E4.1 Vegetated snow patch

Summary

These snow-bed communities are dominated by grasses, sedges, herbs and cryptogams and often grow mixed with or adjacent to F2.1 Dwarf-shrub snow-bed communities. They occur on skeletal, sometimes humic, soils in boreal and arctic mountains and the subarctic lowlands of Europe, the species composition depending on regional climate, altitude and bedrock type, and sometimes including endemics. Both habitat quantity and quality have been affected by influences from climate change, airborne nitrogen inputs, intensive grazing and skiing complexes and, over recent historic time, there have been decrseases in extent and habitat quality.. Concerning conservation, the habitats would benefit from enhanced environmental protection and pollution control measures. As overgrazing and trampling have also negative effects on the species composition of the habitats, provident management strategies are necessary to delimit local overgrazing. This can be realised best in protected areas.

Synthesis

Despite missing data from important countries in terms of area, like Sweden and Iceland, the available data seem to reflect well the pan-European situation. The calculated decreases in quantity and quality are well below the thresholds to qualify for Near Threatened category. The geographic distribution is also not restricted (EOO ≥ 50000 km², AOO ≥ 50). However, some concern exists about future trends, as the habitat is vulnerable to climate change, and it is likely that the abiotic conditions will be (at least slightly) negatively affected over the whole range, leading to the category Vulnerable (VU) for future changes in quality.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Vulnerable	C/D2, C2	Vulnerable	C/D2, C2

Sub-habitat types that may require further examination

Maybe a split in arctic/boreal snow-beds and temperate mountain snow-beds could be made, as these sub-habitats may differ in their vulnerability to climate change.

Habitat Type

Code and name

E4.1 Vegetated snow patch

Vegetated snow-patch with *Crocus veluchensis*, Pirin Mountains, Bulgaria (Photo: Milan Chytrý).

Snow-bed with *Ranunculus crenatus*, Rila Mountains, Bulgaria (Photo: Rossen Tzonev).

Habitat description

The habitat is represented by chionophile vegetation on places that retains late-lying snow (snowfield, snowbed and snow-patch), often on the drift from the melting snow-patches. They are well developed in boreal and arctic mountains and in sub-arctic lowlands. Dominants may be mosses, liverworts, lichens, short graminoids, ferns and small herbs. The species composition depends on the geographical range, the altitude, bedrock (calcareous or siliceous soils) and length of vegetation seasons. On the tops of high mountains in South-Europe snow patches are characterised by the presence of endemic taxa and syntaxa. Often the plant communities are disposed in the depressions of slopes and ridges amongst the dominant acidophilous or caciphilous alpine and sub-alpine grasslands. Soils are poorly developed: Lithosols (1–4 cm), strongly skeletal, often with small stones on the surface. Some of them are rich in fine, organic substances.

The most widespread in mountains throughout the Europe are acidophilous mixed herbaceous-dwarf shrub communities of the class *Salicetea herbaceae*. The dominant species are *Salix herbacea*, *Ligusticum mutelina, Luzula alpinopilosa* many mosses as *Polytrichum sexangulare*, *P. juniperinum*, *Pohlia commutata*, ect. Dwarf willow shrubs belong to shrub not to the snow-patch grasslands, but are included under habitat F2.1. The most widespread acidophilous snow-patch communities in the mountains are dominated from *Omalotheca supina*, *Alopecurus gerardii*, *Carex* spp., *Alchemilla* spp., etc. But the snow-patch vegetation of Iberian Peninsula is rich in endemics and belongs to the endemic alliance *Sedion candollei.* The endemic alliance *Ranunculion crenatii* represents the uncommon, isolated herbaceous snow-patch swards of the southern Dinarides and the Pelagonides. Another endemic alliance *Hyalopoion ponticae* represent the snow-bed vegetation on acidic soils in the Caucasus Mts.

In Northern Europe (Fennoscandia, the Scottish Highlands, Iceland, Greenland and arctic islands) snow-patch communities are dominated by mosses (*Distichium capillaceum*, *Pohlia* spp.), lichens or coarse tussock forming grasses, like *Deschampsia cespitosa*. On Svalbard some snow-beds over siliceous bedrock are dominated by *Dicranoweissia crispula*, with *Andreaea blyttii*, *A. obovata* and *A. rupestris* as

characteristic species. The northern alliance *Cassiopo--Salicion herbaceae* is very similar to the alpine *Salicion herbaceae*, but diagnostic are typical arctic species like *Carex bigelowii* and *Harrimanella hypnoides*. Specific are some snowbed communities of Fennoscandian Mountains, Iceland and Scottish Highlands, which are dominated by ferns as *Cryptogramma crispa*, *Athyrium distentifolium* (*Athyrium alpestre*), *Athyrium filix-femina*, *Dryopteris expansa* (*Dryopteris assimilis*) or *Dryopteris filix-mas.*

Calciphilous boreo-alpine snow patch grasslands (*Arabidetalia caeruleae*) are rich in small herbs, grasses and mosses. Among the characteristic species are *Arabis caerulea*, *Carex atrata*, *Saxifraga androsacea* and *Ranunculus alpestris*. Open, herbaceous communities on wet (from melting snow), calcareous stones in Scandinavian mountains belong to the alliance *Saxifrago oppositifoliae-Oxyrion digynae* (=*Ranunculo-Oxyrion digynae*). Typical species here are *Oxyria digyna*, *Cerastium cerastoides*, *Cetraria delisei* and *Saxifraga oppositifolia*.

The vegetation communities mostly cover small areas above the forest belt (alpine and sub-alpine parts) in the high mountains of Central and Eastern Europe: Alps, Pyrenees, Carpathians and Caucasus, and in the Scottish Highlands and Sudeten. In South-European Mountains, they are spread very locally in the Paeonian Mountains, Sierra Nevada, Cordillera Central, Monti Sibillini, Abruzzi, Balkan Mountains as Pirin and Rila Mts. and some of the Dinarides.

In a good condition the habitat is represented by communities in patches with different sizes, within a matrix of the dominant alpine, subalpine and tundra grasslands. The development of these communities depends on the duration of snow cover, amount of snowfall in winter and water supply from melting snow-patches. Moss and lichen communities are very sensitive to any disturbance. Alpine and subalpine communities are threatened by overgrazing and development for tourism (ski tracks, trampling on tourist routes, etc). Global warming is another serious threat, because it reduces the snow-patch size, decreases the duration of snow cover and increases the duration of the vegetation growing season.

Indicators of good quality:

- High amount of snowfall and long-term snow cover
- High species richness
- Presence of rare and/or threatened species (on high mountains also endemic species)
- High cover of lichens and mosses (in some varieties

Characteristic species:

Vascular plants: *Achillea clusiana*, *A. lingulata*, *Alchemilla pentaphyllea*, *A. fissa, A. pentaphyllea, A. subsericea, Alopecurus gerardii, A. riloensis*, *Androsace carnea* ssp. *laggeri, Arabis alpina*, *A. caerulea*, *Athyrium filix-femina*, *A. distentifolium, Bartsia alpina, Calamagrostis purpurea*, *Carex atrata*, *C. bigelowii, C. foetida*, *C. kitaibeliana, C. lachenalii*, *C. norvegica*, *C. ornithopodioides, C. parviflora, C. pyrenaica, Cardamine alpina*, *C. pratensis* subsp. *dentata*, *Cerastium alpinum, C. arcticum*, *C. cerastoides*, *Crocus veluchensis*, *Cryptogramma crispa*, *Deschampsia alpina*, *Dianthus microlepis, Draba crassifolia, Dryopteris expansa*, *D. filix-mas*, *Festuca picturata, F. supina, Galium saxatile*, *Gentiana alpina, Gentiana verna*, *Geum montanum, Homogyne alpina, Hutchinsia alpina, Juncus biglumis*, *Lepidium stylatum*, *Ligusticum mutellina*, *Luzula alpinopilosa, L. arctica, L. confusa, L. desvauxii, L. spadicea*, *Minuartia biflora*, *Nardus stricta*, *Omalotheca hoppeana, O. supina, Oxyria digyna*, *Phippsia algida*, *Plantago alpina*, *P. atrata*, *Poa alpina, P. arctica, P. granitica*, *Poa pirinica*, *P. supina, Polygonum viviparum, Potentilla brauniana, P. crantzii*, *P. hyparctica*, *P. ternata, Primula integrifolia, P. stricta, Ranunculus alpestris*, *R. crenatus, R. glacialis, R. montanus*, *R. nivalis*, *R. pseudomontanus*, *R. pygmaeus, R. sulphureus*, *Salix herbacea*, *S. polaris*, *Sagina saginoides, Saussurea alpina*, *Selaginella selaginoides, Sibbaldia procumbens, Soldanella alpina, S. carpatica, Saxifraga androsacea, S. cernua*, *S. nivalis, S, oppositifolia, S. rivularis*, *S. stellaris*, *S. tenuis*, *S. wahlenbergii*, *Sedum alpestre, S. candollei*, *Sesleria coerulans*, *S. tatrae, Silene acaulis, Soldanella minima, Taraxacum apenninum*, *T. bithynicum Taraxacum croceum*, *Thalictrum alpinum*, *Trifolium thalii*, *Trisetum*

spicatum Veronica alpina, V. aphylla, Viola biflora

Mosses: *Barbilophozia floerkii*, *Bryum elegans, Dicranum falcatum*, *Distichium capillaceum*, *Gymnomitrion concinnatum*, *Harrimanella hypnoides*, *Hylocomium splendens*, *Jungermania atrovirens, Kiaeria falcata, K. starkei*, *Lophozia wenzelii*, *Oligotrichum hercynicum, Pleurocladula albescens*, *Pohlia albicans*, *P. drummondii*, *Polytrichum alpinum, P. juniperinum*, *P. gracile*, *P. norvegicum, P. pyliferum, P. sexangulare*, *Racomitrium sudeticum, Tayloria froelichiana, Timmia austriaca, T. norvegica, Tortella tortuosa*

Lichens: *Anthelia juratzkana, Cladonia exmocyna, Cetraria delisei, Cetraria islandica, Pogonatum alpinum, Solorina crocea*

Classification

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

EUNIS:

E4.1 Vegetated snow-patch

Annex 1:

6150 Siliceous alpine and boreal grasslands

6170 Alpine and subalpine calcareous grasslands

EuroVegChecklist (alliances):

On siliceous substrate:

Salicion herbaceae Br.-Bl. in Br.-Bl. et Jenny 1926

Salici herbaceae-Caricion lachenalii Béguin et Theurillat 1982

Festucion picturatae Krajina 1933 corr. Dúbravcová 2007

Ranunculion crenati Lakušic 1968

Sedion candollei Rivas-Mart., Fernández González et Loidi in Rivas-Mart. et al. 2011

Hyalopoion ponticae Rabotnova et Onipchenko in Onipchenko 2002

Cassiopo-Salicion herbaceae Nordhagen 1943

Deschampsio-Anthoxanthion Gjaerevoll 1950

Ranunculo-Oxyrion digynae Nordhagen 1943

On calcareous substrate:

Arabidion caeruleae Br.-Bl. in Br.-Bl. et Jenny 1926

Saxifrago oppositifoliae-Oxyrion digynae Gjaerevoll 1950

Ranunculo-Poion alpinae Gjaerevoll ex Daniëls hoc loco

Emerald:

E4.11 Boreo-alpine acidocline snow-patch grassland and herb habitats

E4.12 Boreo-alpine calcicline snow-patch grassland and herb habitats

MAES:

Grassland

IUCN:

4.4. Temperate grassland

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

Regions
Alpine

Justification
Vegetated snow-patches are important elements of boreal and arctic mountains and sub-arctic lowlands. Furthermore, the communities occur in the high mountains of Central and Eastern Europe and in the Scottish highlands and Sudetes.

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	285 Km^2	Decreasing	Decreasing
Bulgaria	Present	Unknown Km^2	Decreasing	Decreasing
Finland	Finland mainland: Present	35 Km^2	Stable	Stable
France	France mainland: Present	688 Km^2	Decreasing	Decreasing
Germany	Present	1 Km^2	Decreasing	Decreasing
Italy	Italy mainland: Present	91 Km^2	Decreasing	Decreasing
Poland	Present	3.5 Km^2	Stable	Stable
Romania	Present	780 Km^2	Decreasing	Decreasing
Slovakia	Present	2 Km^2	Stable	Decreasing
Slovenia	Uncertain	Km^2	-	-
Spain	Spain mainland: Present	21 Km^2	Decreasing	Unknown
Sweden	Uncertain	Km^2	-	-
UK	United Kingdom: Present	360 Km^2	Stable	Unknown

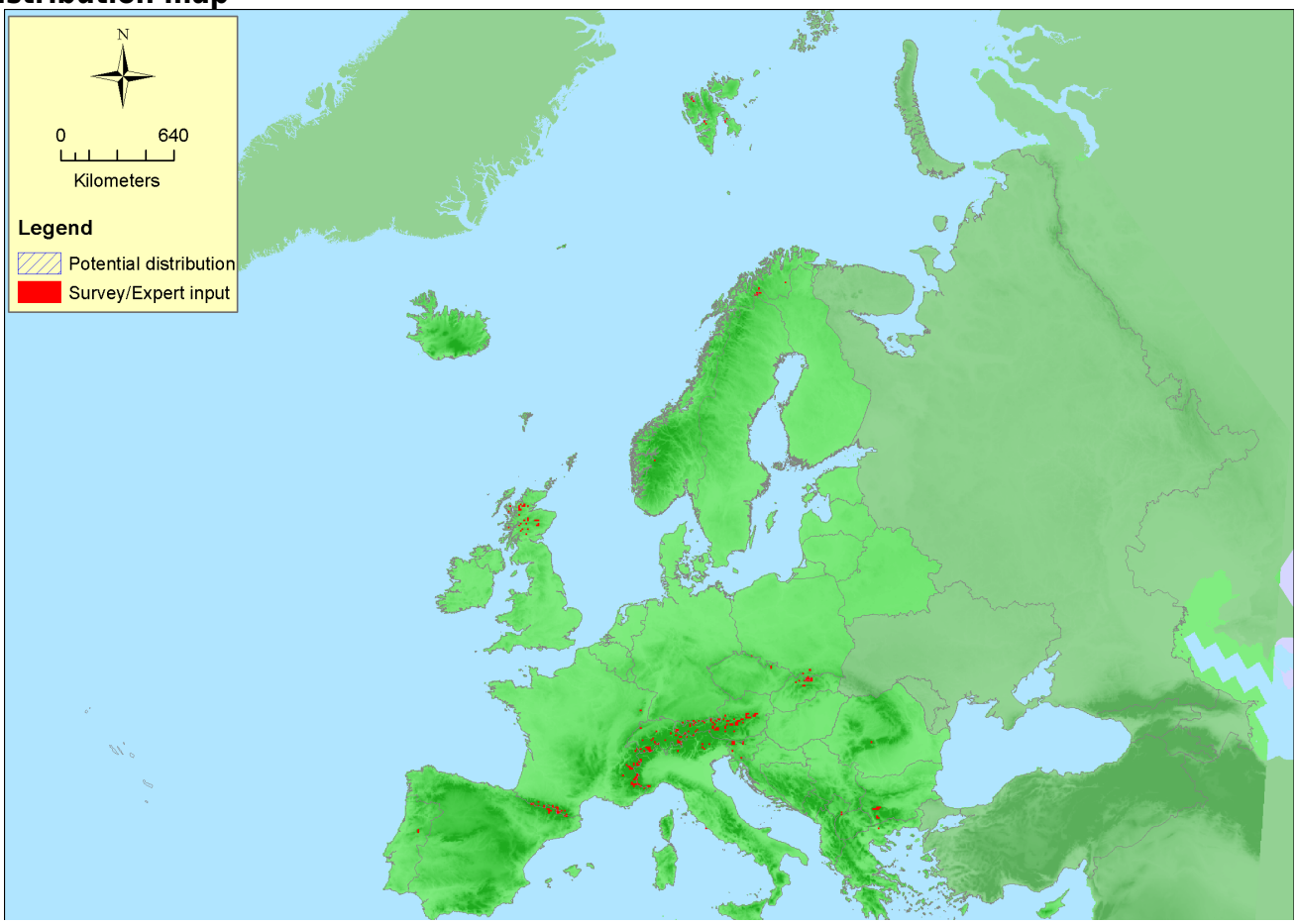
EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Albania	Uncertain	Km^2	-	-
Bosnia and Herzegovina	Present	5 Km^2	Decreasing	Decreasing
Former Yugoslavian Republic of Macedonia (FYROM)	Present	Unknown Km^2	Unknown	Decreasing
Iceland	Uncertain	Km^2	-	-
Kaliningrad	Uncertain	Km^2	-	-
Kosovo	Present	Unknown Km^2	Decreasing	Decreasing

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Norway	Jan Mayen: Present Norway Mainland: Present Svalbard: Present	3736 Km^2	Stable	Stable
Serbia	Uncertain	Km^2	-	-
Switzerland	Present	150 Km^2	Decreasing	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	5162350 Km^2	219	2266 Km^2	no data from Sweden, Slovenia
EU 28+	6537050 Km^2	255	6157 Km^2	no data from Sweden, Slovenia, Albania, Iceland, Russia (Kaliningrad), Serbia

Distribution map



The map is rather incomplete for Scandinavia and the Balkan, and also in most other parts of the range data gaps are likely. Data sources: EVA, NAT.

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

Approximately 45%. Regarding EU28+ further major occurrences are in Norway, Iceland and Switzerland. Outside EU28+ the habitat type is found in Russia, Georgia, Ukraine and in Greenland.

Trends in quantity

Whereas the habitat type remained more or less stable in Scandinavia, a decrease in area has been recorded in the Alps, Carpathians and Pyrenees. Overall, a slight decrease in area of 13.7% (EU28) and 5.8% (EU28+) has been observed across Europe over the last approximately 50 years. On the one hand, the decline was related to the effects of global warming, which lead to alterations of abiotic conditions and species composition. On the other hand, the decrease was due to destruction of sites caused by touristic development (construction of skiing complexes, ski tracks and related infrastructure; piste reshaping) in mountain environments. According to the territorial data the current average trend in habitat quantity is decreasing and this trend looks set to continue in the future. Although the trend in Scandinavia was reported to be stable, there is evidence of declines in snow-bed species in the arctic regions, for example on the island of Jan Mayen.

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  No
  Justification
  The habitat type is widely distributed in temperate, boreal and arctic mountain regions across Europe. The EOO is larger than 50000 km².
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  Though the occurrence of the habitat is dependent on sites that retain late-lying snow like snow-patches, snowfields and snowbeds, the underlying factors are not restricted to a small total area or range. The habitat is widely distributed in high mountain environments and subarctic lowlands across Europe.

Trends in quality

All countries except Norway and Finland reported a decline in quality over the last 50 years. The extent of degradation in EU28 and EU28+ is 9.7% with a severity of degradation of 30.1% and 2.5% with 33.8% severity, respectively. Despite missing or incomplete data from several countries, the calculation of trends in quality is based on a sufficient dataset to reflect the pan-European situation. The degradation was caused by airborne nitrogen inputs and by the effects of global warming, which lead to alterations of abiotic conditions and species composition. Furthermore, the degradation was also due to local overgrazing and trampling impacts. According to the territorial data the current average trend in habitat quality is decreasing and this trend looks set to continue in the future, but little is known about the real effects of climate change on plant species and communities.

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

Pressures and threats

Vegetated snow patches are threatened by global warming, as these habitats depend on the duration of the snow cover, snow depth and water supply from melting snow-patches. The effects of climate change as well as airborne nitrogen intputs cause alteration of abiotic conditions and species composition. On a local scale, deterioration of habitats is also induced by overgrazing. Further major threats are related to sport and leisure structures: the construction or expansion of skiing comlexes may cause habitat loss due to destruction of sites. Already existing resorts have negative impacts on the habitat quality due to measures like piste reshaping and other corresponding disturbances.

List of pressures and threats

Agriculture

Grazing
Intensive grazing

Human intrusions and disturbances

Sport and leisure structures
Skiing complex

Pollution

Air pollution, air-borne pollutants
Nitrogen-input

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

The development and condition of this habitat type depends on snow depth, duration of snow cover and water supply from melting snow-patches and hence the habitats are heavily affected by global warming. Furthermore, the habitat is also affected by nitrogen input due to air pollution. For this reason the habitats will benefit most from enhanced environmental protection and pollution control measures. As overgrazing and trampling have also negative effects on the species composition of the habitats, provident management strategies are necessary to delimit local overgrazing. This can be realised best in protected areas.

List of conservation and management needs

No measures

Measures needed, but not implemented

Measures related to spatial planning

Establish protected areas/sites
Legal protection of habitats and species
Manage landscape features

Conservation status

Annex 1 types:

6150: ALP FV, ATL U2, BOR FV

6170: ALP U1, ATL U2

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

Vegetated snow patches are natural habitats. Once completely destroyed (e. g. due to construction of skiing complexes), the recovery of the habitat type by natural succession processes will take a very long time. Disturbed habitats with modified species composition due to overgrazing have the capacity for

natural recovery in a shorter period of time, if they are not isolated from similar habitats.

Effort required

50+ years	200+ years
Naturally	Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-14 %	unknown %	unknown %	unknown %
EU 28+	-5.8 %	unknown %	unknown %	unknown %

The values for A1 were calculated from the territorial data sheets. The calculated trend in the last 50 years is a reduction of about 13.7% (EU28) and 5.8% (EU28+), resulting in the category Least Concern. No or unsufficient quantitative data are available for A2a, A2b and A3. It is likely that there will be a future further decline in quantity because of global warming. However, it is unsure whether the thresholds for A2a or A2b will be met, therefore these criteria have been assessed as Data Deficient.

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 AOO and EOO are much larger than the thresholds for criteria 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	9.7 %	30 %	unknown %	unknown %	unknown %	unknown %
EU 28+	2.5 %	34 %	unknown %	unknown %	unknown %	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 values for C/D1 were calculated from the territorial data sheets. The calculated figures result in the

Least Concern category. No reliable data (%) are available for C/D2, C/D3, C1, C2, C3, D1, D2 and D3. It is likely that there will be a future decline in abiotic quality because of global warming. This can be assumed to affect almost all occurrences of the habitat, with unknown severity (but at least slight). Therefore, the criteria C/D2 and C2 will meet the thresholds for Vulnerable.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

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

There is no quantitative analysis available that estimates the probability of collapse of this habitat type.

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	LC	LC	VU	DD	DD	VU	DD	DD	DD	DD	DD
EU28+	LC	DD	DD	DD	LC	LC	LC	LC	VU	DD	DD	VU	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Vulnerable	C/D2, C2	Vulnerable	C/D2, C2

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

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