D4.2 Arctic-alpine rich fen

Summary

This habitat includes fens developed on open substrates constantly flushed by icy, base-rich water alongside small rivers, springs or glaciers in the alpine belt of European mountains and in the arctic. Constant disturbance by moving water and freeze-thaw, aeration with turbulent flow and low productivity prevent peat accumulation and mean that its occurrence is typically as small unstable patches colonising bare ground. The vegetation consists of small basiphilous sedges, rushes and herbs, brown mosses and liverworts, and can include endemic species that are perhaps glacial relics. In general, it is threatened less than fen habitats occurring in agricultural landscapes that require management in many cases but water abstraction and pollution, overgrazing and climate change are making this habitat rarer and its naturally sporadic occurrence, representing meta-populations of its characteristic species, makes it especially vulnerable.

Synthesis

Over the last 50 years the habitat has suffered a loss of area and degradation in quality, but not enough to fit any Red List category. However, a severe decline is expected because of climatic change (based on geographical modelling) which argues for (at least) the Vulnerable (VU) category under criterion A2a. This expected decline is supported by ongoing habitat loss in the Alps by development of ski resorts, nutrient enrichment and glacier retreats. The expected decline of the habitat may become reality quickly, if the metapopulation functioning of key species will collapse due to low connectivity of suitable habitats.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Vulnerable	A2a	Vulnerable	A2a

Sub-habitat types that may require further examination

No sub-habitats have been distinguished for further analysis.

Habitat Type

Code and name

D4.2 Arctic-alpine rich fen

Allpine fen with *Trichophorum pumilum*, *Eriophorum angustifolium*, *E. latifolium*, *Equisetum variegatum*, *Eleocharis quinqueflora*, *Juncus alpinus*, *Scorpidium revolvens* and *Catoscopium nigritum* close to Zermatt, Switzerland (Photo: Petra Hájková).

Alpine fen with *Carex atrofusca*, *C. capillaris*, *C. vaginata*, *C. saxatilis*, *Juncus triglumis*, *J. castaneus*, *Equisetum variegatum* and low shrubs at Kongsvoll, the Dovrefjell Mountains Norway (Photo: Petra Hájková).

Habitat description

Fens around springs and small rivers in the alpine belt of European mountains (the Alps, Pyrenees, Scandes, Scotland) and in the northernmost (arctic) part of Europe, including Svalbard and Iceland. They are found on open substrates that are constantly flushed by cold and base-rich water. The sites are extreme with respect to soil and microclimate. Cold water is constantly present in the root horizon and restricts ion uptake of plants. Frequent disturbances, a high amount of oxygen in the soil water as well as low productivity due to low temperature during the short vegetation period prevent any remarkable peat accumulation and peat layer is typically lacking or very thin (< 20 cm). If peat accumulation would increase, other fen habitats would develop. Solifluction and cryoturbation lead to disruption of plant roots and soil surface structures.

The vegetation substitutes at high altitudes and latitudes the *Caricion davallianae* vegetation of type D4.1. The vegetation consists of small sedges, rushes, small herbs and non-sphagnaceous (brown) mosses and includes many arctic-alpine species. Most characteristic are *Carex bicolor*, *Carex microglochin*, *Carex maritima*, *C. norvegica, Carex atrofusca*, *Carex frigida*, *Carex saxatilis, Carex vaginata*, *Carex aquatilis ssp. stans*, *Kobresia simpliciuscula, Scirpus pumilus, Juncus arcticus, Juncus alpinoarticulatus, Juncus castaneus, Juncus triglumis, Juncus biglumis, Saxifraga oppositifolia, Tofieldia pusilla*. Vegetation is usually polydominated. Bryophyte layer consist of hepatics (*Aneura pinguis*) and different brown mosses such as *Amblyodon dealbatus, Bryum pseudotriquetrum, Calliergon richardsonii, Campylium stellatum, C. polygamum, Catoscopium nigritum, Cinclidiun stygium, Paludella squarrosa, Philonotis calcarea, P. tomentella, Scorpidium cossonii, S. revolvens* (locally), *Tayloria lingulata, Tomentypnum nitens* and *Warnstorfia exannulata*. Within these sites appear species that can be treated as glacial relicts in the European mountains or surviving species during the Pleistocene glaciation in the boreal and arctic refugial areas. In high mountains outside the Alps, Pyrenees and Scandes, these habitats are depauperate and transitional to spring and small-sedge fen habitats.

These habitats exist in high-mountain or arctic areas and are threatened by direct human activities: tourism, construction of small power station, construction that cause erosion or snow slide, capture of springs, channelling of streams (water supply) etc. Global changes might change the precipitation and temperature regime and can change dramatically the species composition.

Indicators of good quality:

- Species richness and presence of diagnostic species
- Absence of human intervention
- Permanent water flow
- Low productivity
- Presence of mosses

Characteristic species:

Vascular plants: *Blysmus compressus, Carex atrofusca, Carex bicolor, Carex capillaris, Carex capitata, Carex davalliana, Carex demissa, Carex dioica, Carex maritima, Carex nigra, Carex norvegica, Carex panicea, Carex paralella, Carex saxatilis, Carex vaginata, Carex frigida, Carex stans, Eleocharis quinqueflora, Equisetum variegatum, Juncus alpinoarticulatus, Juncus arcticus, Juncus castaneus, Juncus triglumis, Juncus biglumis, Kobresia simpliciuscula, Pinguicula vulgaris, Primula farinosa, Primula nutans, Primula scandinavica, Primula stricta, Scirpus cespitosus, Scirpus pumilus, Tofieldia pusilla, Trichophorum pumilum, Typha lugdunensis, Typha minima, Typha shuttleworthii*

Mosses: *Fissidens osmundoides, Meesia uliginosa, Oncophorus virens, Tayloria lingulata, Amblyodon dealbatus, Bryum pseudotriquetrum, Campylium stellatum, C. polygamum, Catoscopium nigritum, Philonotis calcarea, P. tomentella, Scorpidium cossonii, S. revolvens, Tomentypnum nitens*

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

EUNIS:

D4.2 Basic mountain flushes and streamsides, with a rich arctic-montane flora

EuroVeg Checklist:

Caricion atrofusco-saxatilis Nordhagen 1943

Caricion stantis Matveyeva 1994

Annex 1:

7240 Alpine pioneer formations of the Caricion bicoloris-atrofuscae

Emerald:

D4.2 Basic mountain flushes and streamside, with a rich arctic-montane flora

MAES-2:

Wetlands (rivers and lakes)

IUCN:

5.11 Alpine Wetlands

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

Regions
Alpine
Arctic

Justification
The habitat has a conspicuous, disjunct arctic-alpine distribution.

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	8.8 Km^2	Decreasing	Decreasing
Finland	Finland mainland: Present	10 Km^2	Stable	Stable
France	France mainland: Present	9 Km^2	Decreasing	Decreasing
Germany	Present	Unknown Km^2	Unknown	Unknown
Italy	Italy mainland: Present	12 Km^2	Decreasing	Decreasing
Romania	Present	0.1 Km^2	Stable	Stable
Slovenia	Present	Unknown Km^2	Unknown	Unknown
Sweden	Present	Km^2	-	-
UK	United Kingdom: Present	0.7 Km^2	Decreasing	Decreasing

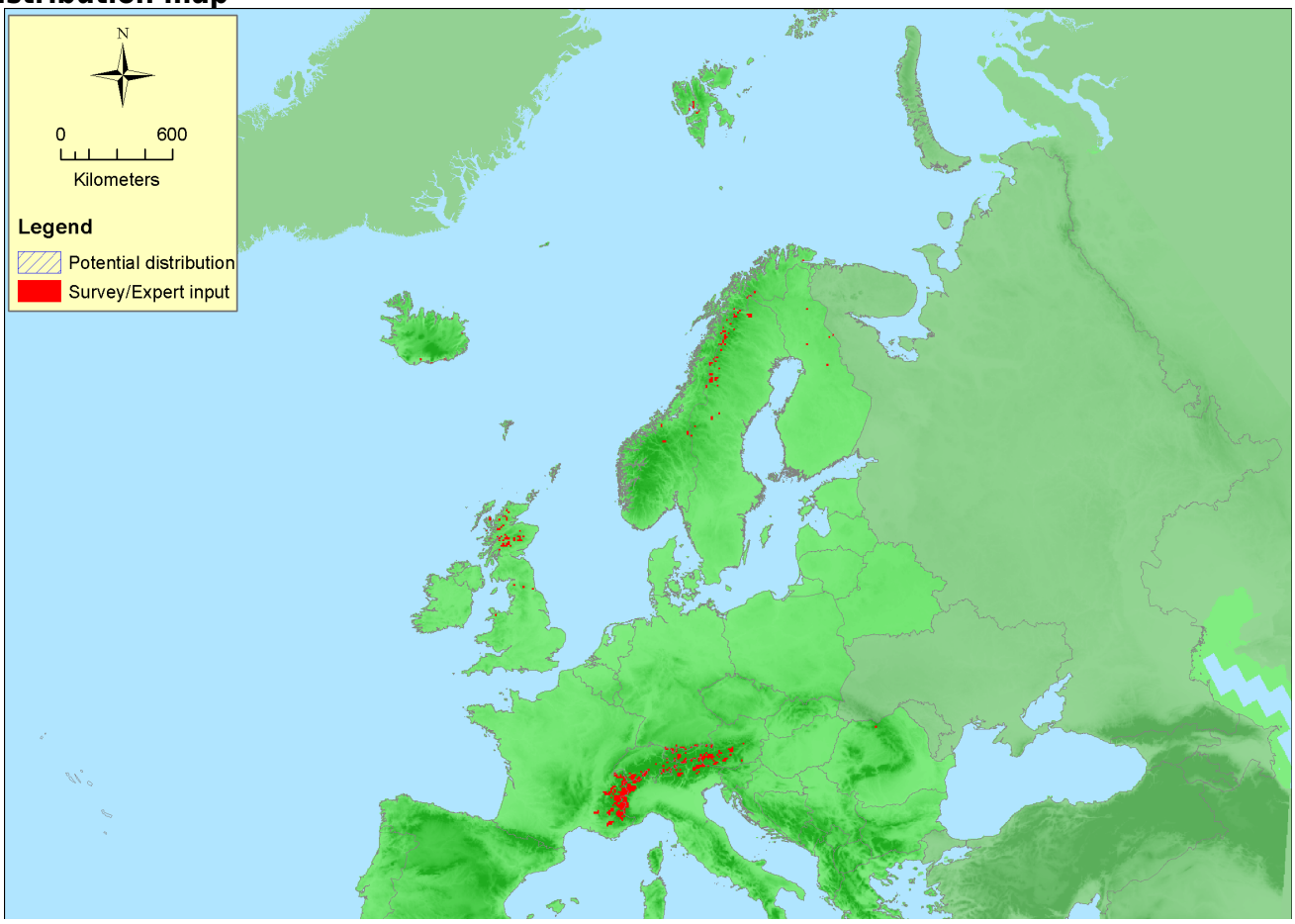
EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Kosovo	Present	1.5 Km^2	Decreasing	Decreasing
Norway	Norway Mainland: Present	750 Km^2	Decreasing	-
Switzerland	Present	2 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	4047750 Km^2	400	41 Km^2	
EU 28+	6190600 Km^2	435	800 Km^2	

Distribution map



The map is rather complete for EU28, but with data gaps for the Pyrenees, Norway and Iceland. Data sources: Art17, EVA, LIT.

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

Less than 10%

Trends in quantity

The area of the habitat is decreasing because of loss of individual fens by water capturing (snow pistols, drinkable water) and glacier retreat in the Alps; this loss is accelerating recently. In arctic and boreal parts of its distribution range the habitat area is stable or decreasing only slightly.

- 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 has a large range, from the Alps to Scandinavia and arctic regions.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  Yes
  Justification
  The habitat is confined to small patches. The habitat requires strongly artic-alpine climate, calcareous bedrock and disturbances. It never occurs in larger areas and in a long term is found only locally. It requires functioning metapopulations of its character species, which cannot be achieved if the calcareous alpine belt is small - hence, not all calcareous arcto-alpine fens belong to this habitat.

Trends in quality

Trends in quality mirror trends in quantity. The habitat is small and anthropogenic pressure leads to its local disappearance rather than a decline in quality. In some case, loss of specialised organisms has been observed before dissapearance. Quality is decreasing in the Alps, but stable in northern Europe.

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

Pressures and threats

The habitat is threatened by climate change (glacier retreat, increasing productivity in cold mountains) and in the Alps also by water capturing for recreational purposes (challets, hotels, snow pistols). Overgrazing may be a problem as well, as it can directly endanger small populations and promote competitors by increasing nutrient availability; on the other hand, disturbances are a part of the habitat's functioning.

List of pressures and threats

Human intrusions and disturbances

Outdoor sports and leisure activities, recreational activities
Skiing complex

Natural System modifications

Human induced changes in hydraulic conditions
Water abstractions from groundwater
Groundwater abstractions for public water supply

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession

Climate change

Temperature changes (e.g. rise of temperature & extremes)
Droughts and less precipitations

Conservation and management

No intervention is needed in most cases. However, some artificial disturbances may be needed if succession towards more productive stands takes place. And restoration of hydrological functioning may

be needed for drained fens.

List of conservation and management needs

No measures

No measures needed for the conservation of the habitat/species

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving the hydrological regime

Measures related to spatial planning

Establish protected areas/sites

Measures related to special resouce use

Regulating/Management exploitation of natural resources on land

Conservation status

Annex 1 type:

7240: ALP U2, ATL U2

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

Naturally, but only if regional metapopulations of species remain in the vicinity.

Through intervention (removing drainage), when the hydrology is disturbed, but also in this case the characteristic species must survive locally.

Effort required

20 years	50+ years	200+ years
Naturally	Naturally	Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-15 %	-30 %	unknown %	-23 %
EU 28+	-20 %	-30 %	unknown %	-20 %

A decline of about 15% was calculated based on estimations of territorial experts from 4 out of 9 EU-countries, covering about 95% of the EU area. Data from two additional countries outside the EU (Norway, Switzerland) lead to a decline in the EU28 of 20% over the about last 50 years. In the case of long-term historical trend (A3) the calculations lead to an average loss of -23% for the EU and -20% for EU28. For future trends regional studies suggest that there is a large risk of decline. In alpine fens of Austria (many of them belong to this type), Essl et al. (2012) predict 52-88% decline up to 2051-2060, depending on the climatic scenario used. Other threats such as water capturing and development of ski resorts must be taken into account as well. On the other hand, this model does not incorporate potential spread of this habitat to deglaciated areas in the high Alps and northern Europe. Based on this study, and taking into account some small increase elsewhere, and extrapolated to the whole range, a slightly conservative approach (as other studies indicate other trends) leads to at least 30% decline and therefore the category Vulnerable (VU) for A2a.

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 has a large EOO and the AOO is larger than 50 gridcells for the EU28, and much more for EU28+. Criterion B therefore leads to Least Concern.

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	35 %	39 %	unknown %	unknown %	unknown %	unknown %
EU 28+	34 %	39 %	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%

Degradation of ca 34-35% of area by ca 39% severity was calculated based on estimations of territorial experts. The data was from only 4 out of 10 countries, but it included all countries with the largest area for EU. Trend data from Norway, that by far reported the largest area, was missing.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

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

There is no detailed modelling study for this habitat on a European scale, but the regional study mentioned under A (Essl et al. 2012) predict 52-88% decline up to 2051-2060, depending on the climatic scenario used. However, this study dooesn't provide an estimation of the probability of collapse, and therefore criterion E is assessed as Data Deficient (DD).

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	VU	DD	LC	LC	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	LC	VU	DD	LC	LC	LC	LC	LC	DD	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
Vulnerable	A2a	Vulnerable	A2a

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

Assessors
M. Hájek

Contributors
Type description: A. Čarni, M. Hájek, T. Tahvanainen

Territorial data: S. Armiraglio, S. Assini, G. Buffa, R. Delarze, P. Finck, P. Jones, T. Kontula, A. Lyngstad, F. Millaku, A. Mikolajczak, A. Moen, D.-I. Øien, D. Paternoster, U. Raths, U. Riecken, D. Spray, A. Ssymank.

Working Group Mires & Bogs: C. Bita-Nicolae, M. Hájek, F. Jansen, T. Tahvanainen

Help with data processing: E. Hettenbergerová

Reviewers
J. Janssen

Date of assessment
16/12/2015

Date of review
12/04/2016

References

Bressoud, B. 1989. Contribution à la connaissance du Caricion atrofuscos-saxatilis dans les Alpes. *Phytocoenologia:* 145-270.

Coldea, G., Filipaş, L. and Stoica, I. A. 2008. Contributions to Romanian vegetation studies (IV). *Contributii Botanice 43*: 45-52.

Dierßen, K. and Dierßen, B. 1985. Corresponding Caricion bicolori-atrofuscae communities in western Greenland, northern Europe and the central European mountains. In *Chorological phenomena in plant communities* (pp. 151-157). Springer Netherlands.

Essl F., Dullinger S., Moser D., Rabitsch W. & Kleinbauer I. 2012. Vulnerability of mires under climate change: implications for nature conservation and climate change adaptation. *Biodiv. Cons.* 21: 655–669

Nordhagen, R. 1943. Sikilsdalen og Norges Fjllbeiter. *Bergens Museums Skrifter* 22.

Steiner, A. J. 2002. *Die Vegetation der Gemeinde Zermatt* (Vol. 74). vdf Hochschulverlag AG.