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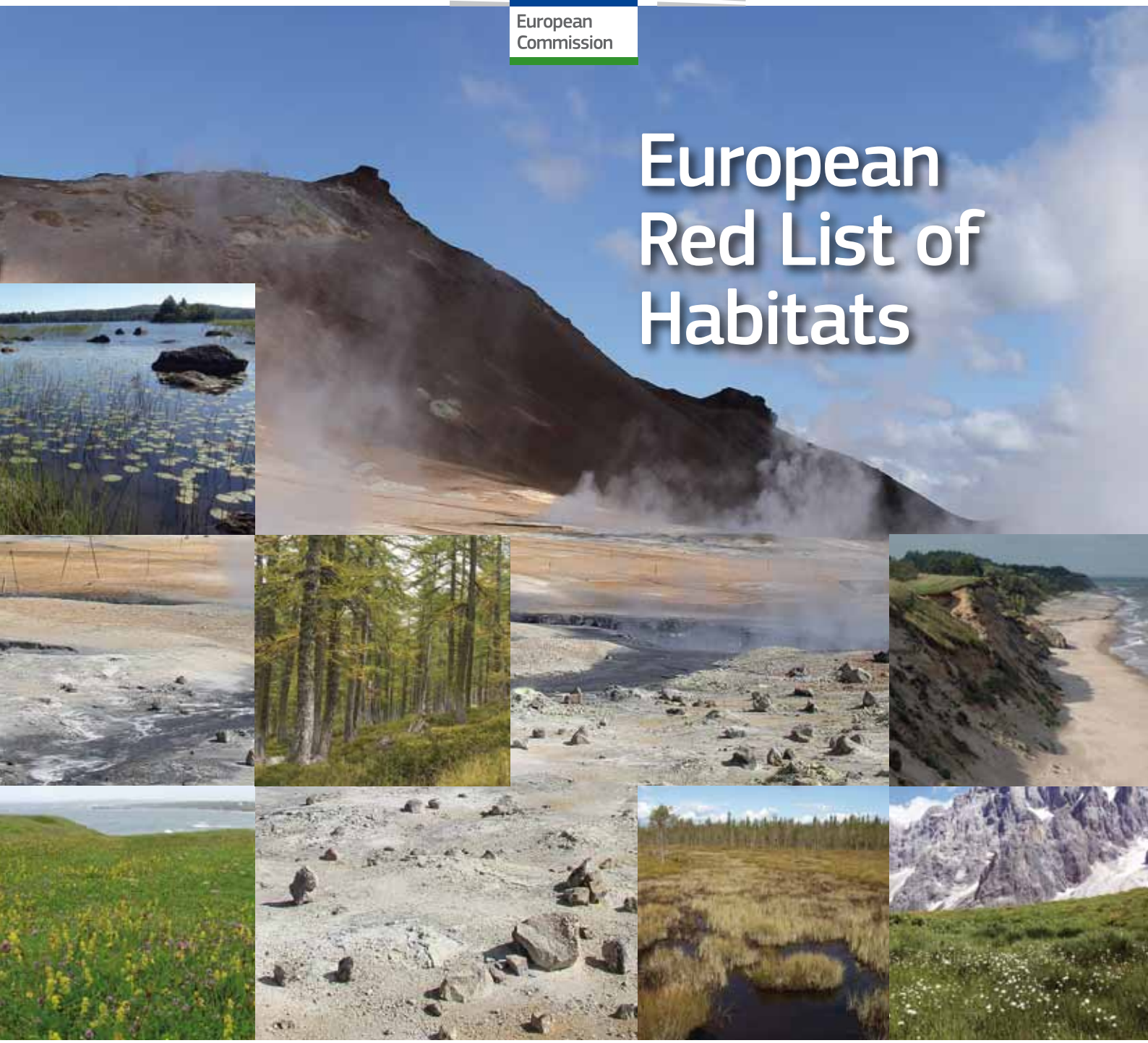

European Red List of Habitats

Part 2. Terrestrial and freshwater habitats

Environment

More information on the European Union is available on the internet (http://europa.eu).
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European Red List of Habitats

Part 2. Terrestrial and freshwater habitats

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Contents

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

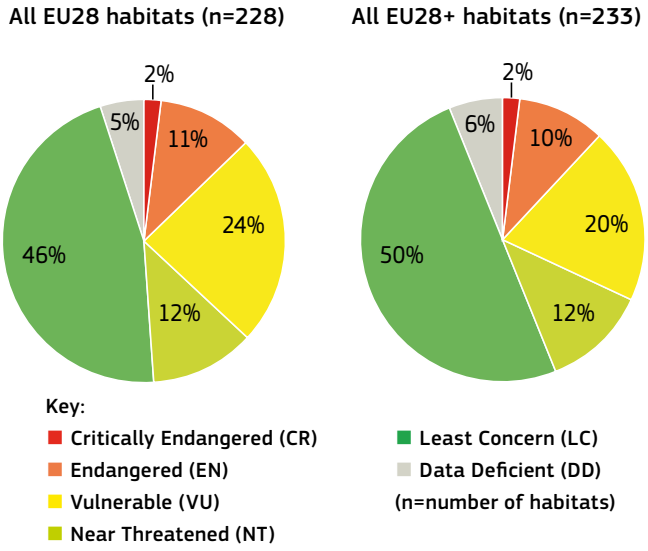
The European Red List of Habitats provides an overview of the risk of collapse (degree of endangerment) of marine, terrestrial and freshwater habitats in the European Union (EU28) and adjacent regions (EU28+), based on a consistent set of criteria and categories and detailed data and expertise from involved countries[1]. Amongst terrestrial and freshwater habitats the highest percentage of threatened types (categories Critically Endangered, Endangered, Vulnerable) was found amongst mires and bogs (85% in the EU28, 54% in the EU28+), followed by grasslands (53%, 49%), freshwater habitats (46%, 38%) and coastal habitats (45%, 43%). Relatively low percentages of heathland and scrub, forests, and sparsely vegetated habitats were assessed to be threatened. Overall the amount of threatened habitats was higher in the EU28 (36%) than in the wider range of the EU28+ (31%). The European Red List of Habitats provides extensive additional information on habitat classification and definition, pressures and threats, conservation and restorability of habitats, distribution, status and trends in individual countries, and sub-habitats that may possibly be threatened. The information provided can inform and support European nature and biodiversity policy in a variety of ways, particularly in relation to the EU2020 Biodiversity Strategy targets. Further applications include the revitalisation of the EUNIS habitat classification, synergies with the Mapping and Assessment of Ecosystems and their Services initiative, and the improvement of Red List methodologies.

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

Executive Summary

Measuring progress to the EU2020 Biodiversity Strategy, aimed at halting 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 on 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 terrestrial and freshwater habitats. It provides an overview on the character, extent and status of 233 natural and semi-natural, terrestrial and freshwater habitat types through assessments undertaken between 2013 to 2016. The results are presented at two geographic levels: across the EU28 and EU28+, including Norway, Switzerland, Iceland, and the Balkan countries.



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).

Territorial data for the EU28 and the EU28+ countries were collected through a network of over 150 experts from 33 countries who supplied information on the area of habitat, trends in quantity and quality (over the past 50 years), long-term and future trends, pressures and threats, conservation measures, data sources and supporting literature used. These background supporting data are available online through the European Environmental Agency (EEA) website.

Overall, 36% of the habitats assessed (31% for EU28+) were in the three threatened categories: Critically Endangered (less than 2% of the total), Endangered (11%) and Vulnerable (24%). An additional 12% were in the Near Threatened category as defined using the thresholds proposed for this assessment. Only 12 habitats (15 in the EU28+) were Data Deficient and unable to be assessed, mostly remote and poorly known habitats.

The main part of this publication presents the results of the assessment under seven broad habitat headings: Coastal, Freshwater, Mires and bogs, Grasslands, Heathland and scrub, Forests, and Sparsely vegetated habitats. The percentage of threatened types differs considerably among the seven major habitat groups. Mires and bogs are the most threatened groups of habitats in the EU28 (with 85% in the threatened categories), followed by Grasslands (53%), Freshwater habitats (46%) and Coastal habitats (45%). The Forests, Heathland and scrub, and Sparsely vegetated habitats have relatively low proportions of threatened types (respectively 29, 14 and 10%).

Of the criteria used to derive the assessment, three were most frequently decisive: Trend in extent over the past 50 years (criterion A1), Trend in quality over the past 50 years (criterion C/D1) and Long-term historical decline in extent (criterion A3). Restricted geographical occurrence (criterion B) was decisive in only relatively few cases and Quantitative analysis to assess probability of collapse (criterion E) was used only once.

The main pressures and threats vary considerably across the different groups but overall, various kinds of agricultural activities are the most widespread and severe dangers to European terrestrial and freshwater habitats. These include both intensification for more productive farming and abandonment of traditional land-use, changes which especially affect Grasslands. Exploitation for peat and shifts to forestry, together with associated modification of hydrological process, have been particularly threatening for Mires and bogs and direct and indirect effects of hydrological change, together with eutrophication from farming, have also severely affected Freshwater habitats. For Coastal habitats in particular, urbanisation and associated infrastructure and communications continue to be threatening. The impact of climate change is as yet hard to assess, but some changes are clear and probably increasing, particularly with higher temperatures in the Arctic and at high altitudes.

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 three particular applications illustrated: for the mapping of ecosystems and their services, for the restoration of habitats, and for characterising distinctive landscapes of high importance for biodiversity and culture.

Conclusions summarise the achievements and implications of the European Red List of Habitats and highlight some possible next steps.

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

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 ecosystem 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).

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 EU2020 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.

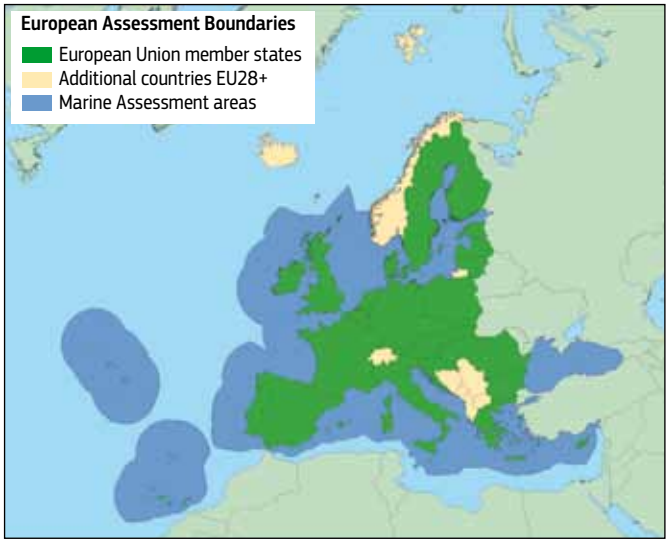


Figure 1.1 Assessment boundaries for the European Red List of habitats. Terrestrial and freshwater regions are given in green (EU28) and orange (additional countries EU28+), marine regions in dark blue.

1.2 Aims and scope of the assessment

The main aim was to assess the Red List status of all natural and semi-natural terrestrial and freshwater habitat types at two geographic levels: EU28 and EU28+, including Norway, Switzerland, Iceland, and the Balkan countries (Figure 1.1).

Two Red List publications have been produced, one for terrestrial/freshwater habitats, one for marine, and factsheets for all the habitats. 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, EuroVeg Checklist, Annex I, Emerald, MAES, IUCN and other relevant classifications)
- **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 10x10 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

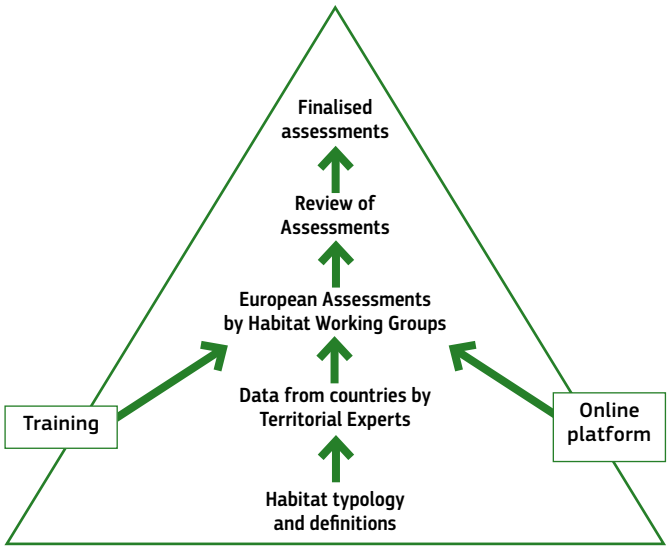
The European Red List of Habitats project was carried out in the stages indicated in Figure 2.1, coordinated through a single Management Team.

For terrestrial and freshwater habitats a Habitat typology based on the EUNIS Classification was produced by an expert group together with standardised habitat definitions to aid recognition. Data for each of these habitats were gathered in the EU28 and EU28+ countries by Territorial Experts and delivered to seven Habitat Working Groups (HWGs), through which the overall European assessments were made. The seven terrestrial/freshwater HWGs were based on the major habitats in the EUNIS typology (B Coastal, C Freshwater, D Mires and bogs, E Grasslands, F Heathland and scrub, G Forests and H Sparsely vegetated habitats) and comprised four to eight experts from different countries. Training exercises and workshops with the HWGs were held to ensure a standardised approach in applying the criteria and categories to the available data and to learn how to use an online platform on which assessments were made. Assessments were then passed to Reviewers and any substantial changes agreed with the HWG assessor.

2.2 Habitat typology

As recommended in the Feasibility Study (Rodwell *et al.* 2013) the EUNIS habitat classification (Davies *et al.* 2004, EUNIS 2007) was used as a basis for the Habitat typology, the level 3 divisions pitched between the fine scale offered by the alliances of phytosociology and a broad classification of ecosystems. Mosaic habitat types (EUNIS group X) and highly anthropogenic habitats were omitted, except those thought to be threatened or of interest for their biodiversity. Salt marshes (grouped in EUNIS under marine habitats) were included with other coastal habitats. The existing EUNIS habitats were reviewed and revised and definitions adapted where EUNIS types were ambiguous, overlapping or of a scale that was considered too broad for Red List assessment across Europe. Many of the proposed Red List habitats were also renamed. The resulting list consists of 233 terrestrial and freshwater habitat types, the numbers in the main groups shown in Table 2.1 and all habitats listed in Annex A.

Figure 2.1 Flow diagram of the work flow.



The resultant habitats for Red List evaluation were defined especially for this assessment task and were not intended as an official revision of EUNIS level 3. However, proposals were aligned with the emerging revision of by the European Environment Agency (Schaminée *et al.* 2012–2016). The final EUNIS typology aims to include all Europe, but some habitat types were not included in the Red List assessment, as these occur only in Ukraine, Belarus, Moldova, Russia, the Caucasus and/or European Turkey, outside the scope of the Red List project.

The description of each habitat provides the definition, which is accompanied by relationships to other classifications (see Figure 1.2), like the Habitats Directive Annex I types and the EuroVeg Checklist alliances (Mucina *et al.* 2016, in print).

2.3 Categories and Criteria

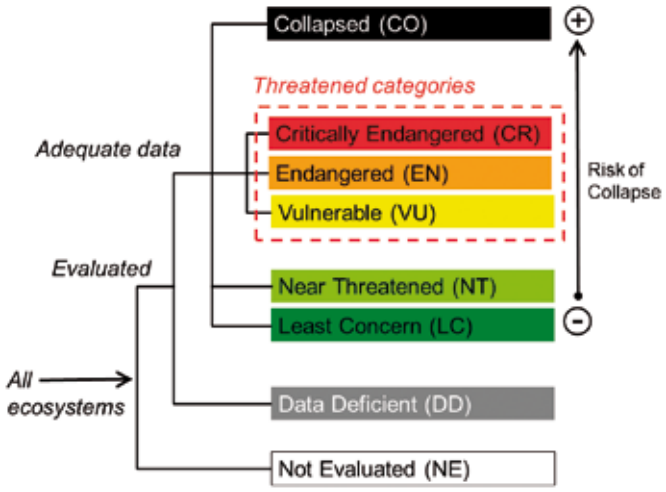
The Categories and Criteria applied in the European Red List of Habitat Types assessment are largely based on a protocol proposed in a feasibility study (Rodwell *et al.* 2013), combined with elements of the IUCN Red List of Ecosystems approach (Keith *et al.* 2013, IUCN 2016).

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, Box 2.1). The first six categories are ordered in decreasing risks 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' (IUCN 2016). These categories are analogous to those of the IUCN Red List of Threatened Species (IUCN 2001) and current details of the categories are given in IUCN (2016).

Table 2.1 Final number of terrestrial and freshwater habitats in the seven main groups.

Coastal	30
Freshwater	26
Mires & bogs	13
Grasslands	53
Heathland & scrub	38
Forests	42
Sparsely vegetated	31
Total	**233**

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



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.

The assessment comprises 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 physical or abiotic degradation (Criterion C) and disruption of biotic processes and interactions (Criterion D). Given that it often is difficult or impossible to separate biotic and abiotic degradation

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	

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 subcriteria. Details on the criteria, with quantitative thresholds, are provided in Annex B.

All habitat types were evaluated against all possible criteria. Meeting any one of the criteria qualified a habitat type for listing at that level of threat. 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

Territorial data

For each habitat type, data on present area of habitat, trend in quantity (over 50 years), trend in quality (over 50 years), long-term and future trends, pressures and threats, and conservation measures were collected in a standard format (so-called 'Territorial data sheets') from individual countries by the Territorial Experts using local inventories and expertise. For the Red List assessment at European level, the territorial data for each habitat type were combined with other information from literature and expert knowledge, and these were used to calculate average European trends in quantity and quality and evaluate the habitat against all the Red List criteria.

Distribution maps

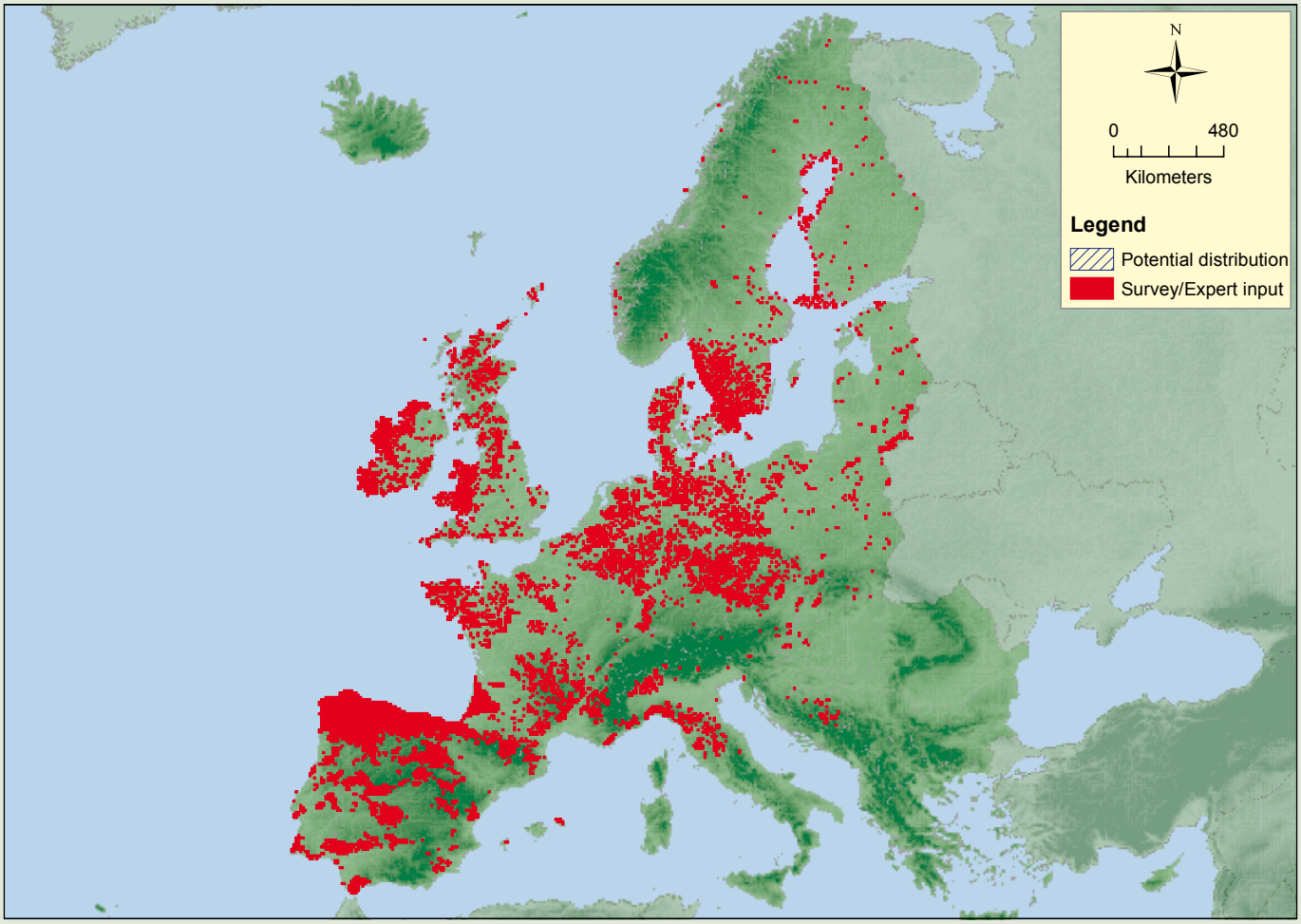
For each habitat a distribution map was produced from a wide variety of sources (Table 2.3) indicating known occurrences of the habitat in 10x10 km grids within EU28+. These maps were used for calculating relevant indicators, like the Extent of Occurrence

(EOO) and Area of Occupancy (AOO), see Annex B. Occurrences in grid cells were given in two classes: actual distribution from relatively reliable sources (surveys, expert knowledge), and potential distribution based on models or less reliable indicators. An example of a distribution map and the calculated AOO and EOO is given in Figure 2.3.

Table 2.3 Data sources used for making distribution maps of terrestrial and freshwater habitats. The given codes of sources are used in the GIS-files of the maps.

Number	Description	Code	Reference
1	Distribution maps of Annex I habitat types provided in the 2013 Article 17 report for the Habitat's Directive (covering EU27)	Art17	EEA, Copenhagen
2	European Vegetation Archive (EVA). Dataset of vegetation relevés in Europe, version January 2016	EVA	Chytrý *et al.* 2016
3	Distribution of plant and animal species from the GBIF website, version January 2016	GBIF	www.gbif.org
4	Natural Vegetation Map of Europe. Potential natural vegetation. Only used for forest types and other habitats where the potential distribution is likely to be similar to the actual distribution	BOHN	Bohn *et al.* 2000/2003
5	European Tree Map, indicating the domiannt tree in an image file. Used for a few forest habitats	ETM	Hengeveld *et al.* 2012
6	National databases of different countries, a.o. Spain (vegetation map), Hungary (habitat distribution maps), Bosnia and Herzegovina (N2000 database)	NAT	-
7	Distribution data of 'wooded grasslands'. This map was compiled in the European project AGFORWARD and was used only for three 'wooded grassland' types (E7)	AGFOR	Plieninger *et al.* 2015
8	Literature and expert knowledge. Only used for habitats with large distribution gaps in the previous sources	EXP, LIT	-

Figure 2.3 Example of a distribution map for habitat F4.2 Dry heath. The number of 10x10 km grid cells is the Area of Occupancy (in this case 8213 for EU28 and 8267 for EU28+), the area of the envelope around the distribution provides a measure for the Extent of Occurrence (in this case 6,337,850 km² for EU28 and 6,541,100 km² for EU28+).



3. Results

3.1 General overview

A Red List assessment was carried out for a total of 233 terrestrial and freshwater habitats, of which five occur only outside the EU28. Table 3.1 provides an overview of the final categories for all habitat types with full details given in Annex A. In total, 36% (EU28) and 31% (EU28+) of the evaluated habitats are assessed as threatened in categories Critically Endangered, Endangered and Vulnerable. An additional 12% are Near Threatened in EU28 (15% in EU28+). These figures are slightly higher if Data Deficient habitats are excluded.

The percentage of threatened habitats differs considerably between the seven main groups of habitats. The highest proportion of threatened habitats in the EU28 was found among Mires and bogs (85%), followed by Grasslands (53%), Freshwater habitats (46%) and Coastal habitats (45%). Forests, heathland and scrub, and Sparsely vegetated habitats had relatively low proportions of threatened types. In the EU28+ the figures of threatened types are generally slightly lower, but much lower for Mires and bogs. Details on each group are given in the next sections.

The treeless wetlands on accumulating peat that compose the 13 **Mires and bogs** occur widely across Europe, though most extensively in the Nordic countries. They have suffered most in recent times amongst the habitats of Europe with long term and recent decline in extent of more than 30%: with peat extraction and conversion to agriculture and forestry are the main and continuing threats. Changes in hydrological functionality by drainage and abstraction in mire watersheds and eutrophication are also threatening and climate change is causing droughts and, critically important for dependent palsa mires, melting of permafrost.

The 53 **Grasslands** of Europe comprise an extraordinarily diverse and often very species-rich range of habitats that have been a mainstay of pastoral agriculture in every biogeographic region for centuries. They are widely threatened, particularly certain dry grasslands, mesic pastures and meadows, heavy metal grassland and certain open wooded grasslands. Reductions in extent and quality have been very substantial and widespread due primarily to 'improvement' for agriculture and abandonment of traditional pastoralism with the spread of scrub and woodland. Disruption of hydrological functioning is damaging to wetter grasslands and, in the alpine belt, warmer winters and longer growing seasons are predicted to be a threat.

The 26 **Freshwater habitats** include moving and standing waters with submerged, emergent and marginal vegetation, also with saline and brackish habitats inland, some temporary waters and a few abiotic types in association with glaciers and ice sheets. None of these habitats is Critically Endangered but the most

Table 3.1 Overall Red List categories for all terrestrial and freshwater habitats in the EU28 (top) and EU28+ (bottom).

EU28

	Coastal	Freshwater	Mires & bogs	Grasslands	Heathland & scrub	Forests	Sparsely vegetated	Total	
CR	-	-	1	3	-	-	-	4	
EN	5	3	3	9	1	2	1	24	
VU	8	9	7	16	5	10	2	55	
NT	3	7	1	7	2	10	2	27	
LC	12	5	1	18	27	19	18	106	
DD	1	2	-	-	1	1	6	12	
total	29	26	13	53	36	42	29	**228**	
threatened %	45	46	85	53	17	29	10	36.4	%
threat. % (excl. DD)	46	50	85	53	17	29	13	37.9	%

EU28+

	Coastal	Freshwater	Mires & bogs	Grasslands	Heathland & scrub	Forests	Sparsely vegetated	Total	
CR	-	-	1	3	-	-	-	4	
EN	5	3	2	9	1	1	1	23	
VU	8	7	4	14	5	9	2	46	
NT	4	7	4	9	1	7	2	29	
LC	12	6	2	18	30	20	20	116	
DD	1	3	-	-	1	3	6	15	
total	30	26	13	53	38	42	31	**233**	
threatened %	43	38	54	49	16	24	10	31.3	%
threat. % (excl. DD)	45	43	54	49	16	26	12	33.3	%

threatened are characteristic of high salinity or tide-related estuarine fluctuations, many types of open waters, shorelines or springs, with widespread recent declines in extent and quality. Being so important for the provision of water supply, such habitats are everywhere vulnerable to abstraction and watercourse management but pollution from waste disposal or agricultural and industrial operations is also a widespread threat.

The 30 **Coastal habitats** include salt-marsh, sand and shingle beaches, sand dune, and coastal heath, scrub and woodland represented in all biogeographic regions of Europe and one also in EU28+. Much coastal vegetation is truly natural and some still subject just to the dynamics of tides and winds. Some habitats are threatened by having a naturally limited distribution. Dune grasslands have experienced widespread declines in extent and quality, with common threats being from infrastructure and communications, tourism and recreation, the invasion of non-native plants and pollution.

The **Forests** of Europe are a diverse constituency of 42 broadleaved, coniferous and mixed types, many of them constituting the potential natural vegetation of their biogeographic zone, though now rarely surviving in pristine condition. They appear to be relatively lightly threatened at the present time and mostly in wetter habitats on bogs, around open waters or along rivers, where there have been substantial recent declines in extent and/or quality but also including some types at threat because of a naturally limited distribution. Over a longer time frame, beyond 250 years, huge losses would probably be accountable for many forest types. The most important threats apart from damage to natural hydrologic functioning are related to commercial forestry or over-grazing, and aerial pollution.

Heathland and scrub habitats, which include 30 habitats where woody sub-shrubs or shrubs dominate, are widespread across Europe as temporary stages in succession from grasslands to forest, types maintained by repeated grazing and burning or climax habitats growing in extreme climates. Few are threatened and mainly because of recent declines in extent and quality with an abandonment of traditional management. In fact, such a shift among grasslands has meant that many losses have been made up by the spread of scrub. Other threats include infrastructure and afforestation, with climatic warming for arctic and high mountain types.

Sparsely vegetated habitats include a diversity of 31 types on cliffs, screes, volcanic deposits, moraines and in snow fields, as well as weed communities of traditionally used arable land. Many of these are remote, hard to survey and little known (so often classed as Data Deficient), their location having provided some protection from many environmental threats. The most threatened types are the weed community, much reduced by shifts to intensive arable cultivation in most parts of Europe, and two abiotic snow and ice habitats threatened by melting in recent warmer years.

The decisive criteria resulting in the final Red List categories are summarised in Figure 3.1. Overall three criteria were most often crucial in determining the final Red List category: A1 Trend in

Figure 3.1 Proportion of different criteria decisive for the final Red List result of Threatened and Near Threatened habitats in the EU28 (left) and EU28+ (right) assessments.

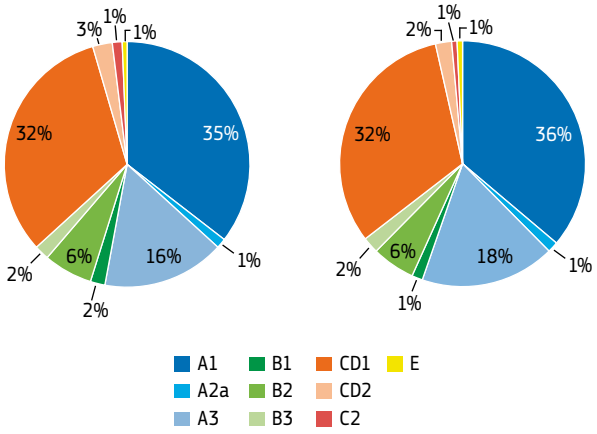
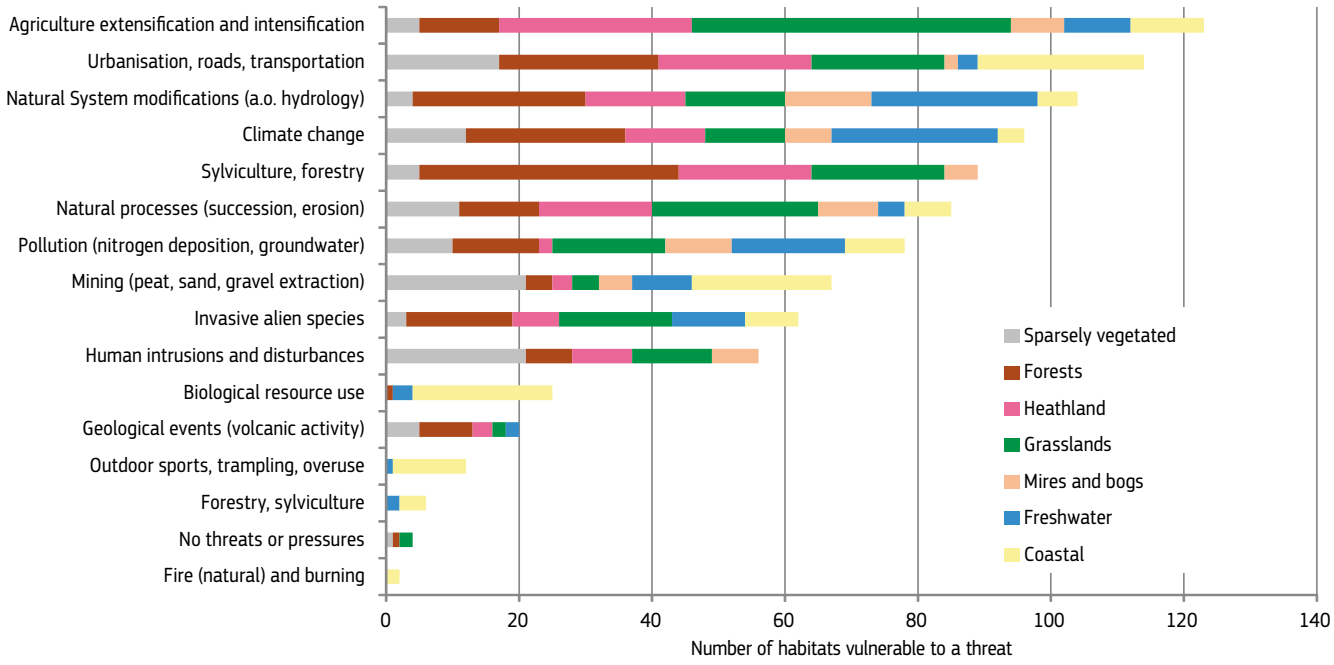


Figure 3.2 Main threats affecting the different European habitat types.



quantity over 50 years (36% of all decisive criteria), C/D1 Trend in quality over 50 years (32%), and A3 Historical decline in quantity (18%). Restricted geographical occurrence (B1, B2, B3) has been decisive relatively few times, and E Quantitative analysis was used only once.

The main pressures and threats vary largely across the different groups, as shown in Figure 3.2. Overall, agricultural activities are listed most often as a threat to habitats, involving both extensification of traditional land-use (abandonment) and intensification of land-use, both of these especially threatening Grasslands and Heathland and scrub. Other main threats are urbanisation (especially in Coastal habitats), modification of natural systems (especially hydrological systems for Freshwater habitats, Mires and bogs), climate change, and afforestation of treeless habitats.

3.2 Coastal habitats

European coastlines are dynamic landscapes, influenced by coastal factors like tides and winds but also in many cases strongly affected by human activities in the past and present. Quite a large percentage of the coastal habitats comprise relatively natural habitats which do not need any management for their survival, for example beach, cliff and foredune types, but also, to a large extent, the salt-marsh habitats. Other habitats contain both natural and semi-natural components, like the grey dune types, but only a few habitat types are largely semi-natural in character, notably the Baltic coastal meadows. Also included among the coastal habitats are essentially inland types of heath, scrub and forest which happen to occur on the coast.

Typological divisions among the coastal habitats of Europe have been made in many cases on the basis of geographical region, often reflected in variation in species composition and ecological processes. Generally, a separation is made between Mediterranean and Black Sea coastal habitats versus Atlantic and Baltic examples, but in cases where these groups still include large differences, further splits have been made.

Assessment results

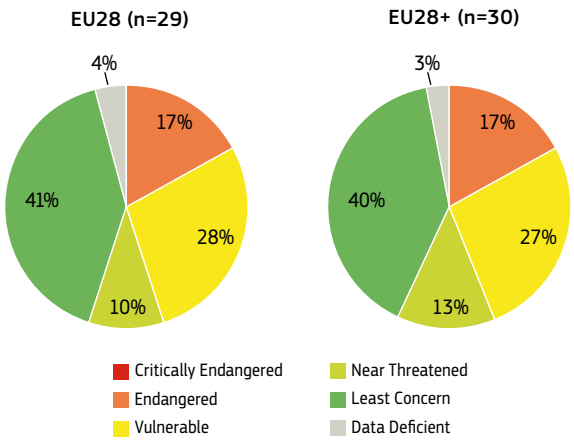
Of the 30 assessed habitats (of which one is occurring only in EU28+), 13 qualify for one of the threatened categories of the Red List, with five being Endangered and eight Vulnerable (Figure 3.4). Four other habitats are assessed as Near Threatened, and of these one occurs only outside the EU28.

Grasslands are among the most threatened coastal habitats, assessed as Endangered. Two types are more or less stabilised Dune grassland (B1.4b, B1.4c), while Dune scrubs of Macaronesia (B1.6c) is related to grassland, and a fourth Endangered type is Baltic coastal meadows (A2.5b). The Endangered Black Sea broadleaved coastal dune woodland (B1.7a) is restricted to Romania and Bulgaria and very rare in both countries.

The eight habitats assessed as Vulnerable consist of one salt marsh type, one beach type and six dune habitats. Two other salt-marsh types have been assessed as Near Threatened. The Vulnerable

Figure 3.3 Coastal dunes along the Atlantic Ocean in South-west France. © John Janssen

Figure 3.4 Overall assessment of coastal habitats in the EU28 and EU28+. (n=number of habitats)



dune habitats include Atlantic and Baltic white dunes (B1.3a), Atlantic and Baltic grey dunes (B1.4a), coastal Empetrum heath (B1.5a), Mediterranean and Black Sea coastal dune scrub (B1.6b), Baltic coniferous forests (B1.7d) and Atlantic and Baltic wet dune slacks (B1.8a). The two heathland/scrub types are presently in a stable condition or even increasing, but have undergone a large historical decline.

Thirteen habitats have been assessed as Least Concern. These include all coastal rocky habitats (cliff types and pebble beaches), with the exception of one soft sea cliff, for which too few data are available, resulting in the Data Deficient designation. Further more, one beach type, two heathland and scrub habitats, two forest types, and one dune slack type are of Least Concern.

The overall picture of the coastal results reflect the results of all other groups. Relatively many grassland habitats are Threatened, a few rocky habitats are relatively little Threatened, and all other types are in between (Figure 3.5). Especially for heathland/scrub and forest types the proportion of Threatened types is a bit higher than for inland habitats. In the Atlantic, Arctic and Baltic region slightly more coastal habitats have been assessed under a Threatened category than in the Mediterranean, Black Sea and Macaronesia (Figure 3.6).

Box 3.1 Threatened Coastal habitats.

Endangered
A2.5b Baltic coastal meadow
B1.4b Mediterranean and Macaronesian coastal dune grassland (grey dune)
B1.4c Black Sea coastal dune grassland (grey dune)
B1.6c Macaronesian coastal dune scrub
B1.7b Black Sea broad-leaved coastal dune woodland

Vulnerable
A2.5c Atlantic coastal salt marsh
B1.1a Atlantic, Baltic and Arctic sand beach
B1.3b Mediterranean and Black Sea shifting coastal dune
B1.4a Atlantic and Baltic coastal dune grassland (grey dune)
B1.5a Atlantic and Baltic coastal *Empetrum* heath
B1.6b Mediterranean and Black Sea coastal dune scrub
B1.7c Baltic coniferous coastal dune woodland
B1.8a Atlantic and Baltic moist and wet dune slack

Figure 3.5 Percentage of threatened coastal habitats in EU28 for different structural groups.

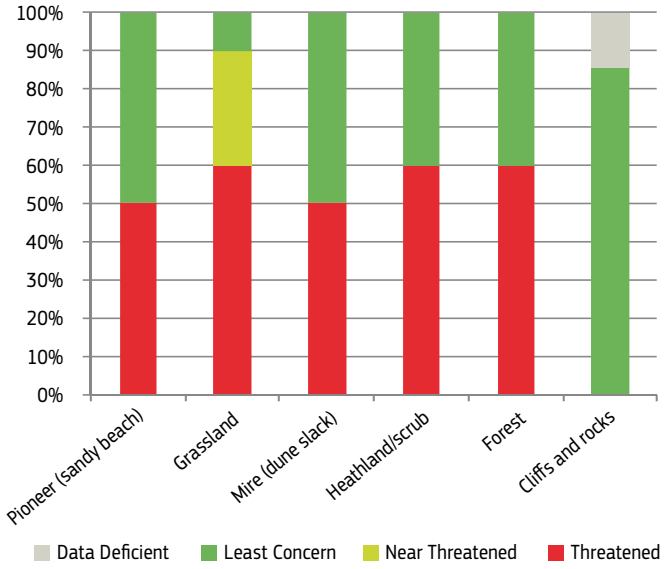
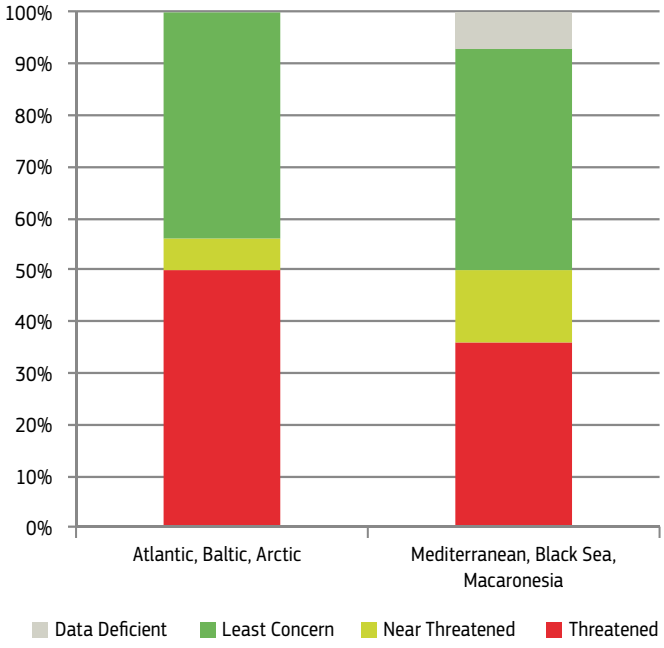


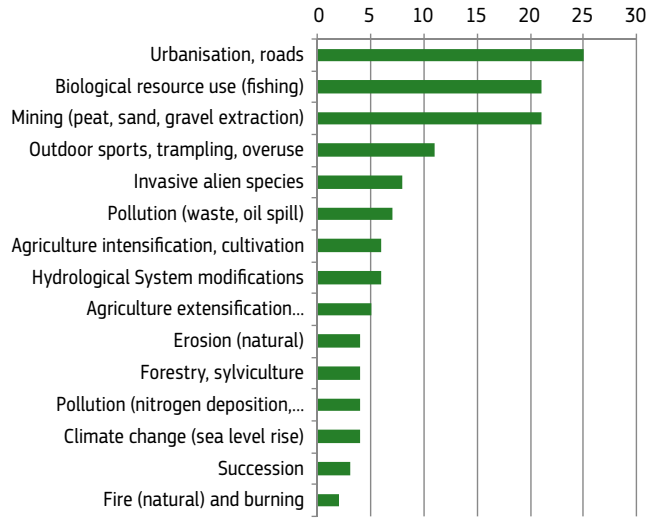
Figure 3.6 Percentage of threatened coastal habitats in EU28 for different geographic regions.



Main pressures and threats

The coastal zone of Europe is one of the most intensively frequented areas by humans. Since early historic times it has provided food (notably, fish and shellfish) and good conditions for transport, especially in estuaries. Many large cities have been built in the vicinity of a river mouth, and their expansion has put pressures on the natural ecosystems in these sites. During the last century, tourism has increased enormously, adding an extra pressure to all coastal areas. Building of houses and associated infrastructure is seen in many coastal areas, because living here is often rewarded with wonderful scenery and an equable climate. Not surprisingly, urbanisation is the most important threat to all coastal habitats (Figure 3.7), followed by recreational (over)use by people. Invasive non-native species form the next important

Figure 3.7 Number of coastal habitats vulnerable to different pressures and threats.



threat in coastal habitats (Figure 3.8), not only in the relatively open types such as beaches, white dunes and cliffs, but also in more stabilised ecosystems, like grey dunes and forests. More specific pressures and threats are pollution (to beach habitats), agricultural intensification and abandonment (in dune grasslands and salt marshes), hydrological modifications (dune slacks, salt marshes), erosion (cliffs, foredunes) and sea level rise due to climate change (beaches, salt marshes).

Data quality and gaps

Data provided for coastal habitats were relatively good and complete, partly because of the good relationship with Annex I-types where Article 17 reporting under the Habitats Directive was a valuable source of information. Exceptions were the two soft cliff types, which have rarely been distinguished in other habitat typologies, and for which little knowledge exists. One of these was assessed as Data Deficient. Another data problem was the area estimation of beach and cliff types, which differs largely between countries and has to be considered relatively uncertain.

3.3 Freshwater habitats

The freshwaters of Europe comprise 26 habitats mainly dominated by plants that are strictly aquatic, emergent or amphibious, or by grasses or herbs that are adapted to occasional floods and able to develop during dry periods. As defined here, freshwater habitats include also inland brackish and saline water bodies and a few habitats totally without vegetation, such as underground waterbodies or lakes developed on glaciers or ice sheets.

Freshwater habitats are widely distributed across Europe, but vary in character and distribution according to climatic and geomorphological conditions. Permanent water bodies are mainly concentrated in the northern and Atlantic regions, while the temporary ones are more typical in areas with a Mediterranean climate. Some of these habitats can be part of very broad ecosystems (like long rivers or large lakes), while others occur as small and localised patches (like springs or ponds). Natural or anthropogenic supplies of nutrients and minerals are important factors determining the species composition of the biotic part of most freshwater habitats and they can be grouped according to their trophic level, whether they are oligotrophic, mesotrophic, eutrophic or dystrophic, or exhibit a range of such conditions.

Plant communities characterising freshwaters are generally species-poor, but some of these habitats host a contingent of locally rare or scarce species. Many characteristic plant species have a relatively wide range, as they are easily dispersed by water fowl. Besides vascular plant, bryophyte and algal communities, most freshwaters are also characterised by distinctive fauna, especially invertebrates, but sometimes also vertebrates (notably fish and amphibians), which sometimes also host high numbers of endemics or rare species.

Most freshwater habitats provide essential resources and services such as drinkable water, supplies of fish, building materials (such as sand, gravel or stones), hydroelectric power, water for agricultural and industrial use and recreation services.

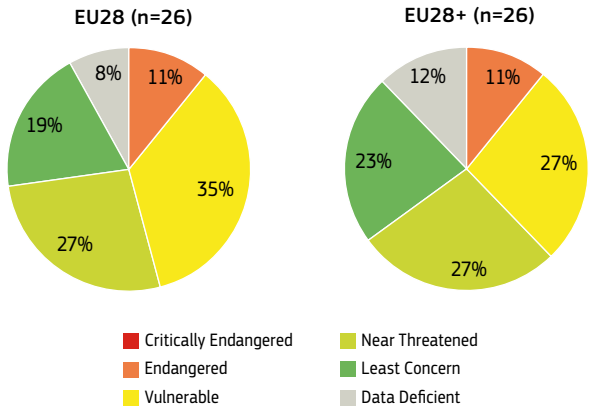
Assessment results

Forty percent of these freshwater habitats are threatened in the EU28, slightly less in the EU28+ (Figure 3.10) and the threatened

Figure 3.8 *Rosa rugosa* is an invasive shrub originating from Japan that threatens dune grassland and shrubland, like here on the Wadden Sea island of Vlieland. © John Janssen

Figure 3.9 Pärnu river in the lowlands of Estonia, an example of habitat: Permanent non-tidal, smooth-flowing watercourse (C2.3). © John Janssen

Figure 3.10 Overall assessment of freshwater habitats in the EU28 and EU28+. (n=number of habitats)



habitats are relatively evenly divided between different subgroups of freshwater habitats (Figure 3.11). The three Endangered habitats are characterised by very specific ecological conditions, for example high salinity (C5.4, C3.5c) or tidal fluctuations (C2.4), that make these habitats exclusive to some geographic areas. They have been destroyed to a large extent during recent or historic time, mainly due to land reclamation for human activities and direct or indirect changes of the natural hydraulic conditions.

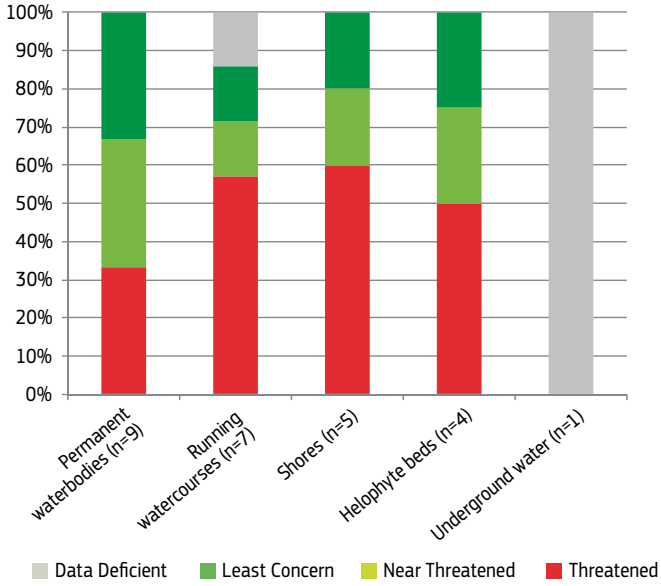
The Vulnerable freshwater habitats include some that, though relatively abundant across Europe, are limited in extent in each site, such as Mediterranean temporary ponds (C1.6b), Base-poor and Calcareous springs (C2.1a, C2.1b), Periodically exposed shores with stable, mesotrophic sediments (C3.5b), and Lakes of glaciers and ice sheets (C1.7). Others are limited to situations with particular physical or chemical conditions such as waterbodies with Characeae (C1.2a), Turbulent water courses with Ranunculus spp. (C2.2b), Sparsely vegetated shores with mobile sediments of montane and alpine regions (C3.5d) and Tall-sedge dominated habitats (C5.2). These habitats are now Vulnerable due to recent large declines in extent or in quality (criterion A1 and C/D1).

Box 3.2 Threatened freshwater habitats.

Endangered
C2.4 Tidal river, upstream from the estuary
C3.5c Periodically exposed saline shore with pioneer or ephemeral vegetation
C5.4 Inland saline or brackish helophyte bed

Vulnerable
C1.2a Permanent oligotrophic to mesotrophic waterbody with Characeae
C1.6b Mediterranean temporary waterbody
C1.7 Permanent lake of glaciers and ice sheets (EU28 only)
C2.1a Base-poor spring and spring brook (EU28 only)
C2.1b Calcareous spring and spring brook
C2.2b Permanent non-tidal, fast, turbulent watercourse of plains and montane regions with Ranunculus spp.
C3.5b Periodically exposed shore with stable, mesotrophic sediments with pioneer or ephemeral vegetation
C3.5d Unvegetated or sparsely vegetated shore with mobile sediments in montane and alpine regions
C5.2 Tall-sedge bed

Figure 3.11 Assessment results in the EU28 for different subgroups of freshwater habitats.

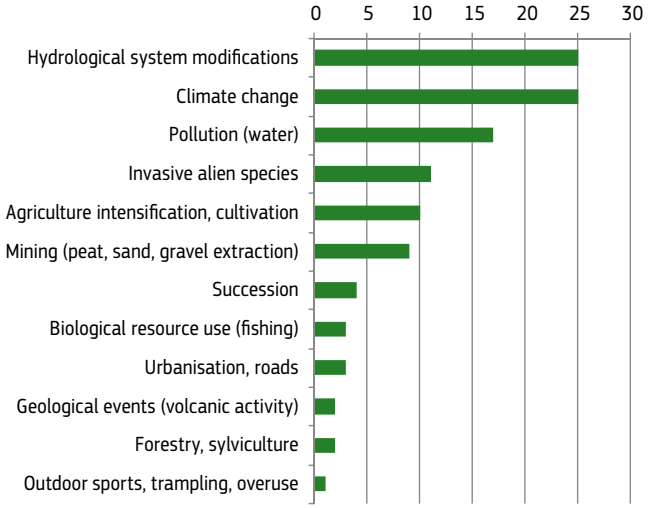


The Near Threatened habitats include some of the most common freshwater habitats in Europe such as Oligotrophic and mesotrophic to eutrophic water body (C1.1a, C1.2b), Dystrophic water body (C1.4), Smooth flowing watercourse (C2.3), Periodically exposed shore with eutrophic sediments (C3.5b) and Small-helophyte bed (C5.1b), but also one rare type (saline and brackish water body, C1.5). Despite their frequency and large extent across Europe, all these habitats are near-threatened because of large declines in abiotic and biotic quality during the last 50 years.

Main pressures and threats

The most important and devastating threats for Freshwater habitats are all related to human activities (Figure 3.12). The first is change in the hydraulic conditions of water bodies, among which direct effects can stem from the constructions of dykes or artificial banks along the watercourses, water abstraction and alteration of the water level of lakes, ponds and rivers for fishing, agriculture and energy production. Threatening indirect actions

Figure 3.12 Number of freshwater habitats vulnerable to different pressures and threats.



include the extraction or deviation of groundwater, the extraction of sediments and alteration of the superficial drainage.

A second important threat is water pollution, originating mainly from the disposal of solid waste or from agricultural and industrial sources, and in the south-eastern countries, solid waste along watercourses and in lakes. Anthropogenic eutrophication comes especially from agriculture and is one of the main problems for habitats that are naturally relatively poor in nutrients, often intensified by the total absence of buffer zones between crops or urban areas and water bodies or marsh vegetation.

Perhaps more slowly destructive, but also important and widespread threats are the introduction of alien species and climate change. The former can involve any category of organism, from microorganisms to vascular plants and animals. Alien species are responsible for long-term changes in the biotic and abiotic components of the habitats and ecosystems, affecting trophic chains and successional processes, transforming the natural characteristics and functionalities of habitats and altering the natural dynamic of the ecosystems.

Climate change affects various processes that can have a more or less rapid and perceptible effect on Freshwater habitats according to their particular characteristics and the geographical region. It can lead to the local disappearance of one habitat or its transformation from one type to another. An example is the transformation of Lakes of glacier and ice sheets (C1.7) to Oligotrophic to mesotrophic lakes (C1.1b) in high mountains. Climate change can also speed up and strengthen other processes like increase in the trophic level, vegetation succession and invasion of alien species.

Other threats more related to particular habitats and thus localised are continuous land reclamation for human use in the expansion of urban and industrial areas, agriculture and construction of infrastructures.

Data quality and gaps

The major data deficiency in the EU28 was with Sweden and, in the EU28+, the Balkans, Norway and Iceland. These gaps are relevant, because the Balkan countries are rather rich in freshwaters and, though they probably still have some of the best-preserved freshwater habitats, due to the speed of development there, future losses are expected. The northern countries are very rich in some specific types of freshwater habitats such as oligotrophic and dystrophic water bodies, and these are probably among those most vulnerable to climate change. Quantitative data on historic and future trends of quality or quantity were rarely available.

Despite the fact that the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC) mention groundwater habitats as very important for biodiversity and human use, no data were available from most countries on underground watercourses. The probable reason lies in the definition of groundwater, conceptually broad in the two European directives, and more restricted as a habitat for the Red List.

3.4 Mires and bogs

Besides their significance for biodiversity, mire habitats have important ecosystem functions. Peat accumulation sequesters carbon from the atmosphere and mires also act as water reservoirs and buffer discharge from catchments into lakes and rivers. In a natural catchment they function as sponges which prevent lower parts of the catchment from flooding in periods of heavy rain, and still support water for a long time in periods of drought. Mires also often have a distinct wilderness character, representing remnant natural habitats in landscapes otherwise altered by humans. Nevertheless, in some temperate regions, groundwater-fed fens have been created or maintained by pre-industrial agriculture whereas natural fens have virtually disappeared in recent times.

Figure 3.13 Calcareous quaking mires in Finland. © Teemu Tahvanainen

Because mires, bogs and fens are wetland habitats with a high water content governing many ecological processes that structure their characteristic communities, their hydrological balance is easily disturbed by increased drainage caused by human activities. Furthermore, mire habitats have been widely destroyed or greatly altered in many areas by the extraction of peat.

Mire habitats are defined as open, treeless wetlands with vegetation on accumulating peat and they were assessed in the Red List under 13 types. Wooded mire types are included among Forest habitats, while calcareous fens in dune slacks are included under Coastal types. Hydrological variation, regulated both by climate and local catchment features, is the main factor driving differences between mire habitats, the distinction between rain-fed bogs and ground-water fed fens being a high-level separation. At a more detailed level, the habitat units reflect variation in water chemistry (notably pH and calcium content) and degree of wetness and climatic and landscape factors related to biogeographic zones. In addition to the existing hydrological and ecological conditions, mires are also affected by their historical legacy of peat accumulation and vegetation succession and the impacts of traditional land uses, like peat cutting, hay-making and grazing.

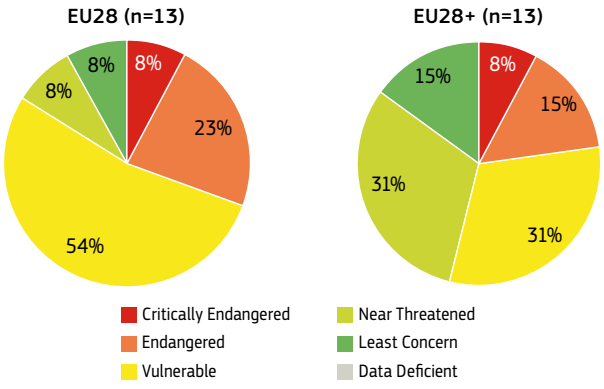
While their range extends over the whole of Europe, the main centre of distribution of mires at the present time is in the boreal region of the Nordic countries where Finland and Sweden together contain 60% of the total area (over 89,000 km^2) of reported mire habitats in EU28. Another significant concentration of mires lies in the Atlantic regions of Ireland and the UK, where Blanket bog (D1.2) alone comprises ca. 27 % of the total mire area in the EU28.

Mires have unique species assemblages and they significantly enrich landscape-scale diversity in many areas. Most species-rich mire complexes include a variety of rich and quaking fens that are at least moderately calcareous habitats with high pH levels. Also, many mire habitats are characterised by patterns such as hummocks and pools which add significantly to their diversity by providing microhabitats for specialised biota. In the more eastern and southern European countries, mires and bogs contain many relict plant and animal species, surviving in small, suitable areas since the Ice Ages.

Assessment results

In the EU28, all but two of the 13 Mire habitat types (85 %) are threatened to some degree (Figure 3.14), and this is the highest percentage of threatened habitats in all terrestrial and freshwater groups. One habitat (D3.1 Palsa mire) is Critically Endangered, three habitats are assessed as Endangered and seven as Vulnerable. Blanket bog (D1.2) was assessed Near Threatened and the boreal Aapa mire (D3.2) is the only habitat in the Least Concern category. The EU28 and EU28+ assessment outcomes were quite different, as in four cases the EU28+ assessments showed a less threatened status. The habitats D1.1 Raised bogs (EN in EU28, VU in EU28+), D2.2a Poor fens (VU in EU28, LC in EU28+) and D2.2c Intermediate fens and soft-water spring mires (VU in EU28, NT in EU28+) have smaller declines and large areas in Norway compared to the EU28. Within the EU28+ the distribution of Relict mires of Mediterranean mountains (D2.2b) is larger than in the EU28 and this brings the assessment to NT in EU28+.

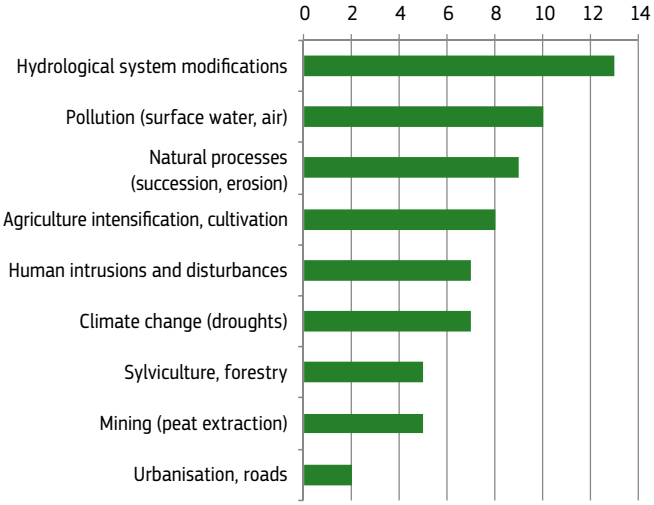
Figure 3.14 Overall assessment of mire and bog habitats in the EU28 and EU28+. (n=number of habitats)



Main pressures and threats

Extraction of peat and conversion of natural mire habitats to productive agricultural and forestry land have been the main reasons for the decline of mire habitats during recent and more long-term historic times and this decline is still continuing. Peat extraction especially threatens mires on thick peats like Raised bog (D1.1), Blanket bog (D1.2) and Aapa mire (D3.2) (see Figure 3.15).

Figure 3.15 Number of mire habitats vulnerable to different pressures and threats.



Box 3.2 Threatened Bog and mire habitats.

Critically Endangered
D3.1 Palsa mire

Endangered
D1.1 Raised bog (EU28 only, Vulnerable in EU28)
D4.1a Small-sedge base-rich fen and calcareous spring mire
D4.1b Tall-sedge base-rich fen

Vulnerable
D2.1 Oceanic valley bog (EU28 only)
D2.2a Poor fen (EU28 only)
D2.2b Relict mire of Mediterranean mountains (EU28 only)
D2.2c Intermediate fen and soft-water spring mire (EU28 only)
D2.3a Non-calcareous quaking mire
D4.1c Calcareous quaking mire
D4.2 Arctic-alpine rich fen

Figure 3.16 Palsa mire with conspicuous palsa mound in northern Finland. © Eva Hettenbergerova

Different types of human-induced changes in hydrological conditions threaten all mire habitat types: canalisation, water re-direction and abstraction and construction of reservoirs. In Finland and to some extent other countries too, drainage of mires aiming at conversion to productive forest areas is a land use with impacts over a wide extent.

Eutrophication mainly due to nitrogen deposition is a common threat to many mire habitats in polluted areas and increased droughts due to climate change are also widespread. These combine with the natural processes of mire development to threaten existing communities via impacts on biocoenotic succession and changes in species composition, though often these effects are hard to distinguish from one another. The situation can be made more complex by local impacts like changes of grazing and mowing. Sometimes also increased pressure from tourism-related activities is reported.

Among northern mire habitats, Palsa mire (D3.1) is threatened by climate change and specifically by melting of the necessary sporadic permafrost. This results in the loss of permafrost mounds or palsas, one of the main defining features of the habitat (Figure 3.16). Climate change may threaten also the northern Aapa mire (D3.2) and Arctic and alpine rich fen (D4.2).

Data quality and gaps

In general, data coverage of habitat occurrence and extent for mires and bogs was fairly good, but many gaps are evident concerning past trends of quantity and quality. Territorial data were not provided from Territorial experts in Sweden, but this significant gap was filled from literature, including detailed inventory reports. The habitat Relict mire of Mediterranean mountains (D2.2b) lacked data from the Balkans and Arctic and alpine rich fen (D4.2) was missing data from Sweden. In both cases, the data gaps are significant to the total habitat area. Some important gaps on trend data were filled by applying expert estimates of declines from neighbouring countries.

Data on A3 Long-term historic trend of quantity or (C/D3) Long-term historic trends in quality were missing from most habitats, except for Raised bog. It is quite obvious, however, that more fertile mire habitats have declined even more in historic times by clearance to create agricultural land. This is probably one main data gap to affect assessments and it is very likely that many habitats would be assessed as more highly threatened if data on historic trends were available.

3.5 Grasslands

The grasslands of Europe comprise 53 habitats dominated by diverse assemblages of grasses and other herbs, sometimes with prominent contingents of bryophytes and lichens. They are widely distributed and extensive through all the biogeographic regions of Europe and, across the lowlands and foothills, have generally been derived originally by forest clearance. Maintained through grazing by stock and wild herbivores, mowing or burning, or various combinations of these agricultural interventions, such grasslands have long been of enormous importance to pastoral farming through the provision of forage and hay crops. Regional traditions of management were often highly distinctive but these have now been widely abandoned. Where grasslands have shifted into very intensive systems of grazing and silage production, the resulting species-poor habitats have been excluded from Red List assessment.

Variation among lowland grasslands is mostly related to differences in regional climate, soil water content and soil reaction (pH) and there are distinct groups of 25 Dry grasslands (E1), including swards on soils with heavy metals, four Mesic grasslands (E2) and seven seasonally or permanently wet grasslands (E3). At higher altitudes, grasslands extend above the tree-line, though can still be grazed and remain an integral part of pastoral systems. Variations among the five types of Alpine and sub-alpine grasslands (E4) reflect differences in regional climate and soil reaction and also include vegetated snow patches. The grassland group also includes six habitats dominated by tall herbs and ferns occurring along woodland fringes (E5) in ungrazed habitats in the lowlands and on mountain slopes and ledges, three types of herbaceous vegetation of inland salty habitats (E6), and three types of wooded pastures and meadows (E7) which occur at landscape-scale.

Many of these grasslands are species-rich and even the more widely distributed types can include contingents of rare or scarce plant species particular to the local or regional habitat conditions. More traditionally managed grasslands included here are also often associated with distinctive local architecture, field patterns and customs, so have high cultural interest.

Assessment results

Just about half of grassland habitats are threatened to some degree (Figure 3.18), which is one of the highest percentages of all seven terrestrial groups of habitats. In both the EU28 and EU28+, the 3 Critically Endangered habitats are two types of Dry grasslands (E1) and one of the Wooded pastures and meadows (E7) with either a very small distribution or a dramatic recent or historic decline in extent. The Endangered habitats are Dry grasslands (E1), Wet grasslands (E3) and one saline grassland (E6) with very large recent or historic declines in extent (criteria A1 and A3), as well as one geographically restricted type (E1.5c).

In the EU28, the 16 Vulnerable habitats include Mesic grasslands (E2), Salt steppes (E6) and Wooded pastures and meadows (E7)

Figure 3.17 Species-rich mountain pasture in the Central Alps of Switzerland. © John Janssen

and these are almost all placed in this category because of A1 Recent large decline in extent. Additionally six Near Threatened habitats in the EU28 have suffered large decline in extent or substantial reduction in quality in recent historic time. In the EU28+, the situation is almost exactly the same, except that two habitats, moves from Vulnerable to Near Threatened, one from Near Threatened to Least Concern, and one from Least Concern to Near Threatened. All of these changes reflect a relatively good status in Balkan countries outside the EU28. Overall the highest proportion of threatened types is found among dry, mesic and wet grasslands, saline grasslands and wooded grasslands, while alpine grasslands and tall-herb fringes are in general of less concern (Figure 3.19).

Figure 3.18 Overall assessment of grassland habitats in the EU28 and EU28+. (n=number of habitats)

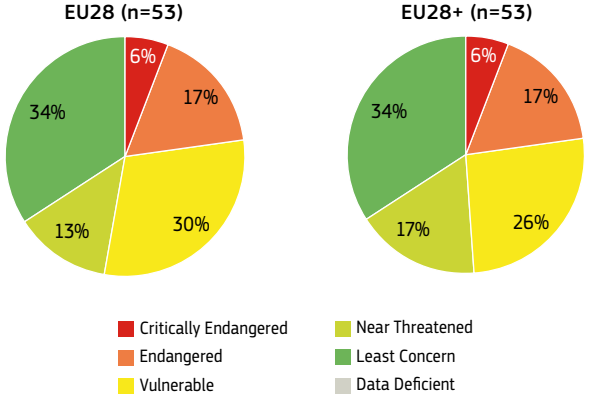
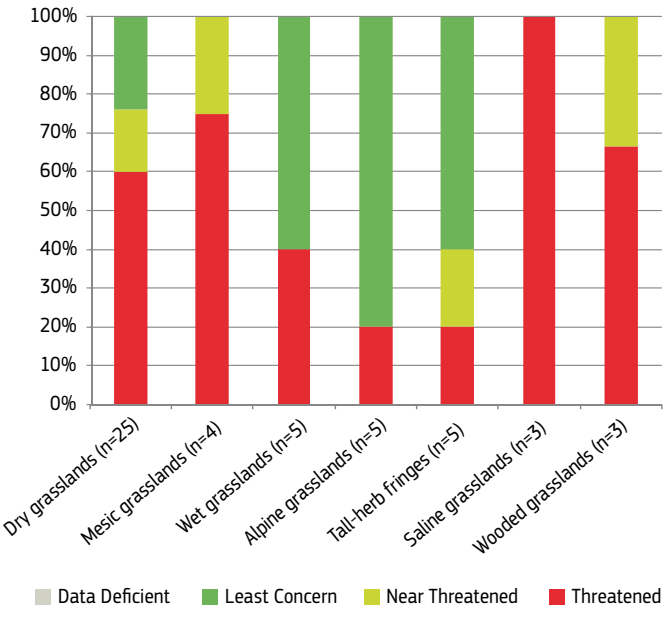


Figure 3.19 Assessment results in the EU28 for different subgroups of grasslands.



Main pressures and threats

Two threats are especially important and widespread for these grassland habitats (Figure 3.20). First, particularly for Mesic Grasslands (E2) and some Wet grasslands (E3), there is a complex of processes concerned with agricultural improvement for more highly productive forms of intensive stock management, either

Box 3.4 Threatened Grassland habitats.

Critically Endangered
E1.1a Pannonian and Pontic sandy steppe
E1.5e Madeiran oromediterranean siliceous dry grassland
E7.2 Hemiboreal and boreal wooded pasture and meadow

Endangered
E1.5c Cyrno-Sardean oromediterranean siliceous dry grassland
E1.9a Oceanic to subcontinental inland sand grassland on dry acid and neutral soils
E1.9b Inland sanddrift and dune with siliceous grassland
E1.B Heavy-metal grassland in Western and Central Europe
E1.F Azorean open dry, acid to neutral grassland
E3.4a Moist or wet mesotrophic to eutrophic hay meadow
E3.4b Moist or wet mesotrophic to eutrophic pasture
E3.5 Temperate and boreal moist or wet oligotrophic grassland
E6.3 Temperate inland salt marsh

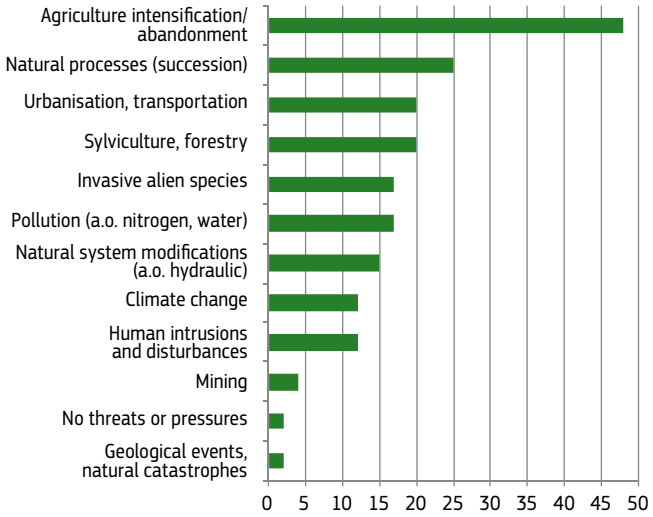
Vulnerable
E1.1b Cryptogam- and annual-dominated vegetation on siliceous rock outcrops
E1.1d Cryptogam- and annual-dominated vegetation on calcareous and ultramafic rock outcrops
E1.1e Perennial rocky grassland of the Italian Peninsula
E1.1i Perennial rocky calcareous grassland of subatlantic-submediterranean Europe
E1.1j Dry steppic, submediterranean pasture of South-Eastern Europe (EU28 only)
E1.2a Semi-dry perennial calcareous grassland
E1.7 Lowland to submontane, dry to mesic Nardus grassland
E1.A Mediterranean to Atlantic open, dry, acid and neutral grassland (EU28 only)
E2.1a Mesic permanent pasture of lowlands and mountains
E2.2 Low and medium altitude hay meadow
E2.3 Mountain hay meadow
E4.1 Vegetated snow patch
E5.4 Lowland moist or wet tall-herb and fern fringe
E6.1 Mediterranean inland salt steppe
E6.2 Continental inland salt steppe
E7.1 Temperate wooded pasture and meadow

outdoor grazing on forage or stall feeding on silage. Such threats were generally reported as involving liberal use of chemical fertilisers rather than the traditional dung, much encouraged under subventions provided through the Common Agricultural Policy. Such eutrophication can be widely increased by air pollution in the form of nitrogen. In the lowlands especially, there is also sometimes a shift out of grassland into intensive crop cultivation.

A second major threat, particular in parts of Eastern Europe and mountainous regions, again for Mesic grasslands (E2) but also for some Dry grasslands (E1) and Alpine and sub-alpine grasslands (E4), and in those landscapes where grasslands form part of Wooded pastures and meadows (E7), is abandonment of traditional management with development of rank grasslands and a reversion to scrub and woodland. Generally this is due to the withdrawal of stock management or, where cutting for hay has been traditional, lack of the necessary mowing regime. Such changes are often part of wider demographic, socio-economic and cultural shifts across large parts of the European rural landscape.

More limited, but of relevance locally for Wet grasslands (E3) dependent on a high ground water table or seasonal flooding,

Figure 3.20 Number of grassland habitats vulnerable to different pressures and threats.



various forms of modification of hydrographic functioning have been important where abstraction can generally lower the water table or catchment management prevent the inundation necessary for sustaining flood meadows.

Although the habitats occurring at higher altitudes, particularly Alpine and sub-alpine grasslands (E4), in which grazing and mowing are less necessary, are among the least threatened habitats in this whole group, there is a concern that they may be strongly impacted by climate change, for example through milder winters with reduced snow-lie and longer growing seasons.

Data quality and gaps

Data for grassland types were in general very good, with the most territorial data reported of all habitat groups. The major lack of data was from Sweden where some Grassland habitats are known to occur and to be of a distinctive character. However, data from here seemed unlikely to elevate any further Grassland types into the Endangered or Critically Endangered categories. Data on historic trends of quantity or quality, particularly for the longer time frame, were often patchy and rarely based on any kind of detailed documentary survey or map evidence for overall territories. Instead they were more usually based on more limited investigations or expert judgement.

3.6 Heathland and scrub

The heath, shrub and tundra types of Europe comprise 40 habitats which are dominated by diverse assemblages of woody shrubs often in combination with herbs, and sometimes with a large contingent of mosses, liverworts and lichens, particularly in the case of the Arctic and Boreal examples. They are distributed across all the biogeographic regions of Europe from the lowlands to the upper levels of the subalpine and oromediterranean belts. With the exception of situations where environmental conditions are extreme, with, for example, strong wind, deep cold, shallow rocky soils, extreme drought or regular flooding, most of these habitats are secondary in character, dependent on interventions, particularly grazing and fire. In such cases, they occupy an

Figure 3.21 Garrigue on the Island of Corsica, France. © K. O'Deye-Guizien

intermediate position between more closely managed grassland types and mature woodlands.

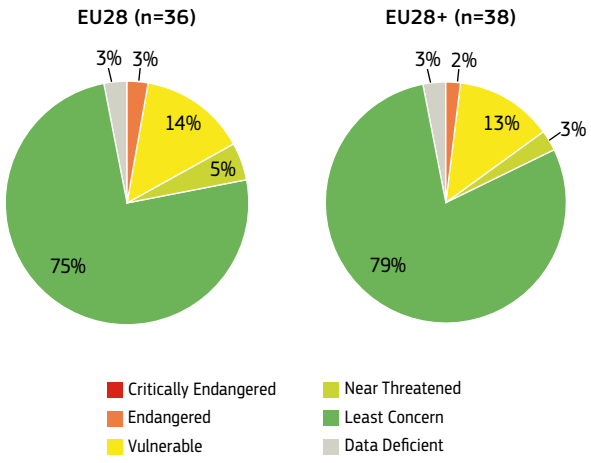
The abundance and diversity of heath and scrub habitats is uneven across the different regions of Europe, with a higher representation in the Mediterranean, the Macaronesian and in the Atlantic regions, where a substantial number of genera of legumes, ericaceous and other sub-shrubs are highly diversified. In these regions, the scrub of the heath, matorral or phrygana occupies a substantial part of the landscape in the hills and mountains, making an important contribution to its plant diversity with a good representation of narrow distribution endemics. As a result of its relationship with traditional pastoral systems, the shrubs are often browsed by sheep and goats, constituting an important resource for herding. The abandonment of such practices has triggered secondary succession towards forests in many areas and the reduction of scrub, in an analogous way to the situation with some types of grasslands. Other scrubs play an important role as forest edges and mantles which are used as living hedges in the traditional rural landscape of the temperate and submediterranean areas of Europe.

Variability among these habitats is related mainly to biogeography, climatic diversity, hydrologic conditions and soil reaction as well as to the disturbance regime. This results in habitats linked to different types and degrees of intervention (seral garrigues, heaths and scrub, woodland mantle hedges), to high mountain situations, to coastal cliffs, to tundra with its low temperatures, to wet soils (as with riparian and fen scrub) and, only for the Mediterranean region, to the high content in nitrogen compounds and gypsum in the soils.

Assessment results

A majority of the heath and scrub types (75% in the EU28, 79% in the EU28+) were assessed as Least Concern (Figure 3.22) Only six types, five Vulnerable and one Endangered, were assessed as

Figure 3.22 Overall assessment of heath and scrub habitats in the EU28 and EU28+. (n=number of habitats)



threatened (see Box 3.5), one of the smallest proportion in any of the major habitat groups. Two additional types are evaluated Near Threatened for the EU28, one for the EU28+.

Main pressures and threats

Since many of these types are successional stages dependent on a certain degree of disturbance – by grazing, fire and wood harvesting – the main threat is that such intervention stops (Figure 3.23), mostly due to rural abandonment, a widespread phenomenon across Europe in recent decades. This triggers secondary succession towards other more developed forms of vegetation, causing the encroachment into those habitats of larger shrub and particularly trees. This affects all the scrubs and heaths which have a seral character by way of a reduction of quantity and quality. However, this threat may be underestimated, as currently in other places scrub develops in former grasslands, due to the same reason, the abandonment of traditional land use.

Another threat comes from infrastructure development and housing, which is responsible for substantial reduction in extent in the cases where urban development has been intense, such as along the Mediterranean coastal areas and in the Canary Islands.

In some territories where there is mountainous relief and a favourable climate for afforestation, planting with alien tree species, usually conifers and eucalypts, has become an important transforming activity. It was implemented to supply the paper industry, furniture-making and other manufacturing in a climate of economic and commercial self-sufficiency. In the 20th century this became a real alternative to traditional land uses devoted to pastoralism and to mountain agriculture, and showed a huge expansion at the expense of these heathlands and scrub and also grasslands and even native forest habitats. Modern forestry practices, with a higher technology, chemicals and fossil energy input, cause severe damage to the soils and the natural species populations of the affected areas, a phenomenon which is still in progress at local or regional scale in some territories.

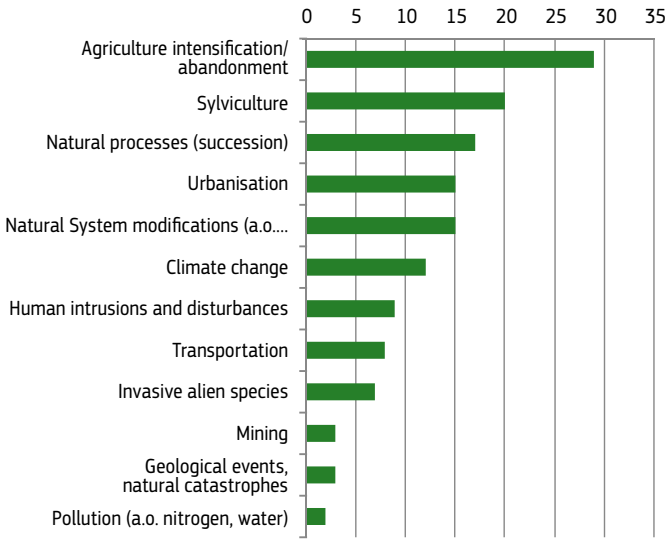
Finally, in the case of arctic and high mountain heath types, less dependent of disturbances such as grazing, climatic warming is a potential threat on a longer time scale.

Box 3.5 Threatened Heathland and scrub habitats.

Endangered
F8.2 Madeiran xerophytic scrub

Vulnerable
F3.1d Balkan-Anatolian submontane genistoid scrub
F4.1 Wet heath
F4.2 Dry heath
F5.5 Thermomediterranean scrub
F8.1 Canarian xerophytic scrub

Figure 3.23 Number of heathland and scrub habitats vulnerable to particular pressures and threats.



3.7 Forests

The Forests[3] of Europe comprise 42 habitats, most of them widely distributed over several biogeographical regions. Many types form the potential natural vegetation of their distribution range, such as Fagus sylvatica woodlands in central Europe, different Quercus woodlands in the Mediterranean Region or coniferous woodlands and taiga in northern Europe. By contrast, among the broadleaved deciduous woodlands, riparian woodlands occur only azonally, in more or less linear form along smaller or bigger river systems with different types in temperate, boreal and Mediterranean regions. Azonal bog and swamp woodland types are also closely linked to a special hydrology and occur patchily, often in small stands but over a large range, depending on climate and local conditions. A few types have a very restricted distribution, like the South Aegean and Canarian Phoenix groves (G2.5a, G2.5b), Macaronesian laurophyllous woodland (G2.3) and the sub-endemic Alnus cordata woodlands (G1.Ba) found only in Corsica and Southern Italy. In several parts of Europe in historic times or even still today, sylvipastoral systems are a particular kind of landscape management with specific structure and a very high biodiversity, but such wooded pastures and meadows are included in the Red List among the Grassland habitats.

The widespread woodland types with a relatively closed canopy are usually dominated by one or only few tree species. The herb layer is highly dependent on soil, hydrology and climatic conditions, being generally more species-rich in calcareous conditions and in woodland types in dry situations or with a more open canopy. Nevertheless, there is also a wide geographic variation among many woodland types, often with a number of sub-types of more restricted distribution, which may have different levels of threat. Woodlands are home to a very large proportion of European biodiversity, including tens of thousands of invertebrate-species, many fungi and a large number of birds that are dependent on a tree cover.

Although woodlands are often considered as more natural vegetation, virgin and pristine examples actually exist only in small remnants and a long history of different use has left its traces on many of these habitats, making them also a rich cultural heritage. These cultural modifications to some extent replace the

[3] Although the major habitat group G is termed 'Forests', all the constituent habitats are termed 'woodland' so this alternative general term is used in the following text.

Figure 3.24 Extensive *Picea abies* forests in the Romanian Carpathians. © John Janssen

natural dynamics of wind throw, fire, and breakdown of senescent trees in the canopy or other natural disturbance regimes and allow a substantial proportion of invertebrate species which need this patchy mosaic for their life cycle to survive in small relict populations. Commercial forestry, by contrast, removes 2/3 or more of the natural life of trees, senescent trees or dead wood being a minor feature in many stands.

At higher altitudes, specific mountain woodland types constitute the upper limit of tree growth, often with a coniferous canopy (as in habitats G3.1a, G3.1b, G3.1c, G3.2). In several mountain ranges, however, deciduous woodland types can also form the upper limit and all higher mountain woodlands can have a diverse herb layer characterised by species growing only at these higher altitudes, often including a considerable number of striking tall herbs.

Woodland habitats occur not only as dense tree stands, but also include all developmental phases and, due to natural or anthropogenic modifications, woodland margins and the herb vegetation of canopy gaps. Herb fringes and margins with distinct shrub vegetation can be considered as an integral structural part of these habitats, though they are included in the Red List among the Grasslands (as E5.2). Natural woodland borders, where tree growth is less vigorous, or where patchy mosaics with fringes or grassland vegetation exist, such as thermophilous forest, steppic forests and ravine forests, are especially species-rich.

Box 3.6 Threatened Forest habitats.

Endangered
- G1.2b Temperate and boreal hardwood riparian woodland
- G3.Db Picea mire woodland (EU28 only)

Vulnerable
- G1.3 Mediterranean and Macaronesian riparian woodland
- G1.4 Broadleaved swamp woodland on non-acid peat
- G1.5 Broadleaved bog woodland on acid peat
- G1.8 Acidophilous Quercus woodland
- G2.3 Macaronesian laurophyllous woodland
- G2.5b Canarian Phoenix grove
- G2.7 Macaronesian heathy woodland
- G3.4d Mediterranean montane Cedrus woodland
- G3.9c Macaronesian Juniperus woodland
- G3.Da Pinus mire woodland

Assessment results

Twelve woodland habitats (29%) were assessed as Threatened to some degree at the EU28 scale (Box 3.6; Figure 3.25), while 10 types were assessed as Near Threatened, often with some distinctly more threatened subtypes or regional variations. The two Endangered habitats are Temperate and boreal hardwood riparian woodland (G1.2b), related to large losses in the majority of the bigger river systems throughout Europe, and Picea mire woodland (G3.Db), due to losses in extent and modifications of hydrology.

Ten woodland habitats were assessed as Vulnerable, including the other bog woodland types (G1.5, G3.Da, G1.4, all with large recent declines in area) and one other riverine woodland (G1.3, with a recent decline in quality). Most other Vulnerable habitats

Figure 3.25 Overall assessment of forest habitats in both the EU28 and EU28+. (n=number of habitats)

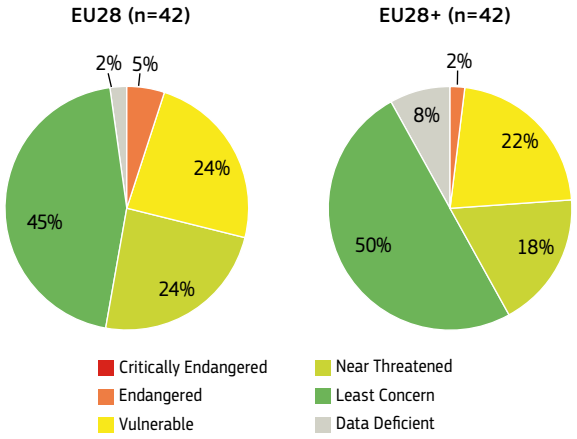
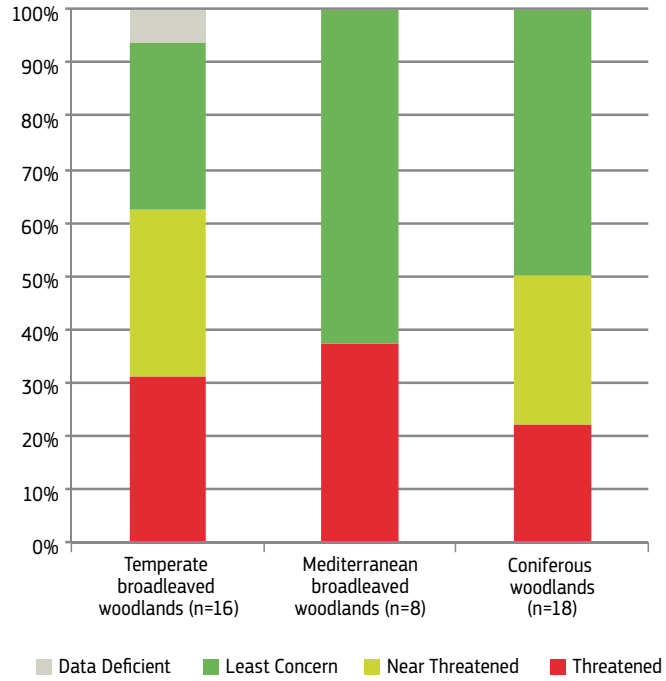


Figure 3.26 Assessment results in the EU28 for different subgroups of forest habitats.



have a small geographical distribution, being restricted mostly to Macaronesia (G2.3, G2.5b, G2.7, G3.9a) or to small parts of the Mediterranean (G3.4d). Three of these woodland types had a large historical reduction in quantity. A large reduction in quality was the main reason to assess Acidophilous Quercus woodland (G1.8) as Vulnerable.

The Near Threatened habitats include several relatively widespread woodlands such as two montane and alpine woodlands (G3.1b, G3.2) and several lowland, broadleaved woodlands (G1.1, G1.6a, G1.6b, G1.Aa, G3.4a; see Figure 3.26), and one of the most common boreal forest types (G3.A Picea taiga woodland), all based on negative recent trends in quality over the past decades (criterion C/D1). In addition, two more restricted woodland habitats, Mediterranean and Balkan subalpine Pinus heldreichii-Pinus peuce woodland (G3.6) and Ravine woodland (G1.Ab), are in this category. Three of all these Near Threatened habitats are Least Concern in the wider range of the EU28+.

Main pressures and threats

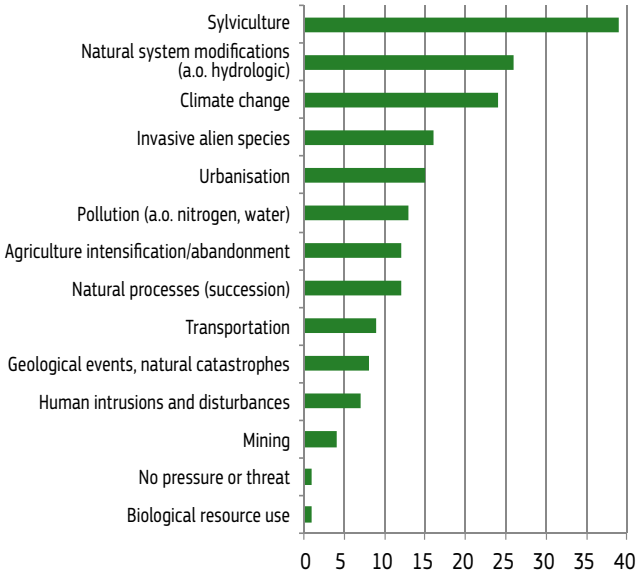
The major threats to most woodland habitats are linked with forestry (Figure 3.27): removal of dead and dying trees, missing deadwood and missing continuity of deadwood and senescent trees, the creation of even-aged stand structure, lack of natural stand dynamics, and removal of undergrowth. In some woodland habitats, at least regionally, clearance as such is also still a threat. Overgrazing by sheep and goats can also be a major threat, especially in several Mediterranean woodland types, for example Olea europaea-Ceratonia siliqua woodland (G2.4), and in Macaronesian types. But also in northern Europe, for example in Fennoscandia or Latvia, overgrazing by reindeer is an important threat to taiga woodlands.

For all woodland types dependent on a special hydrology, such as bog and swamp woodland types, riverine woodlands, and Phoenix palm groves, anthropogenic changes in hydrology are a major threat. For bog woodlands, peat-cutting is also still a danger and, for the riverine woodland types, major threats are canalisation and water deviation, lack of flooding, hydropower and weirs and pollution of surface water – many of these connected with intensive agriculture, for example in former alluvial plains.

For many woodland habitats, fragmentation and anthropogenic loss of habitat connectivity is an additional threat in greater or smaller parts of their range or regionally. Airborne nitrogen input and pollution such as acid rain are major threats mainly to naturally nutrient-poor woodlands, and climate change becomes a more and more important threat to many mountain types and Nordic boreal woodlands, but will also induce changes in dry and thermophilous forest habitats.

For several woodland habitats, the absence of natural fire dynamics is a threat, for example in northern taiga, while anthropogenic burning with destruction or modification in species composition endangers a number of Mediterranean and Macaronesian woodland types.

Figure 3.27 Number of forest habitats vulnerable to different pressures and threats.



Other important threats and pressures for certain habitats or regionally are mining and quarrying and invasive alien species. Urbanisation and infrastructure development are especially threatening for some woodland types with very restricted distribution.

Data gaps

The major country gaps in data belonged to countries outside the EU28, such as Serbia and Norway (for bog woodlands), but in most cases an assessment was still possible as their relative share in the more widespread woodland habitats was low and would not have altered the overall assessment results. Although Criterion C/D1 Reduction in biotic/abiotic quality was assessed against a clear agreed list of quality indicators, it sometimes proved difficult to interpret the loss in quality in precisely the same way, because of the shortage of data on certain woodland features. For these habitats, it is mostly the quality and amount of dead wood, ancient trees and mixed age structure that determine high quality habitats with a specific diversity of typical species and these have not always been recorded in existing data. Especially for forests, the period for criterion A3 Historic losses in extent is not sufficiently generous to capture large declines of woodlands since the Middle Ages or even earlier when large regions were depleted.

3.8 Sparsely vegetated habitats

A total of 31 habitats are considered, forming a very heterogeneous group, including bare or sparsely vegetated rock, lava, ice and snow of cliffs, screes, caves, volcanoes, glaciers and snow-fields. Also included here is the only habitat assessed from the more anthropogenic habitats: Arable land with unmixed crops grown by low-intensity agricultural methods (I1.3).

These habitats are distributed through all the biogeographic regions of Europe, with two types present only outside the EU28: Polar desert (H5.1b), restricted to Svalbard, and Subarctic volcanic field (H5.1c), only in Iceland. In general, the sparsely vegetated habitats are dependent on strong geological or meteorological features and are very often considered as azonal in most bioclimatic maps. However, there are strong geographic differences that have determined the characterisation of the habitat units with two variables generally used: rock type (whether ultramafic, base-rich or siliceous) and the biogeographic zone. This distinction enables independent assessments for such types as Mediterranean inland ultramafic cliffs (H3.2g) or Temperate high mountain siliceous cliff (H2.3). Coastal cliff types are evaluated among the Coastal habitats (B3.1 and B3.4).

Most of the habitats of this group are very susceptible to change and show little resilience, but have been little affected by direct human impact by virtue of their remoteness or inaccessibility. Many of the cliff habitats have functioned as refugia for plant species during the Ice Ages and other periods of changing conditions, and as a result nowadays harbour high numbers of endemic relic species.

Assessment results

With the available data it was possible to assess about three quarters of the habitats. The remaining six habitats (21% in EU28, 19% in EU28+) are assessed Data Deficient, the highest percentage within all groups. Within both the EU28 and EU28+, most habitats are Least Concern with only three Threatened and an additional two Near Threatened (Figure 3.29, Box 3.7).

The single Endangered habitat is Arable land with unmixed crops grown by low-intensity agricultural methods (I1.3), threatened by agricultural intensification in the last 50 years. The assessment

Figure 3.28 Sparsely vegetated rocks, cliffs and snow fields on the Korab mountain in the Former Yugoslav Republic of Macedonia. © Vlado Matevski

Figure 3.29 Overall assessment of sparsely vegetated habitats in the EU28 and EU28+. (n=number of habitats)

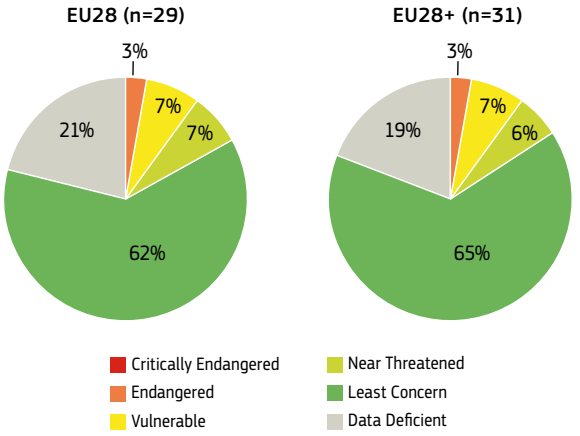
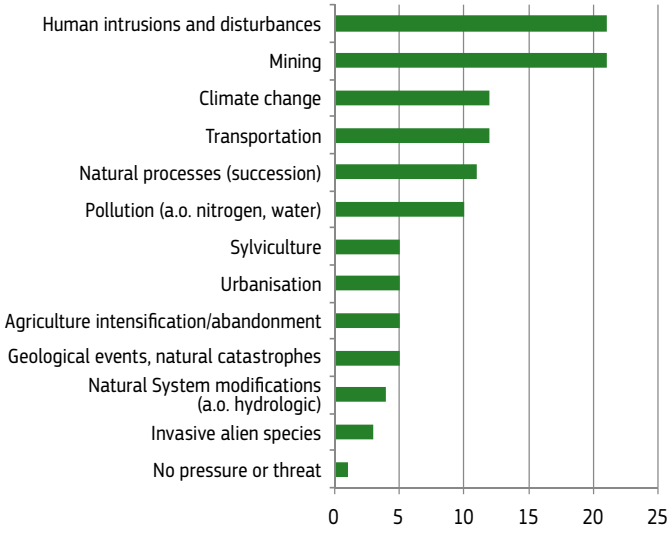


Figure 3.30 Number of sparsely vegetated habitats vulnerable to different pressures and threats.



Box 3.7 Threatened sparsely vegetated habitats.

Endangered
I1.3 Arable land with unmixed crops grown by low-intensity agricultural methods

Vulnerable
H4.1 Snow pack
H4.2 Ice cap and glacier

for this type was rather consistent throughout Europe, with levels of 80–90% decline in area in many countries. The two Vulnerable habitats are Snow pack (H4.1) and Ice cap and glacier (H4.2), both threatened by climate change. Three other boreal and arctic types, also with foreseen declines due to global warming, are evaluated Near Threatened: Rock glacier and unvegetated ice-dominated moraine (H4.3), Polar desert (H5.1b) and Fjell fields (H5.1a; Near Threatened in EU28, but Least Concern in the EU28+).

Main pressures and threats

This is a very heterogeneous group of habitats and the threats affecting them are likewise diverse (Figure 3.30). The most important threat for the snow-related habitats is climate change, which affects the reduction in extent in recent past and which is very likely to continue in the near future. Indeed, if accurate future projections are developed, the level of threat may increase.

Agricultural intensification is responsible for the Endangered status of Arable land with unmixed crops grown by low-intensity agricultural methods (I1.3), where the use of fertilisers, herbicide, insecticide and other agrochemicals, the large-scale removal of field boundaries, mechanisation and adoption of highly-yielding crop varieties have all taken a toll. A different form of agriculture is also responsible for Fjell field (H5.1a) being assessed as Near Threatened in EU28, mainly due to eutrophication through intensive grazing.

For the screes, rock outcrops and cliffs, the threats include mining/quarrying and infrastructure development like roads and other touristic infrastructure.

Data gaps

These sparsely vegetated habitats are in general not very well recorded or studied and, even when the territorial data were completed, data gaps were significant. It was sometimes difficult to ensure that the units of measurement in raw data were identical, as with Caves (H1.1), which were in some cases reported in km^2, in others by cave or cave entrance numbers. Even where the same units were employed, the differences in surface among countries suggest that limit of the habitat was interpreted differently by experts. Determining the areal extent of linear and vertical features like cliffs is also problematic. Long-term historic data from 1750 were missing in most of cases and boreal types presented important data gaps, especially for Sweden and Norway.

4. Discussion

4.1 The geographic scope of the assessment

The Red List provides a single European assessment of status and threats to habitats for the EU28 and EU28+, but it is clear from the territorial data that situations differ widely between countries within this overall frame. Figure 4.1 shows two examples of habitats where separate country assessments have been made using the territorial data supplied (trends in area). For the sake of a sound and effective conservation policy in Europe, it is recommended that the overall assessments are complemented by national and regional projects using the same basic methodology.

4.2 The habitat typology

All typologies are a convenience for understanding rich fields of variation, whether for science or policy. The Red List uses a habitat typology that is conveniently between the fine detail of plant communities and coarse ecosystem classification but its imperfections are plain and they can affect the outcome and validity of assessment.

For example, certain Red List habitats, particularly some Grasslands, Heath and scrub and Forests are very broadly defined and encompass a high variability dependent on differences in regional or altitudinal climate, terrain and soil type. The assessments indicate whether such sub-types are recognisable and would benefit from separate consideration in case they suffer different levels of threat. The crosswalk between the Red List habitats and the EuroVegChecklist alliances in the factsheets (see Figure 1.2) provides a valuable starting point for the definition of such sub-types.

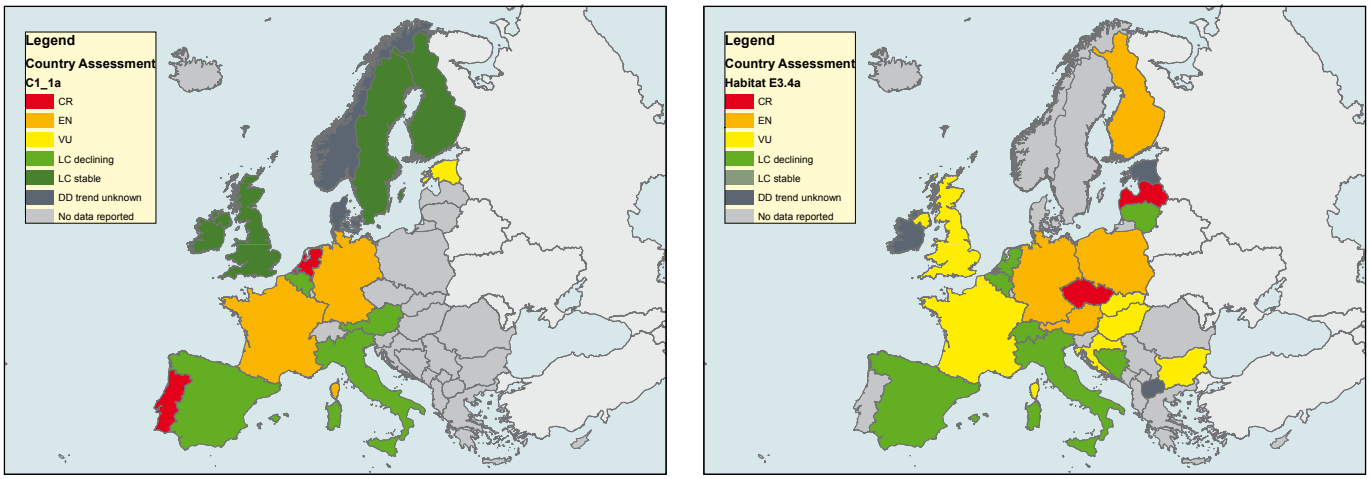
In other cases, the EUNIS typology used as a basis of the Red List habitats makes an uncertain separation between habitats *sensu stricto* and habitat complexes. Such complex habitats include highly diverse habitats related to various other major EUNIS groups which may be differently threatened. Generally, habitat complexes were excluded from the Red List except where they had a 1:1 relationship to Annex I habitat types, like Machair (B1.9) and Limestone pavement (H3.5a). Habitat complexity is especially problematic among mires where Palsa mires (D3.1), Aapa mires (D3.2) and, to a lesser extent, Raised bogs (D1.1) and Oceanic valley bogs (D2.1) can all be seen as complexes of different mire habitats. In some countries included in the Red List, they are interpreted as such, in others not, so understanding data on extent and threat is difficult.

4.3 Gaps and uncertainties in the data

The major source of information for all assessments was the data received from the Territorial Experts of participating countries. Unambiguous habitat definitions aimed for uniform interpretation but it is clear that inconsistency can never be prevented completely, partly due to different expressions of habitat types in different regions and countries, and partly due to mismatch with regional or national habitat classifications used to sort available data.

In total, territorial data were received for more than 2,700 habitat-country combinations and, for many habitats, quantitative territorial data were very good and complete, covering more than 80 to 90% of the area within the region under assessment. No territorial data were requested from relatively small countries, including the EU28 countries Luxembourg and Malta, as these data were expected to have no influence on the overall European Red List assessments. However, where known from expertise or literature, occurrences in such countries were indicated. Within the EU28, data deficiencies were few: for Sweden, grasslands, heath and scrub, for Denmark freshwater habitats, for Ireland relatively few trend data for all habitats.

Figure 4.1 Country by country Red List assessments based upon territorial trend in area data for Permanent oligotrophic waterbody with very soft-water species (C1.1a) assessed overall as Near Threatened and Moist-wet mesotrophic-eutrophic hay meadow (E3.4a) assessed overall as Endangered.



For EU28+ countries, relatively complete data sets were received for Switzerland, the Former Yugoslav Republic of Macedonia, and Bosnia and Herzegovina. From Albania and Kosovo, limited data were received, because of a shortage of expert contacts. Montenegro had very limited basic data available and reported only on forest habitats. In Norway it was difficult to provide adequate data because of different habitat typologies in use there and still ongoing inventories but relatively good data were received for a few forest and freshwater habitats, for some arctic types, and especially for mires and bogs. The most important remaining data gaps for all habitats are from Iceland and Serbia, countries which did not report any territorial data at all.

Overall, relatively poor data were available for habitats that are rarely recognised in national or international typologies and therefore absent from surveys and inventories, for example Soft sea cliffs (B3.4a–b), Temperate temporary waterbodies (C1.6a) and Ultramafic inland cliffs (H3.2e–g).

For the preparation of the habitat distribution maps, data coverage was also relatively good within the EU28, especially for types that correspond closely to Annex I habitats, and poorer for distribution in the EU28+. For habitats not covered by the Annex I data, the European Vegetation Archive, national habitat maps and the Vegetation Map of Europe (Bohn *et al*. 2000/2003) proved useful.

4.4 Assessment criteria

Criterion A1 Reduction in quantity over recent time was one of the most frequent criteria which determined a high level of threat for terrestrial and freshwater habitats, though the time period used was often an approximation to the 50 years and estimates of change were often 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, for many habitats it is a questionable threshold. For Forests also, and maybe for certain kinds of semi-natural grasslands, historic continuity of occupancy in particular sites is of crucial importance for the retention of ecological integrity and, though total extent can remain unchanged in a territory, a habitat may disappear and appear in different places.

Estimates of **Criteria A2a and A2b Likely future loss of extent** were almost never provided and, within the European landscape as it is today, are dependent on unpredictable political and socio-economic changes. The criterion was most relevant for habitats that are likely to suffer from climate change.

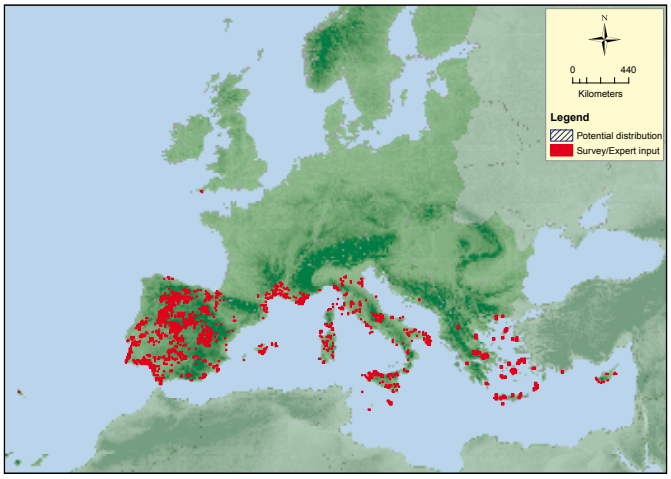
Assessment against **Criterion B1 EOO and B2 AOO** was based on calculations made from distribution maps assembled from a wide variety of sources which are indicated for each map. Inevitably, such maps are an approximation of known distribution and they cannot be fully validated by point source data across the entire range, being sometimes dependent on extrapolation or expert judgement. Although the actual extent of habitats in each country was sometimes approximate or unknown and the European total therefore uncertain, it was almost always possible to assign a habitat to one of the assessment categories under both criteria. However, very few habitats met the thresholds for criteria B1 and B2.

While the existing criteria do not focus specifically on whether localities are over-, under- or evenly-dispersed within the overall EOO, using both the terms of EOO and AOO provides a frame for addressing the degree of dispersion in a distribution and the spread of risk of collapse. The choice of the scale of assessment of AOO, particularly for point and also linear habitats, affects whether the extent of habitats can be accurately registered (Gigante *et al.* 2016; see Figure 4.2).

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 stages of quality degradation. In this way decline in quality relates to the sum of degradations caused by all acting pressures together.

Thresholds for the category Near Threatened were proposed especially for this Red List assessment (Annex B). More gradual thresholds may be considered, especially for criteria C/D, in

Figure 4.2 Mediterranean temporary water bodies (C1.6b), like this example from Greece (photo © Ioannis Bazos), occur in very small stands within the 10x10 km-grids used for the distribution maps, so their actual area is much smaller than the Area of Occupancy (AOO) used for assessment.



order to prevent habitats changing from Vulnerable to Critically Endangered, without qualifying for the Endangered category.

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 almost always impossible 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 for good. When a habitat 'collapses' it is generally transformed into another habitat which, though often of lower quality, nevertheless has the potential to improve.

4.5 Other unassessed characteristics and values

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** 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 plants and animals, 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.

Many habitats have very important integral **cultural characteristics** related to different interactions between local climate, soil conditions, biotic interventions and the accumulation of particular traditions of management. These contribute to the local or regional distinctiveness of habitats which is often lost when the habitat is degraded.

Ease of recoverability – whether intervention was necessary and over what time scale results might be expected – was included in the assessment but this information was not factored into the overall assessments of Red List category. 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.

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 all natural and semi-natural habitats across the EU28 and EU28+. Within the existing framework of the EUNIS habitat classification, it offers a refined typology and full 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 remediation. It thus contributes to analysis of policy effectiveness and facilitates more targeted and coordinated conservation actions. For prioritising in management and policy other information provided is of relevance, like diversity of habitats (including endemic species), regional variability and subtypes of habitats, and recoverability of habitats.

In the paragraphs below, three particular applications relevant to existing policy initiatives are outlined.

5.2 The mapping of ecosystems and their services

The European Red List of Habitats can contribute in a variety of ways to mapping the extent and condition of ecosystems that is an essential part of measuring the attainment of the EU Biodiversity Strategy to 2020 targets, in particular through synergies with the MAES initiative (Erhard *et al.* 2016). This collaboration between the European Commission, the European Environment Agency and Member States aims to understand the causal chain from human actions to impacts on the environment. Understanding the relationships between environmental pressures and biodiversity, mapping the impacts and exploring how to weigh and sum multiple pressures is at an early stage of development because of the lack of empirical evidence. The Red List deliverables could assist in providing such essential data for the MAES initiative and other uses.

First, through the crosswalk with MAES-2 ecosystems provided in the assessments, the Red List can bring fine-grain detail to the definition of threatened habitats. Second, through the enumeration of threats using the Article 17 frame, it can show which habitats are at risk from the five main pressures recognised by MAES – habitat change through such impacts as land take and abandonment, climate change, over-exploitation of resources, invasive alien species and pollution/nutrient enrichment. Third, and maybe most potent, through the distribution maps that are provided for the Red List habitats, it can help make spatially explicit the intensity, location and consequences of particular pressures and threats and their combined effects.

As an example, Figure 5.1 shows the total nitrogen input to grassland in the European Union, mostly from mineral fertilisers and manure, and the combined distribution map for four pastures and meadows which are specifically threatened by agricultural eutrophication.

5.3 Red List evaluations and habitat restoration

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

Figure 5.1 Total nitrogen input to grassland in kg/ha/year (source: ETC/SIA 2014) and combined distribution of four moist, mesotrophic grassland habitats (E2.1, E2.2, E2.3, E2.4) that are threatened by agricultural eutrophication.

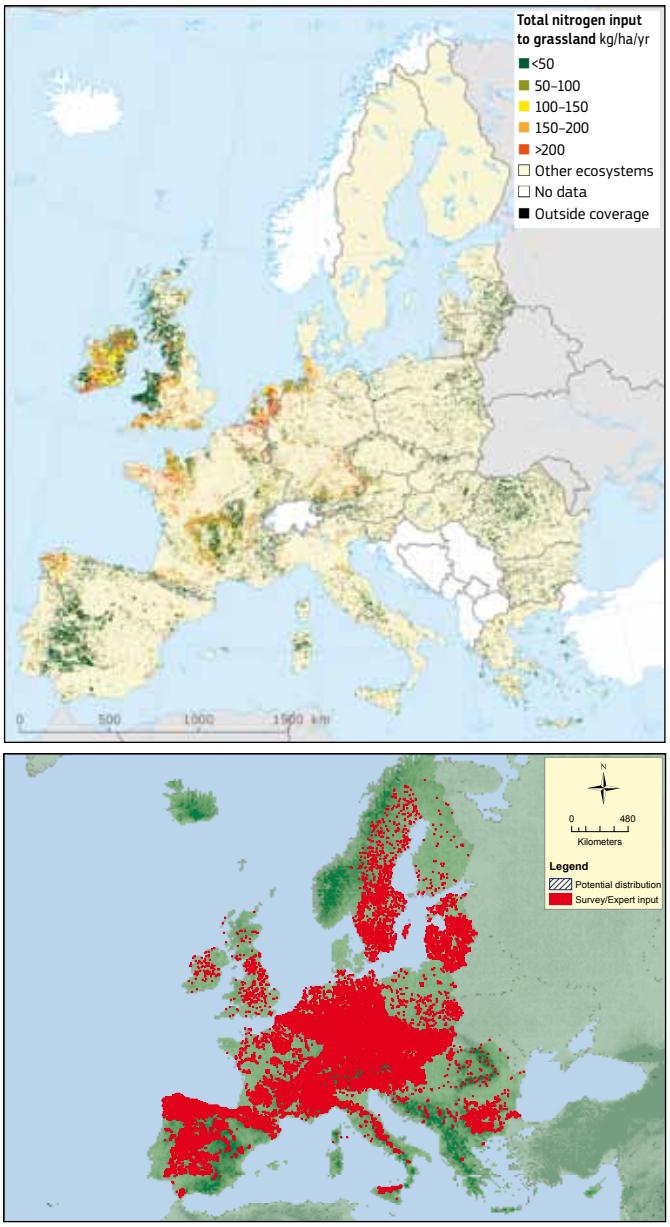


Figure 5.2 Extensively managed arable field in Transylvania, Romania, with the characteristic *Agrostemma githago* flowering. © John Janssen

This application of the Red List can be seen for Arable land with unmixed crops grown by low intensity agricultural methods (I1.3, Figure 5.2), a habitat assessed as Endangered in both the EU28 and EU28+ on the basis of a huge decrease in extent over recent historic time, with the loss of distinctive contingents of winter annual plants able to survive among crops traditionally grown without chemical weed control. The habitat is still widely distributed across Europe, though surviving in small isolated areas except in Italy and, to a lesser extent, France and the Iberian Peninsula, and, in the EU28+, Switzerland. Further losses at the margins of distribution would very substantially reduce the range and be especially significant because the habitat is represented by distinctive sub-types in these regions, characteristic of local climate and farming traditions, associated with different cereal crops.

Restoration of this habitat depends on effective incentives for re-instating low-input arable agriculture and recruitment of the flora previously regarded as weeds. Often the seed-bank is now lost or much depleted and the soils saturated with chemicals but, in less damaged places, recovery may be more speedy. Otherwise, appropriate seed mixtures may be sown and, in arable set-aside programmes, these have been shown to be rather successful in establishing the habitat in wide headlands around intensive fields. Such initiatives also have benefits for some birds, like the partridge. Quality indicators that can measure success would be the seasonal appearance of the typical rare, native or archaeophyte plants without invasion of more nutrient-demanding neophyte weeds. With the pressure for economic arable farming, restoration will always be dependent on conservation initiatives.

5.4 Combining Red List assessments for defining European landscapes

The habitats of Europe occur in unique combinations to form distinctive landscapes with their own patterns and dynamics and their Red List assessments can be considered together on this broader scale. For example, the Chalklands of the southern UK lowlands comprise steep scarps with shallow, base-rich and nutrient poor soils which can sustain a range of different habitats in the warm, dry climate characteristic of the region, listed in Figure 5.3. After early (maybe even prehistoric) forest clearance, much of the steeply sloping ground has been under pastoral agriculture, mainly for sheep grazing, for many centuries and has extensive areas of dry grassland. Where grazing is relaxed or abandoned, shrubs quickly invade to create thorn and *Juniperus* scrub, very locally, on the steepest drought-prone slopes, with *Buxus*. Woodland edge vegetation occurs widely.

The Europe-wide assessments for these habitats are shown in Figure 5.3. The majority of the habitats are in the Least Concern threat category for Europe as a whole, although Fagus woodland (C1.6a) is represented in this landscape by a sub-type which is more vulnerable to particular threats than the habitat as a whole. Taxus woodland (C3.9a) is also a variable habitat represented through much of its range by small far-flung stands, the loss of any of which could substantially reduce the overall range. The Submediterranean psuedomaquis (F5.3) is very much at the north-west edge of its range. The most threatened habitats in this landscape are the two grassland types both of which, as throughout much of Europe, are vulnerable to reduction in grazing with the decline of traditional pastoralism. Such a shift leads to the invasion of shrubs and trees and an enhanced share in the landscape of the characteristic scrub and woodland types. In more dynamic examples of this landscape, Juniperus scrub (F3.1a) is especially disadvantaged against Thorn scrub (F3.1e), because of the often reduced capacity of the tree to regenerate and its vulnerability to light shade.

Whatever the balance of assessment categories of the constituent habitats in a landscape, their unique combination itself has a limited range and extent and vulnerability to threats and its own particular degree of endangerment. Such landscapes also have an internal dynamic comprising the successional relationships between the habitats which may itself be a valuable and threatened set of processes. Within any one landscape, the diminishment of one constituent habitat in extent and quality may well represent gains for a potential replacement with value of its own.

Figure 5.3 Habitats of the UK Chalklands and their European Red List assessment. Photo: Yoesden Bank, Bucks © Peter Creed

Vulnerable
E1.2a Semi-dry calcareous grassland
E1.1d Cryptogam and annual-dominated vegetation on calcareous and ultramafic rock outcrops

Least Concern
G1.6a Fagus woodland on non-acid soils
G3.9a *Taxus baccata* woodland
G5.2a Thermophile woodland fringe on base-rich soils
F3.1e Temperate and submediterranean thorn scrub
F3.1a Temperate and submediterranean Juniperus scrub

6. Conclusions

For the first time, the European Red List of Habitats has applied a framework of assessment agreed with the European Commission to provide a comprehensive and systematic overview of the current extent, quality and degree of endangerment (risk of collapse) of all terrestrial and freshwater habitats across the EU28 and EU28+. In addition it provides for all 233 habitats rich supporting information including habitat definition, species list, distribution map, indications of typicalness for biogeographic regions, a list of threats, conservation measures and restorability.

Of those habitats assessed, 36% (31% for EU28+) were in the three threatened categories: Critically Endangered (less than 2% of the total), Endangered (11%) and Vulnerable (24%). An additional 12% were in the Near Threatened category as defined using the thresholds proposed for this project.

The percentage of threatened types differs considerably among the seven major habitat groups. Mires and bogs are the most threatened groups of habitats in the EU28 (with 85% in the top three categories), followed by grasslands (53%), freshwater habitats (46%) and coastal habitats (45%). The forests, heathland and scrub, and sparsely vegetated habitats had relatively low proportions of threatened types (respectively 29, 17 and 10%). Proportions of threatened habitats were slightly lower in the wider range of the EU28+.

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 restoration 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.

The Red List habitat typology is not identical to that in Annex I and 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 highlights degrees of shortfall in habitat extent and condition which are more inclusive than the Habitats Directive, and the supplementary standardised information on habitat character and distribution can be employed for refining our understanding of European biodiversity.

The Red List brings together quantitative data and expert knowledge from over 150 contributors in 33 countries from the Arctic Circle to the Mediterranean and Macaronesia and including Iceland, Norway, Switzerland and the Balkans from the EU28+. Gaps in geographic coverage are clearly identified and, as far as possible, their impact mitigated by comparison with neighbouring territories with similar climate and geology and an appraisal of their likely effect on the overall assessment. In the main, assessments achieved a medium to high confidence level.

Although the inherited EUNIS habitat classification which formed the basis of the Red List typology has some inherent problems of imprecise and ambiguous definition, it provided a practicable framework for assessment. The modifications of EUNIS undertaken for the Red List have yielded improvements which, together with the revisions underway in EEA projects, will provide a lasting legacy. Furthermore, the habitat descriptions and species lists developed for the Red List represent the first comprehensive attempt to deliver definitions of EUNIS-related habitats that will enable recognition in the field and comparison with other typologies.

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 European 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 a landscape that is highly diverse, fine-grained and dynamic, strongly affected by cultural influences now prey to complex fluxes of socio-economic change.

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 by all interested institutions, NGOs and individual researchers. The crosswalk between the Red List habitats with the alliances of the EuroVegChecklist provides 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 Copernicus 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 in the Red List of Habitats approach and data availability can strengthen our shared commitment to the future of European biodiversity.

7. References

Bohn, U., R. Neuhäusl, with contributions by G. Gollub, C. Hettwer, Z. Neuhäuslová, Th. Raus, H. Schlüter and H. Weber (2000/2003). Karte der natürlichen Vegetation Europas / Map of the Natural Vegetation of Europe. Scale 1: 2 500 000. Budesambt für Naturschutz, Bonn.

Chytrý, M., Hennekens, S.M., Jiménez-Alfaro, B., *et al.* (2016). European Vegetation Archive (EVA): an integrated database of European vegetation plots. *Applied Vegetation Science* 19: 173–180.

Davies, C.E., Moss, D. and Holl, M.O. (2004). Eunis Habitat Classification Revised 2004. European Environment Agency, Copenhagen.

Erhard M., Teller A. and Maes J. *et al*. (2016). Mapping and Assessment of Ecosystems and their Services: Mapping and assessing the condition of Europe's ecosystems: Progress and challenges. 3rd Report, Final, March 2016. European Commission Technical Report – 2016-095.

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

Evans, D. and M. Arvela (2011). Assessment and reporting under Article 17 of the habitats Directive. Explanatory notes and Guidelines for the period 2007–2012. European Topic centre for Biological Diversity, Paris.

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.

Gubbay, S., 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 (2016). European Red List of Habitats. 1. Marine habitats. European Commission, Brussels.

Hengeveld, G.M., Nabuurs, G.-J., Didion, M., Van den Wyngaert, I., Clerkx, A.P.P.M. and Schelhaas, M.-J. (2012). A forest management map of European forests. *Ecology and Society* 17(4): 53. http://dx.doi.org/10.5751/ES-05149-170453

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

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

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

Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J., Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F.J.A., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J.H.J., Lysenko, T., Didukh, Y.P., Pignatti, S., Rodwell, J.S., Capelo, J., Weber, H.E., Solomeshch, A., Dimopoulos, P., Aguiar, C., Hennekens, S.M. and Tichý, L. (2016). Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science* (in print).

Plieninger, T., Hartel, T., Martín-López, B., Beaufoy, G., Bergmeier, E., Kirby, K., Montero, M.J., Moreno, G., Oteros-Rozas, E. and Van Uytvanck, J. (2015). Wood-pastures of Europe: Geographic coverage, social-ecological values, conservation management, and policy implications. *Biological Conservation* 190: 70–79.

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.

Schaminée, J.H.J., M. Chytrý, S.M. Hennekens, L. Mucina, J.S. Rodwell and L. Tichý (2012). Development of vegetation syntaxa crosswalks to EUNIS habitat classification and related data sets. Report for the European Environmental Agency, Copenhagen.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Jiménez-Alfaro, B., Mucina, L., Rodwell, J.S. and Tichý, L. (2013). Review of EUNIS forest habitat classification. Report for the European Environmental Agency, Copenhagen.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Janssen, J.A.M., Jiménez-Alfaro, B., Knollová, I., Mucina, L., Rodwell, J.S. and Tichý, L. (2014). Vegetation analysis and distribution maps for EUNIS habitats. Report for the European Environmental Agency (EEA/NSV/14/006), Copenhagen.

Schaminée, J.H.J., M. Chytrý, S.M. Hennekens, J.A.M. Janssen, B. Jiménez-Alfaro, I. Knollová, C. Marceno, L. Mucina, J.S. Rodwell and L. Tichý (2016). Review of grassland habitats and development of distribution maps of heathland, scrub and tundra habitats of EUNIS habitats classification Report EEA/NSV/15/005, Alterra, Wageningen.

Annex A. List of terrestrial and freshwater habitats and their Red List results

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
Coastal Habitats (B)					
A2.5a	Arctic coastal salt marsh	--	NT	-	A2a, B2
A2.5b	Baltic coastal meadow	EN	EN	A1	A1
A2.5c	Atlantic coastal salt marsh	VU	VU	CD1	CD1
A2.5d	Mediterranean and Black Sea coastal salt marsh	NT	NT	CD1	CD1
B1.1a	Atlantic, Baltic and Arctic sand beach	VU	VU	CD1	CD1
B1.1b	Mediterranean and Black Sea sand beach	NT	NT	CD1	CD1
B1.3a	Atlantic and Baltic shifting coastal dune	NT	NT	A3, CD1	A3, CD1
B1.3b	Mediterranean and Black Sea shifting coastal dune	VU	VU	CD1	CD1
B1.4a	Atlantic and Baltic coastal dune grassland (grey dune)	VU	VU	A1, CD1	A1, CD1
B1.4b	Mediterranean and Macaronesian coastal dune grassland (grey dune)	EN	EN	CD1	CD1
B1.4c	Black Sea coastal dune grassland (grey dune)	EN	EN	B1, B2	B1, B2
B1.5a	Atlantic and Baltic coastal Empetrum heath	VU	VU	A3, CD1	A3, CD1
B1.5b	Atlantic coastal Calluna and Ulex heath	LC	LC	-	-
B1.6a	Atlantic and Baltic coastal dune scrub	LC	LC	-	-
B1.6b	Mediterranean and Black Sea coastal dune scrub	VU	VU	A3	A3
B1.6c	Macaronesian coastal dune scrub	EN	EN	A1, CD1	A1, CD1
B1.7a	Atlantic and Baltic broad-leaved coastal dune woodland	LC	LC	-	-
B1.7b	Black Sea broad-leaved coastal dune woodland	EN	EN	B1	B1
B1.7c	Baltic coniferous coastal dune woodland	VU	VU	CD1	CD1
B1.7d	Mediterranean coniferous coastal dune woodland	LC	LC	-	-
B1.8a	Atlantic and Baltic moist and wet dune slack	VU	VU	A1, A3	A1, A3
B1.8b	Mediterranean and Black Sea moist and wet dune slack	LC	LC	-	-
B1.9	Machair	LC	LC	-	-
B2.1a	Atlantic, Baltic and Arctic coastal shingle beach	LC	LC	-	-
B2.1b	Mediterranean and Black Sea coastal shingle beach	LC	LC	-	-
B3.1a	Atlantic and Baltic rocky sea cliff and shore	LC	LC	-	-
B3.1b	Mediterranean and Black Sea rocky sea cliff and shore	LC	LC	-	-
B3.1c	Macaronesian rocky sea cliff and shore	LC	LC	-	-
B3.4a	Atlantic and Baltic soft sea cliff	LC	LC	-	-
B3.4b	Mediterranean and Black Sea soft sea cliff	DD	DD	-	-
Freshwater Habitats (C)					
C1.1a	Permanent oligotrophic waterbody with very soft-water species	NT	NT	CD1, CD2	CD1, CD2
C1.1b	Permanent oligotrophic to mesotrophic waterbody with soft-water species	LC	LC	-	-
C1.2a	Permanent oligotrophic to mesotrophic waterbody with Characeae	VU	VU	A1	A1
C1.2b	Mesotrophic to eutrophic waterbody with vascular plants	NT	NT	CD1	CD1
C1.4	Permanent dystrophic waterbody	NT	NT	CD1	CD1
C1.5	Permanent inland saline and brackish waterbody	NT	NT	A3	A3
C1.6a	Temperate temporary waterbody	LC	LC	-	-
C1.6b	Mediterranean temporary waterbody	VU	VU	CD1	CD1
C1.7	Permanent lake of glaciers and ice sheets	VU	DD	A1, B2, CD1	-

Annex A cont'd. List of terrestrial and freshwater habitats and their Red List results. Freshwater Habitats (C)

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
C2.1a	Base-poor spring and spring brook	VU	NT	CD1	CD1
C2.1b	Calcareous spring and spring brook	VU	VU	A3, CD1	A3, CD1
C2.2a	Permanent non-tidal, fast, turbulent watercourse of montane to alpine regions with mosses	LC	LC	-	-
C2.2b	Permanent non-tidal, fast, turbulent watercourse of plains and montane regions with Ranunculus spp.	VU	VU	A1	A1
C2.3	Permanent non-tidal, smooth-flowing watercourse	NT	LC	A1, CD1	-
C2.4	Tidal river, upstream from the estuary	EN	EN	CD1	CD1
C2.5a	Temperate temporary running watercourse	DD	DD	-	-
C3.5a	Periodically exposed shore with stable, eutrophic sediments with pioneer or ephemeral vegetation	NT	NT	CD1	CD1
C3.5b	Periodically exposed shore with stable, mesotrophic sediments with pioneer or ephemeral vegetation	VU	VU	A1	A1
C3.5c	Periodically exposed saline shore with pioneer or ephemeral vegetation	EN	EN	A1	A1
C3.5d	Unvegetated or sparsely vegetated shore with mobile sediments in montane and alpine regions	VU	VU	A1	A1
C3.5e	Unvegetated or sparsely vegetated shore with mobile sediments in the Mediterranean region	LC	LC	-	-
C5.1a	Tall-helophyte bed	LC	LC	-	-
C5.1b	Small-helophyte bed	NT	NT	A1, CD1	A1, CD1
C5.2	Tall-sedge bed	VU	VU	A1	A1
C5.4	Inland saline or brackish helophyte bed	EN	EN	A3	A3
C6.1	Underground standing and running waterbody	DD	DD	-	-
Mires and bogs (D)					
D1.1	Raised bog	EN	VU	A3	A3
D1.2	Blanket bog	NT	NT	CD1	CD1
D2.1	Oceanic valley bog	VU	NT	A1	A1
D2.2a	Poor fen	VU	LC	A1	-
D2.2b	Relict mire of Mediterranean mountains	VU	NT	B2	B2
D2.2c	Intermediate fen and soft-water spring mire	VU	NT	A1	A1
D2.3a	Non-calcareous quaking mire	VU	VU	CD1	CD1
D3.1	Palsa mire	CR	CR	E1	E1
D3.2	Aapa mire	LC	LC	-	-
D4.1a	Small-sedge base-rich fen and calcareous spring mire	EN	EN	A1, A3	A1, A3
D4.1b	Tall-sedge base-rich fen	EN	EN	A1	A1
D4.1c	Calcareous quaking mire	VU	VU	A1	A1
D4.2	Arctic-alpine rich fen	VU	VU	A2a	A2a
Grasslands (E)					
E1.1a	Pannonian and Pontic sandy steppe	CR	CR	A3	A3
E1.1b	Cryptogam- and annual-dominated vegetation on siliceous rock outcrops	VU	VU	A1	A1
E1.1d	Cryptogam- and annual-dominated vegetation on calcareous and ultramafic rock outcrops	VU	VU	A1	A1
E1.1e	Perennial rocky grassland of the Italian Peninsula	VU	VU	CD1	CD1
E1.1g	Perennial rocky grassland of Central Europe and the Carpathians	LC	LC	-	-
E1.1h	Heavy-metal dry grassland of the Balkans	NT	LC	B1, B2	-
E1.1i	Perennial rocky calcareous grassland of subatlantic-submediterranean Europe	VU	VU	A1	A1

Annex A cont'd. List of terrestrial and freshwater habitats and their Red List results. Grasslands (E)

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
E1.1j	Dry steppic, submediterranean pasture of South-Eastern Europe	VU	NT	CD1	CD1
E1.2a	Semi-dry perennial calcareous grassland	VU	VU	A1, A3	A1, A3
E1.2b	Continental dry steppe	NT	NT	A1	A1
E1.3a	Mediterranean closely grazed dry grassland	LC	LC	-	-
E1.3b	Mediterranean tall perennial dry grassland	LC	LC	-	-
E1.3c	Mediterranean annual-rich dry grassland	NT	NT	CD1	CD1
E1.5a	Iberian oromediterranean siliceous dry grassland	NT	NT	CD2	CD2
E1.5b	Iberian oromediterranean basiphilous dry grassland	LC	LC	-	-
E1.5c	Cyrno-Sardean oromediterranean siliceous dry grassland	EN	EN	B1, B2	B1, B2
E1.5d	Greek and Anatolian oromediterranean siliceous dry grassland	LC	LC	-	-
E1.5e	Madeiran oromediterranean siliceous dry grassland	CR	CR	B2, B3	B2, B3
E1.7	Lowland to submontane, dry to mesic Nardus grassland	VU	VU	A1	A1
E1.8	Open Iberian supramediterranean dry acid and neutral grassland	LC	LC	-	-
E1.9a	Oceanic to subcontinental inland sand grassland on dry acid and neutral soils	EN	EN	A1, A3	A1, A3
E1.9b	Inland sanddrift and dune with siliceous grassland	EN	EN	A1, A3	A1, A3
E1.A	Mediterranean to Atlantic open, dry, acid and neutral grassland	VU	NT	CD1	CD1
E1.B	Heavy-metal grassland in Western and Central Europe	EN	EN	A1	A1
E1.F	Azorean open dry, acid to neutral grassland	EN	EN	A1	A1
E2.1a	Mesic permanent pasture of lowlands and mountains	VU	VU	A1	A1
E2.2	Low and medium altitude hay meadow	VU	VU	A1, A3, CD1	A1, A3, CD1
E2.3	Mountain hay meadow	VU	VU	A1, A3	A1, A3
E2.4	Iberian summer pasture (vallicar)	NT	NT	A1	A1
E3.1a	Mediterranean tall humid inland grassland	LC	LC	-	-
E3.2a	Mediterranean short moist grassland of lowlands	LC	LC	-	-
E3.2b	Mediterranean short moist grassland of mountains	LC	LC	-	-
E3.3	Submediterranean moist meadow	LC	LC	-	-
E3.4a	Moist or wet mesotrophic to eutrophic hay meadow	EN	EN	A1	A1
E3.4b	Moist or wet mesotrophic to eutrophic pasture	EN	EN	A1	A1
E3.5	Temperate and boreal moist or wet oligotrophic grassland	EN	EN	A1	A1
E4.1	Vegetated snow patch	VU	VU	CD2, C2	CD2, C2
E4.3a	Boreal and arctic acidophilous alpine grassland	LC	LC	-	-
E4.3b	Temperate acidophilous alpine grassland	LC	LC	-	-
E4.4a	Arctic-alpine calcareous grassland	LC	LC	-	-
E4.4b	Alpine and subalpine calcareous grassland of the Balkan and Apennines	LC	LC	-	-
E5.2a	Thermophilous woodland fringe of base-rich soils	LC	NT	-	A1
E5.2b	Thermophilous woodland fringe of acidic soils	LC	LC	-	-
E5.2c	Macaronesian thermophilous woodland fringe	NT	NT	B2, CD1	B2, CD1
E5.3	Pteridium aquilinum stand	LC	LC	-	-
E5.4	Lowland moist or wet tall-herb and fern fringe	VU	VU	A1	A1
E5.5	Subalpine moist or wet tall-herb and fern fringe	LC	LC	-	-
E6.1	Mediterranean inland salt steppe	VU	VU	A1	A1
E6.2	Continental inland salt steppe	VU	VU	A1, A3	A1, A3
E6.3	Temperate inland salt marsh	EN	EN	A1	A1
E7.1	Temperate wooded pasture and meadow	VU	VU	A1, CD1	A1, CD1
E7.2	Hemiboreal and boreal wooded pasture and meadow	CR	CR	A1, CD1	A1, CD1
E7.3	Mediterranean wooded pasture and meadow	NT	NT	A1, CD1	A1, CD1

Annex A cont'd. List of terrestrial and freshwater habitats and their Red List results. Heathlands and scrub (F)

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
Heathlands and scrub (F)					
F1.1	Shrub tundra	--	LC	-	-
F1.2	Moss and lichen tundra	--	LC	-	-
F2.1	Subarctic and alpine dwarf Salix scrub	NT	LC	A2a, CD2, C2	-
F2.2a	Alpine and subalpine ericoid heath	LC	LC	-	-
F2.2b	Alpine and subalpine Juniperus scrub	LC	LC	-	-
F2.2c	Balkan subalpine genistoid scrub	LC	LC	-	-
F2.3	Subalpine deciduous scrub	LC	LC	-	-
F2.4	Subalpine Pinus mugo scrub	LC	LC	-	-
F3.1a	Lowland to montane temperate and submediterranean Juniperus scrub	LC	LC	-	-
F3.1b	Temperate Rubus scrub	DD	DD	-	-
F3.1c	Lowland to montane temperate and submediterranean genistoid scrub	LC	LC	-	-
F3.1d	Balkan-Anatolian submontane genistoid scrub	VU	VU	B2	B2
F3.1e	Temperate and submediterranean thorn scrub	LC	LC	-	-
F3.1f	Low steppic scrub	LC	LC	-	-
F3.1g	Corylus avellana scrub	LC	LC	-	-
F4.1	Wet heath	VU	VU	CD1	CD1
F4.2	Dry heath	VU	VU	A3	A3
F4.3	Macaronesian heath	LC	LC	-	-
F5.1	Mediterranean maquis and arborescent matorral	LC	LC	-	-
F5.3	Submediterranean pseudomaquis	LC	LC	-	-
F5.5	Thermomediterranean scrub	VU	VU	A1	A1
F6.1a	Western basiphilous garrigue	LC	LC	-	-
F6.1b	Western acidophilous garrigue	LC	LC	-	-
F6.2	Eastern garrigue	LC	LC	-	-
F6.6	Supramediterranean garrigue	LC	LC	-	-
F6.7	Mediterranean gypsum scrub	LC	LC	-	-
F6.8	Mediterranean halo-nitrophilous scrub	LC	LC	-	-
F7.1	Western Mediterranean spiny heath	LC	LC	-	-
F7.3	Eastern Mediterranean spiny heath (phrygana)	LC	LC	-	-
F7.4a	Western Mediterranean mountain hedgehog-heath	LC	LC	-	-
F7.4b	Central Mediterranean mountain hedgehog-heath	LC	LC	-	-
F7.4c	Eastern Mediterranean mountain hedgehog-heath	LC	LC	-	-
F7.4d	Canarian mountain hedgehog-heath	LC	LC	-	-
F8.1	Canarian xerophytic scrub	VU	VU	A1, A3	A1, A3
F8.2	Madeiran xerophytic scrub	EN	EN	A1, B2, B3	A1, B2, B3
F9.1	Temperate and boreal riparian scrub	LC	LC	-	-
F9.2	Salix fen scrub	NT	NT	A1, A3	A1, A3
F9.3	Mediterranean riparian scrub	LC	LC	-	-
Forests (G)					
G1.1	Temperate and boreal softwood riparian woodland	NT	NT	CD1	CD1
G1.2a	Alnus woodland on riparian and upland soils	LC	LC	-	-
G1.2b	Temperate and boreal hardwood riparian woodland	EN	EN	A3, CD1	A3, CD1
G1.3	Mediterranean and Macaronesian riparian woodland	VU	VU	CD1	CD1
G1.4	Broadleaved swamp woodland on non-acid peat	VU	VU	A1	A1

Annex A cont'd. List of terrestrial and freshwater habitats and their Red List results. Forests (G)

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
G1.5	Broadleaved bog woodland on acid peat	VU	VU	A1	A1
G1.6a	Fagus woodland on non-acid soils	NT	NT	CD1	CD1
G1.6b	Fagus woodland on acid soils	NT	NT	CD1	CD1
G1.7a	Temperate and submediterranean thermophilous deciduous woodland	LC	LC	-	-
G1.7b	Mediterranean thermophilous deciduous woodland	LC	LC	-	-
G1.8	Acidophilous Quercus woodland	VU	VU	CD1	CD1
G1.9a	Temperate and boreal mountain Betula and Populus tremula woodland on mineral soils	LC	LC	-	-
G1.9b	Mediterranean mountain Betula and Populus tremula woodland on mineral soils	LC	LC	-	-
G1.Aa	Carpinus and Quercus mesic deciduous woodland	NT	NT	CD1	CD1
G1.Ab	Ravine woodland	NT	LC	A1, CD1	-
G1.Ba	Alnus cordata woodland	DD	DD	-	-
G2.1	Mediterranean evergreen Quercus woodland	LC	LC	-	-
G2.2	Mainland laurophyllous woodland	LC	LC	-	-
G2.3	Macaronesian laurophyllous woodland	VU	VU	A3	A3
G2.4	Olea europaea-Ceratonia siliqua woodland	LC	LC	-	-
G2.5a	South-Aegean Phoenix grove	LC	LC	-	-
G2.5b	Canarian Phoenix grove	VU	VU	CD1	CD1
G2.6	Ilex aquifolium woodland	LC	LC	-	-
G2.7	Macaronesian heathy woodland	VU	VU	A3	A3
G3.1a	Temperate mountain Picea woodland	LC	LC	-	-
G3.1b	Temperate mountain Abies woodland	NT	LC	CD1	-
G3.1c	Mediterranean mountain Abies woodland	LC	LC	-	-
G3.2	Temperate subalpine Larix, Pinus cembra and Pinus uncinata woodland	NT	NT	CD1	CD1
G3.4a	Temperate and continental Pinus sylvestris woodland	NT	NT	CD1	CD1
G3.4b	Temperate and submediterranean montane Pinus sylvestris-Pinus nigra woodland	LC	LC	-	-
G3.4c	Mediterranean montane Pinus sylvestris-Pinus nigra woodland	LC	LC	-	-
G3.4d	Mediterranean montane Cedrus woodland	VU	VU	B3	B3
G3.6	Mediterranean and Balkan subalpine Pinus heldreichii-Pinus peuce woodland	NT	LC	B2	-
G3.7	Mediterranean lowland to submontane Pinus woodland	LC	LC	-	-
G3.8	Pinus canariensis woodland	LC	LC	-	-
G3.9a	Taxus baccata woodland	LC	LC	-	-
G3.9b	Mediterranean Cupressaceae woodland	LC	LC	-	-
G3.9c	Macaronesian Juniperus woodland	VU	VU	A3	A3
G3.A	Picea taiga woodland	NT	NT	CD1	CD1
G3.B	Pinus sylvestris taiga woodland	LC	LC	-	-
G3.Da	Pinus mire woodland	VU	DD	A1	-
G3.Db	Picea mire woodland	EN	DD	A1	-
Sparsely Vegetated Habitats (H, I)					
H1.1	Cave	LC	LC	-	-
H2.1	Boreal and arctic siliceous scree and block field	LC	LC	-	-
H2.2	Boreal and arctic base-rich scree	DD	DD	-	-
H2.3	Temperate high-mountain siliceous scree	LC	LC	-	-
H2.4	Temperate high-mountain base-rich scree	LC	LC	-	-

Annex A cont'd. List of terrestrial and freshwater habitats and their Red List results, cont'd. Sparsely Vegetated Habitats (H, I)

Habitat		Red List category		Decisive criteria	
Code	Name	EU28	EU28+	EU28	EU28+
H2.5	Temperate, lowland to montane siliceous scree	LC	LC	-	-
H2.6a	Temperate, lowland to montane base-rich scree	LC	LC	-	-
H2.6b	Western Mediterranean base-rich scree	LC	LC	-	-
H2.6c	Eastern Mediterranean base-rich scree	LC	LC	-	-
H3.1a	Boreal and arctic siliceous inland cliff	LC	LC	-	-
H3.1b	Temperate high-mountain siliceous inland cliff	LC	LC	-	-
H3.1c	Temperate, lowland to montane siliceous inland cliff	LC	LC	-	-
H3.1d	Mediterranean siliceous inland cliff	LC	LC	-	-
H3.2a	Boreal and arctic base-rich inland cliff	DD	DD	-	-
H3.2b	Temperate high-mountain base-rich inland cliff	LC	LC	-	-
H3.2c	Temperate, lowland to montane base-rich inland cliff	LC	LC	-	-
H3.2d	Mediterranean base-rich inland cliff	LC	LC	-	-
H3.2e	Boreal ultramafic inland cliff	DD	DD	-	-
H3.2f	Temperate ultramafic inland cliff	DD	DD	-	-
H3.2g	Mediterranean ultramafic inland cliff	DD	DD	-	-
H3.3	Macaronesian inland cliff	LC	LC	-	-
H3.4	Wet inland cliff	DD	DD	-	-
H3.5a	Limestone pavement	LC	LC	-	-
H4.1	Snow pack	VU	VU	A1, CD1	A1, CD1
H4.2	Ice cap and glacier	VU	VU	A1, A3, CD1	A1, A3, CD1
H4.3	Rock glacier and unvegetated ice-dominated moraine	NT	NT	A3	A3
H5.1a	Fjell field	NT	LC	CD1	-
H5.1b	Polar desert	--	NT	-	A1
H5.1c	Subarctic volcanic field	--	LC	-	-
H6.1	Mediterranean and temperate volcanic field	LC	LC	-	-
I1.3	Arable land with unmixed crops grown by low-intensity agricultural methods	EN	EN	A1	A1

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 km² 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 km², 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 km²) in which the habitat is present.

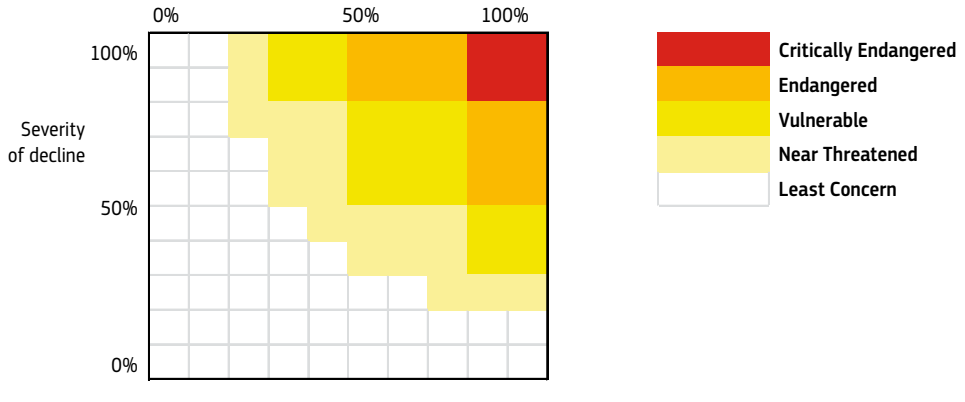
@ Includes the sum of degradation of (a)biotic conditions, interactions, structures and processes, species composition, and landscape-ecological setting (a.o. fragmentation); in the following criteria C and D this criterion may be split, based on the measure used to assess changes in quality (abiotic 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.



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