Pasteurella multocida*) in 1996, 1998 and 2001 affected local eider populations in Sweden and Denmark. A minor epizootic was also evident in 1998 in the largest common guillemot colony in Sweden (Österblom et al. 2004).

Avian Cholera has been rare in the Baltic Sea region and epizootics similar in magnitude to those of North America have not been recorded to date. Instead, prevailing die-offs of coastal birds in Sweden, especially those of herring gulls and eiders, have been linked to thiamine (vitamin B1) deficiency, leading to an idiopathic paralytic disease, which may contribute to adult mortality and breeding failures (Balk et al. 2009). This disease, which is different from what has been described in Paralytic Shellfish Poisoning incidents in Baltic marine birds, has been postulated as the possible cause for bird population declines over larger areas in northern Europe. However, the pathogen ultimately affecting the paralytic disease is not known. Balk et al. (2009) were criticised for not providing enough evidence that idiopathic neurologic syndrome is de facto caused by thiamine deficiency (Rocke & Barker 2010). This topic is currently subject to further investigation.

Intestinal acanthocephalan parasite infestation is high among eiders and may have an impact in association with other predisposing factors, such as impaired feeding ability or virus infections (Desholm et al. 2002).

#### **Disturbance by ships traffic (T)**

Several bird species, especially sea ducks and divers, have large disturbance distances with regard to vessels and usually take flight when a ship is approaching (e.g. Bellebaum et al. 2006, Schwemmer et al. 2011). This pronounced sensitivity to shipping movements may constrain the natural behaviour of the birds and may cause them to avoid busy shipping lanes, thus leading to habitat loss, as has been observed in the North Sea and Baltic Sea (Hüppop et al. 1994, Kube & Skov 1996). Even in less frequently sailed areas, ship traffic may cause fragmentation and loss of suitable feeding and resting habitats, or result in the temporary or permanent loss of suitable habitats. Moreover, frequent escape flights lead to higher energy consumption and at the same time reduce the time available for feeding or resting (Mendel et al. 2008). Red-throated divers in the North Sea were found to have flight distances up to 2 km in front of the observation vessel, with a median value of 400 m (Bellebaum et al. 2006). A study in the southern Baltic Sea revealed that the duration of a temporary habitat loss due to approaching ships is longest for common scoters among sea ducks and no clear habituation to channelled ship traffic was found (Schwemmer et al. 2011). In the Irish Sea, common scoters occurred in the lowest numbers or were absent from areas in which shipping activity was relatively intense, even when these areas held a high prey biomass (Kaiser et al. 2006). Studies in the Wadden Sea revealed that common eiders are seriously disturbed by recreational boat traffic, causing birds to abandon suitable feeding sites and shift to other undisturbed areas (Ketzenberg 1993). Particularly during the energy-consuming phase of moult, duck species like common eiders or common scoters are highly vulnerable to disturbances caused by ship traffic or tourism, and are dependent on undisturbed sea areas with sufficient food resources (Nehls 1991, Hennig 2001).



## 7.5 Red List of marine mammals



See Annex 1 for authors and contributors for the Red List of marine mammals.

### 7.5.1 Introduction to Baltic marine mammals

All mammal species breeding in the HELCOM area with a distinct relationship to the marine or coastal environment of the Baltic Sea were taken into account in the HELCOM Red List assessment (Figure 7.16). Marine mammals do not represent a distinct biological group but are united by their reliance on the sea for feeding. Whales and dolphins are completely dependent on the marine environment, while seals breed on land or on ice. All seal species and the only whale in the Baltic region, the harbour porpoise, and the Eurasian otter are considered in the Red List. The Eurasian otter is generally not regarded as a marine mammal, but since coastal otters are considered having a distinct relationship to the coastal environment of the

Baltic Sea, they were also included in the HELCOM Red List assessment of marine mammals.

### 7.5.2 Level of knowledge

In general, marine mammals are among the better known species groups within the HELCOM Red List assessment when compared to macrophytes or benthic invertebrates, for example. The ecology of the mammal species is usually well-understood and there is also information on the status of the Baltic populations and their development. However, the situation varies between the different species - the data situation is best for the three seal species that have coordinated yearly monitoring programmes in place. For harbour porpoises and otters, the data situation is not as good as for the seals (no coordinated yearly monitoring scheme) but surveys have been carried out frequently. Surveys of the Baltic harbour porpoise populations are also hampered by the small size of the populations that makes conventional techniques less effective. The LIFE+ funded SAMBAH project (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise)



**Figure 7.16.** The marine mammals of the Baltic Sea: Baltic ringed seal *Phoca hispida botnica*, grey seal *Halichoerus grypus*, Eurasian otter *Lutra lutra*, harbour porpoise *Phocoena phocoena* and harbour seal *Phoca vitulina vitulina*.





**The grey seal was considered as Least Concern (LC) in the HELCOM area. Hundreds of grey seals resting on a skerry (Gotska Sandön, Sweden).**

(www.sambah.org) will hopefully increase the knowledge about the Baltic Sea harbour porpoise, estimating densities and total abundance. SAMBAH will survey the Baltic Sea harbour porpoise by using Static Acoustic Monitoring (SAM) devices called C-PODs, which detect and log porpoise sonar click activities inside a radius of about 100 m.

The background data for the Red List assessment have been obtained from published documents and national reports, and directly from national experts. Most of the material used in the assessments has been compiled by researchers working within the HELCOM SEAL expert group, except for the otter assessment, which was prepared by Johanna Arrendal (Sweden).

### 7.5.3 Assessment process

Similarly to other species groups, the Red List assessment of mammals was based on the IUCN methods, categories and criteria (IUCN 2001; 2008). For the category Near Threatened, the modifications proposed by Gärdenfors (2008) have been applied.

The principles of the assessments - the criteria for the selection of species to be assessed and the reference area for the assessment, for example - were discussed and agreed on at a meeting of the *ad hoc* HELCOM SEAL group, and the responsibility for the assessments of mammals were divided among experts: harbour porpoise / Anders Galatius (Denmark), ringed seal and harbour seal / Tero Härkönen (Sweden), and grey seal / Olle Karlsson (Sweden), who also chaired the team of experts preparing the assessments. The assessment of the otter was prepared by Johanna Arrendal (Sweden). The draft assessments were circulated to the HELCOM SEAL group and their comments were integrated into the assessments by Olle Karlsson and by Project Manager Tytti Kontula.

#### Reference area for the assessment

The reference area for the assessment was the sea and coastal areas of the Baltic Sea riparian states. However, for Denmark and Germany / Schleswig-Holstein, the coastal zone of the North Sea has been excluded. In the case of Germany, only the Baltic Federal states Schleswig-Holstein and



Mecklenburg-Western Pomerania have been considered, and for Russia only the St Petersburg and Kaliningrad regions. The border towards the North Sea is given by the border of the Helsinki Convention area, i.e. between the Kattegat and Skagerrak.

#### Generation length

Generation length is the average age of parents of the current cohort (i.e. newborn individuals in the population), and therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, the more natural, i.e. pre-disturbance, generation length should be used (IUCN 2001). Generation time within this group varies between 3 and 15 years.

#### 7.5.4 Threat status

The results for the Baltic Sea marine mammals are given in Table 7.7. Both subpopulations of harbour porpoise were regarded threatened – the Baltic Sea population even as Critically Endangered (CR) due to the dramatic declines and current low numbers. Among seals, the ringed seal and the Kalmarsund population of the harbour seal were categorised

as Vulnerable (VU), whereas the grey seal and the southern Baltic population of the harbour seal were considered Least Concern (LC). The Eurasian otter was assessed Near Threatened (NT).

#### 7.5.5 Main threats

Incidental bycatch in fishing gear is the most serious threat to harbour porpoises and is also an important factor for the other marine mammals. ICES has estimated the bycatch of harbour porpoises, for example in the Danish Straits and Kattegat, where the number of by-caught and drowned individuals is estimated to 242–423 each year (ICES 2011). The numbers of by-caught seals are also considerable. In Sweden alone, 462 grey seals, 461 harbour seals and 50 ringed seals were estimated to have been by-caught in the coastal fisheries in 2001 (Lunneryd et al. 2005).

Environmental pollution has had severe impact on the health and abundance of seals. In the mid-1970s, only 15% of investigated ringed seal females showed normal fertility and, even though the situation has improved clearly since then, it is plausible that the current pregnancy rate has not yet reached its pristine levels. The grey seal is not regarded threatened in the current assessment, but it too has had to suffer from contaminants

**Table 7.7. Red-listed marine mammal species or subpopulations in the HELCOM area. The table gives scientific and English names, past and current threats (codes explained in Chapter 2.7.6), future threats, inclusion in the previous HELCOM list of threatened and/or declining species (HELCOM 2007b), IUCN criteria and the Red List category for each species.**

Species and taxonomic group		Past and current threats	Future threats	HELCOM list 2007b	Red List criteria	Red List category
<b>Cetartiodactyla</b>						
Porpoises ( <i>Phocoenidae</i> )						
Harbour porpoise Western Baltic subpopulation	<i>Phocoena phocoena</i>	Bc, Cp	Bc, Cp	x*	A2a	VU
Harbour porpoise Baltic Sea subpopulation	<i>Phocoena phocoena</i>	Bc, Cp	Bc, Cp	x*	C1+2a(ii)	CR
<b>Carnivora</b>						
True seals ( <i>Phocidae</i> )						
Harbour seal Kalmarsund population	<i>Phoca vitulina</i>	H, Bc, Cp, Ep, OT	Bc, Cp, OT	x*	D1	VU
Baltic ringed seal	<i>Phoca hispida botnica</i>	Bc, Cp, Cc	Cc, Bc, Cp, T	x	A3c	VU
Mustelidae						
Eurasian otter	<i>Lutra lutra</i>	Cp, Co, H, E, Bc, T, OT, O	Cp, Co, E, Bc, T, OT, H, O		D1	NT

\*regarded threatened and/or declining on the species level





**Incidental bycatch in fishing gear is one of the most serious threats to marine mammals. Seal-safe traps are increasingly being used to reduce bycatch.**

- some decades ago their abundance was severely reduced by organochlorine contamination causing reproductive failures. As for the harbour seal, the slow population growth in the 1970s was assumed to be related to impaired reproductivity caused by organochlorines (Härkönen et al. 2005). Persistent organic pollutants and heavy metals are expected to lead to reduced fertility, reduced immune response and illness also in harbour porpoise populations of the Baltic Sea (CORESET indicators Population growth, abundance and distribution of marine mammals and Pregnancy rates of the marine mammals, available at [www.helcom.fi](http://www.helcom.fi)).

Previously, harbour porpoises, seals and also otter have been hunted in the Baltic region (Lockyer & Kinze 2003; HELCOM 2009). For example in the ringed seal population, hunting caused a major decline from 180 000–200 000 to about 25 000 individuals in the 1940s. Of the marine mammals considered in the assessment, hunting is currently allowed only for grey seal. However, in Finland for example, special permits may still be granted also for shooting problematic individuals of ringed seal and otter.

Other reasons behind the population declines of marine mammals in the HELCOM area relate to

disturbance in nursing, the moulting and feeding areas of seals, prey depletion caused by fishing (e.g. MacLeod et al. 2007), noise pollution from military sources (Koschinski & Kock 2009), water traffic, construction, and fatal virus infections that have caused already two dramatic population crashes in the harbour seal populations in 1988 and 2002 (reviewed in Olsen et al. 2010). For small populations such as the harbour seals in the Kalmarsund and the harbour porpoise in the Baltic proper, the loss of genetic diversity through long-term isolation is also a major problem. Human activities such as construction as well as boat and road traffic in coastal areas pose a threat to otters as well as other species, both due to direct interaction and the loss of habitats.

Most of the same threat factors that have affected the marine mammals in the past are expected to continue in the future. Climate change, however, will pose additional threats in the future, especially for the ringed seal which is adapted to ice breeding (HELCOM 2009). This concerns the southern distribution range, in particular, where mild winters might have already significantly affected the reproductive success of these populations (ICES WGMME Report 2005).



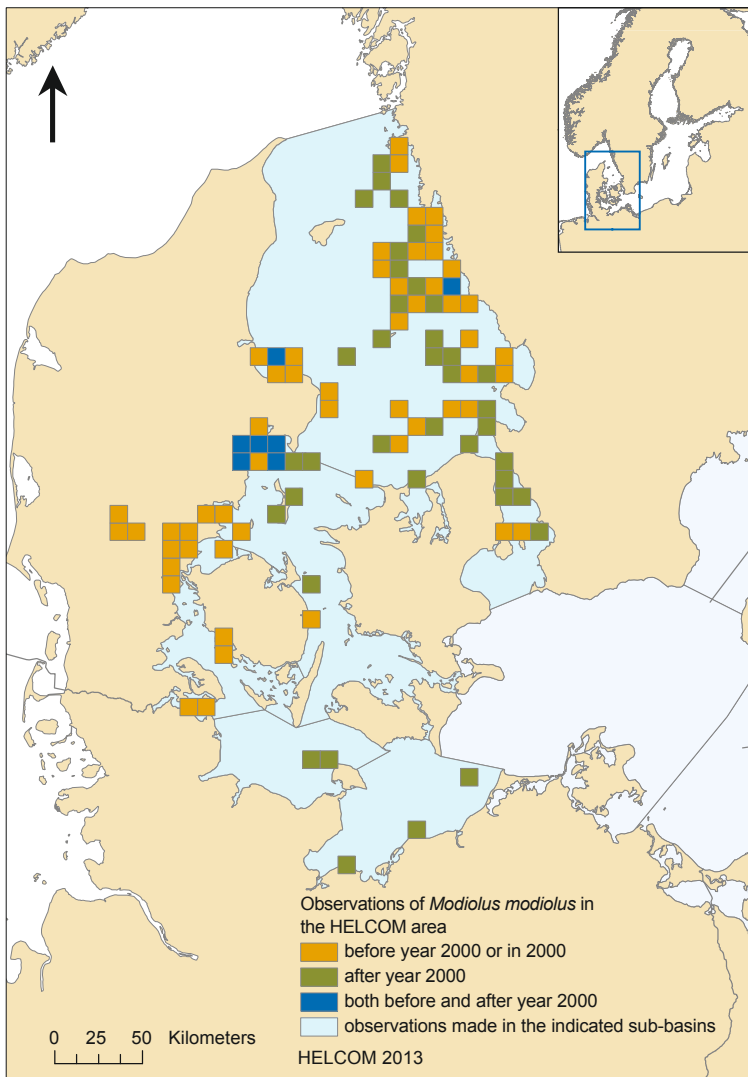
# 8 Species Information Sheets

Species Information Sheets (SIS) have been prepared for all species that were regarded Regionally Extinct, threatened (Vulnerable VU, Endangered EN or Critically Endangered CR), Near Threatened (NT) or Data Deficient (DD) in the current assessment, and also for species that are not currently red-listed but were included in the previous HELCOM list of threatened and/or declining species and biotopes/

habitats (HELCOM 2007b) or the HELCOM Red list of threatened and declining species of lampreys and fishes of the Baltic Sea (HELCOM 2007a). The SISs are available on the Red List website under the HELCOM website and they contain information on:

- the distribution and status of the species in the Baltic Sea region, including a distribution map,
- the habitat and ecology of the species,
- major threats that have affected the species population in the past or will affect it in the future,
- the assessment justification that gives the reasoning behind each Red List category assignment,
- recommendations from the Species Expert Teams for actions to conserve the species,
- common names of the species in HELCOM languages, and
- references.

All SISs follow the same structure in different species groups, except for birds which include additional information on the range and population trends also on the larger European scale. Some differences also exist in distribution maps. For macrophytes and benthic invertebrates, they are based on real observational data on a 10 km x 10 km grid map (Figure 8.1). The maps for fish and lamprey species and for marine mammals are subbasin-based and they indicate areas of reproduction and regular occurrence. The maps for birds also show reproduction and wintering areas.



**Figure 8.1.** An example of the distribution maps prepared for the Species Information Sheets. Observations of the northern horse mussel, *Modiolus modiolus* on a 10 x 10 km grid.

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### Acknowledgements

Data, comments, or other contribution has been kindly provided by the following persons who are greatly acknowledged: Stefan Agrenius (Sweden), Markus Ahola (Finland), Lena Avellan (Secretariat), Matz Berggren (Sweden), Ulrich Breitenbach (Germany), Uwe Böttcher (Germany), Daniel Carstensen (Germany), Karsten Dahl (Denmark), Johan Dannewitz (Sweden), Erik Degerman

(Sweden), Willem Dekker (Sweden), Anna Doronina (Russia), Magnus Eckeskog (Denmark), Jan Ekebon (Finland), Elena Ezhova (Russia), Ronald Fricke (Germany), Jane Groos (Denmark), Peter Göransson (Sweden), Hanna Hahn (Germany), Michael Haldin (Finland), Vladimir Ivanov (Russia), Alf Josefsson (Denmark), Tuomas Kahma (Secretariat), Joni Kaitaranta (Secretariat), Sami Karjalainen (Finland), Marja Koistinen (Finland), Alicja Konopacka (Poland), Jonne Kotta (Estonia), Dorte Krause-Jensen (Denmark), Marie-Louise Krawack (Denmark), Petra Kääriä (HELCOM Secretariat), Steffen Lundsteen (Denmark), Ilpo Mannerkoski (Finland), Jan-Eric Natansson (Sweden), Ruth Nielsen (Denmark), Henning von Nordheim (Germany), Madeleine Nyman (Finland), Matthias Obst (Sweden), Jens Olsson (Sweden), Daniel Oesterwind (Germany), Nina Peuhkuri (Finland), Janne Pitkänen (Finland), Iwona Psuty (Poland), Christina Rappe (Sweden), Anna Razumovskaya (Russia), Juha Salokannel (Finland), Justyna Szumlicz (Poland), Jan Terstad (Sweden), Anna Ulanova (Russia), Susanne Viker (Sweden), Risto Väinölä (Finland), Håkan Wickström (Sweden), and Henrike Wilken (Germany). We are also grateful to Caroline Pollock at the International Union for Conservation of Nature (IUCN, Red List Unit Global Species Programme) for helpful comments and the International Council for the Exploration of the Sea (ICES) for the review of the draft assessment of cod, as well as Mark Dickey-Collas, ICES, for further remarks on the assessment of cod. The ICES/HELCOM WKFLABA 2012 provided extensive feedback on the flatfish assessment and HELCOM FISH/ ENV Forum meetings on the eel assessment.







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