C1.1a Permanent oligotrophic waterbody with very soft-water species

Summary

This is a natural habitat developed in areas with poor bedrock and soils, particularly in regions impacted by the last glaciation or in mountainous areas. Soils in the catchments are mostly poor in nutrients, there is a slow paludification process, and the waters are weakly acid to circumneutral and oligotrophic, clear or brown. Many characteristic species, including plants, fish and crustacea are adapted to the nutrient-poor conditions and cool water temperatures. The vegetation, which is typically dominated by isoetids, extend from the shallows to the lower sub-littoral and is mechanically affected by water movement, ice and wind. Much reduced in extent by land reclamation and drainage, particularly in the southern part of its range, the habitat is now threatened by intensive land use in catchments, mostly caused by settlements and intensive agriculture and forestry and by changes in hydrology, including regulation of water table and lack of flooding. In future, climate change will cause increased stress to the biota of this habitat.

Synthesis

The average decline in quality over the last 50 years results in the category Near Threatened (NT) both in the EU28 and EU28+. Besides, the future trend in quality, roughly based on expert opinion, leads to a Near Threatened category for EU28 and EU28+. The average trend in area was only slightly negative, not leading to any Red List category, but it varied strongly between countries.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	C/D1, C/D2	Near Threatened	C/D1, C/D2

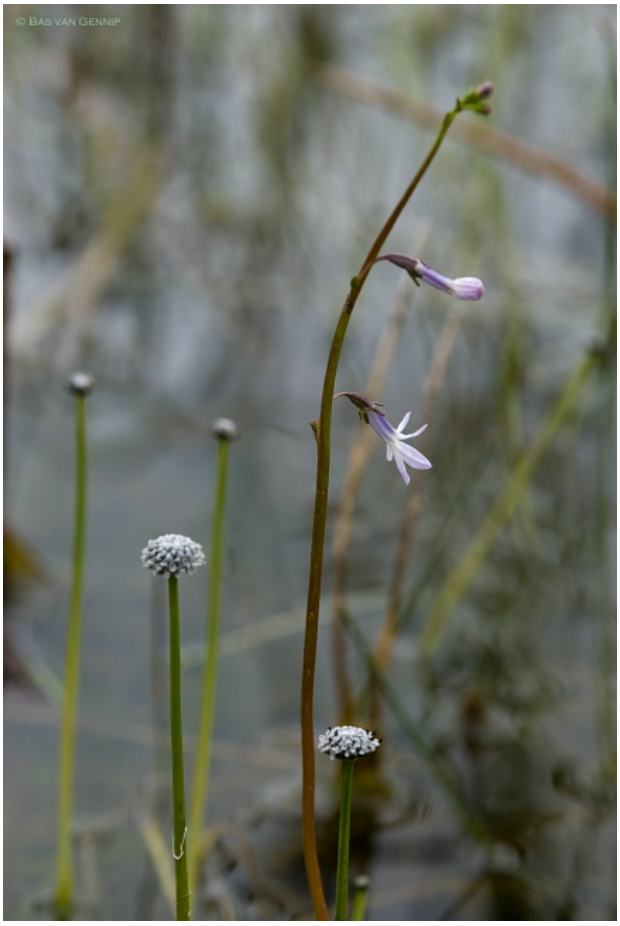
Sub-habitat types that may require further examination

Oligotrophic waters with very soft-water species have wide distribution in Europe and deserve further study. Alpine lakes should be assessed separately from lowland lakes. Besides it is clear that oligotrophic waters in West and Central Europe are much more threatened than those in the Boreal region, and therefore may be assessed independently.

Habitat Type

Code and name

C1.1a Permanent oligotrophic waterbody with very soft-water species



Littoral of the oligotrophic Lake Kaartjärvi in Finland is occupied by sparse helophyte and submerged vegetation (Photo: Heikki Toivonen).

Lobelia dortmanna and *Eriocaulon aquaticum* in an oligotrophic lake in western Ireland (Photo: Bas van Gennip).

Habitat description

Oligotrophic waters of sandy plains and rocky substrates (granites, gravel, stones, till, moraines) containing very few minerals. The substrates are covered by a thin layer of detritus. The water is carbon deficient and very poorly buffered (low alkalinity). The water is weakly acid to circumneutral. Concentrations of nitrogen and phosphorus are very low and in the oligotrophic range. The water is clear sometimes humic (brown) but always with a very low concentration of chlorophyll. The vegetation is low in species diversity and dominated by aquatic isoetids, i.e. submerged plants with a small rosette of stiff leaves and an extended root system. Aquatic isoetids are adapted to low carbon availability (low pH) by taking up carbon from the sediment through their extended root system, by an adapted carbon fixation (C4), and by re-using carbon-dioxide produced during respiration. The vegetated layer extends from the littoral to lower parts of the sub-littoral zone. The vegetation and its substrate are mechanically influenced by water movement, ice sheets and wind exposition. Sometimes these oligotrophic water bodies can be almost totally unvegetated. In the temperate, Atlantic zone the characteristic isoetid vegetation occurs in lakes fluctuating in water levels where they may be semi-permanent in the summer periods (Arts, 2002; Dierssen, 1996). Apart from the dominant isoetid aquatic macrophytes (i.e. *Isoëtes* spp.), other plants may be present in addition (Rørslett & Brettum 1989). Important accompanying isoetid species are *Lobelia dortmanna, Subularia aquatica* in Northern Europe, *Eriocaulon aquaticum* in Northern-Atlantic Europe or *Luronium natans* and *Isolepis fluitans* in Western Europe zones. *Subularia aquatica* also extends into the mountainous areas of Iberia in this habitat type (Molina et al., 1999).

Many large lakes in northern Europe represent this type or the more mesotrophic type C1.1b in terms of water chemistry and abundant isoetid vegetation. Occurrence and abundance of other growth forms vary according to shore and bottom material, topography, exposition and fetch. Exposed shores have sparse stands of aquatic vegetation, in sheltered bays vegetation has clear zonation, but the stands are still open

(Mäkirinta 1978, Rintanen 1982, Toivonen & Lappalainen 1980). The lower limit of submerged vegetation reaches typically the depth of 3-6 meters, sometimes close to 10 meters. Due to postglacial history deeper lakes host some glacial relict crustaceans and vertebrates, including salmonid fish and a critically endangered fresh water seal (*Pusa hispida saimensis*). Large lakes have diverse waterfowl populations and are important parts of bird migration routes Main differences between this habitat type and the C1.1b is that this one is constantly in the oligotrophic range and therefore is generally poorer than C1.1b in species and communities. Indicators of good quality isoetid species are the most characteristic species of this habitat.

The following characteristics may be used as indicators of a favourable quality:

• Large stands of isoetid species;

• Absence or very low abundance of peat mosses;

• Absence or very low abundance of water plants from eutrophic and alkaline waters;

• Low abundance of water plants with other growth forms than the isoetid growth form, e.g. floating or emerged plants e.g. *Potamogeton* species or *Sparganium angustifolium* stands or helophytes (*Phragmites australis, Eleocharis* spp., *Equisetum fluviatile, Carex* spp.);

• Long-term habitat stability, with no rapid successional trends (e.g. no trends in acidification or eutrophication);

• Low concentrations of nutrients and chlorophyll (approximately P < 15 µg/L and chlorophyll < 3 µg/L.);

• pH weakly acid to circumneutral (pH 5.5 - 7), alkalinity < 0.5 meq/L. (Note: Chemical and physical parameters are only indicative, they may change in different geographical area and climatic conditions).

• Thin layer of detritus (no accumulation of organic mud);

• No/ little impact from acidification or regulation;

• Absence or very low abundance of submerged or floating mats of macrophytes e.g. *Juncus bulbosus*;

• Occurrence of conspicuous populations of salmonid fish, but population of roach (*Rutilus rutilus*) and other Cyprinidae low.

Characteristic species:

Flora. Vascular plants: Boreo-atlantic: *Plantago uniflora* (syn. *Littorella uniflora*), *Lobelia dortmanna, Isoëtes echinospora, I. lacustris, Eriocaulon aquaticum. Potamogeton epihydrus, P. polygonifolius, Eleocharis acicularis, Myriophyllum alterniflorum, Juncus bulbosus*; Boreal: *Subularia aquatica, Ranunculus reptans, Eleocharis acicularis*; Atlantic: *Isoëtes boryana, I. velata* subsp. *tenuissima*; In the Atlantic presence of other soft-water species e.g. *Luronium natans* and *Isolepis fluitans*. Mosses: *Warnstorffia procera, W. trichophylla, Scorpidium scorpioides*. Macroalgae: *Nitella opaca, N. flexilis, N. transluncens.* Phytobenthos: *Eunotia naegelii, E. incisa,Tabellaria flocculosa, T. binalis, Navicula parasubtilissima.* Phytoplankton: typical of this habitat are the algae of the class *Chrysophyceae* that often tend to be the dominant in the phytoplankton, common species of other classes are *Spondylosium pulchellum, Bambusina borreri, Micrasterias truncata, Euastrum binale* var. *gutwinskii.*

Fauna. Macroinvertebrates: *Glaenocorisa propinqua, Sigara scotti, Arctocorisa germari.* Odonata: *Lestes dryas*. Diptera: *Pseudochironomus prasinatus, Pagastiella orophila, Telmatopelopia nemorum, Zalutschia humphrisiae.* Trichoptera: *Molanna albicans*. Amphipoda: *Gammarus lacustris, Gammaracanthus lacustris.* Mysida: *Mysis relicta*. Vertebrates: Fish of family *Salmonidae* (e.g. *Coregonus* spp., *Salmo* spp., *Salvelinus* spp., *Thymallus* spp.), *Osmarus eperlanus, Lota lota, Sander lucioperca, Perca fluviatilis, Esox Lucius*. Birds: *Gavia arctica, G. stellata, Anas* spp., *Aythya* spp., *Bucephala clangula, Larus fuscus, Mergus merganser, M.*

serrator, M. albellus, Melanitta nigra, Pandion haliaëtus. Mammals: *Lutra lutra, Pusa hispida* subsp. *saimensis* (in Finland).

Classification

This habitat may be equivalent to, or broader than, or narrower than the habitats or ecosystems in the following typologies.

EUNIS:

C.1.1 Permanent oligotrophic lakes, ponds and pools

C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation

EuroVegChecklist (alliances):

Subularion aquaticae Hadac 1971

Lobelion dortmannae Vanden Berghen 1964

*Littorellion uniflora*e Koch ex Klika 1935

Nitellion flexilis Krause 1969

Annex 1:

3110 Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

Emerald:

C1.1 Permanent oligotrophic lakes, ponds and pools

C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation

MAES-2:

Rivers and lakes

IUCN:

5.5 Permanent freshwater lakes (over 8 ha)

5.7 Permanent freshwater marshes and pools (under 8 ha)

Water Framework Directive:

LN 101

LCB3

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Yes

Regions
Alpine
Atlantic
Boreal

Justification
Oligotrophic very soft water lakes are very characteristic of atlantic, boreal and alpine areas in NW Europe, in regions largely created by the last glaciation. Due to glacial history these water bodies sometimes accomodate relict occurrences of certain fish and crustacea.

Geographic occurrence and trends

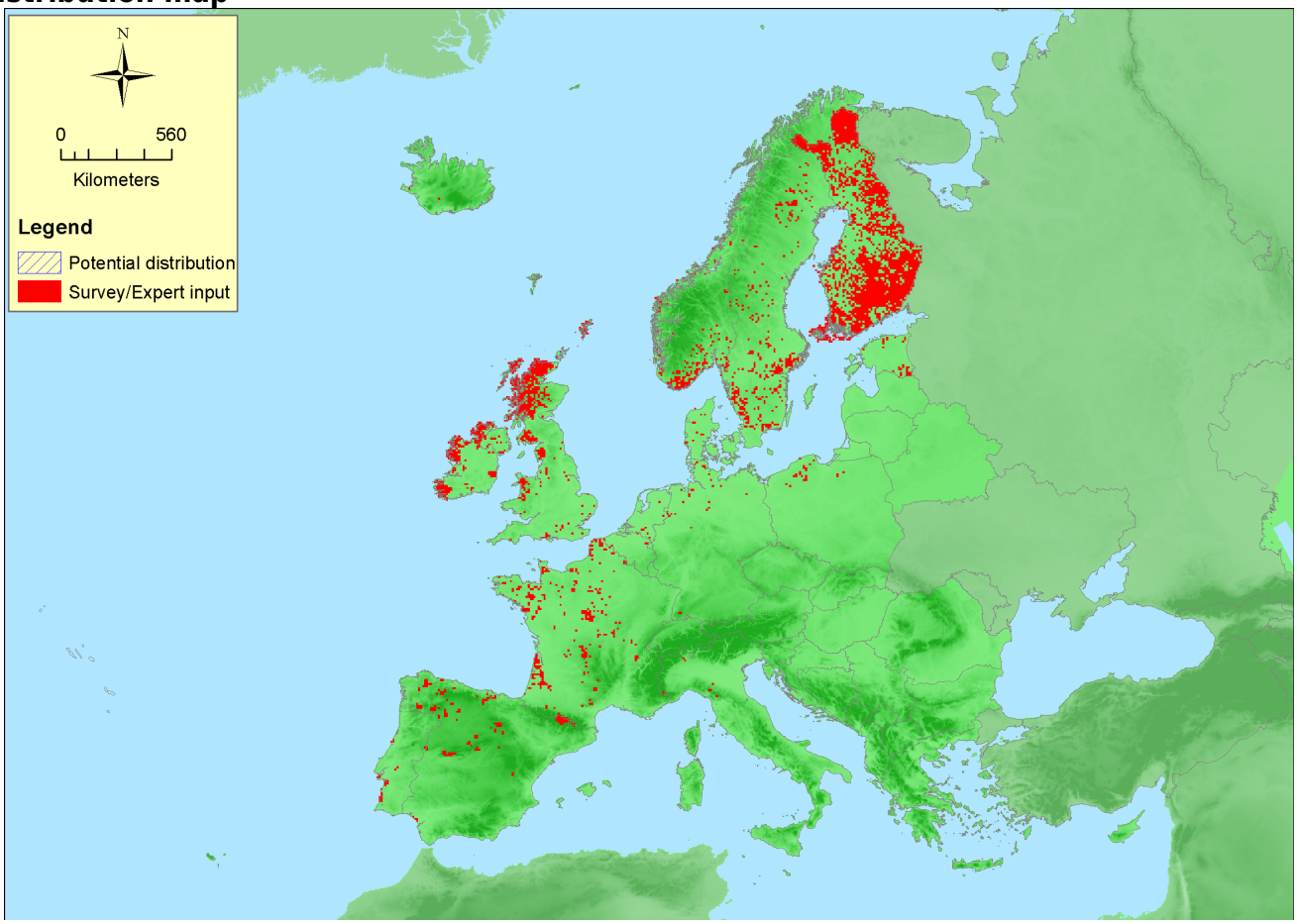
EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Austria	Present	<1 Km^2	Decreasing	Decreasing
Belgium	Present	marginal Km^2	Decreasing	Unknown
Czech Republic	Uncertain	Unknown Km^2	Unknown	Unknown
Denmark	Present	Unknown Km^2	Unknown	Unknown
Estonia	Present	5 Km^2	Decreasing	Decreasing
Finland	Aland Islands: Present Finland mainland: Present	6230 Km^2	Stable	Decreasing
France	France mainland: Present	10-15 Km^2	Decreasing	Decreasing
Germany	Present	<3 Km^2	Stable	Decreasing
Greece	Greece (mainland and other islands): Uncertain	Unknown Km^2	Unknown	Unknown
Ireland	Present	407 Km^2	Stable	Decreasing
Italy	Italy mainland: Present	0.1-0.5 Km^2	Decreasing	Decreasing
Latvia	Present	Unknown Km^2	Unknown	Unknown
Lithuania	Present	Unknown Km^2	Unknown	Unknown
Netherlands	Present	0.4 Km^2	Decreasing	Decreasing
Poland	Present	Unknown Km^2	Unknown	Unknown
Portugal	Portugal mainland: Present	0.1 Km^2	Decreasing	Unknown
Romania	Uncertain	Unknown Km^2	Unknown	Unknown
Slovakia	Present	Unknown Km^2	Unknown	Unknown
Spain	Spain mainland: Present	2 Km^2	Decreasing	Decreasing
Sweden	Present	912 Km^2	Stable	Unknown
UK	United Kingdom: Present	11 Km^2	Stable	Stable

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Albania	Uncertain	Unknown Km^2	Unknown	Unknown
Former Yugoslavian Republic of Macedonia (FYROM)	Uncertain	Unknown Km^2	Unknown	Unknown
Iceland	Present	Unknown Km^2	Unknown	Unknown
Montenegro	Present	Unknown Km^2	Unknown	Unknown
Norway	Norway Mainland: Present	4400 Km^2	Stable	Unknown
Switzerland	Present	x Km^2	Stable	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	5394350 Km^2	3662	ca. 8000 Km^2	
EU 28+	7033050 Km^2	3826	ca. 12500 Km^2	Data from Norway has been estimated

Distribution map



Map is rather complete, with data gaps for Iceland and an understimation for Norway. Data: Art17, GBIF, Lit.

How much of the current distribution of the habitat type lies within the EU 28?

>60%. European habitats have many counterparts in North America (particularly in the NE North America) and Northern Eurasia in terms of abiotic factors (water quality, soils, climate). The species assemblages of European habitats are however mostly oceanic and in this respect differ on the global scale. In Europe, large parts of the habitat occur in Norway, Belorus and Russia.

Trends in quantity

The analyses were made on the basis of data from 14 countries in the EU28 area, and one additional country for EU28+. The area of the habitat has remained relatively stable in northern Europe (Nordic countries), but in Central and Western Europe it suffered from land reclamation for arable land and other land use, as well as nutrient loading from human settlements. In near future the area of habitat seems to be more or less stable. In longer term the climate change and consequent natural eutrophication and brownification of water due humic substances can have impact to the quantity of the type. Changes in quality are, however, more pronounced than changes in quantity.

- Average current trend in quantity (extent)
  EU 28: Stable
  EU 28+: Unknown
- Does the habitat type have a small natural range following regression?
  No
  Justification
  The habitat is widespread in Europe, with a concentration in Boreal, Atlantic and Alpine regions.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  The habitat has a large and more or less continuous distribution area in boreal and adjacent alpine regions, and here the habitat may occur as large water bodies. Instead, sites are often small and scattered in central and western Europe.

Trends in quality

The quality of the type has declined during last centuries, and also in the recent past (last 50 years). Qualitative decline towards a more nutrient-rich state will continue without water protection measures.

- Average current trend in quality
  EU 28: Decreasing
  EU 28+: Decreasing

Pressures and threats

Oligotrophic lakes suffered earlier from land reclamation and eutrophication caused by human settlements and agriculture. These pressures have now to some extent replaced by diffuse pollution from intensified agriculture and forestry (drainage, afforestation), and also by air-borne nitrogen input. Hydrological changes, i.e. water abstraction, water level regulation, lack of flooding are important pressures in many countries. Locally fishing or recreation activities have impact to the biota of oligotrophic lakes. The pressures were historically - and still are - more severe in southern and central Europe (also in some areas of the southern boreal zone) where the land use intensity was greater than in the north, or on higher elevations, where many sites remained intact. In future diffuse pollution may have greater impact in the northern areas, partly due to impacts of climate change (raising temperatures, precipitation, increased input of nutrients and humic substances during longer unfrozen periods).

List of pressures and threats

Agriculture

Cultivation
Modification of cultivation practices
Agricultural intensification

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
Diffuse pollution to surface waters due to agricultural and forestry activities
Nutrient enrichment (N, P, organic matter)
Air pollution, air-borne pollutants
Nitrogen-input

Natural System modifications

Human induced changes in hydraulic conditions
Landfill, land reclamation and drying out, general

Flooding modifications
Water abstractions from surface waters

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession
Species composition change (succession)
Eutrophication (natural)

Climate change

Changes in abiotic conditions
Temperature changes (e.g. rise of temperature & extremes)
Changes in biotic conditions
Habitat shifting and alteration

Conservation and management

Most important conservation measures is decline of diffuse and point loading from catchment areas of the habitat type, along changing practices in agriculture and forestry. Active water protection measures are sometimes needed. The hydrological regime, including flooding, should be natural. Most representative sites should be legally protected, including their shoreline and littoral communities (in these cases there is need to have sufficient buffering areas with low land use intensity around the water bodies).

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality
Restoring/Improving the hydrological regime
Managing water abstraction

Measures related to spatial planning

Establish protected areas/sites
Legal protection of habitats and species

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in limnic systems

Measures related to urban areas, industry, energy and transport

Urban and industrial waste management

Conservation status

Annex 1 types:

3110: ALP FV, ATL U2, BOR U1, CON U1, MED XX

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

Some sites of this habitat may recover in a time span of some tens of years to natural state, but in most cases interventions related to decline of nutrient loads from catchment areas and diminishing internal loading (in extreme cases by removal of sediment) are required.

Effort required

10 years	50+ years
Through intervention	Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-5.5 %	unknown %	unknown %	unknonwn %
EU 28+	unknown %	unknown %	unknown %	unknown %

Analysis of changes during the last 50 years was made on the basis of data from 14 countries in the EU28. The longer historical decrease in area was severe in the southern part of the range (eg. The Netherlands and Belgium) but there are too few data available to give quantitative estimation outside these countries. As regards to EU28+ the assessment is incomplete because data from Norway is too rough.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	> 50000 Km^2	Yes	Yes	No	> 50	Yes	Yes	No	No
EU 28+	> 50000 Km^2	Yes	Yes	No	> 50	Yes	Yes	No	No

The habitat is relatively widespread in Europe with EOO, AOO and number of locations far beyond the threadholds for criterion B.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	43-63 %	33 %	>80% %	>30% %	unkonwn %	unknown %
EU 28+	45-58 %	32-38 %	>80% %	>30% %	unkonwn %	unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%
EU 28+	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%

The analysis was made on the basis of quantitative data combining extent of degradation and severity of degradation from seven EU28+ countries, including major part of the current area of the habitat in the EU28 and EU28+. In most countries estimates have been done as expert judgment and/or on the basis of WPD reporting. In these cases abiotic (physico-chemical parameters) and biotic components

(phytoplankton, primary production, fish, macroinvertebrates and aquatic macrophytes) have been evaluated combined. The analysis results in the Near Threatened category using the criterion C/D1 for both EU28 and EU28+. Because of uncertainty in the data different calculations have been carried out, using assumptions about amount and trends of the habitat degradation in Finland and Norway, two countries with the main area of the habitat in Europe.

There is clear evidence that characteristic isoetid species (*Isoetes* ssp., *Lobelia dortmanna*) will suffer from climate change and be outcompeted by less-specialised, more competitive species, typical for type C1.b. Because of this a large future decline in quality is expected, with large parts of the habitat (> 80%) being slightly (>30%) affected. This results in the Near Threatened category for C/D2.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	Unknown
EU 28+	Unknown

No quantitative analysis to evaluate risk of habitat collapse has been made.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	LC	DD	DD	DD	LC	LC	DD	NT	NT	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	DD	LC	LC	DD	NT	NT	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	C/D1, C/D2	Near Threatened	C/D1, C/D2

Confidence in the assessment
Medium (evenly split between quantitative data/literature and uncertain data sources and assured expert knowledge)

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