D4.1a Small-sedge base-rich fen and calcareous spring mire

Summary

This habitat includes short-sedge fens, spring fens and fen grasslands kept continually wet by base-rich, nutrient-poor waters, occurring through the lowlands and mountains of nemoral Europe and more locally in the boreal zone. They are most common, rich and diverse in the limestone massifs of central European mountains, especially the Alps and Carpathians. Some are primary, developing around natural springs and seepage lines, and may be extremely old, while other vegetation included here has developed on suitably wet ground within the forest zone and been maintained by mowing which depletes nutrients. The soil is rich in organic matter and has high pH, often with precipitation of carbonate or tufa. Small basiphilous sedges dominate the vegetation with a rich associated flora and a patchy carpet of fen bryophytes. Grazing animals often help maintain an open surface favouring high diversity. Eutrophication from surrounding farmland or by atmospheric deposition, interference with the hydrology and invasion of competitive plants pose threats to this habitat which is not readily restorable. Because it serves as a refugium for many plant and invertebrate species, its protection from further damage is urgent.

Synthesis

The category Endangered (EN) is indicated by A1 and A3 categories describing declines in extent over respectively the last 50 years and a longer time frame. In addition, the total area (based on territorial data) is very low, as the habitat almost everywhere occurs in small stands. The subtypes that cover smaller areas and occur outside Sweden, Ireland and Estonia are even more threatened and if assessed separately, the Critically Endangered category should be expected. Considering still continuing and even accelerating degradation, loss of habitat specialists and bad restoration prospects reported by several regional studies, the resulting Endangered category has a high reliability.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Endangered	A1, A3	Endangered	A3

Sub-habitat types that may require further examination

The following subtypes deserve recognition: (1) Travertine fens, on active travertines in the intermountain basins of Western Carpathians of Slovakia with both fen specialists and subhalophytes, relicts of glacial times and extremely endangered, with few sites persisting up today; (2) Mountain small-sedge fens in the temperate mountains which differ from boreal small-sedge fens in Scandinavia by a wider set of habitat specialists that are rare or absent in Scandinavia, with frequent precipitation of calcium carbonate and supporting some rare animal species.

Habitat Type

Code and name

D4.1a Small-sedge base-rich fen and calcareous spring mire

Spring aspect of a spring-fed short-sedge fen close to Ulreichsberg, Austria (the Alps). *Primula farinosa* characterises mountain short-sedge fens in the Alps and Carpathians that are rich in habitat specialists. (Photo: Petra Hájková).

Short-sedge fen close to Rakša village, Slovakia, in the foothills of a limestone part of the Veľká Fatra Mountains, part of the Western Carpathians. This site shows one of the highest concentrations of habitat specialists among both vascular plants and land snails. (Photo: Petra Hájková).

Habitat description

This habitat includes calcareous fen vegetation of the lowlands and mountains of the European nemoral zone, and it also occurs more rarely in the boreal zone where calcareous substrates and the influence of base-rich water are scarce. Calcareous fens occur at sites with a permanently high water table, often near springs, and they are particularly common in areas with calcareous bedrock, especially in the mountain systems of central Europe. Water is rich in calcium, magnesium and bicarbonates and precipitation of calcium-carbonate and tufa formation is common, and also accumulation of organic matter due to permanently wet conditions which reduce decomposition processes. The soil has a high proportion of organic matter and is base-rich, but with limited availability of nutrients.

The vegetation of base-rich fens is dominated by small sedges such as *Carex davalliana, C. flava, C. hostiana, C. lepidocarpa* and other short or medium-tall Cyperaceae such as *Blysmus compressus, Eleocharis quinqueflora, Eriophorum angustifolium* and *E. latifolium*. In some places these species typical of fens grow together with species characteristic of wet meadows on mineral soil such as *Anthoxanthum odoratum, Briza media, Caltha palustris, Cirsium palustre, C. rivulare, Cynosurus cristatus, Festuca rubra* agg., *Holcus lanatus, Lychnis flos-cuculi, Plantago lanceolata* and *Ranunculus acris.* Bryophytes are common, in some stands reaching a cover close to 100% and, in the moss layer, species of fens (e.g. *Bryum pseudotriquetrum, Campylium stellatum, Hamatocaulis vernicosus, Palustriella commutata* and *Scorpidium cossonii*) can grow together with species typical of mineral soils (e.g. *Cirriphyllum piliferum, Climacium dendroides, Plagiomnium affine* agg., *Rhytidiadelphus squarrosus*), although the latter may be absent at some sites, especially in primary fens.

Small-sedge calcareous fens can be primary habitats developed around springs and seepages of calcium-rich water. Some of them can be several thousand years old and the long-term habitat continuity can be indicated by the occurrence of species such as *Primula farinosa, Salix rosmarinifolia* or *Triglochin maritimum*. At some sites, however, fens can be natural but only a few centuries old, and in other sites they can be secondary, developed on formerly forested land and be dependent on regular mowing. Many of them have been mown once a year without input of fertilizers for several centuries. Export of nutrients with hay has led to partial elimination of nutrient-demanding tall-growing species of wet meadows. Many of these species are still growing in these grasslands but their competitive ability is too weak to outcompete short-growing fen species. Small-sedge fens are most common and most diverse in the limestone massifs of the central European mountain systems, especially the Alps and the Carpathians.

In many places calcareous fen meadows have been damaged or destroyed by artificial drainage, which has caused mineralization of nutrients in the fen sediment and the spread of nutrient-demanding species of wet meadows or species of strongly-drained mesic meadows. To some extent they can be negatively influenced by livestock grazing as well.

Indicators of good quality:

In general, primary fens without species of wet meadows are more valuable than secondary fens. However, in some areas, especially in the lowlands, primary fens may not occur and in that case the secondary fens with meadow species have the highest conservation value.

- Stable hydrological regime
- Continued traditional management at secondary habitats
- Absence of overgrazing
- No encroachment of trees or shrubs
- No spread of tall-growing nutrient-demanding herbs
- Absence or low incidence of neophytes

Characteristic species:

Flora: Vascular plants: *Anthoxanthum odoratum, Aster bellidiastrum, Bartsia alpina, Blysmus compressus, Briza media, Caltha palustris, Carex davalliana, Carex flava, Carex hostiana, Carex lepidocarpa, Cirsium palustre, Cirsium rivulare, Crepis paludosa, Cruciata glabra, Cynosurus cristatus, Dactylorhiza incarnata, Dactylorhiza majalis, Eleocharis quinqueflora, Epipactis palustris, Eriophorum angustifolium, Eriophorum latifolium, Festuca rubra agg., Galium uliginosum, Holcus lanatus, Juncus alpinoarticulatus, Juncus effusus, Lathyrus pratensis, Lychnis flos-cuculi, Menyanthes trifoliata, Parnassia palustris, Pinguicula vulgaris, Plantago lanceolata, Primula elatior, Primula farinosa, Prunella vulgaris, Ranunculus acris, Scirpus sylvaticus, Selaginella selaginoides, Tofieldia calyculata, Trichophorum cespitosum, Triglochin palustris, Valeriana dioica, Valeriana simplicifolia*

Mosses: *Bryum pseudotriquetrum, Calliergonella cuspidata, Campylium stellatum, Cirriphyllum piliferum, Climacium dendroides, Cratoneuron filicinum, Hamatocaulis vernicosus, Palustriella commutata, Palustriella falcata, Plagiomnium affine* agg., *Rhytidiadelphus squarrosus, Scorpidium cossonii, Thuidium philibertii*

Classification

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

EUNIS:

D4.1 Rich fens, including eutrophic tall-herb fens and calcareous flushes and soaks

EuroVegChecklist:

Caricion davallianae Klika 1934

Caricion viridulo-trinervis Julve ex Hájek et Mucina in Theurillat et al. 2015

Sphagno-Tomentypnion Dahl 1956 (marginally)

Annex I:

7230 Alkaline fens

Emerald:

D4.1 Rich fens, including eutrophic tall-herb fens and calcareous flushes and soaks

MAES-2:

Wetlands

IUCN:

5.4. Bogs, Marshes, Swamps, Fens, Peatlands

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

Yes

Regions

Alpine

Boreal

Continental

Justification

The most typical examples with greatest concentration of habitat specialists occur in the Alps and Carpathians. Large areas are reported also from Scandinavian countries.

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	85 Km^2	Decreasing	Decreasing
Belgium	Present	0.2 Km^2	-	-
Bulgaria	Present	5 Km^2	Decreasing	Decreasing
Croatia	Present	Unknown Km^2	-	-
Czech Republic	Present	0.5 Km^2	Decreasing	Decreasing
Denmark	Present	90 Km^2	Decreasing	Decreasing
Estonia	Present	130 Km^2	Unknown	Decreasing
Finland	Finland mainland: Present	370 Km^2	Decreasing	Decreasing
France	France mainland: Present	93 Km^2	Decreasing	Decreasing
Germany	Present	50 Km^2	Decreasing	Decreasing
Greece	Greece (mainland and other islands): Present	1.5 Km^2	-	Stable
Hungary	Present	3.5 Km^2	Decreasing	-
Ireland	Present	130 Km^2	Decreasing	Decreasing
Italy	Italy mainland: Present	62 Km^2	Decreasing	Decreasing
Latvia	Present	9 Km^2	Decreasing	Decreasing
Lithuania	Present	10 Km^2	Decreasing	Decreasing
Netherlands	Present	0.1 Km^2	Decreasing	Decreasing
Poland	Present	90 Km^2	Decreasing	Decreasing
Romania	Present	15 Km^2	Decreasing	Decreasing
Slovakia	Present	0.4 Km^2	Decreasing	Decreasing
Slovenia	Present	1.3 Km^2	Decreasing	Decreasing
Spain	Spain mainland: Present	27 Km^2	Decreasing	Decreasing
Sweden	Present	1000 Km^2	Decreasing	Decreasing

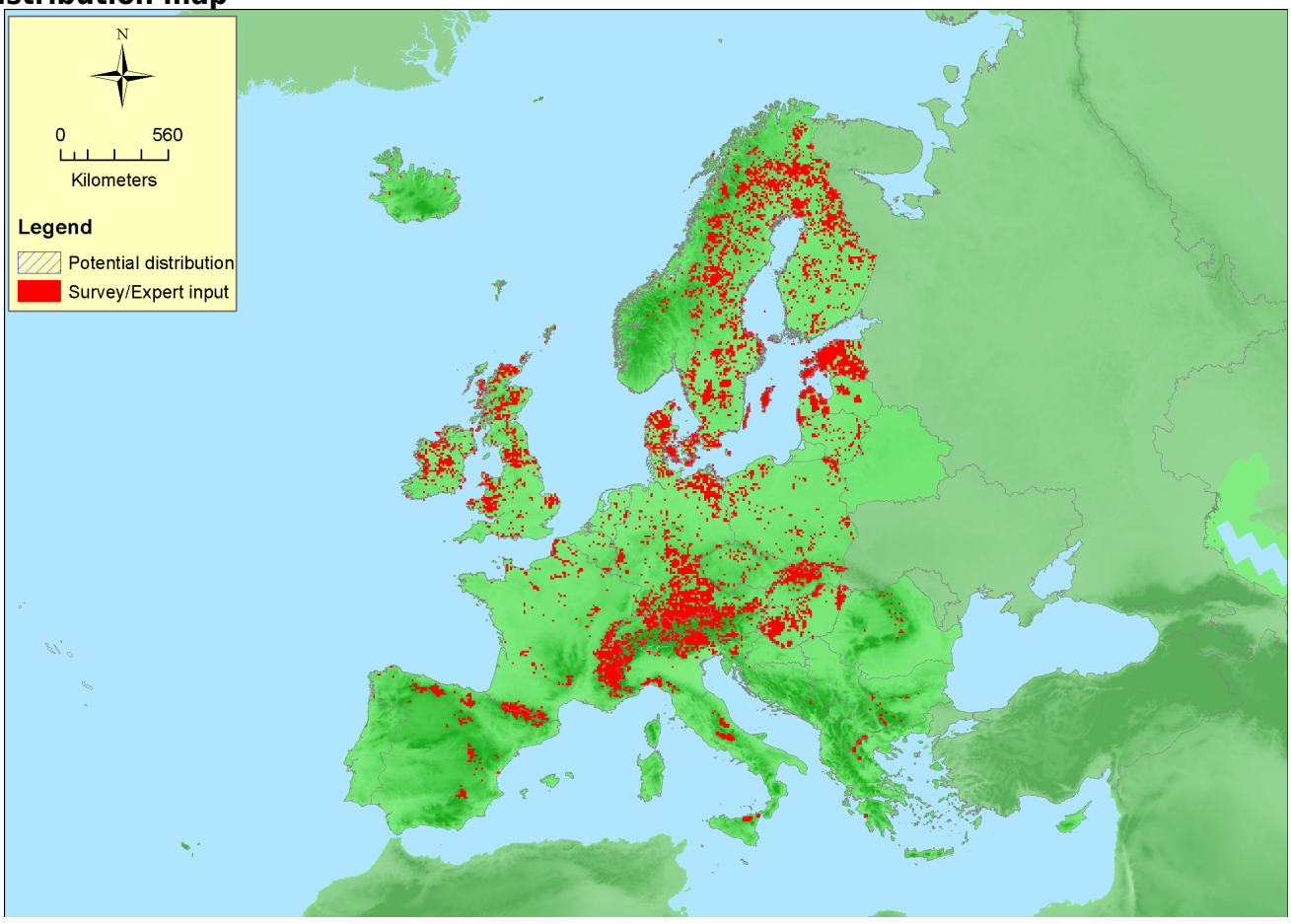
EU 28	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
UK	United Kingdom: Present	30 Km^2	Unknown	Decreasing

EU 28 +	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Bosnia and Herzegovina	Present	20 Km^2	Decreasing	Decreasing
Former Yugoslavian Republic of Macedonia (FYROM)	Present	Unknown Km^2	Decreasing	Decreasing
Norway	Norway Mainland: Present	1250 Km^2	Decreasing	-
Switzerland	Present	100 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	7447400 Km^2	7446	2203 Km^2	
EU 28+	9295750 Km^2	7621	2323 Km^2	

Distribution map



As for other mire habitats, the largest areas are reported from Scandinavia and Ireland. Nevertheless, this habitat is quite common in the Alps and Carpathians as well, where it occurs as the most typical sub-type. It occurrs also in lower altitudes in temperate Europe and extends southwards to the Balkans, Apennines and Spanish mountains. Spring hydrology and calcium-rich bedrock are good determinants of its

occurrence.

The map is complete for EU28, but incomplete for Norway, the Balkan and possibly Iceland.

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

20%

Trends in quantity

During last decades, most of these fens have disappeared from agricultural landscapes, including semi-natural mountain landscapes such as the Alps. The trend is the same in northern Europe, with regions experiencing strong decline occurring northwards to Central Sweden, including all the Baltic region. Decline is continuing even in nature reserves because of overall eutrophication of the landscape, water table decline and lack of management. Less declining are fens in alpine zones.

- Average current trend in quantity (extent)
  EU 28: Decreasing
  EU 28+: Decreasing
- Does the habitat type have a small natural range following regression?
  Yes
  Justification
  Still ongoing. Decline of small-sedge fens, especially those limited by phoshorus (Caricion davallianae) are still not fixed. Even in some protected areas these fens are changing into *Sphagnum* fens, reed beds or broadleaved wet grasslands.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  Yes
  Justification
  The habitat requires high calcium content (a rather rare phenomenon in the regions richest in peatlands), low nutrient availability and stable high water level. A regional stability of the habitat at a millenial scale is important as well.

Trends in quality

Quality is still declinining, even in protected landscapes. Loss of habitat specialists have been repeatedly reported even from protected areas with active management and it is difficult to fix it. The habitat is changing into wet grasslands with an increase of generalist wetland and grassland species, reed beds or alder and willow carrs.

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

Pressures and threats

The main threats are connected with increasing nutrient input (especially phosphorus) and drainage. Because many of these fens are small, also direct destruction by developmental activies is frequent. Increasing nutrient input (diffuse groundwater pollution especially) and water table decline leads to succession towards poor or intermediate fens, reed beds (*Phragmites australis*) or broadleaved wet grasslands. Management may slow down or block the succession and hence counteract the undesired succession, so cessation of management is also a threat. Some territorial data report lack of grazing as a threat, but the effect of grazing is equivocal - if it leads to increasing nutrient input, succession may continue or even accelerate, especially when grazing has ceased temporarily. On the other hand, grazing creates surface disturbance supporting some rare species. Generally, once-a-year mowing is the best way

to block succession on sites with decreased water table and increased nutrient content.

List of pressures and threats

Agriculture

Cultivation
Modification of cultivation practices
    Agricultural intensification
Mowing / Cutting of grassland
    Abandonment / Lack of mowing
Grazing
    Abandonment of pastoral systems, lack of grazing

Sylviculture, forestry

Forestry activities not referred to above

Human intrusions and disturbances

Outdoor sports and leisure activities, recreational activities
Sport and leisure structures

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
Pollution to groundwater (point sources and diffuse sources)
    Diffuse groundwater pollution due to agricultural and forestry activities
Other forms of pollution

Natural System modifications

Human induced changes in hydraulic conditions
    Modification of hydrographic functioning, general
    Water abstractions from groundwater
    Other human induced changes in hydraulic conditions
    Anthropogenic reduction of habitat connectivity

Natural biotic and abiotic processes (without catastrophes)

Biocenotic evolution, succession
    Species composition change (succession)

Conservation and management

The following procedures are advised:

No intervention - in boreal or high mountain fens, with stable high water level, no extra supply of nutrients and no invasive species.

Mowing - in fens enriched in nutrients or with declining water level, typically in young habitats with shallow peat level that has developed since Middle Ages. Also in fens invaded by *Molinia, Phragmites, Calamagrostis, Filipendula* or tall willows. Additional spring mowing can supress invasive grasses such as *Molinia* or *Phragmites*, should not be applied permanently

Grazing - with caution only, may bring extra nutrients.

Artificial disturbances - if acidicole, late-successional *Sphagnum* species invade, disturbances without nutrient input (e.g., removal of expanding peat mosses) may be applied to support original brown-moss

vegetation.

Extensive restoration measures (blocking drainage channels, sod removal) - in heavily damaged fens.

List of conservation and management needs

No measures

No measures needed for the conservation of the habitat/species
Measures needed, but not implemented

Measures related to agriculture and open habitats

Maintaining grasslands and other open habitats

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

Specific single species or species group management measures

Measures related to special resouce use

Regulating/Management exploitation of natural resources on land

Conservation status

Annex I:

7230: ALP U1, ATL U2, BOR U1, CON U2, MED U2, PAN U2

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

Naturally only if habitat specialists survived at site, nutrient availability is not increased and water regime is unaffected.

Through intervention restoration is extremely difficult as demonstrated by several studies, especially because of problems with nutrient oversupply, iron toxicity and cessation of carbonate precipitation during water level manipulations

Effort required

10 years	20 years	50+ years	200+ years
Through intervention	Through intervention	Through intervention	Through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	-51 %	-28 %	unknown %	-70 %

Criterion A	A1	A2a	A2b	A3
EU 28+	-47 %	-28 %	unknown %	-70 %

Decline 50.4% (recent trend EU28) and 67% (historical trend) is calculated from the average of estimations of territorial experts, but without including declines in Belgium, Croatia, Greece, Ireland, Latvia, Romania and United Kingdom where no trend data are available. If estimation based on similar countries (in terms of land use and environmental conditions) is applied, total decline is about 52%. When the same simulation is used for historical trend, the long-term decline will reach ca. 70%. Some uncertainty is imputed by the extremely large area reported for Sweden, almost one half of total European area, with rather low decline reported (ca. 20%) and no estimation for historical decline which was substantial because of drainage already since late 1800s. The delimitation of short-sedge fens is less clear in Central Sweden (from where largest area and lowest decline are reported) with many transitions towards calcareous quaking fens and tall-sedge calcareous fens and absence of some indicators of small-sedge calcareous fens. The real declines are probably higher than reported here, especially for historical trend. The classification into the Endangered (EN) category hence seems clear and realistic.

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	unknown	>50	Yes	Yes	unknown	unknown
EU 28+	>50000 Km^2	Yes	Yes	unknown	>50	Yes	Yes	unknown	unknown

EOO, AOO and number of locations are far beyond the thresholds for criterion B1, B2 and B3.

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	44 %	49 %	unknown %	unknown %	unknown %	unknown %
EU 28+	53 %	46 %	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%

Percentages are based on territorial data provided by local experts. Among countries reporting large areas of this habitat, no data were provided from Estonia (where severe degradation is expected) and Ireland (where less severe degradation is expected), hence adding data for these two countries would not alter the result substantially. Result is again strongly governed by Sweden, where half of the area is reported to be affected by moderate severity. As a results, data supports VU category, but note that degradation of

this habitats still continues.

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 European scale, even though literature suggests that there is a great risk of decline (Essl et al. 2012).

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	EN	LC	DD	EN	LC	LC	LC	NT	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	VU	LC	DD	EN	LC	LC	LC	NT	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
Endangered	A1, A3	Endangered	A3

Confidence in the assessment
High (mainly based on quantitative data sources and/or scientific literature)

Assessors
M. Hájek

Contributors
Habitat description: M. Chytrý

Territorial data: E. Agrillo, A. Alegro, S. Armiraglio, S. Assini, F. Attorre, L. Aunina, C. Bita-Nicolae, G. Buffa, L. Casella, A. Čarni, R. Delarze, I. Diack, P. Dimopoulos, P. Finck, C. Giancola, D. Gigante, M. Hájek, B. Hamill, P. Ivanov, J. Janssen, P. Jones, N. Juvan, Z. Kącki, G. Király, T. Kontula, E. Leibak, A. Lyngstad, V. Matevski, A. Mikolajczak, Đ. Milanović, A. Moen, J.A. Molina, B. Nygaard, F. O'Neill, D.I. Øien, J. Paal, D. Paternoster, G. Pezzi, V. Rašomavičius, U. Raths, U. Riecken, D. Spray, A. Ssymank, J. Šibík, Ž. Škvorc, T. Tahvanainen, R. Venanzoni, P, Verté, D. Viciani, E. Weeda.

Help with data processing: E. Hettenbergerová

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

Reviewers
J. Rodwell

Date of assessment
05/01/2016

Date of review
29/02/2016

References

Bergamini, A., Peintinger, M., Fakheran, S., Moradi, H., Schmid, B. and Joshi, J. 2009. Loss of habitat specialists despite conservation management in fen remnants 1995–2006. *Perspectives in Plant Ecology,*

Evolution and Systematics 11(1): 65-79.

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

Hájková, P., Horsák, M., Hájek, M., Jankovská, V., Jamrichová, E., Moutelíková, J. 2015. Using multi-proxy palaeoecology to test a relict status of refugial populations of calcareous-fen species in the Western Carpathians. *The Holocene 25*(4): 702-715.

Jiménez-Alfaro, B., Hájek, M., Ejrnaes, R., Rodwell, J., Pawlikowski, P., Weeda, E. J., Laitinen, J., Moen, A., Bergamini, A., Aunina, L., Sekulová, L., Tahvanainen, T., Gillet, F., Jandt, U., Dítě, D., Hájková, P., Corriol, G., Kondelin, H., Díaz, T. E. 2014. Biogeographic patterns of base-rich fen vegetation across Europe. *Applied Vegetation Science* 17: 367-380.

Moen, A., Lyngstad, A. and Øien, D. I. 2012. Boreal rich fen vegetation formerly used for haymaking. *Nordic Journal of Botany 30*(2): 226-240.