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European Red List of Habitats Part 1. Marine habitats

Gubbay, S

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European Red List of Habitats

Part 1. Marine habitats

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Cover: Seagrass beds on Atlantic infralittoral sand (Macaronesian). © F. Espino, EcoAqua. Insets: Communities of marmara circalitorral muddy detritic bottoms. © Marzia Bo, UNIGE - Simonepietro Canese, ISPRA. Annual algal communities on Baltic infralittoral rock and mixed substrata. © J. Nyström, FINMARINET. Circalittoral biogenic habitats in the Mediterranean. © K. Milonakis

European Red List of Habitats

Part 1. Marine habitats

Authors

S. Gubbay, N. Sanders, T. Haynes, J.A.M. Janssen, J.R. Rodwell, A. Nieto, M. García Criado, S. Beal, J. Borg, M. Kennedy, D. Micu, M. Otero, G. Saunders and M. Calix

With contributions from

L. Airoldi, V.V. Alexandrov, E. Alcázar, J. de Andalucia, L. Babbini, T. Bakran-Petricioli, E. Ballesteros, E. Bañares España, M. Bariche, E. Bastos, D. Basso, L. Bat, C. Battelli, H. Bazairi, C.N. Bianchi, G. Bitar, M. Bo, P. Brazier, L. Bush, S. Canese, S.P. Catrense, M. E. Cefalì, C. Cerrano, R. Chemello, E. B. Chernysheva, D. Connor, R. Cook, N. Dankers, A. Darr, A.R. Davis, N. Dolenc-Orbanić, S. Dubois, F. Espino, A. Flores Moya, J. Ford, M. Foulquie, S. Fowler, M. Fourt, S. Fraschetti, I. Fuller, K. Fürhaupter, B. Galil, V. Gerovasileiou, A. Giangrande, C. Giuseppe, P. Goriup, J. Grall, M.F. Gravina, A. Guelmami, A. Güreşen, L. Hadjioannou, J. M. Haldin, J. Hall-Spencer, J.G. Harmelin, R. Haroun-Tabrae, D. Harries, K. Herkül, T. Hetman, K. Hiscock, S. Hiscock, R. Holt, Y. Issaris, E. Jackson, A. Jeudy, C. Jimenez, C. Karamita, A. Karlsson, D. Kersting, E. Keskinen, F. Klinge, L. Klissurov, L. Knittweis-Mifsud, V. Kopiy, D. Korolesova, P. Kružić, G. Komakhidze, B. La Porta, J. Leinikki, P. Lehtonen, C. Linares, L. Lipej, V. Mačić, L. Mangialajo, S. Mariani, C. Melih, R. Metalpa, E. Mielke, V. Mihneva, N. Milchakova, K. Milonakis, C. Minguell, N.V. Mironova, J. Näslund, C. Numa, J. Nyström, O. Ocaña, N.F. Otero, V. Peña Freire, C. Pergent, S. Perkol-Finkel, A. Pibot, S. Pinedo, D. Poursanidis, A. Ramos, N.K. Revkov, J-T. Roininen, A. Rosso, J. Ruiz, M. Salomidi, P. Schembri, T. Shiganov, N. Simboura, M. Sini, C. Smith, A. Soldo, P. Somerfield, J. Templado, A. Terentyev, T. Thibaut, N. E. Topçu, C. Trigg, R. Turk, H. Tyler-Walters, L. Tunesi, K. Vera, M. Viera , J. Warzocha, S. Wells, M. Westerbom, S. Wikström, C. Wood, B. Yokes and H. Zibrowius.

ALTERRA WAGENINGEN UR · IUCN · naturebureau · Susan Gubbay · John Rodwell Ecologist

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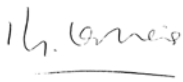
Foreword

Europe is a continent rich in natural and cultural heritage with a diverse range of terrestrial and marine habitats: from maquis in the south to extensive mires in the north and from sea grass meadows in shallow areas to cold water coral reefs in the ocean depths. Over the centuries, European landscapes and seascapes have been changed by human activities so that now the continent is covered with a mosaic of natural and semi-natural habitats surrounding urban and other intensively used land. Similarly, seabed habitats are extensively altered.

While the Habitats Directive focuses on the protection of approximately 230 threatened and characteristic European terrestrial, marine and freshwater habitat-types, in DG Environment we wanted to bring together in a systematic manner available knowledge about the status of all European habitats. This first ever European Red List of Habitats is the result of an extensive and thorough assessment carried out by Alterra and IUCN with the support of a wide range of experts across Europe. In keeping with the Red List tradition, the report provides a comprehensive and systematic overview of the degree of endangerment of habitats assessed, and summarises data on 490 natural and semi-natural habitat types occurring within the European territory of the EU. Together with the current publication, the datasets produced as part of this work are made publicly available in various formats. They will help policy makers assess progress towards reaching the 2020 biodiversity objectives and targets and support the implementation of relevant EU legislation, such as the Habitats Directive and the Marine Strategy Framework Directive. They can also be used in a wide range of applications in policy, science and public awareness work.

I am therefore very proud to present to you this state-of-the-art piece of work.



Daniel Calleja Crespo
Director-General of DG Environment

Abstract

The European Red List of Habitats provides an overview of the risk of collapse (degree of endangerment) of marine, terrestrial and freshwater habitats in the European Union (EU28) and adjacent regions (EU28+), based on a consistent set of categories and criteria, and detailed data and expert knowledge from involved countries[1]. A total of 257 benthic marine habitat types were assessed. In total, 19% (EU28) and 18% (EU28+) of the evaluated habitats were assessed as threatened in categories Critically Endangered, Endangered and Vulnerable. An additional 12% were Near Threatened in the EU28 and 11% in the EU28+. These figures are approximately doubled if Data Deficient habitats are excluded. The percentage of threatened habitat types differs across the regional seas. The highest proportion of threatened habitats in the EU28 was found in the Mediterranean Sea (32%), followed by the North-East Atlantic (23%), the Black Sea (13%) and then the Baltic Sea (8%). There was a similar pattern in the EU28+.

The most frequently cited pressures and threats were similar across the four regional seas: pollution (eutrophication), biological resource use other than agriculture or forestry (mainly fishing but also aquaculture), natural system modifications (e.g. dredging and sea defence works), urbanisation and climate change. Even for habitats where the assessment outcome was Data Deficient, the Red List assessment process has resulted in the compilation of a substantial body of useful information to support the conservation of marine habitats.

[1] http://ec.europa.eu/environment/nature/knowledge/redlist_en.htm

Executive Summary

Background

Measuring progress to the EU2020 Biodiversity Strategy, aimed at halting – among others – the loss of ecosystem extent and quality, needs reliable and timely information on the status and trends of biodiversity across Europe. To supplement existing European species Red Lists[2], the European Commission has extended this approach to the status assessment of European terrestrial, freshwater and marine habitats to deliver an effective reporting frame for assessing their current status and future prospects. This will complement conservation status assessments of those habitat types included in the Habitats Directive Annex I and the Marine Strategy Framework Directive (MSFD).

This publication summarises the results of the European Red List for marine habitats. It provides an overview on the character, extent and status of benthic marine habitat types through assessments undertaken between 2013 and 2016. The results are presented at two geographic levels: across the EU28 and EU28+, the latter including parts of Russia and Norway, as well as Montenegro, Bosnia, Albania, Turkey, Ukraine and Georgia.

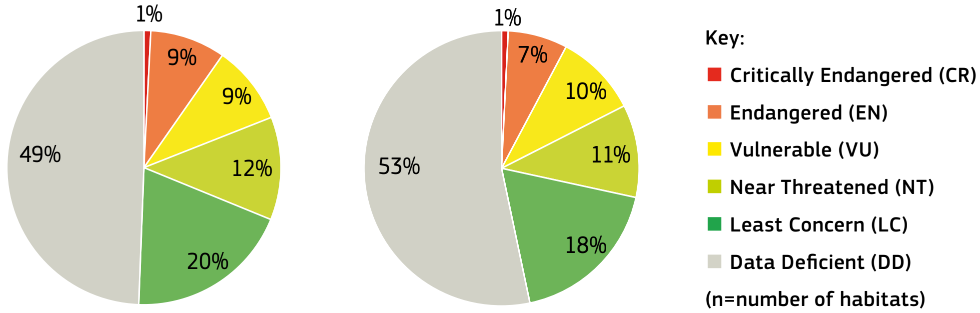
The publication outlines the development of a Red List typology which, following the Feasibility Study (Rodwell *et al.*, 2013), used a modification of the EUNIS habitat classification (Davies *et al.*, 2004; EUNIS, 2007), a scheme integral to policy delivery for the European Commission and already widely used by Member States and NGOs across Europe. The criteria and categories applied in the European Red List of Habitats are based on modifications of proposals for ecosystem risk assessment in the IUCN Red List of Ecosystems Categories and Criteria (Keith *et al.*, 2013; IUCN 2016).

Data on the present area of habitat, trends in quantity and quality (over the past 50 years), long-term and future trends where possible, pressures and threats, conservation measures, data sources and supporting literature used were collected through a network of expert contributors working in four regional sea groups. These background supporting data are available online through the European Environmental Agency (EEA) website.

Overall 19% of the habitats assessed (18% for the EU28+) were in the three threatened categories: Critically Endangered (1%), Endangered 9% (7% for the EU28+) and Vulnerable 9% (10% for the EU28+) (see figure on page 6). An additional 12% (11% in the EU28+) were in the Near Threatened category. A large proportion of the habitats (49% in the EU28 and 53% in the EU28+) were Data Deficient. Whilst there was insufficient quantifiable data on trends to determine the status of the latter habitat types, the Red List project provides extensive additional information on habitat classification and definition, pressures and threats, conservation measures, recoverability, distribution, and trends in quantity and quality, as well as identifying possibly threatened sub-habitats for these Data Deficient habitat types.

The results of the assessment are presented under four broad headings: the Baltic Sea, North-East Atlantic, Mediterranean Sea and Black Sea. The percentage of threatened habitat types differs across the regional seas. The highest proportion of threatened habitats in the EU28 was found in the Mediterranean Sea (32%), followed by the North-East Atlantic (23%), the Black Sea (13%) and the Baltic Sea (8%). There was a similar pattern in the EU28+. A large proportion of marine habitats were Data Deficient in the Black Sea (83%), the North-East Atlantic (60%), and the Mediterranean Sea (49%). The exception was the Baltic Sea (5% Data Deficient), because of previous similar work by the Helsinki Commission. Excluding these Data Deficient habitat types, the highest percentage of threatened marine habitats for the EU28 was in the Black Sea (78%) and for the EU28+, in the Mediterranean Sea (74%). The assessments also reveal some patterns in the status of habitat types depending on key characteristics such as substrate type, and the biological zones where they typically occur e.g. littoral (the intertidal zone), infralittoral (permanently submerged habitat but with sufficient light for growth of algae), and circalittoral (permanently submerged habitat with insufficient light for growth of algae). There are also some commonalities in the status of similar habitats across the four regions, for example infralittoral seagrass beds, estuarine habitat types and infralittoral mussel beds which are all of conservation concern (Near Threatened to Critically Endangered) across the regional seas.

All EU28 habitats (n=247) **All EU28+ habitats (n=257)**



[2] http://ec.europa.eu/environment/nature/knowledge/index_en.htm

Of the criteria used to derive the assessment, two were most frequently decisive: reduction in extent over 50 years (criterion A1), and reduction in quality over the past 50 years (criterion C/D1). Restricted geographical occurrence (criterion B) was decisive in only relatively few cases and quantitative analysis to assess probability of collapse (criterion E) was not used on any occasions.

The most frequently cited pressures are similar across the four regional seas: pollution (eutrophication), biological resource use other than agriculture or forestry (mainly fishing but also aquaculture), natural system modifications (e.g. dredging and sea defence works), urbanisation and climate change, although there are differences in the detail. For example, urban development pressures are commonly cited for the Mediterranean Sea and the Black Sea, infrastructure development and pollution for infralittoral habitats, and fishing being the most frequently cited pressure on circalittoral habitats which tend to be in deeper waters or more distant from the coast.

The publication also reviews the geographic scope of the Red List assessment and variation across Europe in degrees of endangerment to habitats; the adequacy of the typology; the gaps and uncertainties in the data; and the robustness and comprehensiveness of the assessment criteria.

The general values of the Red List for European environmental policy are outlined and the conclusions summarise the achievements and implications of the European Red List of Habitats and highlights some possible next steps.

1.Introduction

1.1 Background

To underpin the EU2020 Biodiversity Strategy adopted in 2011, the European Council has committed itself to a long-term vision and mid-term headline target: "*to halt the loss of biodiversity and the degradation of ecosystems services in the European Union by 2020, restore them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss*".

It is impossible to measure progress to this target without reliable and timely information on the status and trends of biodiversity across Europe. In order to improve available knowledge, Red Lists have been compiled by IUCN, HELCOM and many national teams for different groups of species, both at the EU28 level, at a pan-European scale and in different countries. Extending the Red List approach to European habitat types, including terrestrial, freshwater and marine, will complement the listing of habitats requiring conservation measures in the European Union such as those included in the Habitats Directive Annex I and the Marine Strategy Framework Directive (MSFD).

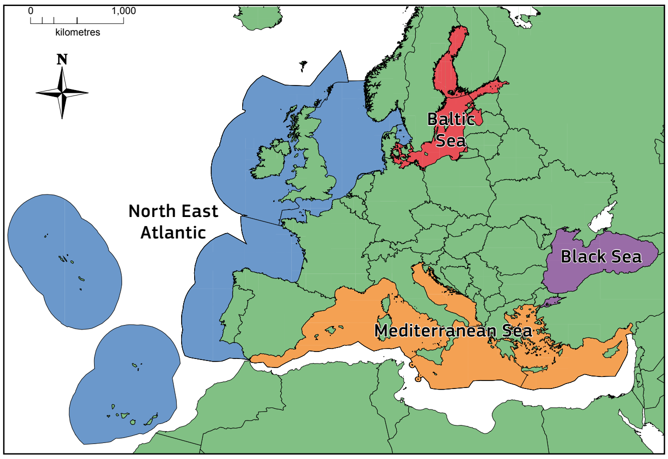


Figure 1.1 Marine assessment areas (shaded) and regional sea groupings for the European Red List of Habitats (note that, within these boundaries, habitats below 200 m depth and pelagic habitats were not assessed).

In combination with European Red Lists of species, knowledge on the status and trends of habitats should deliver synergistic added value. Since habitat degradation and loss often precede species decline, the Red List assessment of habitats provides valuable signals of upcoming problems for threatened species and their protection. In addition, it could help identify possible future threats to habitats and scope the possibilities of their restoration under the EU 2020 Biodiversity Strategy, where there is an associated action of at least 15% restoration of degraded ecosystems under Target 2.

Since habitat types represent an important and widely-used scale for classifying and understanding 'ecosystems', assessments of their status and trends should also contribute to the evaluation of the services which ecosystems can deliver.

1.2 Aims and scope of the assessment

The main aim was to assess the Red List status of benthic marine habitats at two geographic levels: EU28 and EU28+, but limited to the continental shelf (<200 m depth) (Figure 1.1).

Marine habitats were grouped into the four regional seas for the purposes of assessment, according to the Marine Strategy Framework Directive (MSFD) regions (Figure 1.1). It should be noted that these differ from the boundaries used by Regional Sea Conventions, therefore the western boundary of the Baltic Sea region does not include the Kattegat, and the Sea of Marmara is included in the Black Sea. Sub-basins definitions were also guided by the MSFD. The availability of data and expertise meant that only countries which lie on the northern shores of the Mediterranean together with Turkey, Malta and Cyprus were included in the Mediterranean Sea assessments. The boundary of the North-East Atlantic region, adjacent to the coast of Norway, corresponds to the boundary of the North Sea ecoregion used in the Norwegian Red List assessment work (Lindgaard & Henriksen 2011).

There are two Red List publications available, one for marine and one for terrestrial/freshwater habitats, based on factsheets for every assessed habitat. The contents of each factsheet are shown in Figure 1.2 and these, together with raw territorial data and distribution maps, are available for public download through the website of the European Environmental Agency (EEA).

Figure 1.2 Contents of Red List habitat factsheet.

Habitat code and name

- **Summary** (providing a summary description, distribution, threats, conservation)
- **Synthesis** (Red List category and justification)
- **Sub-habitat types** (requiring further examination)
- **Images** (with brief text description and provider)
- **Habitat description** (including characteristic species and indicators of quality)
- **Classification** (relationships to EUNIS, Annex 1, MAES, MSFD, EUSeaMap, IUCN and other regional sea classifications such as Barcelona Convention, HELCOM HUB.
- **Geographic occurrence** (km^2 extent in countries/sea regions in the EU28 and EU28+, summary of trends in quantity and quality)
- **EOO** (Extent of Occurrence, in km^2) and **AOO** (Area of Occupancy, number of 10 x 10 km grid cells)
- **Map** (known distribution from modelled or surveyed data and expert opinion)
- **Proportion of habitat in EU28** (%, compared to the worldwide distribution)
- **Trends in quantity and quality** (text summaries)
- **Pressures and threats** (using Article 17 and MSFD typology)
- **Conservation and management measures** (using Article 17 typology and indication of restorability)
- **Red List assessment** (with confidence measure, lists of assessor, contributors, reviewer and dates of assessment and review)
- **References** (most relevant ones)

2. Methodology

2.1 The work flow

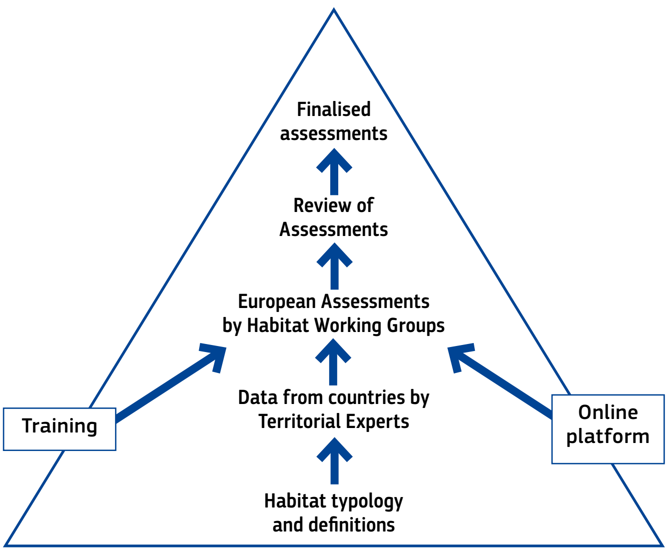
The European Red List of Habitats project was carried out in the stages indicated in Figure 2.1, coordinated through a single Management Team.

For marine habitats a Habitat Typology based on the EUNIS Classification was used by an expert group (details below) together with standardised habitat definitions to aid recognition and ensure consistency across countries. Data for each of these habitats were gathered in the EU28 and EU28+ countries by 147 marine Territorial Experts and Regional Sea Working Groups (RSWGs), through which the overall European assessments were made. In the Baltic Sea, the starting point was the assessments and data gathered within the HELCOM Red List project between 2009 and 2013 (HELCOM 2013a). The four marine RSWGs were the Baltic Sea, the North-East Atlantic Ocean, the Mediterranean Sea and the Black Sea. Training exercises and workshops with the RSWGs were held to ensure a standardised approach in applying the criteria and categories to the available data and to learn how to use the online platform on which assessments were made. Assessments were then passed to Reviewers and any substantial changes agreed with the RSWG assessor. In the Baltic Sea region, the overall assessment for the EUNIS level 4 habitats was led by NatureBureau and project management team member Susan Gubbay based on the HELCOM Red List assessments for the associated HELCOM HUB habitats as a starting point.

2.2 Habitat typology

The marine habitat typology is based on the EUNIS classification (version 2011-10-06) at level 4 but has incorporated relevant typologies and habitat descriptions specific to Regional Seas, most particularly from the Baltic Sea and the Mediterranean Sea as well as recently proposed additions and information from national schemes (Bellan-Santini *et al*., 2002; Connor *et al*., 2004; UNEP 2006; HELCOM 2013b; Monteiro *et al*., 2013).

Figure 2.1 Flow diagram of the work flow.



Shortfalls in the EUNIS typology, which had remained largely unchanged since 2004, were formally documented in 2012 (Galparsoro *et al*., 2012) and a provisional new listing of EUNIS marine types to reflect these proposals was prepared in 2013 (Connor 2013). These proposals were discussed at a meeting of EUNIS marine habitat experts in November 2013 where agreements and adjustments to the proposals were made (Evans 2014). This proposal was subject to a consultation process in 2015, leading to a further iteration before being finalised as part of a formal update of the EUNIS habitat classification in late 2016/ early 2017 by the European Environmental Agency (EEA).

As the revision of marine EUNIS is ongoing, the most up-to-date version available at the beginning of this project was used as a starting point for preparing the marine typology to be used for the Red List project. This was presented at a typology workshop in April 2014 attended by project team members from all four regional seas and a European Commission representative. A worksheet subsequently prepared by David Connor (European Commission) was used as the basic typology for this project (interim version of May 2014, hereafter EUNIS-v1405). Working at EUNIS level 4, this was cross-checked for consistency across the Baltic Sea, North-East Atlantic, Mediterranean Sea and Black Sea, resulting in some minor changes and bringing the total number of marine habitat types to be assessed at EUNIS level 4 to 257. Additionally, a small number of EUNIS level 5 habitats were selected to illustrate the availability of data and scope to undertake assessments at a more detailed level. Ice-covered habitats, pelagic habitats and deep-sea habitats (>200 m/shelf break) were excluded as they were out of the scope of the current project.

The resultant set of habitats for Red List assessment were defined specifically for this assessment task and were not intended as an official revision of EUNIS level 4 types. Current EUNIS codes were used as a prefix to habitat descriptions but were not always available due to the evolving typology.

A total of 257 EUNIS level 4 habitats were assessed across all the regional sea areas (Table 2.1) with the lowest number in the Mediterranean where the continental shelf is mostly a narrow fringe representing only 23% of the Mediterranean Sea area. The same exercise was also carried out for nine EUNIS level 5 habitats to explore the outcomes of working at a more detailed level.

Table 2.1 Number of EUNIS level 4 habitats assessed in each Regional Sea area.

Regional Sea	EUNIS L4
Baltic Sea	61
North-East Atlantic	86
Mediterranean	47
Black Sea	63
Total number of marine habitats	**257**

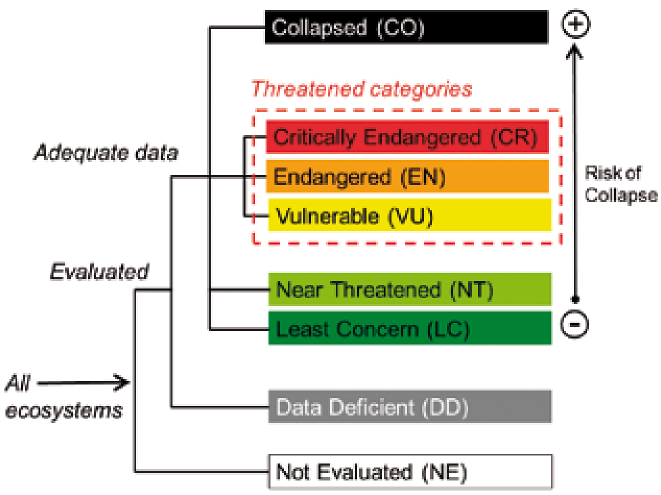
Where EUNIS habitat descriptions were available these were used as the starting point for the habitat definition. Where none were available (most particularly in the Black Sea, although also for some Mediterranean habitats), descriptions were drafted by the regional sea teams/experts or were elaborated from national or other regional classification schemes. For the Baltic Sea, the starting point was the HELCOM HUB typology, with habitats then grouped according to the main divisions in EUNIS. All definitions were included in the review process and included a crosswalk to Annex 1 habitat features, and the habitat classifications used by EUSeaMap, MAES and IUCN. It should be noted that for marine habitats Annex I of the Habitats Directive is very limited, with only 10 types listed, and almost all of these can be considered habitat complexes. Most marine Annex I habitat types therefore incorporate a number of Red List habitat types. Only one Annex I type (1120 Posidonia beds (*Posidonion oceanicae*)) has a simple one to one relationship with a Red List habitat type.

2.3 Categories and Criteria

The Categories and Criteria applied in the European Red List of Habitat Types assessment are largely based on a protocol proposed in a feasibility study (Rodwell *et al.*, 2013), combined with elements of the IUCN Red List of Ecosystems approach (Keith *et al.*, 2013; IUCN 2016).

The basis for this European Red List of Habitats is a set of eight categories and five criteria that provide a method for assessing the risk of habitat collapse, a measure of degree of endangerment The Red List Categories are: Collapsed (CO), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE) (Figure 2.2). The first six categories are ordered in decreasing risk of collapse, while categories DD and NE indicate that a level of risk cannot be or has not been identified. Habitats listed in any of the CR, EN or VU categories are referred to as 'threatened'. These categories are analogous to those of the IUCN Red List of Threatened Species (IUCN 2001).

Figure 2.2 European Red List of Habitats categories (based on Keith *et al.*, 2013).



The assessment comprised the application of five main criteria (Criteria A to E, modified from Keith *et al.*, 2013) which have a set of quantitative and qualitative thresholds that determine for which (if any) of the threatened categories a habitat qualifies (Table 2.2). Two of the criteria assess spatial symptoms of habitat collapse in terms of declining spatial distribution (Criterion A) and restricted spatial distribution (Criterion B). Two criteria assess functional symptoms (degradation of ecological processes) in terms of

Box 2.1 Summary of the Red List Categories (modified from Keith *et al.* 2013).

- **Collapsed (CO):** A habitat is Collapsed when it is virtually certain that its defining biotic or abiotic features are lost, and the characteristic native biota are no longer sustained.
- **Critically Endangered (CR):** A habitat is Critically Endangered when the evidence indicates that it meets any of the criteria A to E for CR, and is then considered to be at an extremely high risk of collapse.
- **Endangered (EN):** A habitat is Endangered when the evidence indicates that it meets any of the criteria A to E for EN, and is then considered to be at a very high risk of collapse.
- **Vulnerable (VU):** A habitat is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for VU, and is then considered to be at a high risk of collapse.
- **Near Threatened (NT):** A habitat is Near Threatened when it has been evaluated against the criteria but does not qualify for CR, EN or VU, but the status and trends are close to qualifying for a threatened category.
- **Least Concern (LC):** A habitat is of Least Concern when it has been evaluated against the criteria and does not qualify for CR, EN, VU or NT. Widely distributed and relatively un-degraded habitats are included in this category.
- **Data Deficient (DD):** A habitat is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of collapse. DD is not a category of threat and does not imply any level of collapse risk. Listing habitats in this category indicates that their situation has been reviewed, but that more information is required to determine their risk status.
- **Not Evaluated (NE):** A habitat is Not Evaluated when it is has not been assessed against any of the criteria.

Table 2.2 European Red List of Habitats criteria (from Keith *et al.*, 2013).

Criterion A. Reduction in quantity (area or distribution)	
A1	Present decline (over the last 50 years)
A2a	Future decline (over the next 50 years)
A2b	Future/present decline (over a 50-year period including present and future)
A3	Historic decline
Criterion B. Restricted geographic distribution	
B1	Restricted Extent of Occurrence (EOO)
B2	Restricted Area of Occupancy (AOO)
B3	Present at few locations
Criterion C. Reduction in abiotic quality	
Criterion D. Reduction in biotic quality	
C/D1	Reduction in quality over the last 50 years
C/D2	Reduction in quality in the future or in a period including present and future
C/D3	Historic reduction in quality
Criterion E. Quantitative analysis of probability of collapse	

physical or abiotic degradation (Criterion C) and disruption of biotic processes and interactions (Criterion D). Given that it is often difficult or impossible to separate biotic and abiotic degradation processes, Criteria C and D have been combined in this project (Criterion C/D), with the option to separate where data were available. The fifth criterion facilitates the integration of multiple threats and symptoms of collapse in a model that estimates the likelihood of collapse over time (Criterion E). Most of these criteria have been divided into sub-criteria. Details on the criteria, with quantitative thresholds, are provided in Annex B.

All habitat types were evaluated against all possible criteria. In the case of the Baltic Sea habitats, draft assessments were derived using a weighted approach whereby the HELCOM assessment outcomes were assigned a score. This was averaged across the relevant habitats. The outcomes were reviewed by independent Baltic Sea experts to reach a final conclusion. Meeting any one of the criteria qualified a habitat type for listing at that level of threat although in some cases the final assessment outcome was different in light of expert opinion. Habitats did not need to meet all five criteria to be listed in a given category for the overall assessment. The overall European Red List of Habitat Types status was the highest category of threat identified by any of the criteria.

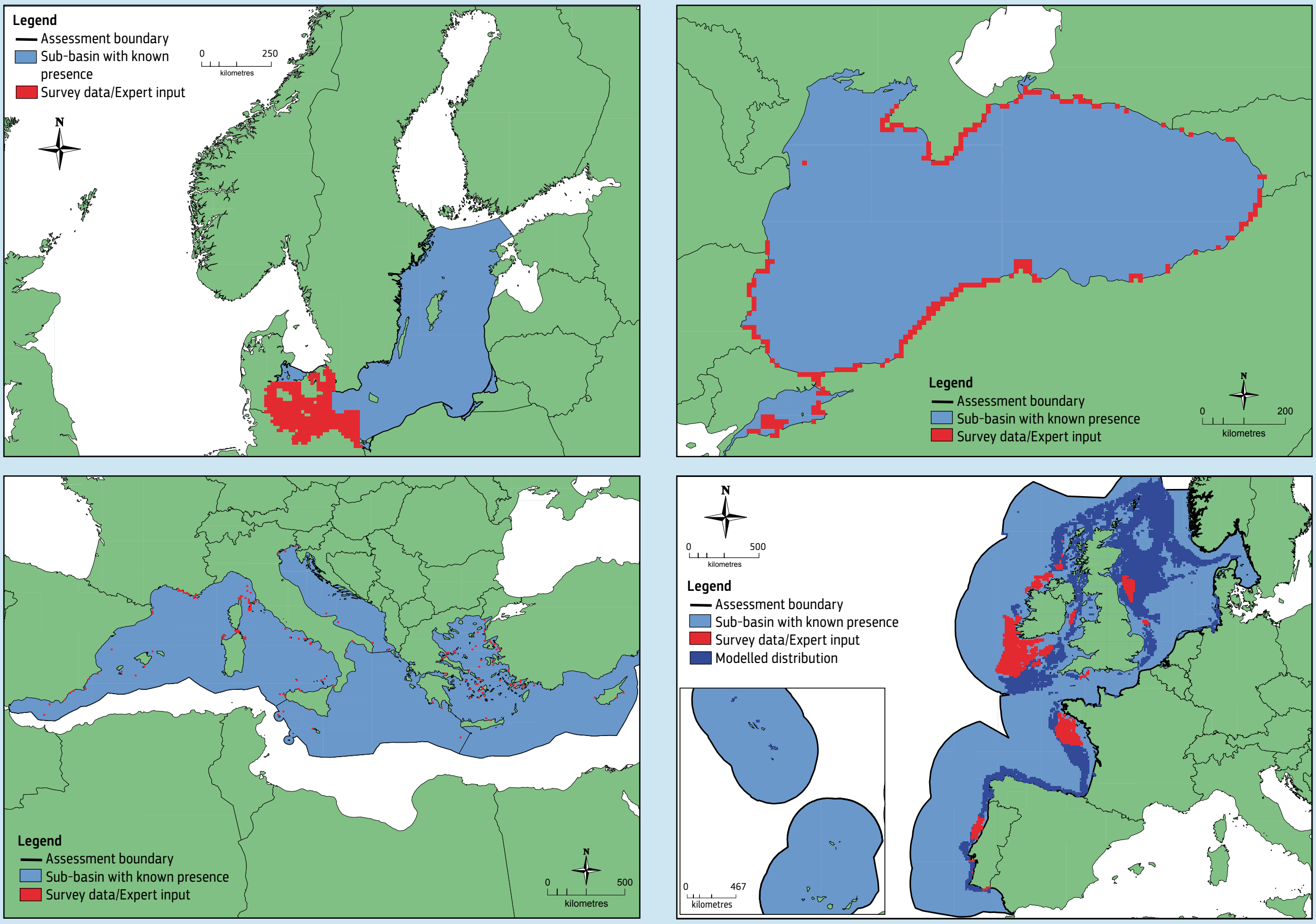
2.4 Data sources

Three main types of data were required to apply the Red List criteria; habitat extent, habitat quality, and time-series information to pick up the scale and direction of any trends in these parameters. Typically, the starting point was the most recent assessment of conservation status of relevant habitats and species under the Habitats Directive Article 17 (for the period 2007–2012) and the collation of data available in EMODnet, alongside publications in refereed journals. There was also a considerable reliance on 'grey literature' such as survey reports, project reports and specialist publications, as well as expert input.

For habitat extent, a base map of the European regional seas, superimposed with 10 km x 10 km grid squares, was used to present information on the distribution of each habitat type, as well as to calculate Extent of Occurrence (EOO) and Area of Occupancy (AOO) which was required to apply one of the assessment criteria. These were derived from a combination of survey data, Article 17 data, modelled data and expert knowledge.

For some habitats exact localities were unknown, however these habitats may have been known to be present in certain sub-

Figure 2.3 Examples of habitat maps derived from a variety of data sources and used for the calculation of EOO and AOO. Top left: Baltic Sea (predominantly HELCOM mapping of 100 km x 100 km cells and expert input). Kelp communities on Baltic infralittoral coarse sediment/shell gravel. Top right: Black Sea (predominantly expert input). Fucales and other algae on Pontic (Black Sea) sheltered upper infralittoral rock, well illuminated (A3.34)'. Bottom left: Mediterranean (predominantly expert input). Rhodolith beds in the Mediterranean (A5.51). Bottom right: North-East Atlantic (predominantly EMODnet data from modelled/surveyed records supplemented with expert input) Atlantic lower circalittoral sand (A5.27).



basins. To represent this situation, sub-basins were shaded a darker shade of blue when the habitat was known to be present. Examples of mapping outputs using various data sources are shown in Figure 2.3.

Data on trends are mostly only available for the most recent decades and were typically obtained from published literature. A degree of interpretation, in combination with expert input was often required to draw consistent conclusions because of the variety of scales at which such data were presented (overviews of regional seas as well as detailed studies of particular locations), and because of the range of parameters that were measured, especially when considering habitat quality. For example, in the case of '*Baltic perennial algae communities of* Fucus spp. *and* Furcellaria lumbricalis', quality could be inferred with reference to data on changes in the depth zone occupied by the habitat type. In the case of beds of the seagrasses *Posidonia* and *Zostera,* studies on associated species have been used with other information to infer trends in habitat quality.

Useful information on trends also came from other habitat assessments at a Regional Sea scale such as the Article 17 reports, the HELCOM Red List for the Baltic Sea and the OSPAR list of threatened and/or declining habitats and species for the North-East Atlantic. All of these use combinations of data and expert opinion to draw conclusions on trends.

Information was also provided on the pressures/threats and conservation measures for each habitat type using the Habitats Directive reference list, using information from various sources, sometimes directly relevant to a particular habitat (e.g. seagrass bed, worm reef, mussel bed) but also frequently presented in work on habitat complexes such as estuaries. The sensitivity assessments of the Marine Life Information Network (MarLIN) and the more recent Marine Evidence-based Sensitivity Assessment (MarESA) approach (Tillin & Tyler-Walters 2014) were a useful starting point. Knowledge of the extent of fishing pressure and the impact of different types of demersal fishing gears on benthic habitats was also available and provided useful information on one of the main pressures on marine habitats. The information on conservation measures was typically based on expert knowledge of existing initiatives, specifically for the habitat being considered, as well as actions which have been taken to address similar threats for comparable or related habitat types.

3. Results

3.1 General overview

A Red List assessment was carried out for a total of 257 benthic marine habitats, of which 10 occur only outside the EU28 (in the Sea of Marmara). Table 3.1.1 provides an overview of the final categories for all habitat types with full details given in Annex A. In total, 19% (EU28) and 18% (EU28+) of the evaluated habitats are assessed as threatened in categories Critically Endangered, Endangered and Vulnerable. An additional 12% are Near Threatened in the EU28 and 11% in the EU28+. These figures are approximately doubled if Data Deficient habitats are excluded.

The percentage of threatened habitat types differs across the regional seas. The highest proportion of threatened habitats in the EU28 was found in the Mediterranean Sea (32%), followed by the North-East Atlantic (23%), the Black Sea (13%) and then the Baltic Sea (8%). There was a similar pattern in the EU28+. A large proportion of marine habitats were Data Deficient in the Black Sea (83%), the North-East Atlantic (60%), the Mediterranean Sea (49%) and then the Baltic Sea (5%). Excluding these habitat types, the highest percentage of threatened marine habitats in the EU28 was in the Black Sea (78%) and for the EU28+, in the Mediterranean (74%).

Baltic Sea

In the Baltic Sea, 61 benthic habitats were assessed. Of these, 8% (five habitats) were threatened (Vulnerable or Endangered) with a further 26% (16 habitats) assessed as Near Threatened. The threatened habitats were characterised by coarse or muddy sediments, which had declined in quantity or quality, and/or had a restricted geographical distribution, only being present in the western Baltic. The small number of Data Deficient habitats in the Baltic Sea is largely due to previous work under the auspices of HELCOM where trends in extent were quantified.

Despite improvements to the water quality in recent decades, eutrophication caused by nutrient enrichment still remains a widespread issue in the Baltic Sea. This was the most frequently cited pressure (for 65% of Baltic habitats) as well as for more than half of the habitat types that which were assessed as Least Concern. The next most frequently cited pressures were natural system modifications (mainly changes in hydraulic conditions such as the removal of sediments), climate change and fisheries (mostly from commercial fishing where mobile demersal gears routinely disturb and alter the seabed). For many habitat types it was not possible to quantify trends in habitat quality and such information is important to strengthen any future assessments using the same criteria and methodology. The assessment outcomes in this project were similar to those determined by the Helsinki Commission (HELCOM), although the latter was carried out at a finer resolution of habitat types (the equivalent of EUNIS level 5).

North-East Atlantic

Red List assessments were carried out for 86 benthic habitats in the North-East Atlantic. Of these, 60% (52 habitats) were Data Deficient. Of the remaining 40% (34 habitats), 59% were threatened (Vulnerable to Critically Endangered); these were almost exclusively sediment habitats from estuarine, littoral, infralittoral and

EU 28	Baltic Sea	North-East Atlantic	Mediterranean Sea	Black Sea	TOTAL	
CR	0	1	0	1	2	
EN	2	10	5	5	22	
VU	3	9	10	1	23	
NT	16	8	5	1	30	
LC	37	6	4	1	48	
DD	3	52	23	44	122	
Total	61	86	47	53	247	
Threatened %	8	23	32	13	19	%
Threat % (excl.DD)	9	59	63	78	38	%

EU 28 +	Baltic Sea	North-East Atlantic	Mediterranean Sea	Black Sea	TOTAL	
CR	0	1	0	1	2	
EN	2	10	4	2	18	
VU	3	9	10	3	25	
NT	16	8	3	1	28	
LC	37	6	2	2	47	
DD	3	52	28	54	137	
Total	61	86	47	63	257	
Threatened %	8	23	30	10	18	%
Threat % (excl.DD)	9	59	74	67	38	%

Table 3.1.1 Overall Red List categories for marine habitats in the EU28 (above) and EU28+ (below).

circalittoral zones. Two exceptions were Macaronesian communities on sheltered rocky shores which have declined in both quality and extent, primarily because of coastal developments.

The most frequently cited pressures on North-East Atlantic habitats were pollution (mainly eutrophication), natural system modifications (mainly changes in hydraulic conditions such as the removal of sediments), fisheries (mostly from commercial fishing where mobile demersal gears routinely disturb and alter the seabed) and climate change. There were differences across the habitats depending on the depth zone in which the habitat occurs. Pressures associated with fishing activity, for example, were most frequently cited as an issue for circalittoral habitats, whereas for littoral habitats, pollution and modification of the shoreline were the two most common pressures.

Looking over historical time scales, it is clear that the use of mobile demersal fishing gears has been the most consistent, intensive and cumulative pressure on sublittoral (covered with seawater at all states of the tide) habitat. This remains the predominant pressure on most of the sediment benthic habitats in the North-East Atlantic and is the reason why these habitats are the most threatened. Closer to the coast, the pressures associated with pollution from the discharge of hazardous chemicals and nutrient enrichment remain, although probably not on the same scale as in previous decades, whilst the possible effects of climate change are now considered one of the top four pressures on intertidal habitats.

Mediterranean Sea

Red List assessments were carried out for 47 benthic habitats in the Mediterranean. Forty-nine percent (23 habitats) of those in the EU28 and 60% (28 habitats) of those in the EU28+ were Data Deficient. Of the remaining 24 habitats in the EU28, 63% (15 habitats) were threatened to some degree. A high proportion (74%, 14 habitats) were also threatened in the EU28+.

The most frequently cited pressures were pollution, fisheries, urbanisation, invasive alien species and climate change. Along the shoreline, coast protection schemes and development projects such as the construction of marinas as well as urban and tourist infrastructure have altered the hydrographic conditions. In shallow waters the spread of invasive non-indigenous macroalgae, such as *Caulerpa racemosa* has also contributed to the loss of habitat such as *Posidonia* seagrass meadows although the most significant threat is from seabed trawling. Eutrophication, resulting from nutrient discharges from the agricultural plains, is a further widespread and significant pressure, and climate change is already affecting some mediolittoral (i.e. the shoreline exposed by the tide in sea areas where there is a small tidal range such as the Mediterranean) and infralittoral habitats. Sediment habitats are particularly subjected to the physical disturbance caused by demersal fishing activities such as bottom trawling and dredging. This has severely altered the nature of some habitats. The continuing scale and widespread nature of these pressures are a significant threat to the benthic habitats of the Mediterranean Sea.

Black Sea

Red List assessments were carried out for 53 benthic habitats in the Black Sea EU28 countries (Romania and Bulgaria) and a further 10 benthic habitats in the EU28+. Of the 53 habitats only occurring in the EU28, 83% (44 habitats) were assessed as Data Deficient, 13% (seven habitats) as threatened (Vulnerable to Critically Endangered) and a further 2% Near Threatened. Excluding Data Deficient habitats, 78% of the remaining nine habitats were threatened.

The Sea of Marmara is included in the EU28+ assessments to correspond with MSFD boundaries, although the habitats there are much more consistent in character and therefore frequently grouped with habitats in the Mediterranean. Given the larger area on the EU28+ in comparison to the EU28, criterion B on habitat extent was not as relevant, but declines in quality and quantity played a key role in threatened habitat status.

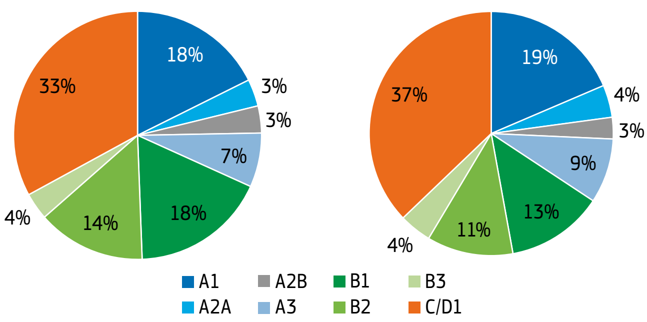
The most frequently cited pressure on Black Sea habitats was pollution (mainly nutrient enrichment and inputs of contaminants into surface waters), natural system modifications (mainly siltation rate changes from dredging and dumping activities) and from urbanisation and coastal development. Pollution from nutrient enrichment, led to widespread eutrophication during the 1970s and up to the mid-1990s. It was such a significant problem in the Black Sea that it resulted in almost a complete collapse in food webs. Stricter regulations now in place have resulted in a recovery of many species and habitats, but this study highlights that pollution from nutrient enrichment and contamination of surface waters is still a cause for concern. Fishing pressures, for example from beam trawling are current threats and coastal zone development will only further exacerbate threats to benthic habitats in the Black Sea.

Criteria and pressures

The decisive criteria resulting in the presented Red List categories are summarised in Figure 3.1.1. Overall, two criteria were most often crucial in determining the final Red List category in both the EU28 and EU28+. These were: trend in quantity over 50 years (criteria A1) and trend in quality over 50 years (C/D1). Historical decline in quantity (A3) and restricted geographical occurrence (criteria B) has been decisive relatively few times, and a quantitative analysis that assesses the risk of collapse (criteria E) was not used on any occasions.

The most frequently cited pressures were similar across the four regional seas (Figure 3.1.2). Based on the Habitats Directive Article 17 reporting categories, these were pollution, biological resource use other than agriculture or forestry (mainly fishing but also aquaculture), natural system modifications (e.g. dredging and sea defence works), urbanisation and climate change. Pollution

Figure 3.1.1 Proportion of different criteria decisive for the final Red List result of threatened in the EU28 (left) and EU28+ (right) assessments.



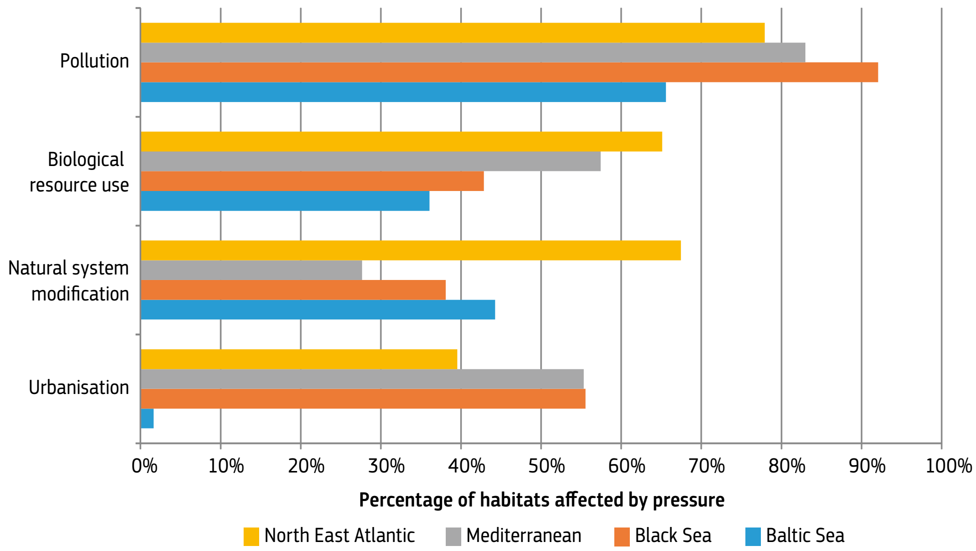


Figure 3.1.2 Comparison of most frequently cited pressures in each regional sea. Full titles, taken from Habitats Directive Article 17 reporting are Pollution; Biological resource use other than agriculture and forestry; Natural system modification; Urbanisation, residential and commercial development.

was the most frequently cited pressure in all the regional seas with nutrient enrichment being a common concern although this also related to toxic chemical discharges, plastics and oil spills at sea. Urban development pressures were more commonly cited for the Mediterranean Sea and the Black Sea. There were some differences when infralittoral and circalittoral habitats are compared with more reference to land-based sources of pressures for infralittoral habitats (coastal development, pollution). Fishing was more frequently cited as a pressure on circalittoral habitats compared with infralittoral habitats. Annex C provides a correspondence table between the Article 17 list of pressures and the latest proposals for a revised MSFD Annex III list of pressures.

3.2 The Baltic Sea

The Baltic Sea environment

The Baltic Sea is a non-tidal inland sea in northern Europe which is bordered by the countries of Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark. The surface area is estimated to be more than 413,000 km², making it one of the largest brackish water bodies in the world. It extends over 10 degrees of latitude, and during winters sea-ice can cover the northern parts and the Danish Straits.

The main physiographic features of the Baltic Sea are the Gulf of Bothnia, the Gulf of Finland and, in the east, the Gulf of Riga. At its westernmost extent it is connected to the North Sea through the Danish Straits, Kattegat and Skagerrak. Although a relatively shallow sea with an average depth of 57 m, shallow sills, numerous islands and archipelagos, there are deeper areas in some of the basins. These include the Landsort Deep (459 m) in the western Gotland Basin, and the Lågskär Deep (220 m) in the Åland Sea. Six sub-basins distinguishing parts of the Baltic with different characteristics and a combination of the sub-divisions used by HELCOM (2015) have been used to indicate the geographical distribution of the marine habitats for this Red List assessment (Figure 3.2.1).

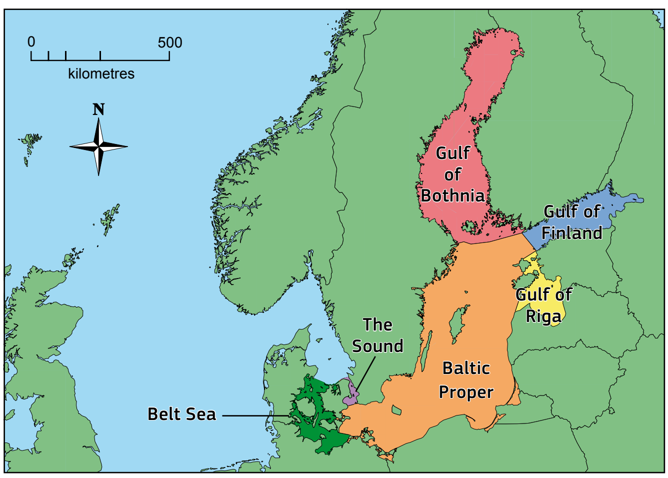
There is restricted water exchange with the North Sea and North-East Atlantic through the Kattegat. This leads to a long residence time (25–35 years) of water in the Baltic and means that its deeper waters are naturally and periodically subject to low-oxygen conditions. Oxygen depleted areas have however increased since the early 1900s which has been attributed to eutrophication. The consequences of oxygen depletion and eutrophication include changes to and loss of habitats and reductions in biodiversity. When combined with the significant freshwater inflows to the sea, these oceanographic conditions result in a significant salinity gradient, ranging from brackish to virtually freshwater at the northern extent. There are also changes through the water column, with surface waters being mostly brackish, and more saline waters found below about 60–70 m. These differences in salinity (the halocline) and density (the pycnocline) form natural barriers to oxygen, nutrients and species dispersal.

There is no daily tidal rise and fall in the Baltic Sea although water levels do change due to atmospheric conditions (storms and associated changes in air pressure), and therefore no extensive intertidal zone.

Benthic marine habitats of the Baltic Sea

The benthic marine habitats of the Baltic Sea have been classified according to environmental gradients of light levels and substrate type as well as by the characteristic communities of flora and

Figure 3.2.1 The Baltic Sea region with six sub-basins.



fauna. Light levels influence the extent to which plants and algae dominate the seabed habitats and therefore such habitats occur in shallow waters or where there is highest water clarity, variously described as the infralittoral zone or the photic zone (Figure 3.2.2a). In the deeper, darker waters of the circalittoral or aphotic zone, animal communities dominate (Figure 3.2.2b). Where conditions are unfavourable for the establishment of macrobenthic species, for example where the sediments are highly mobile or the conditions are anoxic, epifaunal and infaunal communities may be sparse or absent (Figure 3.2.2c).

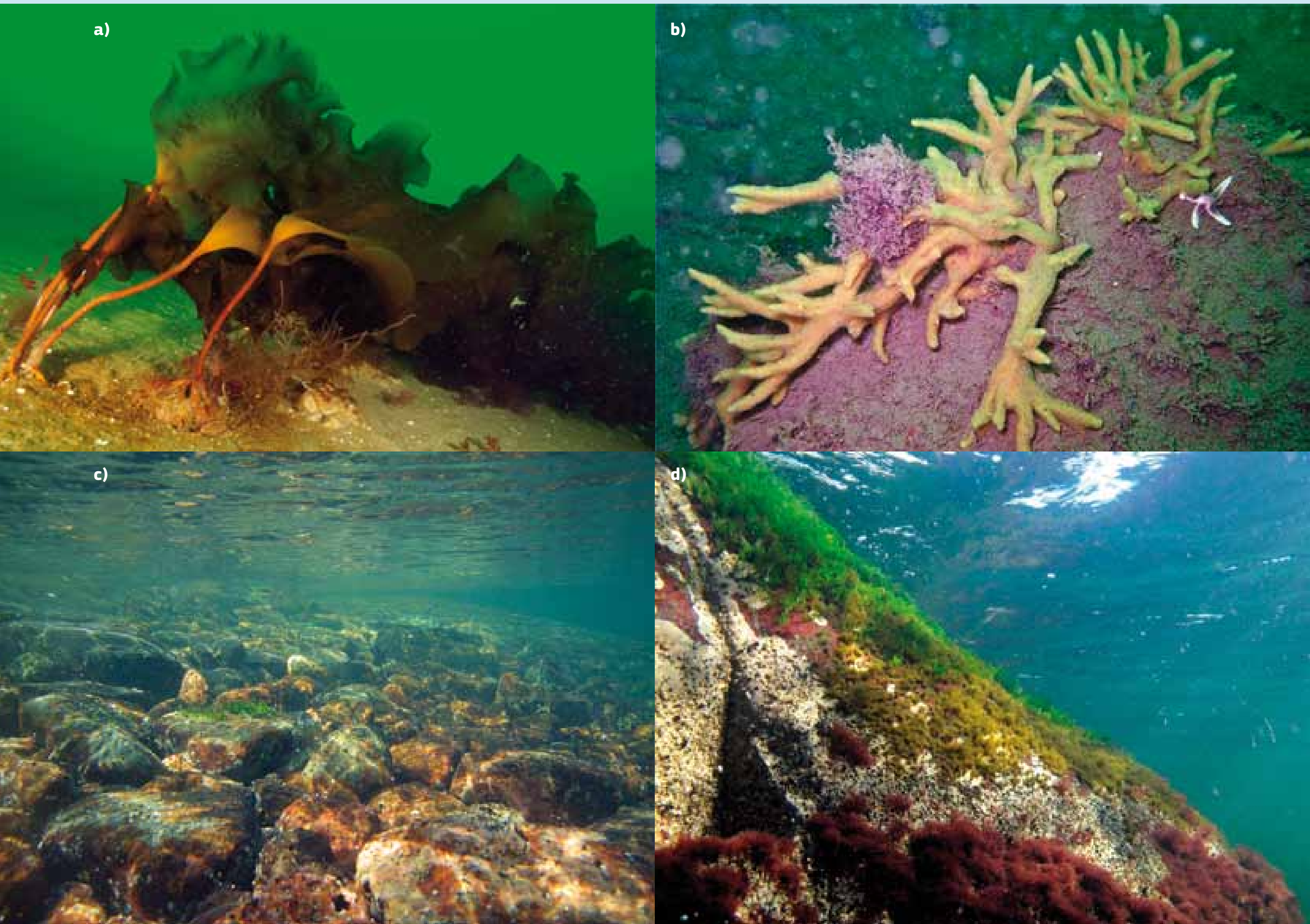
Sixty-one benthic habitats have been described for the Baltic Sea. The majority of these are on mixed or soft substrates. The hard substrate (rocky habitats) are generally found close to the mainland coastlines or fringing islands (Figure 3.2.2d), whilst the sediment habitats are widely distributed. The boundaries between the habitat types are frequently indistinct and the associated communities show natural variability, for example in response to seasonal and decadal events, as well as changes in response to the pressures from human activity. Two of the 61 habitats are only present in the EU28 due to the relatively small area of non-EU waters in the Baltic Sea. These are: 'Kelp communities on infralittoral rock and mixed substrates' and 'Kelp communities on infralittoral coarse sediment/shell gravel'. The HELCOM Red List assessment (HELCOM, 2013a) was based on the HELCOM HUB typology which listed 209 benthic habitats[3]. These were translated into the 61 EUNIS level 4 habitats, which were used for the European Red List of habitats.

Assessment results

Around one third (21 habitats, 34%) of the Baltic Sea habitats were of current concern (Figure 3.2.3). Of these, the majority (16 habitats, 26%) were in the Near Threatened category, three (5%) assessed as Vulnerable and two (3%) as Endangered (Box 3.2.1 and Table 3.2.1). The latter three assessment outcomes were for habitats associated with coarse and muddy sediments. The coarse sediment habitats are only present in the EU28 in the Baltic and had a threatened status because of a restricted geographical distribution as well as decline in extent over the last 50 years. The threatened muddy sediment habitats are more widespread but have also declined in extent and quality over this period. Only a small number of Baltic Sea habitat types (three habitats, 5%) were Data Deficient. A larger proportion of circalittoral habitats had a threatened status when compared to the infralittoral (Figure 3.2.3).

[3] The terminology used by HELCOM to describe these habitats is biotopes which are mostly equivalent to level 5 of the EUNIS typology.

Figure 3.2.2 Baltic Sea benthic habitats
a) *Saccharina latisissa* attached to stones on coarse sediment. © OCEANA/C. Minguell
b) Erect growing branched sponge (*Haliclona oculata*) attached to a boulder. © K. Fürhaupter, MariLim GmbH
c) Loose stones with sparse epifauna, Korpo in the Archipelago Sea. © Forest and Park Service, 2005
d) Annual algal communities on infralittoral rock. © J. Nyström, FINMARINET



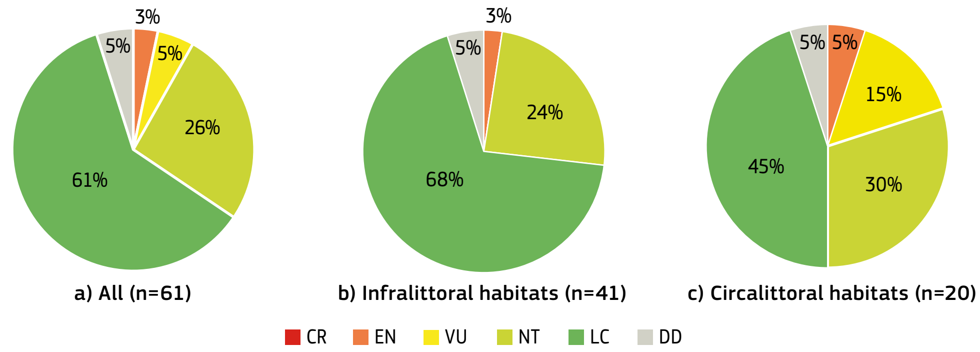


Figure 3.2.3 Proportion of Baltic Sea habitats assigned to each Red List category for both the EU28 and EU28+:
a) all (n=61)
b) infralittoral habitats (n=41)
c) circalittoral habitats (n=20).
(n=number of habitats)

Box 3.2.1 Threatened Baltic Sea habitats (for more information refer to the full assessments).

Endangered

- Infaunal communities on Baltic infralittoral shell gravel
- Sparse epibenthic communities of Baltic upper circalittoral muddy sediment

Vulnerable

- Infaunal communities in Baltic upper circalittoral coarse sediment and shell gravel dominated by bivalves
- Infaunal communities of Baltic upper circalittoral muddy sediment dominated by bivalves
- Communities of Baltic lower circalittoral soft sediments (mud and sand)

Table 3.2.1 Number of Baltic Sea habitats in each Red list category for both the EU28 and the EU28+ in the Baltic Sea.

Red List category	EU28	EU28+
CR	0	0
EN	2	2
VU	3	3
NT	16	16
LC	37	37
DD	3	3
TOTAL	**61**	**61**

The assessment outcomes for the EU28+ are identical to those for the EU28. This is because most of the Baltic Sea lies within the EU28 and because there are no habitats that solely occur outside the EU28 area. Due to data gaps and quality (see below), the confidence in all the assessments is reported as low.

Overall, the most frequently used criterion was A1 'Recent reduction in quantity', with the scale of decline being based on a review of assessments made by HELCOM in 2013. Criterion B, 'Restricted geographic distribution' was only cited for four habitats, which have a Baltic distribution concentrated in The Sound and The Belt Sea. Criterion C/D1 'Reduction in abiotic and/or biotic quality' was only used in one case, for deep-water muddy habitats which have become degraded through extended periods of oxygen depletion. Overall, there was a lack of data and confidence on quality trends and therefore assessments were largely based on loss in quantity.

Main pressures and threats

Despite improvements to the water quality in recent decades, eutrophication caused by nutrient enrichment still remains a widespread issue in the Baltic Sea. This was the most frequently cited pressure (for 65% of Baltic habitats) as well as for more than half of the habitat types that which were assessed as Least Concern. Overall the four most frequently cited pressures on benthic Baltic Sea habitats were pollution (mainly eutrophication cause by nutrient enrichment), natural system modifications (mainly changes in hydraulic conditions such as the removal of sediments), climate change and fisheries (mostly from commercial fishing where mobile demersal gears routinely disturb and alter the seabed) (Figure 3.2.4). This was regardless of the depth zone in which the habitat occurred, although pollution and natural system modifications were cited more often for infralittoral habitats, and pollution and fishing/ aquaculture more frequently for circalittoral habitats.

Furthermore, in all cases where pollution was identified as a pressure, the specific issue cited was nutrient enrichment. An increase in nutrients (nitrogen and phosphorus) and the widespread consequential eutrophication has been well documented in the Baltic Sea. Deleterious effects include an increase in hypoxia and anoxia, loss of benthic communities and changes in the balance between species (reed and sedges) in emergent vegetation communities (HELCOM 2013b). Whilst some of this increase in nutrient enrichment has been reversed in recent years, it remains a significant pressure in the Baltic Sea, for which very slow flushing rates contribute significantly to the likelihood of continued degradation into the future. Changes in hydrological conditions, for example as a result of dredging, spoil disposal, and coastal construction works threaten particular habitats, either by direct removal of the substrate or through increasing sedimentation rates and increasing turbidity, as well as potentially releasing toxic contaminants into the water column. The threat from fishing is predominantly direct damage to benthic habitats by mobile demersal fishing gears, while effects of aquaculture facilities in sheltered locations include anoxic conditions and the growth of bacterial mats on the seabed.

In the future, climate change is expected to alter the distribution of some species which characterise particular habitats, such as the kelps and fucoid algae, by altering sea temperatures, while changes in wave climate and storm frequency are considered a threat to habitats characterised by stable aggregations of unattached perennial vegetation.

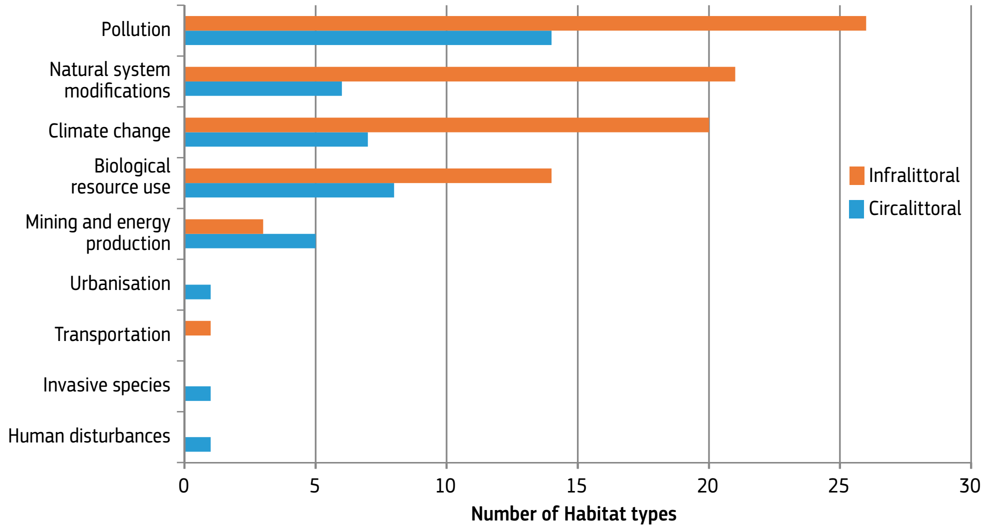


Figure 3.2.4 Most frequently cited pressures on Baltic Sea infralittoral and circalittoral habitats (EU28 and EU28+). Full titles, taken from Habitats Directive Article 17 reporting are Pollution; Natural system modification; Climate change; Biological resource use other than agriculture and forestry; Mining, extraction of minerals and energy production; Urbanisation, residential and commercial development; Transportation and service corridors; Invasive, other problematic species; Human intrusions and disturbances.

Box 3.2.2 BALTIC SEA CASE STUDY
Submerged rooted plant communities on Baltic infralittoral sand
Assessment outcome: NEAR THREATENED

This habitat occurs in all Baltic Sea sub-basins in the shallow waters of the photic zone with the submerged rooted plant communities providing structure for the benthic environment and associated communities on the underlying sediment. Distribution of the associated sub-habitats depends on the dominant species and is influenced mainly by salinity and wave exposure. The seagrass *Zostera noltei*, for example, is not found east of the Darss Sill in the Arkona basin, while the macrophytes *Potamogeton perfoliatus* occurs mostly in the northern part of the Bothnian Bay, and *Chara horrida* in the central Baltic and Archipelago Sea. This habitat has been assessed as Near Threatened because of past and expected future declines in quantity, the latter considered likely because of a number of factors including predicted changes in salinity and temperature associated with climate change.

Eutrophication (due to increased inputs of Nitrogen, Phosphorus and organic matter) has both direct and indirect negative impacts on this habitat. It reduces light penetration through the water column which can lead to reductions in the maximum depth to which the submerged species can grow, increased sedimentation can prevent settlement, and excess nutrients often favour opportunistic species with short life cycles and rapid development over perennial species with lower productivity, causing a shift in the associated species. Climate change may also result in a shift in the dominant species, due to predicted associated changes in salinity.

There have been significant declines in the extent of the seagrass and charophyte-dominated communities in the last 50 years and the deeper water seagrass meadows are at risk of disappearing in the future if there is continued reduction in light levels at the sea floor. *Zostera marina* and several species of Charales are on the HELCOM Red List of threatened species in the Baltic.

Charophytes (mainly* Chara baltica*) mixed with some higher plants on a sandy seabed in the Greifswalder Bodden, Germany. © K. Fürhaupter

Data quality and gaps

The assessment of Baltic Sea habitats was heavily reliant on the most recent HELCOM Red List assessment of Baltic Sea (HELCOM 2013a). This was the culmination of a four-year process, bringing together data and experts to apply IUCN Red List assessment criteria that were under development at the time (Rodriguez *et al.*, 2011; Keith *et al.*, 2013) with some modifications by HELCOM, to a total of 209 habitats as defined in the HELCOM HUB classification (HELCOM 2013b). Data gaps were identified as part of that process, most especially on trends in quality over recent (50 years) and historical (150 year) time periods. Further information was sought to update the HELCOM Red List assessments but these same data gap issues remain. In some cases, data gaps were reported even though some trend data were available. This situation occurred where the available data related to habitats at a different scale (e.g. for some, but not all, of the infaunal communities on Baltic infralittoral coarse sediment), or was available for a habitat-characteristic species rather than the habitat as a whole (e.g. the bladder wrack *Fucus vesiculosus* rather than 'Perennial algal communities (excluding kelp) on Baltic infralittoral rock and mixed substrata'). In other situations, there were good data for a habitat, but only in part of its range. This arose when there were long-term monitoring programmes or opportunities to revisit localities some decades after some mapping and habitat assessment work had been undertaken. Another area of weakness concerned indicators of quality, a pre-requisite to quantifying any trends in quality. Whilst these could be described in general terms for all habitats, the majority of habitats are still in the process of being described, and therefore there is insufficient knowledge to have quantifiable quality indicators.

These data gaps were not unexpected and are the main reason why virtually all the assessments were given a 'low' confidence rating. To overcome this, the HELCOM relied on assessors using the best available information in combination with inference and projection, and the same approach was taken for the European Red List of Habitats.

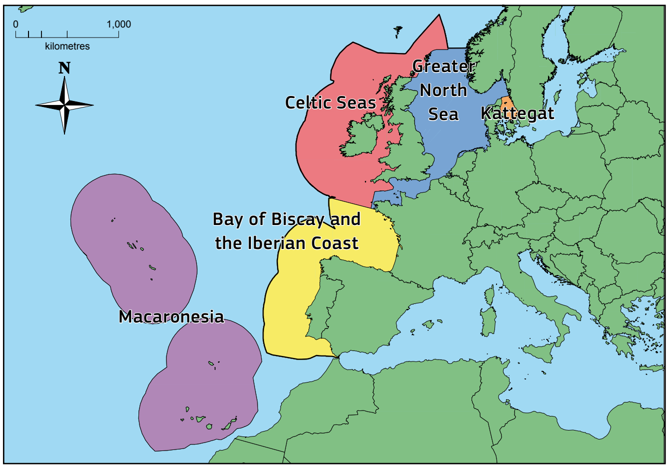


Figure 3.3.1 The North-East Atlantic region with five sub-basins.

Data Deficient habitats

Three Baltic Sea habitats were assessed as Data Deficient:

- Sparse or no macrocommunities on Baltic infralittoral shell gravel;
- Epibenthic macrocommunity on Baltic infralittoral sand;
- Infaunal communities in Baltic upper circalittoral mixed sediment.

These are habitats that were not evaluated during the HELCOM Red List assessment process due to lack of information. Lack of data on extent and on any trend in quality or quantity remain an issue, hence their Data Deficient status.

3.3 The North-East Atlantic

The North-East Atlantic environment

The North-East Atlantic region is bordered by Ireland, the UK, The Netherlands, Belgium and Portugal as well as some of the marine territory of Spain, France, Germany, Denmark and Sweden. It includes the Macaronesian islands of the Azores and Madeira (Portugal) and the Canary Islands (Spain). Norway and the UK Crown Dependencies of the Isle of Man and the Channel Islands lie within this region but are not members of the EU. Five sub-basins have been used to indicate the geographical distribution of the marine habitats for this Red List assessment (Figure 3.3.1).

Benthic marine habitats of the North-East Atlantic

The benthic marine habitats of the North-East Atlantic represent a wide spectrum of substrate types, characterising species, biological zones and depth ranges (Figure 3.3.2).

They include sediment, hard substrate and biogenic habitats. Although all these types are present in all the sub-basins, the latitudinal range of this regional sea (over 30 degrees), as well as the different physiographic conditions, currents, variable salinity and tidal range mean that certain habitats are more typical of some regions than others. Because of the wave-exposed shores, absence of continental shelf and steep drop-off adjacent to the Macaronesian islands, the marine habitats in this part of the North-East Atlantic support communities that are characteristic of conditions of high exposure to waves and currents. Off the west coasts of Ireland and Scotland the highly indented coastline has many sheltered bays, inlets, and sea lochs (or loughs) whilst in the southern North Sea there are large expanses of mudflat, estuarine and other sediment habitats.

Differences in the associated communities in the northern and southern parts of this region are particularly apparent in the infralittoral zone with extensive kelp forests in the colder northern waters being replaced by other types of characterising frondose algae colonising the rocky reefs of the infralittoral zone further south. Further offshore, and in deeper waters, there are more similarities across the regional sea. Large expanses of soft substrate dominate most of the seabed away from the coast. Examples include the Grande Vasiere off France, the Celtic deep in the Irish Sea, and the Fladden Ground in the northern North Sea. There are also major physiographic features which form rocky reefs, examples of which include the Rockall Bank to the west of Scotland, seamounts such as the Gorringe Bank south-west of the Iberian Peninsula and the Kattegat Trench.

Assessment results

The majority of habitats in the North-East Atlantic were Data Deficient (52 habitats, 60%). In these cases, although pressures, conservation actions and general trends may have been described, there was insufficient information to determine an outcome. Of the remaining habitats 10% (9 habitats) were Vulnerable, 12% (10 habitats) Endangered, and 1% (one habitat) Critically Endangered (Figure 3.3.3, Table 3.3.1 and Box 3.3.1). Some differences were also apparent across depth zones and between substrate types. All the circalittoral habitats assessed were either Endangered or Vulnerable, whereas there was a greater spread of assessment outcomes for infralittoral habitats (Figure 3.3.4). There was also a marked difference between the assessment outcomes for hard and soft substrate habitats, with just over 70% of the sediment habitats threatened (VU-CR) compared to 30% of the rocky habitats across all depth zones.

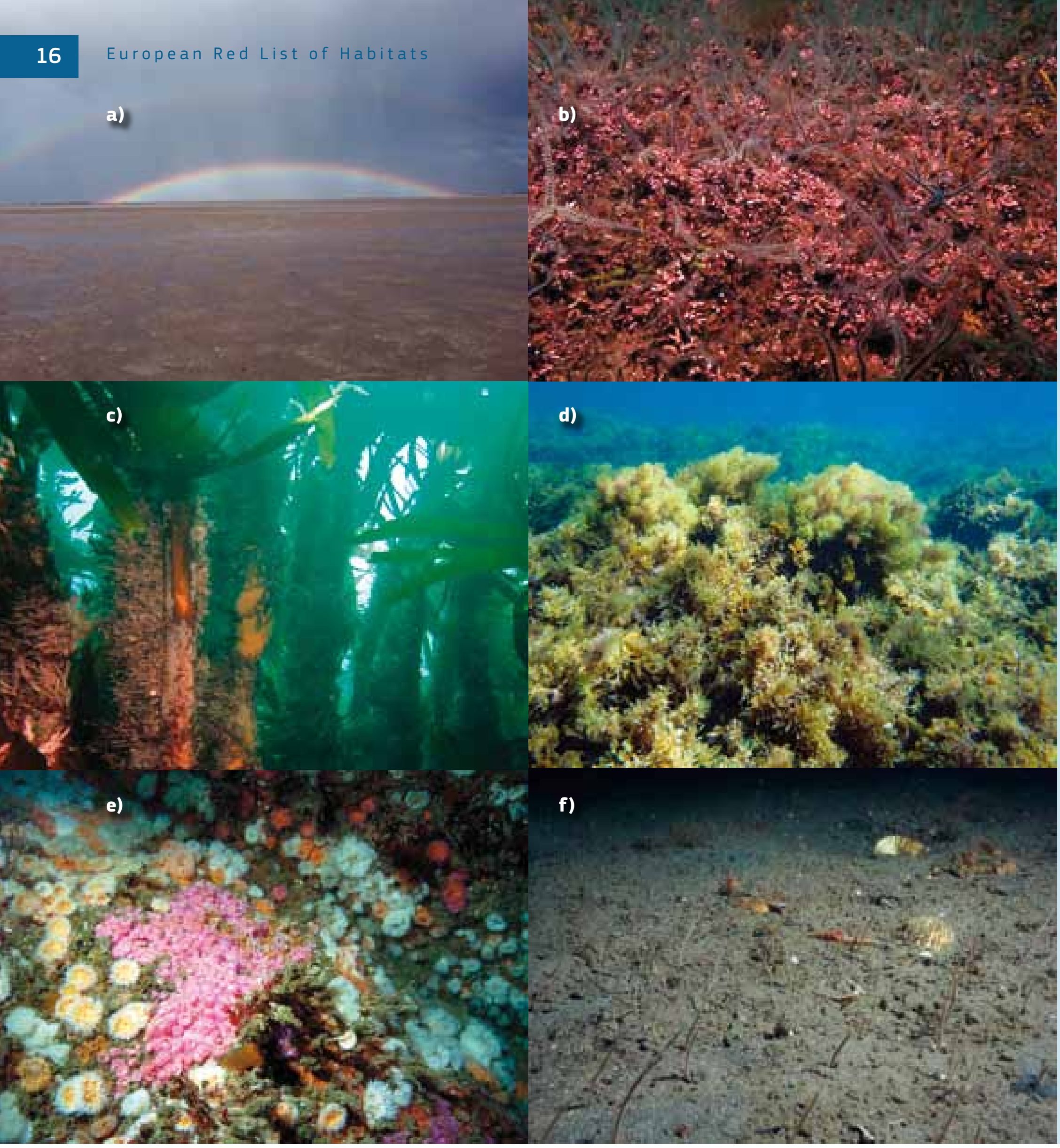


Figure 3.3.2 Examples of benthic habitats in the North-East Atlantic Region.
a) Extensive intertidal mudflats in the Bay of Mont Saint-Michel, France. © S. Gubbay
b) A bed of maerl (a calcareous alga) *Lithothamnion glaciale* surrounded by brittlestars in Loch Sween, Scotland. © G. Saunders
c) Infralittoral rock habitat with understory of *Laminaria hyperborea* kelp forest and red seaweeds, Orkney, Scotland. © C. Wood/MCS
d) Belt of the fucoid alga *Cystoseira abies-marina* forming a dense cover of wave-exposed infralittoral rock. Alegranza, Lanzarote, Spain. © R. Haroun
e) Upper circalittoral tide-swept rock colonised by a carpet of anemones including the jewel anemone *Corynactis viridis*, the plumose anemone *Metridium senile* and *Sagartia elegans*, Isle of Man, UK. © C. Wood/MCS
f) Upper circalittoral sandy mud habitat with arms of brittlestars *Amphiuria* spp. visible, extended into the water column to filter feed. Plymouth, UK. © K. Hiscock

Figure 3.3.3 Proportion of EUNIS-4 habitats assigned to each Red List category in the North-East Atlantic for both EU28 and EU28+: (a) all habitats (n=86) (b) excluding Data Deficient habitats (n=34). (n=number of habitats)

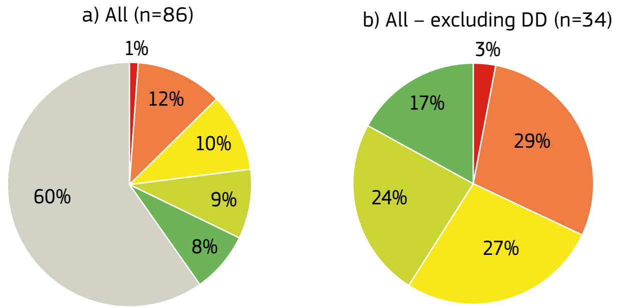
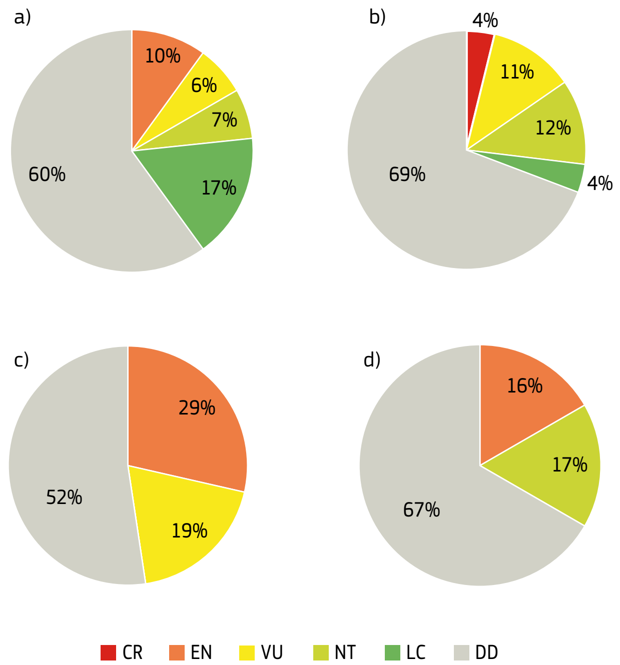


Table 3.3.1 Number of North-East Atlantic habitats in each Red List category for both the EU28 and the EU28+ in the North-East Atlantic.

Red List category	EU28	EU28+
CR	1	1
EN	10	10
VU	9	9
NT	8	8
LC	6	6
DD	52	52
TOTAL	**86**	**86**

Figure 3.3.4 Proportion of assessed habitats assigned to each Red List category in the North-East Atlantic: (a) littoral (n=30) (b) infralittoral (n=26) (c) circalittoral (n=21) (d) estuarine (n=6). (n=number of habitats)



Box 3.3.1 Threatened North-East Atlantic habitats (for more information refer to the full assessments).

Critically Endangered

A5.53 Seagrass beds on Atlantic infralittoral sand (non-Macaronesian)

Endangered

A2.31 Polychaete/bivalve-dominated mid-estuarine Atlantic littoral mud
A2.32 Polychaete/oligochaete-dominated upper estuarine Atlantic littoral mud
A2.33 Marine Atlantic littoral mud with associated communities
A2.72 Mussel beds in the Atlantic littoral zone
A5.25 Atlantic upper circalittoral fine sand
A5.26 Atlantic upper circalittoral muddy sand
A5.27 Atlantic lower circalittoral sand
A5.35 Atlantic upper circalittoral fine sandy mud
A5.36 Atlantic upper circalittoral fine mud
A5.37 Atlantic lower circalittoral mud

Vulnerable

A1.24 Macaronesian communities of eulittoral rock moderately exposed to wave action
A1.34 Macaronesian communities of lower eulittoral rock sheltered from wave action
A5.13 Faunal communities in marine Atlantic infralittoral coarse sediment
A5.14 Atlantic upper circalittoral coarse sediment
A5.15 Atlantic lower circalittoral coarse sediment
A5.44 Atlantic upper circalittoral mixed sediment
A5.45 Atlantic lower circalittoral mixed sediment
A5.51 Atlantic maerl beds
A5.53 Seagrass beds on Atlantic infralittoral sand (Macaronesian)

Box 3.3.2 NORTH-EAST ATLANTIC REGIONAL SEA CASE STUDY
Atlantic lower circalittoral mud
Assessment outcome: ENDANGERED

This habitat has a widespread distribution across the region, including in the Kattegat, the Grand Vasiere off Gascony, France, in the offshore mud basins to the west of Ireland and in deep, sheltered inlets, including some of the Scottish sea lochs. It has been assessed as Endangered because of both past and likely continuing declines in quality.

Mobile demersal fishing gears (such as otter trawls, beam trawls, etc.) disturb the upper layers of the sediment and can damage both the epifauna and shallow infaunal communities. Associated increases in suspended sediments may also have a smothering effect on filter feeding species. The severity of effects depends on factors such as the local conditions, intensity and frequency of disturbance by the trawls. Frequent trawling can lead to a permanently altered species composition dominated by fast growing scavenger/predator species. Research suggests that some fishing gears may also be modifying the biogeochemistry of the sediments by affecting organic matter remineralisation and nutrient cycling through sediment resuspension and burial of organic matter to depth although some examples of relatively undisturbed habitat occur in certain sea lochs which trawlers cannot reach.

Fine mud habitat in the circalittoral zone, with Dublin Bay prawn **Nephrops norvegicus** *burrows visible. Loch Sween, Scotland.*
© G. Saunders

Most sediment benthic systems of the continental shelf of Europe have been modified by bottom-fishing activity in the last 100 years, particularly by mobile demersal gears, and this remains a significant pressure. For example, various analyses reveal considerable overlap between intensive use of mobile demersal fishing gears and this habitat type. They also indicate that very large areas (more than 80%) of deep circalittoral mud habitats across the North-East Atlantic shelf area are subject to physical disturbance from such gears. Regional studies, such as for the North Sea, the Celtic Sea and the Kattegat also show this pattern with the use of bottom gears that are known to alter the habitat quality taking place at frequencies which maintain a disturbed condition. These studies use relatively recent or short term data and are therefore likely to underestimate the footprint of activity, its intensity and any cumulative impacts of bottom-fishing gears on the lower circalittoral mud habitat in the North-East Atlantic. The true effects, when considered over historical (150 year) and more recent (50 year) time scales, are likely to be much more severe.

Overall, the most frequent criterion used for habitats with a threatened status was C/D1, indicating a decline in quality. In some instances, quantified data and/or expert opinion was used to infer there had been significant declines in extent under criteria A. The thresholds for a threatened category were rarely met under criteria B, as virtually all the habitats are known to have a wide range. The one exception was a Macaronesian habitat currently only reported from sheltered shores, although possibly present elsewhere.

Main pressures and threats

Overall the four most frequently cited pressures and threats to North-East Atlantic benthic habitats were pollution, fishing, human induced changes in hydraulic condition, and climate change. On more detailed examination, there were differences across the habitats depending on the depth zone in which the habitat occurred, making it important to refer back to the detailed text in each habitat assessment (Figure 3.3.5). In the case of climate change for example, modifications to the wave exposure regime and sea level rise are of particular relevance to littoral habitats, whereas changes in temperature and pH are emphasised for the deeper circalittoral habitats.

Coastal and nearshore habitats are identified as being under a common pressure: that of historical and various types of continuing pollution. These include nutrient enrichment, oil spills at sea, and synthetic compound contamination. Urbanisation and hydrological changes are also frequently cited as a major pressure on many of these habitats, particularly those commonly associated with estuaries. The pressures on infralittoral and circalittoral habitats are similar, but with pollution most frequently cited for the former and biological resource use (primarily the impacts of mobile demersal fisheries) the most frequently cited pressure on the predominantly deeper sediment habitats.

Climate change is identified as a significant issue for a wide range of habitats across all zones. This is largely raising concerns about the possible future effects of sea level rise (a considerable issue for intertidal habitats), sea temperature rise, acidification, species migration and increased storminess and exposure effects. While the concerns are largely in the category of future predictions, some examples of clear climate change effects, such as a northward migration of species, have been already detected (e.g. Edwards *et al.*, 2016).

Data gaps

There has been a long history of study of the benthic habitats in the North-East Atlantic. Despite this, there remain major gaps in knowledge for all the aspects required for undertaking a Red List assessment, namely: habitat definitions, distribution, and trends in quality and quantity.

The EUNIS habitat definitions for this regional sea were mostly derived from descriptions of marine habitats around the British Isles and required particular attention to adequately cover the Macaronesian islands and the Iberian coast. Work is still needed to ensure a good definition for habitats across this regional sea as part of the ongoing efforts to finalise the marine EUNIS typology. There was also very limited information on potential indicators of habitat quality, a gap that can only be filled once there is greater understanding of the structural and functional elements of habitats as well as their characteristic species.

EUSeaMap was a starting point for information on habitat extent. In some cases, the habitat typology corresponded to that used for this Red List assessment so some indication of area covered and extent could be given. Nevertheless, because of the nature of this type of data, a broad scale habitat mapping/modelling exercise, there were expected limitations with its use for this assessment process as it could not be used to determine trends in habitat extent.

Data on historical trends in quantity or quality, over both 50-year and longer time scales were mostly absent, although there were repeated survey data for some habitats in some locations. Where pressures could be identified and, in some cases represented spatially, overlaying these with modelled distribution of EUNIS level 4 habitats was used to consider the likely current scale of impact. Knowledge of the time period over which such pressures have been taking place enabled some determination of trends based on expert judgement. This resulted in relatively frequent application of the trend in quality criterion (C/D1).

Data Deficient habitats

A large proportion (60%, 52 habitats) of the habitats in the North-East Atlantic region were Data Deficient. Most of these are thought to have a wide distribution and extensive occurrence. They are therefore unlikely to be threatened under criterion B 'Restricted Geographical Distribution'. There was often some information on threats and pressures, for example based on the outcomes of the MarLIN and MarESA sensitivity assessments and on potentially beneficial conservation measures, albeit sometimes derived from knowledge of similar habitats or the presence of common characterising species. Detailed descriptions and studies on impacts in particular localities were used where available, but ultimately it was a lack of data on overall trends in either quantity or quality that resulted in the majority of habitats being considered as Data Deficient at the present time.

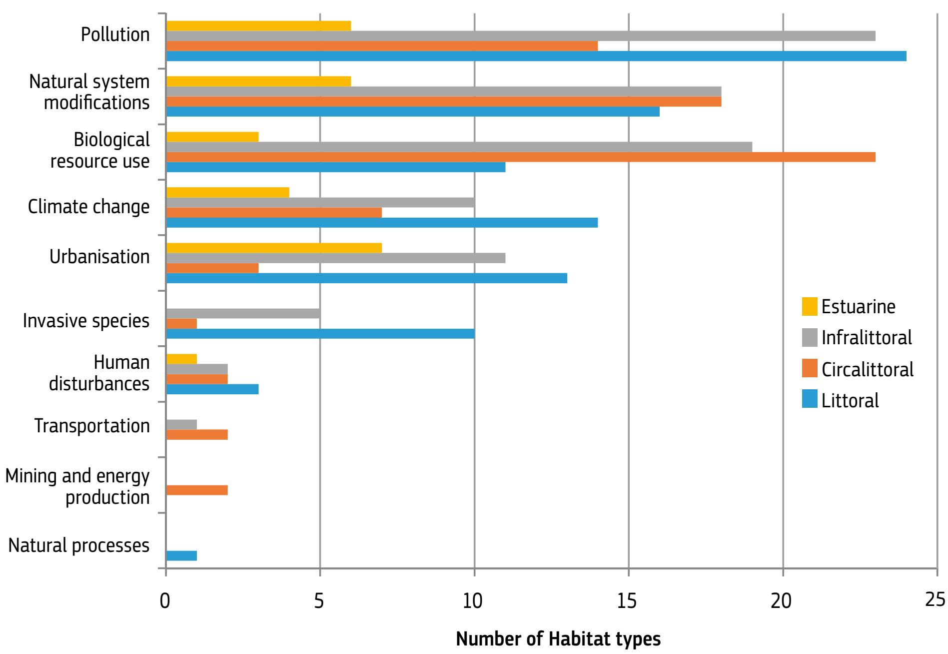


Figure 3.3.5 The most frequently cited pressures and threats for littoral, infralittoral, circalittoral and estuarine habitats in the North-East Atlantic region (EU28 and EU28+). Full titles, taken from Habitats Directive Article 17 reporting are Pollution; Natural system modifications; Biological resource use, other than agriculture and forestry; Climate change; Urbanisation, residential and commercial development; Invasive, other problematic species and genes; Human intrusions and disturbances; Transportation and service corridors; Mining, extraction of minerals and energy production; Natural biotic and abiotic processes (without catastrophes).

3.4 The Mediterranean Sea

The Mediterranean environment

The Mediterranean is a semi-enclosed sea with diverse oceanographic dynamics and water circulation patterns (such as gyres, upwelling and fronts), which result in surges of biological productivity in different places and at different times. It connects to the Atlantic Ocean through the Strait of Gibraltar in the west and to the Sea of Marmara and Black Sea through the Dardanelles in the north-east.

In the Strait of Sicily, a shallow ridge at 400 m depth separates the island of Sicily from the coast of Tunisia, dividing the Mediterranean Sea into two main sub-regions: the western and the eastern. The Mediterranean has narrow continental shelves and a large area of deep sea below 200 m depth, but in the northern region the continental shelves are wider (e.g. the north and central Adriatic Sea, the Aegean Sea, and the Gulf of Lion).

Four sub-basins (corresponding to MSFD subregions) have been used to indicate the geographical distribution of the marine habitats for this Red List assessment (Figure 3.4.1). These are bordered by the EU28 countries of Spain, France, Italy, Malta, Slovenia, Croatia, Greece and Cyprus. The EU28+ countries in the study area are: Montenegro, Albania and Turkey. The total area covered by the regional assessments is an estimated 1,697,108 km^2.

Benthic marine habitats of the Mediterranean

The Mediterranean Sea has a narrow continental shelf in most parts. The sea-floor drops from seagrass beds, rocky shores and sandy beaches to the continental slope and steep underwater geological structures such as submarine canyons, seamounts, mud volcanoes, cold seeps, and trenches more than 5,000 m deep. Tides are of a very low amplitude with the tidal range mostly only a few centimetres. One consequence is a limited intertidal (mediolittoral) zone compared to the North-East Atlantic.

The sea is generally oligotrophic, although there are exceptions such as parts of the Adriatic Sea where municipal sewage and discharge of nutrients have resulted in a highly eutrophic system. Regional features enrich coastal areas and allow the development of a varied and unique mosaic of marine and euryhaline habitats (Figure 3.4.3 see over). There are strong environmental gradients across the Mediterranean basin, with the eastern end more oligotrophic than the western, as well as different local wind conditions, temporal thermoclines, currents and river discharges. The diversity of the environmental conditions is reflected in the diversity of the habitats across the basin. Past human influences have also strongly interacted with the environment, influencing the distribution and condition of marine habitats.

An estimated 28% of Mediterranean marine species are considered to be endemic (Fredj *et al.*, 1992). In terms of species diversity, the Western Mediterranean with the influence of the Atlantic and its wide range of physicochemical conditions, is considered the richest part of the Mediterranean, followed by the central Mediterranean, Adriatic, and Aegean Seas. In the Adriatic (particularly the North Adriatic with its much shallower depth) and the Gulf of Lion the

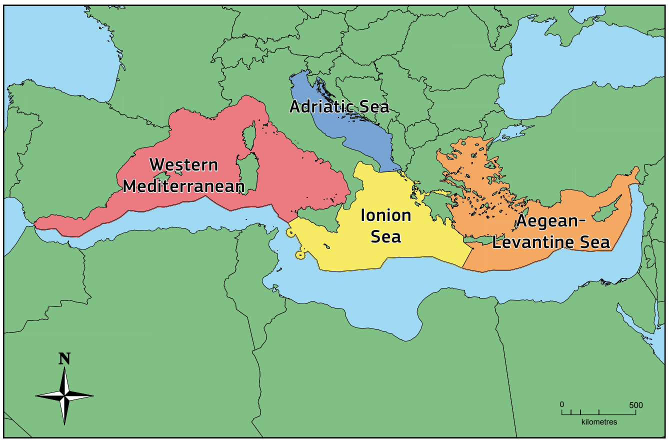


Figure 3.4.1 The Mediterranean Sea region with four sub-basins.

presence of freshwater riverine inputs and the larger amplitude of temperature variations and colder winters have resulted in a relatively high proportion of endemic species.

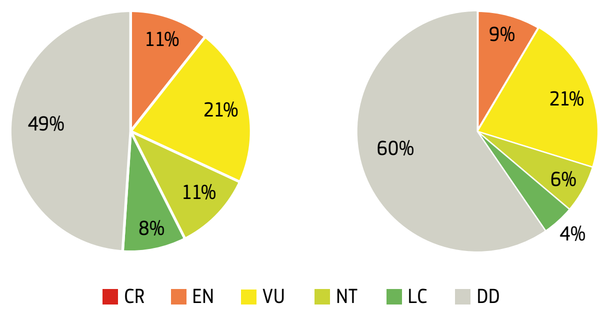
Assessment results

Just under half of the habitats in the Mediterranean (23 habitats, 49%) were Data Deficient in EU28 countries. Of the remainder (24 habitats) 83% were of conservation concern (NT-CR) with 63% threatened to some degree (42% Vulnerable and 21% Endangered). The situation was similar for the EU28+ with 90% of habitats which were not Data Deficient (19 habitats) being of conservation concern (NT-CR) and 74% (14 habitats) threatened to some degree (53% Vulnerable and 21% Endangered (Box 3.4.1, Table 3.4.1 and Figure 3.4.2).

Table 3.4.1 Number of Mediterranean Sea habitats in each Red List category for both the EU28 and EU28+.

Red List category	EU28	EU28+
CR	0	0
EN	5	4
VU	10	10
NT	5	3
LC	4	2
DD	23	28
TOTAL	**47**	**47**

Figure 3.4.2 Proportion of Mediterranean Sea habitats assigned to each Red List category in the EU28 and EU28+: (a) all habitats EU28 (n=47), (b) all habitats EU28+ (n=47). (n=number of habitats)



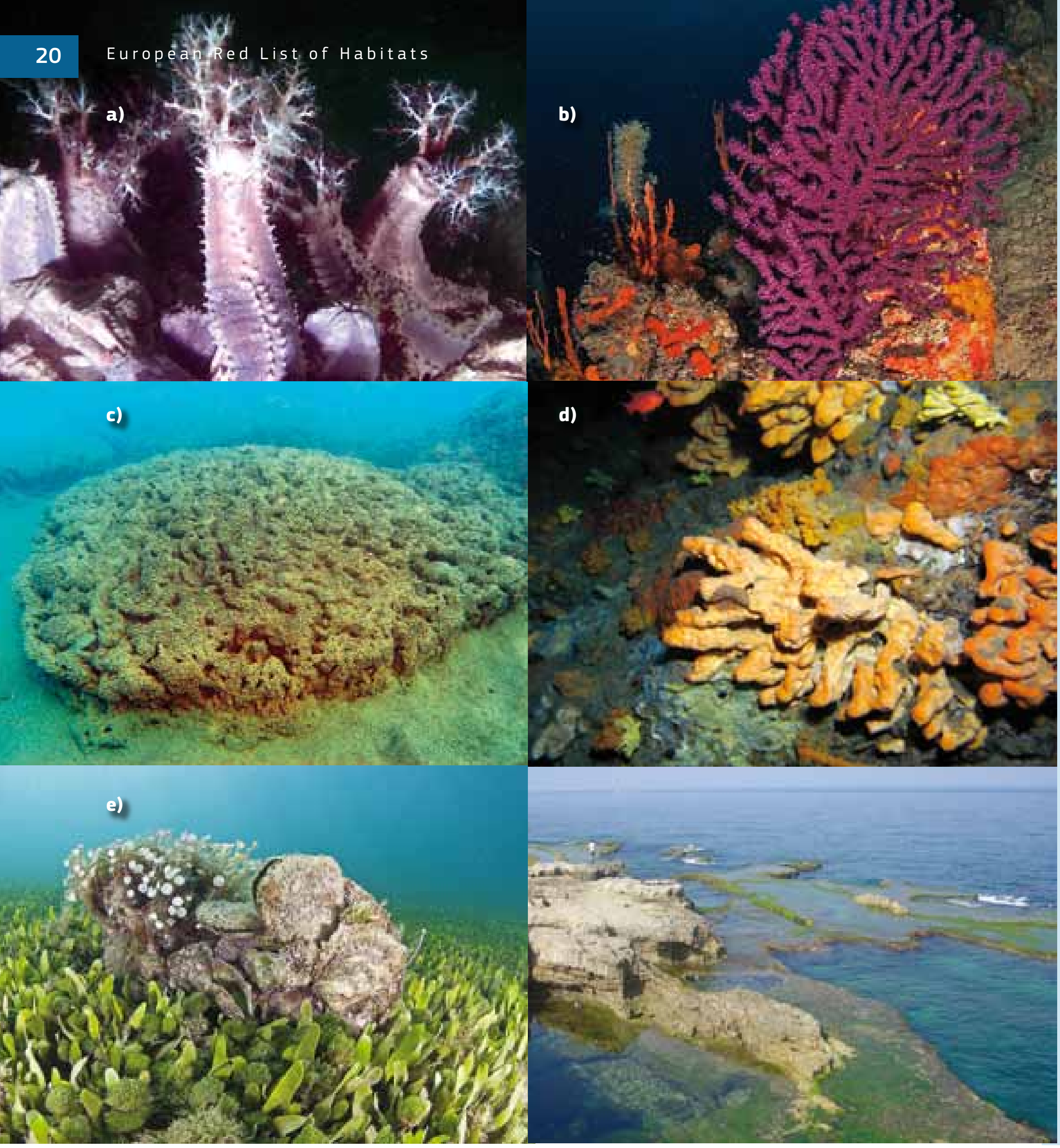


Figure 3.4.3 Examples of habitats in the Mediterranean Sea region.

a) *Pseudothyone raphanus* from the North Adriatic Sea at 18 m depth. © S. Canese/ ISPRA

b) Gorgonian (*Paramuricea clavata*) at 60 m depth, Patraikos Gulf, Greece. © K. Milonakis

c) *Sabellaria spinulosa* worm reef from Torre Mileto, Adriatic Sea. © Corriero

d) Semi-dark cave communities, Aegean Sea. © V. Gerovasileiou

e) Infralittoral oyster beds. South Evoikos, Greece. © D.Pousanidis

f) Vermetid reef in Lebanon on mediolittoral rock. © M.Bariche

Box 3.4.1 Threatened Mediterranean Sea marine habitats (for more information refer to the full assessments).

Endangered

A2.31 Communities of Mediterranean mediolittoral mud estuarine
A3.13 Photophilic communities with canopy-forming algae in Mediterranean infralittoral and upper circalittoral rock
A5.52B Algal dominated communities in the Mediterranean infralittoral sediment
A5.6v Mediterranean infralittoral mussel beds
A5.6y Mediterranean infralittoral oyster beds

Vulnerable

A2.25 Communities of Mediterranean mediolittoral sands
A2.33 Communities of Mediterranean mediolittoral mud
A2.7x Biogenic habitats of Mediterranean mediolittoral rock
A3.23 Photophilic communities dominated by calcareous, habitat-forming algae
A3.36 Communities of Mediterranean infralittoral estuarine rock
A4.23 Communities of Mediterranean soft circalittoral rock
A5.27 Communities of Mediterranean lower circalittoral sand
A5.32 Communities of Mediterranean infralittoral mud estuarine
A5.38 Communities of Mediterranean infralittoral muddy detritic bottoms
A5.535 Posidonia beds in the Mediterranean infralittoral zone

According to the present results, the most threatened habitats occur in estuarine environments where all the habitats with enough data to apply the criteria had a threatened status. A good proportion of habitats in infralittoral and mediolittoral environments were nevertheless either Vulnerable or Endangered (Figure 3.4.4). They include algal-dominated communities on infralittoral sediments, and circalittoral sediments and rocks (such a *Cystoseira* dominated communities) together with mussel and oyster beds (Box 3.4.1 and Figure 3.4.4).

The criteria under which habitats were most frequently assessed as threatened in both the EU28 and EU28+ were A1, decline in extent and C/D1, a decline in quality. This was established using either quantified data or expert opinion to infer if there had been significant declines in habitat extent and if they were projected to continue into the near future leading to loss in extent.

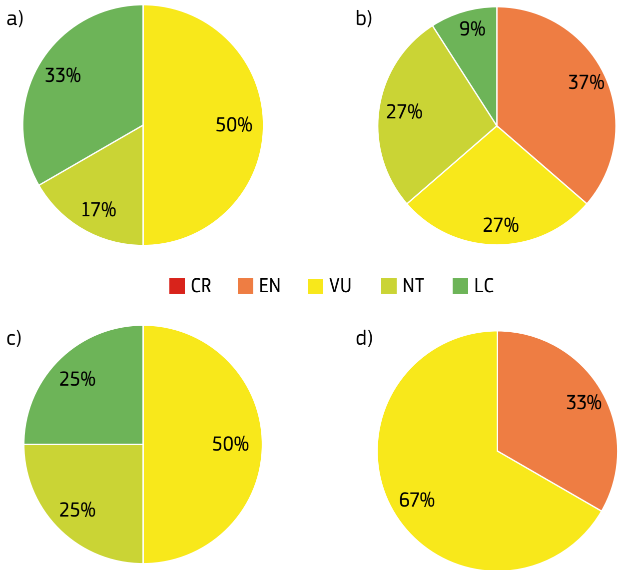
Only two habitats were assessed as threatened under criterion B2. These were habitats formed by endemic dominant structural species; Biogenic habitats of Mediterranean mediolittoral rock represented by vermetid molluscs and by red algae such as *Lithophyllum byssoides* and *Neogoniolithon brassica-florida* (A2.7x), and Photophilic communities dominated by calcareous, habitat forming algae (A3.23), as they are found at only a few sites on the European side of the Mediterranean Sea.

Main pressures and threats

Mediterranean habitats are mostly being affected and threatened by pollution, biological resource use in the form of damage by various fishing techniques and gears as well as aquaculture, human impacts caused by coastal urbanisation, and invasive non-indigenous species together with climate change (Figure 3.4.5). In general, information regarding individual threats to different habitats is quite well known, but knowledge is very limited about how multiple pressures interact with the different habitats.

Eutrophication (resulting from the discharges of agricultural nutrients, organic matter, aquaculture and urban waste) and pollution, especially in coastal regions that are heavily populated, are a problem, particularly in the northern Adriatic, where it is caused by municipal sewage and discharges of nutrients by the northern rivers (EEA, 2002). Fishing, aquaculture and aggregate dredging activities also alter the composition of the infralittoral and circalittoral communities and their productivity. More than 25% of habitat types in the Mediterranean were reported to be under threat from demersal/benthic trawling.

Figure 3.4.4 Proportion of Mediterranean Sea EU28 habitats assigned to each Red List category: (a) mediolittoral (n=6); (b) infralittoral (n=11); (c) circalittoral (n=4); (d) estuarine (n=3). Data Deficient habitats have been excluded. (n=number of habitats)



The destruction of the coastline from building and harbour development is resulting in loss of habitat and decrease in the quality of the different mediolittoral habitats and their associated communities. Some, such as beaches, rock pools, sand and rock environments are also degraded by poor water quality and marine litter. Sea level rise and increases in storm activity and intensity in the near future could contribute significantly to beach erosion and decline in the spatial extent and biotic quality of biogenic mediolittoral concretions, such as those of the alga *Lithophyllum byssoides*, and platforms formed by the algae *Neogoniolithon brassica-florida* and the vermetid mollusc *Dendropoma petraeum.*

Climate change and invasive non-indigenous species are identified as significant issues for a wide range of habitats across the marine zones in the Mediterranean Sea and the increase and unusual fluctuations of seawater temperature and storms are also known to affect several key structural species in different habitats. Moreover, ocean acidification is considered as a potential threat to some habitats, such as coralligenous communities and rhodolith beds.

Mediterranean estuarine environments are particular pressure points because of the combined impact of urbanisation, fisheries, pollution from land-based activities and aquaculture.

Data gaps

There are important gaps in basic information about the definition, distribution and temporal trends of marine habitats in the Mediterranean Sea. Many of the EUNIS Level 4 habitats

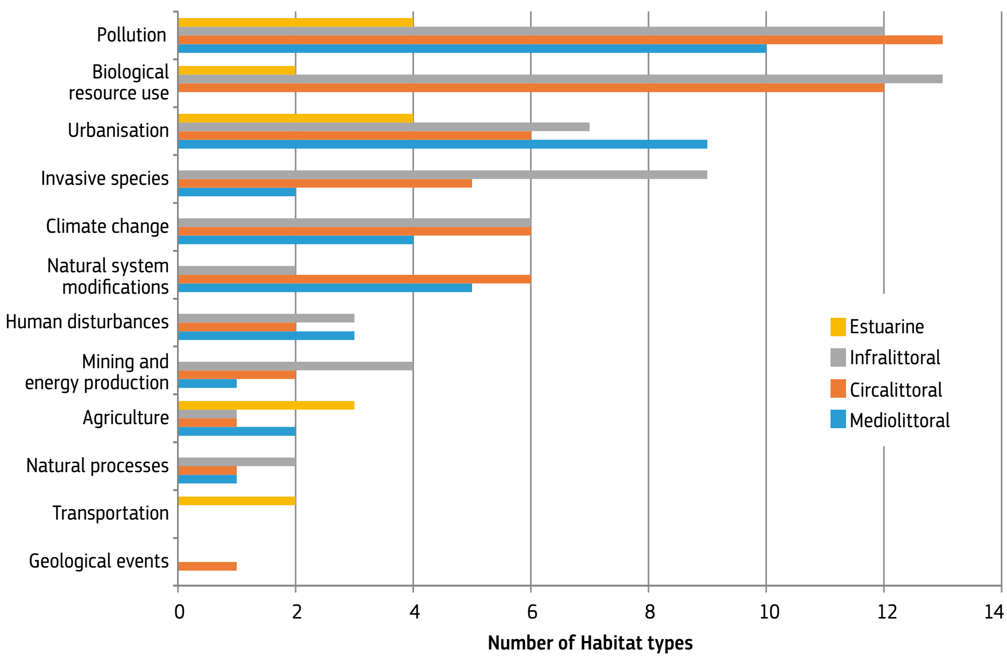
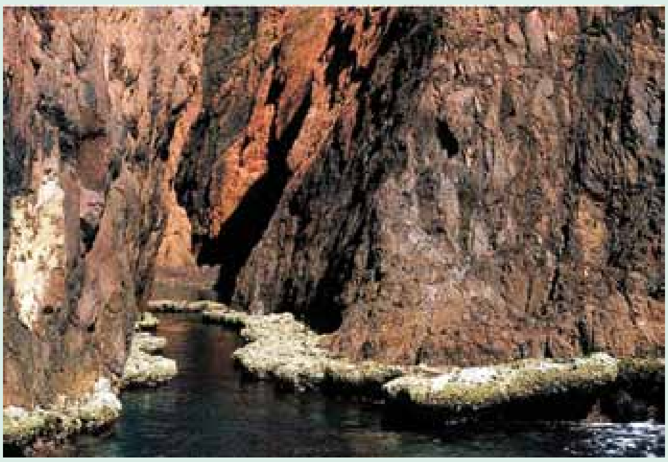


Figure 3.4.5 Most frequently cited pressures across different Mediterranean Sea habitat types in the EU28. Full titles, taken from Habitats Directive Article 17 reporting are: Pollution; Biological resource use other than agriculture and forestry; Urbanisation, residential and commercial development; Invasive, other problematic species and genes; Climate change; Natural system modification; Human intrusions and disturbances; Mining, extraction of minerals and energy production; Agriculture; Natural biotic and abiotic processes (without catastrophes); Transportation and service corridors; Geological events, natural catastrophes.

Box 3.4.2 **MEDITERRANEAN SEA CASE STUDY**
Biogenic habitats of Mediterranean mediolittoral rock
Assessment outcome: VULNERABLE

Biogenic concretions such as those of the red algae *Lithophyllum byssoides* and platforms formed by the algae *Neogoniolithon brassica-florida* and the gastropod *Dendropoma petraeum* have been described from only a few localities along the Mediterranean coastline. Their distribution is mostly restricted to the northwestern Mediterranean, the warmest part of the basin. Both reefs and rims represent unique archives to reconstruct past Mediterranean climate and especially sea level oscillations. They play an important role in preventing or slowing down the rock erosive processes. Where these reefs are well developed they increase microhabitat complexity and the associated biodiversity on the narrow Mediterranean intertidal fringe.

The habitat is vulnerable to physical impacts, such as coastal developments and trampling, and very sensitive to environmental stresses related to water quality and changes in sea level as they develop. Ocean acidification, predicted to be one of the consequences of climate change, impairs recruitment success and causes shell dissolution, as well as altering the shell mineralogy of the reef-building gastropod, *Dendropoma petraeum*.



Lithophyllum byssoides ***rims fringing rocky coastline.*** © E. Ballesteros

This habitat has a restricted distribution: there are continuing declines in its spatial extent and biotic quality and given its vulnerability to current impacts such as pollution and sea-level rise, a continuing decline in the quantity and quality is considered likely. This habitat has therefore been assessed as Vulnerable.

are lacking accurate documentation of consistent associated communities that are recognisably characteristic across the Mediterranean EU28+ countries.

The detailed distribution, and hence EOO and AOO for many habitats, is still poorly known.

Regional expertise, research and monitoring programmes over the last few decades have tended to concentrate their attention on only a few specific Mediterranean habitats, such as seagrass beds, consequently limiting the information available to undertake many assessments on other less-well studied habitats. At country level, data was not easily accessible, because the inventories were rarely publicly available. Data gaps increased towards the eastern Mediterranean. Thus, the mapping information provided through these assessments should be viewed within the scope of the present work rather than as a full and accurate representation of the exact distribution of the habitats.

For most habitats, long-term monitoring programmes were absent or unavailable for many countries. Data on historical trends in quantity or quality, over both 50 year and longer time scales, were absent and projections were used in specific cases where expert judgement was able to extrapolate observation from the recent past to estimate future trends.

Data Deficient habitats

Forty-nine percent of the habitats assessed in the EU28 (23 habitat types) and 60% (28 habitat types) in the EU28+ were Data Deficient. These were represented by habitats across all the depth zones from the mediolittoral to the circalittoral environment. This illustrates that in the Mediterranean there are many regions and habitats that remain poorly studied and there is a strong need to develop comprehensive monitoring and survey programmes.

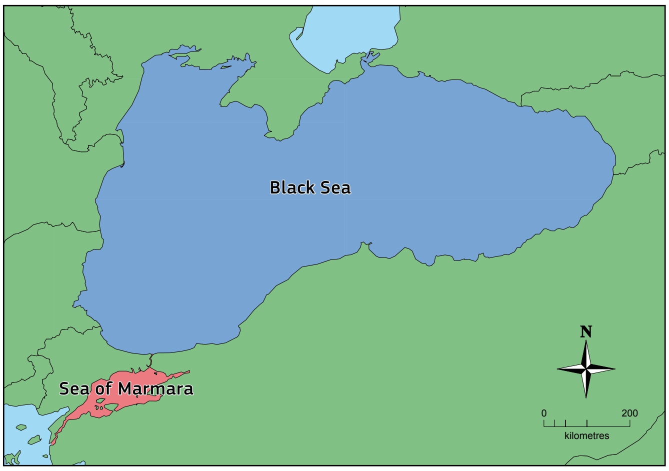
Most of the Data Deficient habitats are suspected or known to have a large natural range extending throughout the Mediterranean Sea. Nonetheless, some habitats such as polychaete worm reefs and mediolittoral caves, which are very distinctive, with a high degree of variability, are believed to have a more restricted geographical distribution.

3.5 The Black Sea

The Black Sea environment

The Black Sea is an isolated, semi-enclosed, inter-continental sea. It has a surface area of some 423,000 km^2, occupies a volume of 547,000 km^3 and has a maximum depth of 2,212 m. The shoreline is about 4,440 km long which is approximately divided between six coastal states as follows: Bulgaria (378 km), Romania (245 km), Ukraine (1,628 km), Russia (475 km), Georgia (310 km) and Turkey (1,400 km). It is connected to the Sea of Azov in the north via the Kerch Strait and to the Sea of Marmara in the south-east via the 32 km-long Istanbul Strait (Bosphorus). The Sea of Marmara, which has an area of 11,350 km^2 and lies entirely within Turkey's waters, is distinguished as a sub-basin of the Black Sea for this report (Figure 3.5.1).

Figure 3.5.1 Map of the Black Sea indicating two sub-basins.



The Black Sea has a highly specialised marine ecosystem derived from its current post-glacial condition. During glacial periods, the Bosporus Sill (30 m below current sea level) formed an effective barrier to the Mediterranean, exposing a continental shelf that was characterised by meandering river valleys, deltas and wavecut beaches. Sometime between 9,400 and 7,500 years BP, the most recent lacustrine phase ended abruptly; the Bosporus Sill was breached and the lake catastrophically flooded with marine water from the Mediterranean. As a result, the salinity of the Black Sea is about half that of the Mediterranean. The incoming salt water, denser than the freshwater it displaces, plunges to the bottom while the freshwater, flowing in from the northern rivers and out via the Bosphorus, floats on top. This phenomenon represses the natural convective heat exchange that causes water to circulate, while the large quantities of sediment and organic matter brought by the rivers, increase the turbidity of the water and sink to the deep, stagnant bottom. As a result, while the top 140 m layer of the Black Sea is constantly renewed and can support an abundance of marine life, below this level the waters become anoxic, with a high concentration of hydrogen sulphide, and inimical to life. In fact, the Black Sea is the largest body of anoxic water on the planet (87% of its volume is anoxic).

Owing to its small size and isolation from the Atlantic and Mediterranean, the tidal range of the Black Sea is not more than 8 cm, meaning that small river estuaries tend to take the form of shallow, brackish lagoons or “limans”. Especially along the northern and western shores, the coastal zone has extensive wetland ecosystems which form transitional zones connecting the vast terrestrial drainage basin and the Black Sea itself.

In addition to the Bosphorus flow currents, the Black Sea also has a unique basin-wide cyclonic boundary current (known as the rim current) that is driven by prevailing winds and the large freshwater discharge (Figure 3.5.2). In turn, the cyclonic rim current encloses two cyclonic cells within the interior basin and separates the cyclonically-dominated inner basin from the anticyclonically-dominated coastal zone: anticyclonic eddies near the Istanbul Strait, Sakarya, Sinop, Kizilirmak and Batumi are important for accumulating and transporting pelagic larvae between the coastal zone and the open sea.

The marine basin is divided into two distinct regions by the Crimean peninsula. The north-west part the basin is characterised by a relatively large shallow shelf up to 190 km wide, with gradients

Figure 3.5.2 Examples of habitats in the Black Sea Region.
a) **Turf algae on Pontic moderately exposed lower mediolittoral rock, Maslen Nos area, Bulgaria.** © D. Micu
b) **Pontic mediolittoral caves and overhangs, Bulgaria.** © D. Micu
c) **Fucales and other algae on Pontic sheltered upper infralittoral rock, visible from the surface, Strandja coast, Bulgaria.** © D. Micu
d) **Seagrass meadows in Pontic lower infralittoral sands, around Karadag, Russia.** © N. Milchakova
e) **Mussel beds on Pontic circalittoral terrigenous muds, Bulgaria.** © Y. Klissurov
f) **Invertebrate-dominated Pontic ciralittoral rock, Cherni Nos reef, Bulgaria.** © D. Micu

between 1:40 and 1:1,000. In contrast, the southern edge around Turkey and the eastern edge around Georgia has a shelf that rarely exceeds 20 km width and a gradient that is typically 1:40 with numerous submarine canyons and channel extensions.

The extensive semi-connected coastal wetlands along the northern shore extend out to the limit of submerged marine vegetation (from 6 to 20 m depth). Because of their transitional and dynamic nature, marine habitat classification around this part of the coast is complex. The main habitats in shallow-water areas are more or less shelly, or sandy, with terrigenous muds in the zone between 10 to 20 m and 150 to 200 m depth. There are extensive biogenic reefs and Black Sea-specific "fields" of the red alga *Phyllophora crispa*. The coasts of southern Crimea, the Caucasus, Anatolia, some capes in the western part of the Black Sea (Kaliakra, Emine, Maslen Nos, Galata) and Zmeiny Island are mostly rocky (Figure 3.5.2).

The Black Sea coast is highly developed for shipping (ports), hydrocarbon extraction and tourism, resulting in the extensive presence of artificial coastal structures on the land.

Assessment results

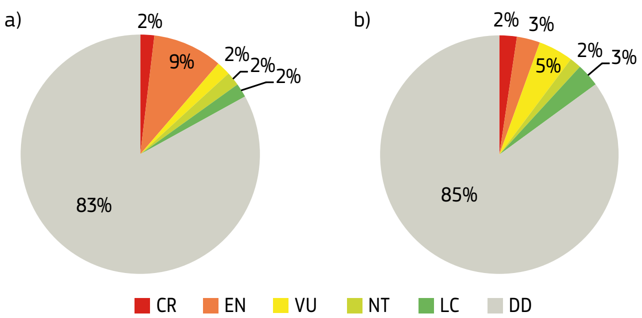
A total of 63 habitat types were assessed in the Black Sea and Sea of Marmara, an area defined as EU28+ (Table 3.5.1), while a total of 53 habitats were assessed for the EU28 (i.e. Bulgaria and Romania). As shown in Figure 3.5.3, for the EU28+ 86% of the habitats were Data Deficient (including nine habitat types only occurring in the Sea of Marmara), while for the EU28, 44 habitats (83%) were Data Deficient. The habitats assessed as threatened in either the EU28 and/or the EU28+ are set out in Box 3.5.1. The Red List categories for EU28 habitats are in all cases the same as, or higher than those in the EU28+. This is explained by the fact that the EU28 only includes 14% of the whole Black Sea coast and therefore space for habitats is more constrained.

Table 3.5.1 Number of Black Sea habitats in each Red List category for both the EU28 and EU28+.

Red List category	EU28	EU28+
CR	1	1
EN	5	2
VU	1	3
NT	1	1
LC	1	2
DD	44	54
TOTAL	**53**	**63***

* EU28+ includes nine habitats that are found in the Sea of Marmara but not in the Black Sea proper. All the latter were in the Data Deficient category.

Figure 3.5.3 Proportion of Black Sea habitats assigned to each Red List category in: (a) the EU28 (n=53) and (b) EU28+ (n=63). (n=number of habitats)



Excluding Data Deficient habitats, 78% of Black Sea habitat types found in the EU28 are threatened (VU-CR) (11% of them Critically Endangered), while 67% of habitats in the EU28+ are threatened (11% Critically Endangered) (Figure 3.5.4)

For both the EU28 and EU28+, the circalittoral shows a somewhat higher level of threat. However, in the EU28 all habitat types are quite threatened with 67% or more being assessed as Endangered or Critically Endangered. Only the circalittoral habitats show the same level of threat in both the EU28 and EU28+ (Figure 3.5.5).

Within the EU28, habitats were frequently assessed as threatened under criterion B, reflecting the smaller area involved, as well as the greater knowledge of habitat status in Bulgaria and Romania following accession to the EU and the need to implement the Habitats Directive. In the EU28+, the main criteria under which habitats were assessed as threatened were A1, highlighting declines in extent, and C/D1, indicating a decline in quality.

Main pressures and threats

The most frequently cited pressures and threats to Black Sea benthic habitats are shown in Figure 3.5.6. Across all habitat types, pollution was the most frequently cited threat, whether from the historic eutrophication experienced by the Black Sea in the 1970s to the mid-1990s, or as a potential future threat, as the coastal zone becomes ever more developed and shipping increases. The latter pressures are already cited as significant direct threats for the littoral, infralittoral and estuarine zones. For the infralittoral and circalittoral zones, modification of natural systems and use of natural resources were also highlighted as important threats.

Box 3.5.1 Threatened Black Sea habitats (for more information refer to the full assessments).

Critically Endangered

A5.xx Pontic circalittoral biogenic detritic bottoms with dead or alive mussel beds, shell deposits, with encrusting corallines (*Phymatolithon*, *Lithothamnion*) and attached foliose sciaphilic macroalgae

Endangered

A1.1xx Turf algae on Pontic moderately exposed lower mediolittoral rock
A1.44 Pontic mediolittoral caves and overhangs
A3.34 Fucales and other algae on Pontic sheltered upper infralittoral rock, well illuminated
A5.5w Seagrass meadows in Pontic lower infralittoral sands
A5.62 Mussel beds on Pontic circalittoral terrigenous muds

Vulnerable

A4.24 Invertebrate-dominated Pontic circalittoral rock

Box 3.5.2 BLACK SEA CASE STUDY

A5.xx Pontic circalittoral biogenic detritic bottoms with encrusting corallines (Phymatolithon, Lithothamnion) and attached foliose sciaphilic macroalgae

Assessment outcome: CRITICALLY ENDANGERED

This habitat is characterised by extensive stands of perennial red algae (genera Phyllophora, and Coccotylus) on a substrate of mixed sediments (shelly mud to pure shell hash) covered by dead or living crustose coralline algae *Lithothamnion crispatum*, *Lithothamnion propontidis*, and *Lithophyllum cystoseirae*. It is only present on the north-west shelf of the Black Sea, a locality linked to specific bathymetry and oceanographic conditions. There is also a delicate nutrient balance which provides suitable conditions for this habitat to form.

During the 1970s and 1980s the north-western Black Sea was heavily affected by eutrophication due to nutrient enrichment and this resulted in the reduction in extent (by several orders of magnitude) of the Phyllophora field, a habitat that was first described in 1908. Harvesting for agar was also a past pressure on this habitat. Today only a small nucleus of the habitat survives on the Ukrainian shelf. The diversity of the associated fauna and flora has also severely declined, although it is now thought to be largely stable. Bottom-trawling and expanding gas exploration activities are current and future threats to this habitat. This habitat has been assessed as Critically Endangered because of a severe reduction in quality and extent over the last 50 years.

Coccotylus truncatus ***in Zernov's Phyllophora field, Ukraine.*** © T. Hetman

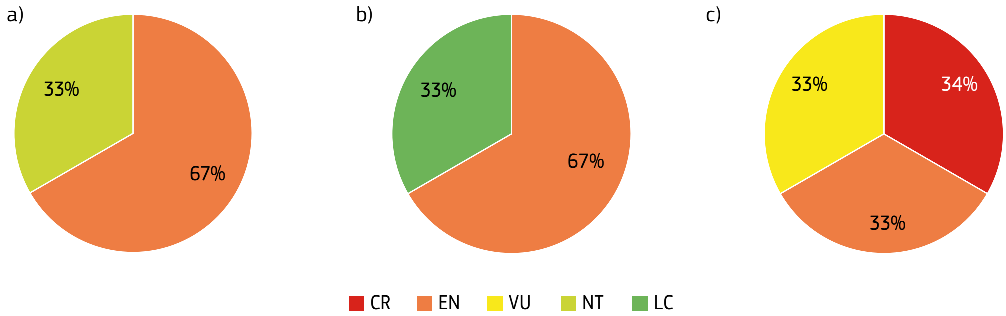


Figure 3.5.4 Proportion of assessed habitats in the Black Sea assigned to each Red List category in the EU28 excluding Data Deficient habitats: (a) littoral (n=3); (b) infralittoral (n=3); (c) circalittoral (n=3). (n=number of habitats)

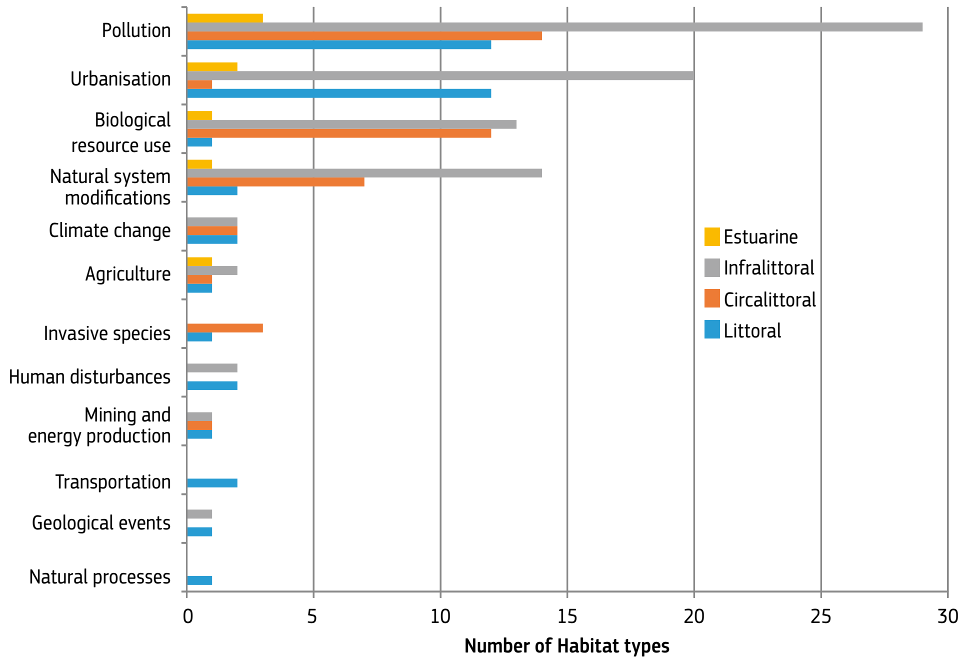


Figure 3.5.5 Most frequently cited pressures across different Black Sea habitat types in the EU28+. Full titles, taken from Habitats Directive Article 17 reporting are Pollution; Urbanisation, residential and commercial development; Biological resources use other than agriculture and forestry; Natural system modification; Climate change; Agriculture; Invasive, other problematic species and genes; Human intrusions and disturbances; Mining, extraction of minerals and energy production; Transportation and service corridors; Geological events, natural catastrophes; Natural biotic and abiotic processes (without catastrophes).

Data gaps

The classification and mapping of benthic habitats in the Black Sea using contemporary methods, harmonised across the countries under the guidance of the Black Sea Commission, has only recently begun. The typology developed within this project following the EUNIS hierarchy contributes to this process.

Data on historical trends in quantity or quality, over both 50 year and longer time scales, were mostly absent. There were some repeated survey data, for some habitats in some localities (in particular the *Phyllophora* algal fields), but in the great majority of cases the determination of trends was usually based on expert judgement.

Data Deficient habitats

Following on from the above, a very large proportion (83% in EU28 and 86% in EU28+) of the habitats in the Black Sea region were assessed as Data Deficient.

4. Discussion

4.1 The geographical scope of the assessment

Both EU28 and EU28+ countries were included in the geographical scope of this study. This was a useful approach, specifically incorporating recognition of the highly interconnected nature of marine habitats and their associated species. The regional sea areas were defined to be consistent with the MSFD but recognising significant data gaps, hence the exclusion of the southern Mediterranean countries. Whilst this was a pragmatic approach, it created concerns, for example from an ecological perspective in the case of the Sea of Marmara which has more affinities with the Mediterranean than the Black Sea, and from a policy perspective in the Kattegat which is in the HELCOM area. The Kattegat was considered in the Baltic Sea in the HELCOM Red List assessment (HELCOM 2013a), but in the North-East Atlantic region in the current assessment because the sub-basin is allocated to this region in the MSFD and is also part of the OSPAR Convention area. This is relevant when making comparisons between regional seas, and comparing this assessment with other regional sea assessments which may use different boundaries. It is less of an issue if data are to be presented at the level of the EU28 or EU28+. Future assessments may therefore reconsider these boundaries, in light of the revised EUNIS typology. Overall assessments could also be usefully complemented by national and regional projects using the same basic methodology.

4.2 The habitat typology

The starting point for the assessments was the habitat typology and the EUNIS scheme as recommended in the feasibility study (Rodwell *et al*., 2013). This had the major benefit of providing a useful European framework although its marine section was in the process of being restructured to improve consistency and applicability across European seas. The links between the EUNIS typology and some regional and national schemes are also still to be clarified, particularly in the case of the Baltic, making a direct read across problematic, as different parameters are used to distinguish habitat types under these two typologies. One consequence of this is that future iterations of this or similar assessments will need to work with the updated EUNIS scheme, so may not be directly comparable.

A further issue was the level of the typology used for the assessments. EUNIS 4 is a relatively high level of typology for marine habitats. Whilst appropriate for a European scale assessment, which is not intended to replace similar work done at a regional sea or national level, one consequence is that the coarser level obscures some very well-known endangered sub-habitats (i.e. defined at EUNIS level 5) and indicates significant data deficiencies where there may be useful material to inform assessments.

To explore this issue, a small number of EUNIS level 5 habitats identified as being of particular importance, largely due to existing international concerns and accession to other priority conservation lists were assessed using the same methodology as previously described for the Level 4 habitats. This exercise indicates that it may be possible to gather sufficient information for some EUNIS level 4 habitats by reviewing data available at EUNIS level 5. It also suggests that assessment at a more detailed level may result in a greater proportion of habitat types having a more threatened status than the broader "parent" habitat type defined at EUNIS level 4. This is because they will, by definition, have a more restricted set of characteristics and associated vulnerabilities (Table 4.2.1). This is an inherent feature of a hierarchical typology as it should become increasingly less likely that habitat types are threatened, higher up the hierarchy.

Table 4.2.1 Assessment outcomes for a number of EUNIS level 5 habitats and for the relevant EUNIS level 4 habitat (a) North-East Atlantic (b) Mediterranean Sea (c) Black Sea.

Level 4	Level 5	Habitat name	Assessment EU28
A5.43		Marine Atlantic infralittoral mixed sediments	DD
	A5.434	*Limaria hians* beds in Atlantic tide-swept sublittoral muddy mixed sediments	VU
	A5.435	*Ostrea edulis* beds on Atlantic shallow sublittoral muddy mixed sediments	CR
A5.51		Atlantic maerl beds	VU
	A5.514	*Lithophyllum* maerl beds	EN
A5.61		Polychaete worm reefs	DD
	A5.613	*Serpula vermicularis* reefs	EN

Level 4	Level 5	Habitat name	Assessment EU28
A3.23		Mediterranean and Pontic communities of infralittoral algae moderately exposed to wave action	VU
	A3.238	Facies with *Cladocora caespitosa*	EN

Level 4	Level 5	Habitat name	Assessment	
			EU28	EU28+
A3.3z		Pontic lower infralittoral rock, with significant cover of sciaphilic algae	DD	DD
	A3.3z1	Lower infralittoral rock with extensive stands of *Phyllophora crispa* with some *Apoglossum ruscifolium* and *Gelidium spinosum*	CR	CR
A5.24		Pontic infralittoral muddy sand	DD	DD
	A5.24A	Pontic lower infralittoral thalassinid-dominated muddy sands with *Upogebia pusilla* and sparse macrofauna	EN	LC
A5.61		Polychaete worm reefs in the Pontic infralittoral zone	DD	DD
	A5.61a	Biogenic reefs of *Ficopomatus enigmaticus* on sheltered upper infralittoral rock	LC	LC
	A5.61c	Massive serpulid reefs with bivalves *Ostrea edulis*, *Mytilus galloprovincialis* and *Petricola lithophaga* on lower infralittoral rock	CR	CR

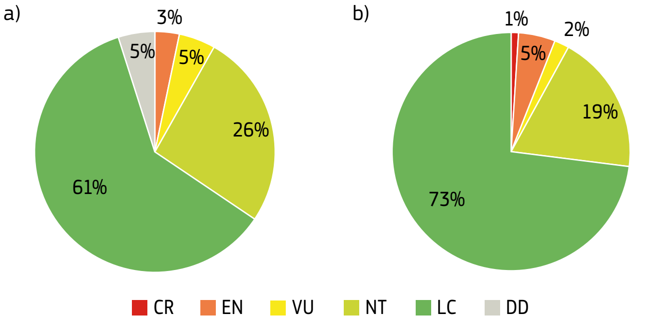
A comparison of the assessment outcomes of this project compared to those undertaken by HELCOM in 2013, where the latter were equivalent to EUNIS level 5, shows a similar pattern (Figure 4.2.1). Whilst there is no difference in percentage of threatened habitats with the two approaches (8%), working at the equivalent to EUNIS level 5 has resulted in a higher proportion in the more threatened categories (VU-CR).

The limited investigation of EUNIS level 5 habitats undertaken during this project was useful in not only informing the EUNIS level 4 assessment but also revealing that whilst a habitat may be Data Deficient at level 4, there can be a good body of information on sub-habitats at level 5. A more comprehensive look at EUNIS level 5 habitats, not necessarily for assessment at an EU-wide level, but perhaps to draw out as recommendations for assessment at Regional Sea level, as has been done for the Baltic by HELCOM, would therefore be a useful addition to the methodology in the future.

4.3 Gaps and uncertainties in the data

Due to a lack of quantitative data in most cases, and often also a lack of qualitative information, particularly relating to historical status and trends in habitat quantity or quality, assessments generally had mostly low and only occasionally medium confidence in the outcomes. Gaps in knowledge were identified and, as far as possible, mitigated by expert knowledge or identified as currently Data Deficient for Red List assessment. This highlights a clear need to increase the quantity and quality of current data on marine habitats and establish programmes for regular reporting to document any future trends, in order to improve future assessments of this type.

Figure 4.2.1 Comparison of assessment outcomes of the European Red List of habitats: a) (EUNIS level 4) n=61; and b) HELCOM Red List (~ EUNIS level 5) (HELCOM 2013a). (n=number of habitats)



4.4 Comparison across regional sea areas

The highest proportion of threatened habitats in the EU28 was in the Mediterranean Sea (32%, 15 habitats), followed by the North-East Atlantic (23%, 20 habitats), the Black Sea (13%, seven habitats), and the Baltic Sea (8%, five habitats). There was a similar pattern in the EU28+. There are a high percentage of Data Deficient habitat types (with the exception of the Baltic Sea). Lack of data was most pronounced for Black Sea habitats (83% for the EU28) followed by the North-East Atlantic (60%) and then the Mediterranean Sea (49%) (Figure 4.3.1). The small number of Data Deficient habitats in the Baltic Sea is largely due to previous work under the auspices of HELCOM, where trends in extent were quantified during a four-year process, bringing together data and experts to apply similar criteria to habitats defined in the HELCOM HUB classification (HELCOM 2013a, b).

For those habitats in the EU28 which were not Data Deficient, the situation was most severe in the Black Sea where 78% of habitats were either Critically Endangered, Endangered or Vulnerable. Equivalent figures of threatened habitats in other regional seas were 63% in the Mediterranean Sea, 59% in the North-East Atlantic and 8% in the Baltic Sea. Overall, the proportion of threatened habitats (excluding those which were Data Deficient) was similar in both the EU28 and the EU28+.

The assessment outcomes also reveal some commonalities in the status of similar habitats across regional seas. One example is the status of infralittoral seagrass beds. With two exceptions (seagrass beds of species other than *Posidonia* in the Mediterranean, and seagrass and rhizomatous algal meadows in Pontic freshwater-influenced sheltered infralittoral muddy sands and sandy muds in the Black Sea) the majority (eight out of 10) habitats characterised by seagrasses were of conservation concern (NT-CR) and four of these were threatened (VU-CR) (Table 4.4.1). Other examples are estuarine habitat types and infralittoral mussel beds which were of conservation concern (NT-CR) across all the regional seas.

4.5 Assessment criteria

For most marine habitats there was insufficient information to be precise about their present quantity and therefore criteria A, reduction in quantity, either expressed as an area, or as presence in a 10 km x 10 km grid square. More typically coarser-grained information, such as modelled habitat distribution or known

Figure 4.3.1 Comparison of assessment outcomes across regional seas for the EU28. (n=number of habitats)

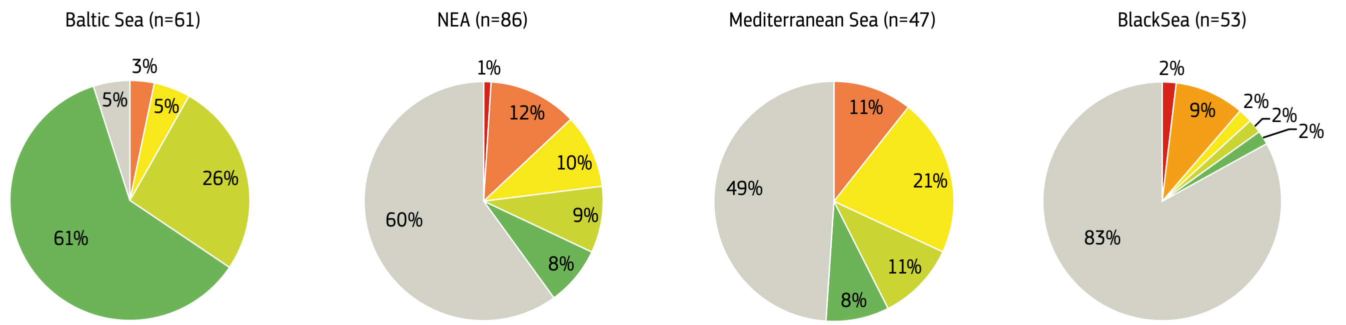


Table 4.4.1 Assessment outcomes across regional seas for infralittoral seagrass habitat types.

Region	EU28 Assessment	Habitat type
Baltic Sea	**NT**	Submerged rooted plant communities on Baltic infralittoral coarse sediment
	NT	Submerged rooted plant communities on Baltic infralittoral mixed substrata (predominantly soft)
	NT	Submerged rooted plant communities on Baltic infralittoral sand
	NT	Submerged rooted plant communities on Baltic infralittoral muddy sediment
North-East Atlantic	**VU**	Seagrass beds on Atlantic infralittoral sand (Macaronesian)
	CR	Seagrass beds on Atlantic infralittoral sand (non-Macaronesian)
Mediterranean Sea	**LC**	Seagrass beds (other than *Posidonia*) on Mediterranean infralittoral soft
	VU	*Posidonia* beds in the Mediterranean infralittoral zone
Black Sea	**LC**	Seagrass and rhizomatous algal meadows in Pontic freshwater-influenced sheltered infralittoral muddy sands and sandy muds
	EN	Seagrass meadows in Pontic lower infralittoral sands

presence in particular sub-basins within a regional sea, were used as a starting point to consider reduction in habitat quantity. Qualitative information together with expert opinion were therefore the approach to applying Criterion A1, reduction in quantity of a habitat. The time period used was often an approximation to the 50 years and estimates of change were mostly based on expert knowledge. Quantitative data were almost never available for estimating Criterion A3 Historic loss of extent and, though the period 'since 1750' may have a general validity in Europe as signalling the start of the agricultural and industrial revolutions, it is not particularly meaningful for marine habitats. For the latter a more significant benchmark in recent times would be the advent of steam powered fishing vessels. Their introduction at the end of the 19th century, resulted in a significant increase in the range, scope and intensity of fishing, a major pressure on the continental shelf habitats of European seas.

Assessment against Criterion B1 EOO was based on calculations made from distribution maps assembled from a wide variety of sources which are indicated for each map, and it was calculated by creating the minimum convex polygon encompassing all known occurrences of the habitat. Inevitably, such maps are an approximation of known distribution and they cannot be fully validated by point source data across the entire range, being sometimes dependent on extrapolation or expert judgement.

In most cases these maps were not comprehensive even when derived from existing European databases (e.g. EMODnet). Modelled data were used as supporting information, and aside from the shortcomings of such data there was also a frequent issue of availability restricted to EUNIS level 3. In practice, Criterion B could be based on expert opinion for the majority of marine habitats at EUNIS level 4 even if precise locations cannot be provided as these habitat types are often known to be present in all sub-basins and widely distributed. Future assessments may therefore reconsider the role of such maps and the need for EOO/AOO calculations for such habitats in the assessment process.

While most marine habitats had a large EOO (larger than the threatened thresholds), no other information was available to assess the risk of collapse. Expert opinion was that such habitats would more appropriately be reported as Data Deficient overall, even though they were assessed as Least Concern under Criterion B.

Even where very accurate EOO and AOO data are available, other information could be of significance for assessment of geographic distribution, vulnerability to threats and capacity for recovery. For example, some habitats are differently distributed across Europe even where their EOO is more or less the same. An unevenly distributed AOO within a large EOO and uneven changes in quantity and quality across the range could all influence the eventual assessment.

The existing criteria take no account of habitat dispersal - that is, whether such locations are over-, under- or evenly-dispersed within the overall EOO. Nor do they deal sensitively with habitats which are habitually represented in areas that are much smaller than the 10 km x 10 km grid used for estimating occupancy. Choice of scale, particularly for point and also linear habitats, affects whether the extent of habitats can be accurately registered (Gigante *et al*., 2016).

Because habitats comprise assemblages of plants and animals inextricably linked with the environmental context which sustains them, it can be difficult or impossible to distinguish declines in abiotic quality from the biotic, even though some of these differences can be important when it comes to conservation and they can sometimes be measured by strictly biotic or abiotic variables In the European assessments it was therefore agreed that **Criteria C and D Trends** in quality could be combined. Also, different degradation processes were often added together to assess overall quality decline, using a simplified qualitative scheme of stage of quality degradations caused by all acting pressures together. In this way decline in quality relates to the sum of degradations caused by all acting pressures together.

Guidance on potential indicators of quality for assessment under Criterion C/D were provided but with a few exceptions (e.g. seagrass beds and various biogenic reef types), there is still much uncertainty on detailed quality parameters for EUNIS level 4 habitats, and even less on trends for any measures of quality that can be quantified. It is also the case that each pressure can have a differing severity of impact across the variation within the habitat. Converting such terms as 'moderate' or 'severe' declines in quality into numerical values for calculating the scale and extent of changes in quality was therefore largely an exercise based on expert judgement. Indeed, for marine habitats there was considerable reliance on expert judgement, and under such circumstances, the value of joint assessment by several experts working together, through regional sea groups, is a useful approach.

Application of **Criterion E**, involving analysis using potential changes and scenarios through quantitative model of ecosystem processes to help forecast possible outcomes for habitats over time, was not possible for any of the marine habitats through lack of available research. In fact, the notion of collapse is altogether more problematic for habitats than for populations of plant or animal species which, once extinct, disappear completely. When a habitat 'collapses' it is generally transformed into another habitat which, though often of lower quality, nevertheless has the potential to improve unless it is fully replaced, such as by a terrestrial habitat.

4.6 Other elements of assessment

The list of threats and pressures used for the assessment was taken from the Habitats Directive Article 17 reporting which is used for both terrestrial and marine habitats. Although this proved generally adequate for marine habitats, the marine specific categories being used in the MSFD are more meaningful in a marine context. Most especially, fishing impacts should be identified as such rather than '*biological resource use other than agriculture or fisheries*'. The correspondence between the two lists of threats and pressures is shown in Annex C.

The classification available for indicating 'Conservation and management needs' (from Article 17 reporting) are unhelpfully brief to adequately cover the actions necessary for sustainability and restoration or recoverability of the Red List habitats and need revision.

Ease of recoverability – whether intervention was necessary and over what time scale results might be expected – are included in the assessment but this information was not factored into the overall calculation of the assessment outcome. It is clear that habitats that are equally threatened may have rather different prospects of recovery, dependent on the particular threats, their impact and the habitat resilience. Also different contingents of the biota may re-establish at different rates.

Although a list of characteristic species was provided for each habitat and general references to species richness included in the Summary, Habitat description and among the Indicators of quality, no measure of **species richness and rarity** was included in the actual assessment. In particular, apart from mentions in the text, no lists of scarce, or endemic species, species on the edge of their distribution range are provided. It is clear that sub-types are sometimes characterised by such species, and that these endemics may be themselves more highly threatened than the habitat as a whole. It would be especially valuable to compare the habitat assessments with the distribution of any red-listed species found among them.

5. Applications of the Red List

5.1 General policy applications

For the first time, the European Red List of Habitats provides an overview of extent and threat for benthic marine habitats on the continental shelf of the EU28 and EU28+. Within the existing framework of the EUNIS habitat classification, it offers a refined typology and description of the habitats, distribution maps, indication of threats and conservation measures and an assessment of the risk of collapse, a measure of degree of endangerment. This complements and goes beyond information already available for habitats that are protected under existing European legislation, identifying further vulnerabilities and offering options for restoration and recovery. It thus contributes to assessments and implementation of the Habitats Directive and the Marine Strategy Framework Directive as well as to analysis of policy effectiveness, and facilitates more targeted and coordinated conservation actions.

5.2 Red List evaluations and habitat restoration and recovery

The various outcomes of the European Red List of Habitats provide vital information to help meet the associated action goals of restoring degraded habitats under Target 2 in the EU 2020 Biodiversity Strategy. For marine habitats, where the main opportunities are recovery rather than restoration, the information behind the assessments themselves indicate (1) which habitats need restoration or recovery most urgently and (2) which particular threats must be alleviated for recovery to be initiated. There are expert judgements about (3) whether habitats might recover from damage with or without intervention and (4) how long recovery might take. Then, (5) indicators of quality, available for some marine habitats, provide some specific characteristics against which progress to restoration or recovery might be measured.

5.3 Combining Red List assessments at a seascape scale

Marine and coastal ecosystems comprise many different habitats which have functional relationships and often are mutually dependent on each other. More so than in terrestrial habitats, where animals have to migrate or be transported by wind, in marine and tidal systems water is the prime transporting agent. Furthermore, tidal movements and waves are responsible for maintaining the morphology and interconnection between habitats (Figure 5.1).

Larvae are transported between habitats, and different life stages prefer different habitats, nutrients and food. For example, plankton are interchanged between habitats, and sediment is transported back and forth giving rise to intertidal flats with different sediment characteristics, saltmarshes and primary dunes. In this way seascapes are formed on a short timescale (years, decades or centuries) in contrast to longer time frame landscape forming processes in terrestrial, fluvial and mountainous systems. One of the criteria on which the Wadden Sea gained the UNESCO World Heritage label is the ongoing natural development leading to and maintaining this type of ecosystem (Baptist *et al.*, 2008; Reise *et al.*, 2010). Habitats with functional inter-relationships of this type may as a whole be threatened if one of the component habitats is under some form of stress. Assessments at the scale of a 'seascape' (interconnected habitats, sometimes also referred to as habitat complexes), would therefore complement assessments of individual habitat types. Assessments of the conservation status of the Wadden Sea (Ssymank & Dankers 1996) and of some of the Habitats Directive Annex I types (e.g. estuaries, and shallow bays and inlets) illustrate such an approach.

Figure 5.1 Eastern tip of the Wadden Sea barrier island Schiermonnikoog showing different habitats forming a seascape. © Google Earth

6. Conclusions

General conclusions

For the first time, the European Red List of Habitats has applied an accepted framework of assessment to provide a comprehensive and systematic overview of the current extent, quality and degree of endangerment (risk of collapse) of all benthic marine habitats on the continental shelf (<200 m depth) of the EU28 and EU28+. In addition, it provides for all 257 habitats rich supporting information including habitat definitions, characteristic species, distribution maps, lists of threats, conservation measures and recoverability.

Overall 19% of the habitats assessed (18% for the EU28+) were in the three threatened categories: Critically Endangered (1%), Endangered 9% (7% for the EU28+) and Vulnerable 9% (10% for the EU28+). An additional 12% (11% in the EU28+) were in the Near Threatened Category. A large proportion of the habitats (49% in the EU28 and 53% in the EU28+) were Data Deficient.

The highest proportion of threatened habitats in the EU28 was in the Mediterranean Sea (32%, 15 habitats), followed by the North-East Atlantic (23%, 20 habitats), and the Black Sea (13%, seven habitats). There was a similar pattern in the EU28+. A large proportion of marine habitats were Data Deficient in the Black Sea (83%), the North-East Atlantic (60%), and the Mediterranean Sea (49%). The exception was the Baltic Sea (5% Data Deficient), because of previous similar work by the Helsinki Commission.

Excluding Data Deficient habitat types, the highest percentage of threatened marine habitats for the EU28 was in the Black Sea (78%) and for the EU28+, in the Mediterranean Sea (74%). The assessments also reveal some patterns in the status of habitat types depending on key characteristics such as substrate type, and the biological zones (littoral, infralittoral and circalittoral) where they typically occur. There are also some commonalities in the status of similar habitats across the four regions, for example infralittoral seagrass beds, estuarine habitat types and infralittoral mussel beds which are all of conservation concern (Near Threatened to Critically Endangered) across the regional seas.

Due to a lack of quantitative data in some cases, assessments generally had only low to medium confidence in the outcomes. Gaps in knowledge were identified and, as far as possible, mitigated by expert knowledge or identified as currently Data Deficient for the Red List assessment. There is a clear need to increase the quantity and quality of data on marine habitats to underpin future assessments of this type.

The results of the European Red List of Habitats can be appraised and implemented as one entirely new tool for enabling policy-makers to assess commitments for environmental protection and recoverability within the EU2020 Biodiversity Strategy. In particular, they will allow an appraisal of how a Red List assessment can complement monitoring the effectiveness of the Habitats Directive through Article 17 reporting and of the Marine Strategy Framework Directive.

The Red List habitat typology is not identical to that in Annex I of the Habitats Directive and, in the case of marine habitats, the latter is far less comprehensive to that used for this Red List assessment. Furthermore, the reasons for designation under the Habitats Directive are concerned with more than the degree of threat; also, the assessments of threat in the European Red List of Habitats are not identical to the categories of Conservation Status. Nonetheless, the Red List provides information on status and trends for a more comprehensive suite of benthic marine habitats, and the supplementary standardised information on habitat character and distribution can be employed for refining our understanding of European biodiversity.

Although the inherited EUNIS habitat classification, which formed the basis of the Red List typology was in the process of being revised, it provided a common framework for all regional seas. The modifications of EUNIS undertaken for this project have, in fact, yielded improvements which, together with the revisions underway in EEA projects, will provide a lasting legacy.

The assessment methodology was based on modifications of the IUCN Red List of Ecosystems Categories and Criteria (Keith *et al.*, 2013; IUCN 2016), which gave the project the benefit of a familiar framework. Following the Red List Feasibility Study (Rodwell *et al.*, 2013), modifications to applying the criteria for the European Red List were a realistic response to the amount of available data for benthic habitats that are highly diverse and dynamic.

The supportive information provided by this project behind the Red List assessments themselves – on habitat definition, species content and distribution, main pressures and threats, and Red List assessment details – provides a rich resource that will be made available for public download for all interested institutions, NGOs and individual researchers. The cross-walks between the Red List habitats with EUSeaMap, MSFD predominant habitat types, and threatened habitats identified under regional sea conventions for marine habitats provide an open door for wider ownership of the results of the project among a European community of end-users. Since the results of the Red List can be made spatially explicit on a fine-scale European grid through distribution and impact maps, the results offer an important new resource for exploring the well-being of ecosystems and their services through MAES and will deliver relevant supporting information for implementation of the MSFD.

The wide community of experts who participated in the European Red List of Habitats project from across Europe represents a network through whom the results can be promoted in policy, science and conservation management forums. More widely, they can stimulate an open-minded discussion of the method of Red List assessment as implemented in this project, for example on the usefulness of the typology to capture European biodiversity, the validity of the existing criteria, thresholds and categories used to measure the degree of threat, the need for further criteria, and the value of further mapping and monitoring. Improvements to the Red List of Habitats approach and data availability can strengthen our shared commitment to the future of European biodiversity.

7. References

Avellan, L., Haldin, J., Kontula, T., Leinikki, J., Naslund, J. and Laamanen, M. (2013). HELCOM HUB. Technical Report on the HELCOM Underwater Biotope and habitat classification. *Baltic Sea Environment Proceedings* No. 139. 96pp.

Baptist, M.J., Dankers, N. and Smit, C. (2008). The outstanding universal values of the Wadden Sea: An ecological perspective. In: CWSS (ed) Nomination of the Dutch-German Wadden Sea as a World Heritage Site. *CWSS Wadden Sea Ecosystem* 24: 183–194.

Barrow, E.G., Bland, L.M., Boe, K., Keith, D.A., Miller, R.M., Murray, N.J. and Rodríguez, J.P. (Eds.) (2016). *An Introduction to the IUCN Red List of Ecosystems: A Global Standard for Monitoring the Status of Ecosystems*. Gland, Switzerland: IUCN. iii + 14pp.

Bellan-Santini, D., Bellan, G., Bitar, G., Harmelin, J.G. and Pergent, G. (2002). *Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest.* UNEP Action Plan for the Mediterranean. Regional Activity Centre for Specially Protected Areas. UNEP publication. 217pp.

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004). *The Marine Habitat Classification for Britain and Ireland Version 04.05*. In: JNCC (2015) The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. Available from: jncc.defra.gov.uk/MarineHabitatClassification ISBN 1 861 07561 8.

Connor, D.W. (2013). *Proposal for a revision of the EUNIS marine habitat classification*. Unpublished report to European Environment Agency.

Edwards, M., Helaouet, P., Alhaija, R.A., Batten, S., Beaugrand, G., Chiba, S., Horaeb, R.R., Hosie, G., Mcquatters-Gollop, A., Ostle, C., Richardson, A.J., Rochester, W., Skinner, J., Stern, R., Takahashi, K., Taylor, C., Verheye, H.M. and Wootton, M. (2016). *Global Marine Ecological Status Report: results from the global CPR Survey 2014/2015*. SAHFOS Technical Report, 11: 1–32. Plymouth, U.K. ISSN 1744-0750 Published by: Sir Alister Hardy Foundation for Ocean Science ©SAHFOS 2016.

EUNIS (2007). EUNIS Habitat Classification. http://www.eea.europa.eu/themes/biodiversity/eunis/eunis-habitat-classification.

European Environment Agency (2002). *Europe's biodiversity – biogeographical regions and seas. The Mediterranean Sea*. EEA Report No.1/2002. 22pp. Available to download at http://www.eea.europa.eu/publications/report_2002_0524_154909.

Evans, D. and Arvela, M. (2011). *Assessment and reporting under Article 17 of the Habitats Directive – Explanatory Notes & Guidelines for the period 2007–2012*. Final Draft, July 2011. European Topic Centre on Biological Diversity. Available to download at http://bd.eionet.europa.eu/article17/reference_portal.

Evans, D., Condé, S. and Gelabert, E.R. (2014). *Crosswalks between European marine habitat typologies – a contribution to the MAES marine pilot*. European Topic Centre on Biological Diversity. Technical paper 1/2014. 29pp.

Galparsoro, I., Connor, D.W., Borja, A. *et al.* (2012). Using EUNIS habitat classification for benthic mapping in European seas: Present concerns and future needs. *Marine Pollution Bulletin* 64: 2630–2638.

Galparsoro, I., Borja, A. and Uyarra, M.C. (2014). Mapping ecosystem services provided by benthic habitats in the European North Atlantic Ocean. *Frontiers in Marine Science* 1:23. doi:10.3389/fmars.2014.00023.

Gigante, D., Foggi, B., Vananzoni, R., Viciani, D. and Buffa, G. (2016). Habitats on the grid: The spatial dimension does matter for red-listing. *Journal for Nature Conservation* 32: 1–9.

HELCOM (2013a). Red List of Baltic Sea underwater biotopes, habitats, and biotope complexes. *Baltic Sea Environment Proceedings* No. 138. Helsinki Commission. 69pp.

HELCOM (2013b). HELCOM HUB – Technical Report on the HELCOM Underwater Biotope and habitat classification. *Baltic Sea Environment Proceedings* No. 139. 96pp.

HELCOM (2015). HELCOM sub-divisions and assessment units for core indicators. HOLAS II 2-2015. Baltic Marine Environment Protection Commission. Project for the development of the second holistic assessment of the Baltic Sea. 6pp.

IUCN (2001). *IUCN Red List Categories and Criteria: Version 3.1*. Gland, Switzerland and Cambridge, U.K.: Species Survival Commission, World Conservation Union (IUCN). 30pp.

IUCN (2016). *Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria. Version 1.0*. Bland, L.M., Keith, D.A., Murray, N.J., Miller, R. and Rodríguez, J.P. (Eds.). International Union for Conservation of Nature (IUCN), Gland, Switzerland. ix + 93pp.

Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes, T., Nieto, A., Sanders, N., Landucci, F., Loidi, J., Ssymank, A., Tahvanainen, T., Valderrabano, M., Acosta, A., Aronsson, M., Arts, G., Attorre, F., Bijlsma, R.-J., Bioret, F., Biță-Nicolae, C., Biurrun, I., Calix, M., Capelo, J., Čarni, A., Chytrý, M., Dengler, J., Dimopoulos, P., Essl, F., Gardfjell, H., Gigante, D., Giusso del Galdo, G., Hájek, M., Jansen, F., Jansen, J., Kapfer, J., Kontula, T., Mickolajczak, A., Molina, J.A., Molnar, Z., Paternoster, D., Pierik, A., Poulin, B., Renaux, B., Schaminée, J.H.J., Sumberova, K., Toivonen, H., Tonteri, T., Tsiripidis, I., Tzonev, R. and Valachovič, M. (2016). *Red List of European Habitats. 2. Terrestrial and freshwater habitats*. European Commission, DG Environment, Brussels.

Keith, D.A., Rodríguez, J.P., Rodríguez-Clark, K.M., Nicholson, E., Aapala, K., Alonso, A., Asmussen, M., Bachman, S., Bassett, A., Barrow, E.G., Benson, J.S., Bishop, M.J., Bonifacio, R., Brooks, T.M., Burgman, M.A., Comer, P., Comín, F.A., Essl, F., Faber-Langendoen, D., Fairweather, P.G., Holdaway, R.J., Jennings, M., Kingsford, R.T., Lester, R.E., Mac Nally, R., McCarthy, M.A., Moat, J., Nicholson, E., Oliveira-Miranda, M.A., Pisanu, P., Poulin, B., Riecken, U., Spalding, M.D. and Zambrano-Martínez, S. (2013). Scientific Foundations for an IUCN Red List of Ecosystems. *PLoS ONE* 8(5):e62111. http://dx.doi.org/10.1371/journal.pone.0062111

Lindgaard, A. and Henriksen, S. (Eds.) (2011). *The 2011 Norwegian Red List for Ecosystems and Habitat Types*. Norwegian Biodiversity Information Centre, Trondheim.

Monteiro, P., Bentes, L., Oliveira, F., Afonso, C., Rangel, M., Alonso, C., Mentxaka, I., Germán Rodríguez, J., Galparsoro, I., Borja, A., Chacón, D., Sanz Alonso, J.L., Guerra, M.T., Gaudêncio, M.J., Mendes, B., Henriques, V., Bajjouk, T., Bernard, M., Hily, C., Vasquez, M., Populus, J. and Gonçalves, J.M.S. (2013). *Atlantic Area Eunis Habitats. Adding new habitat types from European Atlantic coast to the EUNIS Habitat Classification*. Technical Report No.3/2013 - MeshAtlantic, CCMAR-Universidade do Algarve, Faro, Portugal. 72pp.

OSPAR (2011). *Pressure list and descriptions*. Intersessional Correspondence Group on Cumulative Effects – Amended 25th March 2011. Presented by the United Kingdom and the Netherlands on behalf of the Intersessional Correspondence

Group Cumulative Effects. EIHA 11/5/3 Add.2-E http://jncc.defra.gov.uk/pdf/20110328_ICG-C_Pressures_list_v4.pdf

Reise, K., Baptist, M., Burbridge, P., Dankers, N., Fischer, L., Flemming, B., Oost, A.P. and Smit, C. (2010). *The Wadden Sea – A Universally Outstanding Tidal Wetland.* Wadden Sea Ecosystem No. 29. Common Wadden Sea Secretariat, Wilhelmshaven, Germany, pp7–24.

Rodriguez, J.P., Rodriguez-Clark, K.M. and Baillie, J.E.M. *et al*. (2011). Establishing IUCN Red List Criteria for Threatened Ecosystems. *Conservation Biology*. 15(1):21–29.

Rodwell, J.S., Janssen, J.A.M., Gubbay, S. and Schaminée, J.H.J. (2013). *Red List Assessment of European Habitat Types. A feasibility study*. Report for the European Commission, DG Environment, Brussels.

Ssymank, A. and Dankers, N. (1996). *Red List of Biotopes and Biotope Complexes of the Wadden Sea Area.* Helgoländer Meeresuntersuchungen 50, suppl. 9–37.

Tillin, H. and Tyler-Walters, H. (2014). *Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities*. Phase 2 Report – Literature review and sensitivity assessments for ecological groups for circalittoral and offshore Level 5 biotopes. JNCC Report No. 512B. 260pp. Available from http://www.marlin.ac.uk/assets/pdf/Report512-B_phase2_web.pdf

UNEP (2006). *Classification of Marine Habitat Types for the Mediterranean Region*. RAC/SPA. 14pp. Available from http://www.rac-spa.org/sites/default/files/doc_fsd/lchm_en.pdf

Zampoukas, N., Henna, P., Bigagli, E., Hoepffner, N., Hanke, G. and Cardoso, A.C. (2012). *Monitoring for the Marine Strategy Framework Directive: Requirements and Options*. EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print) ISBN 978-92-79-22811-7 doi:10.2788/77640. Luxembourg: Publications Office of the European Union. 36pp.

Annex A – Lists of EUNIS level 4 marine habitats and their Red List results

A.1 Baltic Sea Results

Habitat number	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
1	Kelp communities on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
2	Perennial algal communities (excluding kelp) on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
3	Aquatic moss communities on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
4	Stable aggregations of unattached perennial vegetation on Baltic infralittoral mixed substrata (predominantly hard)	LC	LC	-	-
5	Crustose algal communities on Baltic infralittoral rock and mixed substrata	LC	LC	-	-
6	Annual algal communities on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
7	Epifaunal communities on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
8	Sparse or absent epifaunal communities on Baltic infralittoral rock and mixed substrata (predominantly hard)	LC	LC	-	-
9	Communities on Baltic infralittoral clay and other hard substrata	NT	NT	A1	A-1
10	Kelp communities on Baltic infralittoral coarse sediment/shell gravel	NT	NT	A1/2/3, B3	A1/2/3, B3
11	Perennial algae communities (excluding kelp) on Baltic infralittoral coarse sediment	LC	LC	-	-
12	Aquatic moss communities on Baltic infralittoral coarse sediment	LC	LC	-	-
13	Stable aggregations of unattached perennial vegetation on Baltic infralittoral coarse sediment	LC	LC	-	-
14	Annual algal communities on Baltic infralittoral coarse sediment	LC	LC	-	-
15	Submerged rooted plant communities on Baltic infralittoral coarse sediment	NT	NT	A1	A1
16	Emergent vegetation communities on Baltic infralittoral coarse sediment	LC	LC	-	-
17	Unvegetated epifaunal communities on Baltic infralittoral coarse sediment	LC	LC	-	-
18	Infaunal communities on Baltic infralittoral coarse sediment	NT	NT	A1	A1
19	Sparse or no macrofaunal communities on Baltic infralittoral coarse sediment	LC	LC	-	-
20	Unvegetated communities on Baltic infralittoral shell gravel	NT	NT	A1, A2a	A1, A2a
21	Infaunal communities on Baltic infralittoral shell gravel	EN	EN	B1a(ii), B3	B1a(II), B3
22	Sparse or no communities on Baltic infralittoral shell gravel	DD	DD	-	-
23	Emergent vegetation communities on Baltic infralittoral mixed substrata (predominantly soft)	LC	LC	-	-
24	Submerged rooted plant communities on Baltic infralittoral mixed substrata (predominantly soft)	NT	NT	A1	A1
25	Unvegetated Baltic infralittoral mixed sediment (hard and soft) with sparse or no macrofaunal community	LC	LC	-	-
26	Stable aggregations of unattached perennial vegetation on Baltic infralittoral sand	LC	LC	-	-
27	Annual algal communities on Baltic infralittoral sand	LC	LC	-	-
28	Submerged rooted plant communities on Baltic infralittoral sand	NT	NT	A1	A1
29	Emergent vegetation communities on Baltic infralittoral sand	LC	LC	-	-
30	Epibenthic macrocommunity on Baltic infralittoral sand	DD	DD	-	-
31	Infaunal communities in Baltic infralittoral sand - bivalves	NT	NT	A1	A1
32	Infaunal communities in Baltic infralittoral sand not dominated by bivalves	LC	LC	-	-
33	Sparse or no macrofauna communities on Baltic infralittoral sand	LC	LC	-	-
34	Stable aggregations of unattached perennial vegetation on Baltic infralittoral muddy sediment	LC	LC	-	-

A.1 Baltic Sea Results, cont'd

Habitat number	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
35	Annual algal communities on Baltic infralittoral muddy sediment	LC	LC	-	-
36	Submerged rooted plant communities on Baltic infralittoral muddy sediment	NT	NT	A1	A1
37	Emergent vegetation communities on Baltic infralittoral muddy sediment	LC	LC	-	-
38	Epifaunal communities on Baltic infralittoral muddy sediment	LC	LC	-	-
39	Infaunal communities in Baltic infralittoral muddy sediment - bivalves	NT	NT	A1	A1
40	Infaunal communities in Baltic infralittoral muddy sediment not dominated by bivalves	LC	LC	-	-
41	Sparse or no macrofaunal communities on Baltic infralittoral muddy sediment	LC	LC	-	-
42	Epifaunal communities on Baltic circalittoral rock and mixed substrate (predominantly hard)	NT	NT	A1	A1
43	Sparse or no macrofaunal communities on Baltic circalittoral rock and mixed substrate (predominantly hard)	LC	LC	-	-
44	Communities on Baltic circalittoral clay and other hard substrata	LC	LC	-	-
45	Epifaunal communities on Baltic upper circalittoral coarse sediment and shell gravel	NT	NT	A1	A1
46	Infaunal communities in Baltic upper circalittoral coarse sediment and shell gravel dominated by bivalves	VU	VU	B1/2/3	B1/2/3
47	Infaunal communities in Baltic upper circalittoral coarse sediment not dominated by bivalves	LC	LC	-	-
48	Sparse or no macrofaunal community on Baltic upper circalittoral coarse sediment and shell gravel	LC	LC	-	-
49	Epibenthic communities in Baltic upper circalittoral mixed sediment	NT	NT	A1	A1
50	Infaunal communities in Baltic upper circalittoral mixed sediment	DD	DD	-	-
51	Sparse or no macrofaunal communities in Baltic upper circalittoral mixed sediment	LC	LC	-	-
52	Epifaunal communities of Baltic upper circalittoral sand	LC	LC	-	-
53	Infaunal communities of Baltic upper circalittoral sand dominated by bivalves	NT	NT	A1	A1
54	Infaunal communities of Baltic upper circalittoral sand not dominated by bivalves	LC	LC	-	-
55	Sparse or no macrofaunal communities in Baltic upper circalittoral sand	LC	LC	-	-
56	Epifaunal communities of Baltic upper circalittoral muddy sediment	NT	NT	A1	A1
57	Infaunal communities of Baltic upper circalittoral muddy sediment dominated by bivalves	VU	VU	A1	A1
58	Infaunal communities of Baltic upper circalittoral muddy sediment not dominated by bivalves	LC	LC	-	-
59	Sparse epibenthic community of Baltic upper circalittoral muddy sediment	EN	EN	A1, B/1/2/3	A1, B1/2/3
60	Sparse or no macrocommunities of Baltic upper circalittoral muddy sediment	NT	NT	A1	A1
61	Communities of Baltic lower circalittoral soft sediments (mud and sand)	VU	VU	C/D1	C/D1

A.2 North-East Atlantic Results

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A1.11	Mytilus edulis and/or barnacle communities on wave-exposed Atlantic littoral rock	LC	LC	-	-
A1.12	Robust fucoid and/or red seaweed communities on wave-exposed Atlantic littoral rock	LC	LC	-	-
A1.13	Macaronesian communities of upper eulittoral rock	DD	DD	-	-
A1.14	Macaronesian communities of lower eulittoral rock very exposed to wave action	DD	DD	-	-
A1.15	Fucoids on tide-swept Atlantic littoral rock	DD	DD	-	-
A1.16	Macaronesian communities of exposed eulittoral rock	DD	DD	-	-
A1.17	Low coverage of fauna and flora of mediolittoral rock and boulders	LC	LC	-	-
A1.2_PT9	Seaweeds on moderately exposed shores	DD	DD	-	-
A1.21	Barnacles and fucoids on moderately wave-exposed Atlantic littoral rock	DD	DD	-	-
A1.22	Mytilus edulis and fucoids on moderately wave-exposed Atlantic littoral rock	DD	DD	-	-
A1.24	Macaronesian communities of eulittoral rock moderately exposed to wave action	VU	VU	C/D2	C/D2

A.2 North-East Atlantic Results, cont'd

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A1.31	Fucoids on sheltered Atlantic littoral rock	DD	DD	-	-
A1.32	Fucoids on variable salinity Atlantic littoral rock	DD	DD	-	-
A1.34	Macaronesian communities of lower eulittoral rock sheltered from wave action	VU	VU	B2, C/D2	B2, C/D2
A1.41	Communities of Atlantic littoral rockpools	LC	LC	-	-
A1.44	Communities of Atlantic littoral caves and overhangs	LC	LC	-	-
A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on Atlantic littoral non-mobile substrata	DD	DD	-	-
A2.11	Marine Atlantic littoral shingle (pebble) and gravel	DD	DD	-	-
A2.12	Estuarine Atlantic littoral coarse sediment	DD	DD	-	-
A2.22	Barren or amphipod-dominated Atlantic littoral mobile sand	DD	DD	-	-
A2.23	Polychaete/amphipod-dominated Atlantic littoral fine sand	DD	DD	-	-
A2.24	Polychaete/bivalve-dominated Atlantic littoral muddy sand	DD	DD	-	-
A2.31	Polychaete/bivalve-dominated mid-estuarine Atlantic littoral mud	EN	EN	A3	A3
A2.32	Polychaete/oligochaete-dominated upper estuarine Atlantic littoral mud	EN	EN	A3	A3
A2.33	Marine Atlantic littoral mud with associated communities	EN	EN	A3	A3
A2.41	Hediste diversicolor dominated variable salinity Atlantic littoral gravelly sandy mud	DD	DD	-	-
A2.42	Species-rich Atlantic littoral mixed sediment	DD	DD	-	-
A2.43	Species-poor Atlantic littoral mixed sediment	DD	DD	-	-
A2.61	Seagrass beds on Atlantic littoral sediment	NT	NT	A1,A3,C/D3	A1, A3. C/D3
A2.71	Worm reefs in the Atlantic littoral zone	NT	NT	A1	A1
A2.72	Mussel beds in the Atlantic littoral zone	EN	EN	A1,C/D1	A1,C/D1
A2.82	Vegetated (ephemeral) Atlantic littoral mixed sediment	DD	DD	-	-
A3.1_PT14	Faunal communities of high energy Atlantic infralittoral rock	DD	DD	-	-
A3.11	Kelp with cushion fauna and/or foliose red seaweeds on wave-exposed Atlantic infralittoral rock	DD	DD	-	-
A3.12	Kelp and seaweed communties on sediment-affected or disturbed Atlantic infralittoral rock	DD	DD	-	-
A3.14	Encrusting algal communities on exposed Atlantic infralittoral rock	LC	LC	-	-
A3.15	Frondose algal communities (other than kelp) on exposed Atlantic infralittoral rock	DD	DD	-	-
A3.21	Kelp and red seaweeds on moderate energy Atlantic infralittoral rock	DD	DD	-	-
A3.22	Kelp and seaweed communities in tide-swept sheltered Atlantic infralittoral rock	DD	DD	-	-
A3.23	Macaronesian communities of infralittoral algae moderately exposed to wave action	DD	DD	-	-
A3.2x	Macaronesian seaweed communities on moderate energy infralittoral rock	DD	DD	-	-
A3.31	Atlantic silted kelp on marine low energy infralittoral rock	DD	DD	-	-
A3.32	Kelp in variable salinity low energy Atlantic infralittoral rock	DD	DD	-	-
A3.34	Submerged fucoids, green or red seaweeds on low salinity Atlantic infralittoral rock	DD	DD	-	-
A3.35	Faunal communities on low energy marine Atlantic infralittoral rock	DD	DD	-	-
A3.36	Faunal communities on variable or reduced salinity Atlantic infralittoral rock	DD	DD	-	-
A3.3X/3.33	Macaronesian submerged fucoids, green or red seaweeds on full salinity infralittoral rock	DD	DD	-	-
A3.71	Robust faunal cushions and crusts in Atlantic infralittoral surge gullies and caves	DD	DD	-	-
A4.11	Faunal communities on very tide-swept Atlantic upper circalittoral rock	DD	DD	-	-
A4.12	Sponge communities on Atlantic lower circalittoral rock	DD	DD	-	-
A4.13	Mixed faunal turf communities on high energy Atlantic upper circalittoral rock	DD	DD	-	-
A4.21	Echinoderms and crustose communities on moderate energy Atlantic upper circalittoral rock	DD	DD	-	-
A4.22	Sabellaria reefs on moderate energy Atlantic circalittoral rock	DD	DD	-	-
A4.23	Communities on Atlantic soft circalittoral rock	DD	DD	-	-
A4.24	Mussel beds on moderate energy Atlantic circalittoral rock	DD	DD	-	-
A4.25	Faunal communities on variable salinity Atlantic circalittoral rock	DD	DD	-	-
A4.31	Ascidian/Brachiopod communities on Atlantic sheltered upper circalittoral rock	DD	DD	-	-

A.2 North-East Atlantic Results, cont'd

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A4.71	Communities of Atlantic circalittoral caves and overhangs	DD	DD	-	-
A5.12	Faunal communities in estuarine Atlantic sublittoral coarse sediment	DD	DD	-	-
A5.13	Faunal communities in marine Atlantic infralittoral coarse sediment	VU	VU	C/D1	C/D1
A5.14	Atlantic upper circalittoral coarse sediment	VU	VU	C/D1	C/D1
A5.15	Atlantic lower circalittoral coarse sediment	VU	VU	C/D1	C/D1
A5.22	Estuarine Atlantic sublittoral sand	DD	DD	-	-
A5.23	Marine Atlantic infralittoral fine sand	DD	DD	-	-
A5.24	Marine Atlantic infralittoral muddy sand	NT	NT	C/D1	C/D1
A5.25	Atlantic upper circalittoral fine sand	EN	EN	C/D1	C/D1
A5.26	Atlantic upper circalittoral muddy sand	EN	EN	C/D1	C/D1
A5.27	Atlantic lower circalittoral sand	EN	EN	C/D1	C/D1
A5.32	Estuarine Atlantic sublittoral mud	NT	NT	C/D1, C/D3	C/D1,C/D3
A5.33	Marine Atlantic infralittoral sandy mud	NT	NT	C/D1	C/D1
A5.34	Marine Atlantic infralittoral fine mud	NT	NT	C/D1	C/D1
A5.35	Atlantic upper circalittoral sandy mud	EN	EN	C/D1	C/D1
A5.36	Atlantic upper circalittoral fine mud	EN	EN	C/D1	C/D1
A5.37	Atlantic lower circalittoral mud	EN	EN	C/D1	C/D1
A5.42	Estuarine Atlantic sublittoral mixed sediment	DD	DD	-	-
A5.43	Marine Atlantic infralittoral mixed sediments	DD	DD	-	-
A5.44	Atlantic upper circalittoral mixed sediments	VU	VU	C/D1	C/D1
A5.45	Atlantic lower circalittoral mixed sediment	VU	VU	C/D1	C/D1
A5.51	Atlantic maerl beds	VU	VU	A1, C/D1	A1, C/D1
A5.52	Kelp and seaweed communities on Atlantic infralittoral mixed sediment	DD	DD	-	-
A5.53	Seagrass beds on Atlantic infralittoral sand (Macaronesian)	VU	VU	A1, C/D1	A1, C/D1
A5.53	Seagrass beds on Atlantic infralittoral sand (non-Macaronesian)	CR	CR	A3, C/D3	A3, C/D3
A5.6_PT01	Neopycnodonte cochlear beds on exposed and tide-swept circalittoral rocks and cobbles	DD	DD	-	-
A5.61	Polychaete worm reefs in the Atlantic sublittoral sediment	DD	DD	-	-
A5.62	Mussel beds (Mytilus edulis) on Atlantic sublittoral sediment	NT	NT	A1	A1
A5.62	Mussel beds Modiolus modiolus on Atlantic sublittoral sediment	NT	NT	A2b, C/D2	A2b, C/D2

A.3 Mediterranean Sea Results

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A1.13	Communities of Mediterranean upper mediolittoral rock	LC	DD	-	-
A1.14	Communities of exposed Mediterranean lower mediolittoral rock	NT	DD	A1	-
A1.23	Communities of moderately exposed Mediterranean lower mediolittoral rock	DD	DD	-	-
A1.34	Communities of sheltered Mediterranean lower mediolittoral rock	LC	DD	-	-
A1.41	Communities of Mediterranean mediolittoral rockpools	DD	DD	-	-
A1.44	Communities of Mediterranean mediolittoral caves and overhangs	DD	DD	-	-
A2.12	Communities of Mediterranean mediolittoral coarse sediment estuarine	DD	DD	-	-
A2.13	Communities of Mediterranean mediolittoral coarse sediment	DD	DD	-	-
A2.25	Communities of Mediterranean mediolittoral sands	VU	VU	A1, A2ab	A1, A2ab
A2.31	Communities of Mediterranean mediolittoral mud estuarine	EN	EN	A1, A2ab	A1, A2ab
A2.33	Communities of Mediterranean mediolittoral mud	VU	VU	C/D1	C/D1

A.3 Mediterranean Sea Results, cont'd

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A2.42	Communities of Mediterranean mediolittoral mixed sediment	DD	DD	-	-
A2.7x	Biogenic habitats of Mediterranean mediolittoral rock	VU	VU	B2a,b	B2a,b, C/D2
A3.13	Photophilic communities with canopy-forming algae in Mediterranean infralittoral and upper circalittoral rock	EN	DD	A1, A2b	-
A3.1x	Photophilic communities without canopy-forming algae in Mediterranean infralittoral and upper circalittoral rock	DD	DD	-	-
A3.23	Photophilic communities dominated by calcareous, habitat-forming algae	VU	VU	B2b	B2b
A3.36	Communities of Mediterranean estuarine rock	VU	VU	A1, C/D1	A1, C/D1
A4.23	Communities of Mediterranean soft circalittoral rock	VU	VU	A1, A2a, C/D1	A1, A2a, C/D1
A4.27	Communities of Mediterranean lower circalittoral rock	DD	DD	-	-
A4.2x	Circalittoral biogenic habitats in the Mediterranean – worm reefs	DD	DD	-	-
A4.71	Communities of Mediterranean circalittoral caves and overhangs	LC	LC	-	-
A5.13	Faunal communities in Mediterranean infralittoral coarse sediment	DD	DD	-	-
A5.14	Communities of Mediterranean upper circalittoral coarse sediments	DD	DD	-	-
A5.15	Communities of Mediterranean lower circalittoral coarse sediments	DD	DD	-	-
A5.23	Faunal communities of Mediterranean infralittoral fine sands	DD	DD	-	-
A5.25	Communities of Mediterranean circalittoral well-sorted fine sands	DD	DD	-	-
A5.25x	Communities of Mediterranean very shallow circalittoral fine sands	NT	NT	C/D1	C/D1
A5.27	Communities of Mediterranean lower circalittoral sand	VU	VU	C/D1	C/D1
A5.28	Faunal communities of sheltered Mediterranean infralittoral muddy sands	DD	DD	-	-
A5.32	Communities of Mediterranean sublittoral estuarine sediments	VU	VU	A1, C/D1	A1, C/D1
A5.38	Communities of Mediterranean infralittoral muddy detritic bottoms	VU	VU	C/D1	C/D1
A5.38x	Communities of Mediterranean circalittoral muddy detritic bottoms	DD	DD	-	-
A5.39	Communities of Mediterranean infralittoral (coastal) terrigenous muds	NT	NT	C/D1	C/D1
A5.46	Communities of Mediterranean upper circalittoral coastal detritic bottoms	DD	DD	-	-
A5.47	Communities of Mediterranean lower circalittoral (shelf-edge) detritic bottoms or open-sea detritic bottoms	DD	DD	-	-
A5.51	Rhodolith beds in the Mediterranean	DD	DD	-	-
A5.52A	Algal dominated communities in the Mediterranean circalittoral sediment	DD	DD	-	-
A5.52B	Algal dominated communities in the Mediterranean infralittoral sediment	EN	EN	A1	A1
A5.53	Seagrass beds (other than Posidonia) on Mediterranean infralittoral sand	LC	LC	-	-
A5.535	Posidonia beds in the Mediterranean infralittoral zone	VU	VU	A1	A1
A5.5x	Communities of Mediterranean infralittoral coastal detritic bottoms	NT	NT	C/D1	C/D1
A5.61	Polychaete worm reefs in the Mediterranean infralittoral zone	DD	DD	-	-
A5.6v	Mediterranean infralittoral mussel beds	EN	EN	A3	A3
A5.6x	Infralittoral biogenic habitats in the Mediterranean – coralligenous bioconcretions	NT	DD	A1, A2ab, C/D1	-
A5.6y	Circalittoral biogenic habitats in the Mediterranean – coralligenous bioconcretions	DD	DD	-	-
A5.6w	Mediterranean infralittoral oyster beds	EN	EN	A3	A3
A5.6z	Circalittoral biogenic habitats in the Mediterranean – oyster beds	DD	DD	-	-

A.4 Black Sea Results

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A1.15	Pontic supralittoral rock	DD	DD	-	-
A1.16	Invertebrate-dominated exposed Pontic mediolittoral rock	DD	DD	-	-
A1.1xx	Invertebrate-dominated moderately exposed Pontic mediolittoral rock	DD	DD	-	-
A1.1xx	Pontic exposed lower mediolittoral barren rock	DD	DD	-	-
A1.1xx	Turf algae on Pontic exposed lower mediolittoral rock	DD	DD	-	-
A1.1xx	Turf algae on Pontic moderately exposed lower mediolittoral rock	EN	LC	B1b	-
A1.3x	Sheltered Pontic mediolittoral rock	DD	DD	-	-
A1.42	Pontic mediolittoral rock pools	NT	DD	A1	-
A1.44	Pontic mediolittoral caves and overhangs	EN	LC	B1abc, B2abc	-
A2.132	Pontic mediolittoral cobbles and gravels	DD	DD	-	-
A2.2x	Pontic mediolittoral sands	DD	DD	-	-
A2.32	Polychaete/oligochaete-dominated upper estuarine Pontic littoral mud	DD	DD	-	-
A2.42	Communities of Marmara littoral mixed sediment	N/A	DD	-	-
A3.13	Exposed Pontic upper infralittoral rock with turf of Corallinales	DD	DD	-	-
A3.15	Mytilid-dominated Pontic exposed upper infralittoral rock with foliose algae (other than Fucales)	DD	DD	-	-
A3.1x	Pontic exposed upper infralittoral rock with rock borers	DD	DD	-	-
A3.1x	Mytilid-dominated Pontic exposed upper infralittoral rock with Fucales	DD	DD	-	-
A3.23	Corallinales on moderately exposed Pontic upper infralittoral rock	DD	DD	-	-
A3.2x	Mytilid-dominated Pontic moderately exposed upper infralittoral rock, blocks and boulders with Fucales	DD	DD	-	-
A3.2x	Mytilid-dominated Pontic moderately exposed upper infralittoral rock, blocks and boulders, with foliose algae (other than Fucales)	DD	DD	-	-
A3.34	Fucales and other algae on Pontic sheltered upper infralittoral rock, well illuminated	EN	VU	C/D1	C/D1
A3.3q	Pontic barren lower infralittoral rock	DD	DD	-	-
A3.3w	Invertebrate-dominated Pontic lower infralittoral rock	DD	DD	-	-
A3.3x	Foliose algae, other than Fucales on Pontic sheltered upper infralittoral rock, well illuminated	DD	DD	-	-
A3.3y	Pontic sheltered, shaded upper infralittoral rock, with sciaphilic algae	DD	DD	-	-
A3.3z	Pontic lower infralittoral rock, with significant cover of sciaphilic algae	DD	DD	-	-
A3.74	Caves, overhangs and surge gullies in Pontic infralittoral rock	DD	DD	-	-
A4.24	Invertebrate-dominated Pontic circalittoral rock	VU	VU	C/D1	C/D1
A4.26	Marmara coralligenous communities moderately exposed circalittoral rock	N/A	DD	-	-
A4.2x	Pontic barren circalittoral rock	DD	DD	-	-
A4.2x	Pontic circalittoral rock affected by sedimentation	DD	DD	-	-
A4.2x	Marmara circalittoral biogenic habitats - worm reefs	N/A	DD	-	-
A4.71	Pontic circalittoral dark caves and tunnels	DD	DD	-	-
A4.AA	Invertebrate-dominated Marmara circalittoral rock	N/A	DD	-	-
A5.13	Pontic infralittoral mixed substrata	DD	DD	-	-
A5.22	Estuarine Pontic infralittoral sand	DD	DD	-	-
A5.237	Pontic infralittoral sands and muddy sands without macroalgae	DD	DD	-	-
A5.24	Pontic infralittoral muddy sand	DD	DD	-	-
A5.26	Pontic circalittoral muddy sand	DD	DD	-	-
A5.32	Communities of Marmara infralittoral mud estuarine	N/A	DD	-	-
A5.33	Pontic infralittoral terrigenous muds	DD	DD	-	-
A5.34	Pontic infralittoral fine mud	DD	DD	-	-
A5.35	Pontic upper circalittoral sandy mud	DD	DD	-	-

A.4 Black Sea Results, cont'd

ENUIS CODE	Name of habitat type	EU28 Category	EU28+ Category	EU28 Criteria	EU28+ Criteria
A5.36	Pontic upper circalittoral fine mud	DD	DD	-	-
A5.37	Pontic lower circalittoral mud	DD	DD	-	-
A5.38	Communities of Marmara circalittoral muddy detritic bottoms	N/A	DD	-	-
A5.39	Communities of Marmara infralittoral (coastal) terrigenous muds	N/A	DD	-	-
A5.46	Communities of Marmara infralittoral (coastal) detritic bottoms	N/A	DD	-	-
A5.53	Seagrass and rhizomatous algal meadows in Pontic freshwater-influenced sheltered infralittoral muddy sands and sandy muds	LC	NT	-	A1
A5.5w	Seagrass meadows in Pontic lower infralittoral sands	EN	VU	B1b, B2b	C/D1
A5.5z	Seagrass meadows in Pontic moderately exposed upper infralittoral clean sands	DD	DD	-	-
A5.61	Polychaete worm reefs in the Pontic infralittoral zone	DD	DD	-	-
A5.62	Mussel beds in the Pontic infralittoral zone	DD	DD	-	-
A5.62	Mussel beds on Pontic circalittoral terrigenous muds	EN	EN	A1, C/D1	A1
A5.64	Oyster reefs on Pontic lower infralittoral rock	DD	DD	-	-
A5.a	Fauna-dominated Pontic infralittoral cobbles and gravels	DD	DD	-	-
A5.aa	Pontic infralittoral sands and muddy sands with stable aggregations of perennial unattached macroalgae	N/A	EN	-	B1c, B2c
A5.bb	Pontic infralittoral sands and muddy sands with annual algae	DD	DD	-	-
A5.xx	Pontic circalittoral biogenic detritic bottoms with dead or alive mussel beds, shell deposits, with encrusting corallines (Phymatolithon, Lithothamnion) and attached foliose sciaphilic macroalgae	CR	CR	A1, B1bc, C/D1	C/D1
A5.xy	Pontic circalittoral biogenic detritic bottoms with unattached form of Phyllophora crispa	DD	DD	-	-
A5.xZ	Pontic circalittoral terrigenous muds	DD	DD	-	-
AA.XY	Invertebrate-dominated Pontic other hard substrata	DD	DD	-	-
-	Communities of Marmara mediolittoral caves and overhangs	N/A	DD	-	-

Annex B. Red List criteria, thresholds and categories

Main criteria (priority for data collection) are indicated in black, additional criteria (applied if data were available) in green.

A. Reduction in quantity *		CR	EN	VU	NT
A1	Present (over the past 50 years)	≥80%	≥50%	≥30%	25–30%
A2a	Future (over the next 50 years) **$$**	≥80%	≥50%	≥30%	25–30%
A2b	Future/present (over any 50 year period including the present and future) **$$**	≥80%	≥50%	≥30%	25–30%
A3	Historic (since ca 1750) **	≥90%	≥70%	≥50%	40–50%

B. Restricted geographic distribution		CR	EN	VU	NT
B1	Extent of Occurrence (EOO)... **#** **AND** at least one of the following (a-c):	≤2,000 km²	≤20,000 km²	≤50,000 km²	close to VU threshold ***
	(a) A continuing decline in **EITHER**:				
	i. spatial extent **OR**				
	ii. abiotic (environmental) quality appropriate to characteristic biota of the habitat **OR**				
	iii. biotic quality (disruption to biotic interactions) appropriate to the characteristic biota of the habitat				
	(b) A threatening process that is likely to cause continuing declines in quantity and/or quality within the next 20 years				
	(c) Habitat exists at very few locations... **##**	1 location	≤5 locations	≤10 locations	close to VU threshold
B2	Area of Occupancy (AOO)... **###** **AND** at least one of a, b or c above (same subcriteria as for B1)	≤2	≤20	≤50	close to VU threshold ***
B3	Habitat exists at very few locations **## AND** due to human activities or stochastic events in an uncertain future, and thus capable of becoming Critically Endangered or Collapsed within a very short time period			<5 locations	close to VU threshold

C/D. Reduction in quality @		CR	EN	VU	NT
C/D1	Reduction in abiotic and/or biotic quality in the last 50 years	extreme reduction	very substantial reduction	substantial reduction	fairly substantial reduction
	In a quantitative way:	severe decline (≥80%) affecting ≥80% of the extent	intermediate decline (≥50%) affecting ≥80% of the extent **OR** severe decline (≥80%) affecting ≥50% of the extent	slight decline (≥30%) affecting ≥80% of the extent **OR** intermediate decline (≥50%) affecting ≥50% of the extent **OR** severe decline (≥80%) affecting ≥30% of the extent	close to VU threshold ***
C/D2	Reduction in abiotic and/or biotic quality in the future (next 50 years) or in any 50-year period incl. past, present and future **$$**	See C/D1	See C/D1	See C/D1	See C/D1
C/D3	Historic reduction in abiotic and/or biotic quality, affecting... ***	Very severe decline (≥90%) affecting ≥90% of the extent	Very severe decline (≥90%) affecting ≥70% of the extent **OR** severe decline (≥70%) affecting ≥90% of the extent	Intermediate decline (≥50%) affecting ≥90% of the extent **OR** severe decline (≥70%) affecting ≥70% of the extent **OR** very severe decline (≥90%) affecting ≥50% of the extent	close to VU threshold

Annex B cont'd. Red List criteria, thresholds and categories

C. Reduction in abiotic quality @@		CR	EN	VU	NT
C1	Reduction in abiotic quality (environmental degradation) in the last 50 years	See C/D1	See C/D1	See C/D1	See C/D1
C2	Reduction in abiotic quality in the future (next 50 years) or in any 50 year period including present and future **$$**	See C/D1	See C/D1	See C/D1	See C/D1
C3	Historic reduction in abiotic quality, affecting... ***	See C/D3	See C/D3	See C/D3	See C/D3

D. Reduction in biotic quality $		CR	EN	VU	NT
D1	Reduction in biotic quality in the last 50 years	See C/D1	See C/D1	See C/D1	See C/D1
D2	Reduction in biotic quality in the future (next 50 years) or in any 50 year period including present and future **$$**	See C/D1	See C/D1	See C/D1	See C/D1
D3	Historic reduction in biotic quality, affecting... ***	See C/D3	See C/D3	See C/D3	See C/D3

E. Quantitative analysis $$		CR	EN	VU	NT
E	Quantitative analysis estimating the probability of collapse	≥50% within 50 years	≥20% within 50 years	≥10% within 100 years	close to VU threshold

Comments and explanations

* Any measure of the distribution or extent of an ecosystem may be used, including km^2 of area or range.

** In cases where historic declines began after 1750, a shorter relevant time frame reflecting the onset of decline may be chosen for groups of related habitat types. For habitat types that have remained stable between 1750 and about 1960, the historic decline will be the same as that over the past 50 years.

*** For the 'Near Threatened' category no quantitative thresholds were given in Keith *et al*. (2013), however for reasons of consistency, the following thresholds were applied: criterion B1: ≤100,000 km^2, criterion B2: ≤100 grid cells, and thresholds for criterion C/D as indicated in Figure A.1.

EOO (Extent of Occurrence) = area of a minimum convex polygon enclosing all occurrences of the habitat; this polygon may include areas where a type cannot exist.

Locations (in the sense of the Red List-criteria) are areas within the distribution of the habitat type in which one threat may affect all localities at once. Their extent therefore depends on the nature and size of the threat.

AOO (Area of Occupancy) = number of grid cells (of 10x10 km^2) in which the habitat is present.

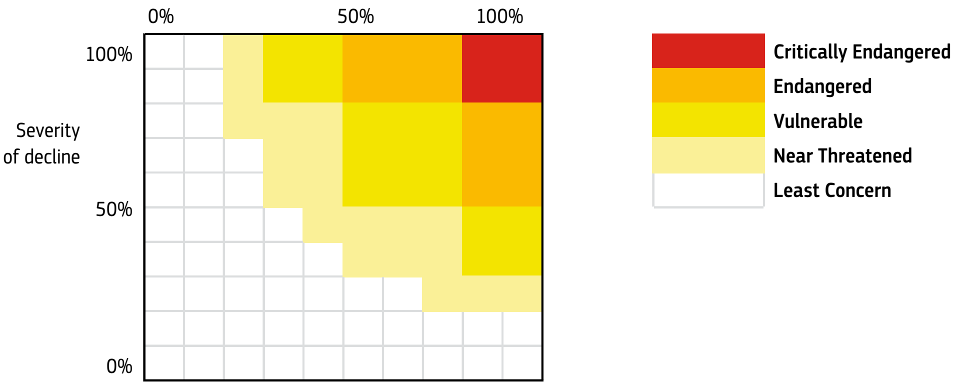
@ Includes the sum of degradation of (a)biotic conditions, interactions, structures and processes, species composition, and landscape-ecological setting (a.o. fragmentation); in the following criteria C and D this criterion may be split, based on the measure used to assess changes in quality (abiotic or biotic). The severity of decline has been described in a quantitative sense in the original IUCN-criteria. A qualitative alternative may be used here as well.

@@ Abiotic conditions, abiotic processes and landscape-ecological setting.

$ Biotic processes, biotic interactions, biotic structure or species composition.

$$ Should be supported by scientific evidence (scientific publications relating to the specific habitat type), and not only be based on speculation.

Figure A.1. Thresholds for criterion C/D.



Annex C. Correspondence table of MSFD and Habitat Directives pressures and impacts

Biological					
		MSFD Annex III Table 2 (2008)		Habitats Directive Reporting reference list 20110330 (relevant to marine only given)	
	Type	Pressure	Impacts	Pressure	Impacts
Input or spread of non-indigenous species	Inputs	introduction of non-indigenous species		Invasive non-native species	
Input of microbial pathogens	Inputs	Introduction of microbial pathogens,		Introduction of disease (microbial pathogens)	
Input of genetically-modified species and translocation of native species	Inputs	translocations		Introduced genetic material, GMO	
Loss of, or change to, natural biological communities due to cultivation of animal or plant species	Change				
Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Change			Other human intrusions and disturbances	
Extraction of, or mortality/injury to, wild species, including target and non-target species (by commercial and recreational fishing and other activities)	Extraction	Selective extraction of species	incidental non-target catches of species	Death or injury by collision	Reduction of prey availability (including carcasses)

Physical					
		MSFD Annex III Table 2 (2008)		Habitats Directive Reporting reference list 20110330 (relevant to marine only given)	
	Type	Pressure	Impacts	Pressure	Impacts
Physical disturbance to seabed (temporary or reversible)	Change	Physical damage - abrasion	Changes in siltation (e.g. by outfalls, increased run-off)	Shallow surface abrasion/ mechanical damage to seabed surface Penetration/ disturbance below surface of the seabed	Reduction or loss of specific habitat features
Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)	Inputs	Physical loss - smothering, Physical loss - sealing	Significant changes in salinity regime		Reduction or loss of specific habitat features Anthropogenic reduction of habitat connectivity Reduction in migration/ migration barriers Altered water quality due to anthropogenic changes in salinity Reduction or loss of specific habitat features

Physical, cont'd						
	Type	**MSFD** Annex III Table 2 (2008)		**Habitats Directive** Reporting reference list 20110330 (relevant to marine only given)	
		Pressure	**Impacts**	**Pressure**	**Impacts**
	Extraction	Physical damage - selective extraction		Removal of sediments (mud ...)	Reduction or loss of specific habitat features
Changes to hydrological conditions	Change	Interference with hydrological processes	Changes in siltation (e.g. by outfalls, increased run-off)	Canalisation and water deviation Modification of water flow (tidal and marine currents) Other human induced changes in hydraulic conditions	Other siltation rate changes Wave exposure changes
Extraction of water	Extraction	Interference with hydrological processes	Significant changes in salinity regime	Water abstractions from surface waters	

Substances, litter and energy					
	Type	**MSFD** Annex III Table 2 (2008)		**Habitats Directive** Reporting reference list 20110330 (relevant to marine only given)	
		Pressure	**Impacts**	**Pressure**	**Impacts**
Inputs of nutrients - diffuse sources, point sources, atmospheric deposition	Inputs	Inputs of fertilisers and other nitrogen and phosphorus-rich substances		"Pollution to surface waters (limnic, terrestrial, marine and brackish) Pollution to groundwater (point sources and diffuse sources) Air pollution, air-borne pollutants"	
Inputs of organic matter - diffuse sources and point sources	Inputs	Inputs of organic matter			
Input of hazardous substances (synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, atmospheric deposition, acute events	Inputs	"Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances), Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from ..[..] atmospheric deposition, riverine inputs), — introduction of radio-nuclides. Systematic and/or intentional release of substances— Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions."		"Pollution to surface waters (limnic, terrestrial, marine and brackish) Pollution to groundwater (point sources and diffuse sources) Toxic chemical discharge from material dumped at sea Air pollution, air-borne pollutants Oil spills in the sea"	

Annex C cont'd. Red List criteria, thresholds and categories

Substances, litter and energy, cont'd					
		MSFD Annex III Table 2 (2008)		**Habitats Directive** Reporting reference list 20110330 (relevant to marine only given)	
	Type	**Pressure**	**Impacts**	**Pressure**	**Impacts**
Atmospheric input of CO_2 [and other greenhouse gases]	Inputs				"Temperature changes (e.g. rise of temperature and extremes) Decline or extinction of species Wave exposure changes Sea level changes pH-changes Water flow changes (limnic, tidal and oceanic) Habitat shifting and alteration Desynchronisation of processes Migration of species (natural newcomers)"
Input of litter (solid waste matter, including micro-sized litter)	Inputs	Marine litter		Marine macro-pollution (i.e. plastic bags, styrofoam)	
Input of other forms of energy (including electromagnetic fields, light and heat)	Inputs			"Electromagnetic changes Seismic exploration, explosions"	
	Inputs	Interference with hydrological processes	Significant changes in thermal regime	Thermal heating of water bodies	
	Inputs			Light pollution	
Input of water (point sources e.g. brine)	Inputs	Interference with hydrological processes		"Disposal of household / recreational facility waste Disposal of industrial waste Disposal of inert materials Other discharges"	

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