Natura 2000 Seminars

Atlantic
Biogeographic Region

Peer-Reviewed Literature Bibliography

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Introduction

The main search engine that was used in this literature review was the Web of Science. This is an online academic citation index that provides access to multiple databases, cross-disciplinary research, and specialized fields within specific academic disciplines. This encompasses approximately 12,000 high-impact journals as well as open access journals and over 150,000 conference proceedings. It has advanced search and filtering capabilities which made it an ideal choice for this project in comparison to other more limited search engines such as Google Scholar.

The results were subject to a three-stage, iterative filtering process so that only the most suitable references were captured. The first stage consisted of applying filters to the initial search results. References were discarded if they were more than 12 years old, attributed to countries outside the Atlantic Biogeographic Region or from an entirely irrelevant source, e.g. medical sub-disciplines.

The second stage involved the direct evaluation of specific references, their keywords and the journal titles. Suitability at this stage was simply determined by broad relevance to the selected habitat types. Very few of the references used the specific EU habitat classification, either in their titles or keywords. This meant that broader terms such as ‘saltmarsh’, rather than ‘Atlantic salt meadows (Glauco-Puccinellietalia maritimae)’, yielded the most potentially relevant literature.

Where doubt remained about the suitability of a reference, a third stage filter was applied where the abstract was directly evaluated. References that passed all three filters were then transferred (with abstracts) to EndNote Web. This online bibliographic database was used because of its compatibility with the search engine and to enable further collaboration between project partners. Once complete, the references were exported as bibliographies to this document and a spreadsheet where further analysis of the results could occur.

This analysis involved the classification of references in order to identify knowledge gaps. The classification was derived from insights gained from the Boreal Workshop, themes that arose during the literature search and the ETC Article 17 pressures list. The following list was used:


Once each reference was attributed, bar charts were generated to summarise the knowledge gaps for each of the broad habitat groupings. These have been shown in the following sections. Care is needed when interpreting these figures as some of the categories are only relevant to specific habitats, e.g. limnology is only relevant to three out of four groupings.
HEATHLAND HABITATS

Core Information Sources

BNF - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: [http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html] [Accessed 2 April, 2012]


Northern Atlantic wet heaths with Erica tetralix (4010)

Humid, peaty or semi-peaty heaths, other than blanket bogs, of the Atlantic and sub-Atlantic domains. Plant text: [Erica tetralix].

Pasted from: [http://eunis.eea.europa.eu/habitats/10082]

European dry heaths (4030)

Mesophile or xerophile heaths on siliceous, podsolic soils in moist Atlantic and sub-Atlantic climates of plains and low mountains of Western, Central and Northern Europe. The
following subtypes are included: Pal. 31.21 Submontane [Vaccinium-Calluna] heaths.
[Calluna vulgaris]; usually with [Calluna vulgaris]. The northern and western British Isles, the Hercynian ranges and the lower levels of the Alps, the Carpathians, the Pyrenees and the Cordillera Cantabrica. Pal. 31.22 Sub-Atlantic [Calluna-Genista] heaths.
[Calluno-Genistion pilosae] p. Low [Calluna] heaths often rich in [Genista], mostly of the
Germano-Baltic lowlands. Similar formations occurring in British upland areas, montane
zones of high mountains of the western Mediterranean basin and high rainfall Adriatic
influenced areas are most conveniently listed here. Pal. 31.23 Atlantic [Erica-Ulex] heaths.
[Ulicenion minoris]; [Daboecion cantabricae] p.; [Ulicion maritimae] p. Heaths rich in
gorse ([Ulex]) of the Atlantic margins. Pal. 31.24 Ibero-Atlantic [Erica-Ulex-Cistus] heaths.
[Daboecion cantabricae] p.; [Ericenion umbellatae] p., [Ericenion aragonensis]; [Ulicion
heaths with numerous species of heathers (notably [Erica umbellata], [Erica aragonensis])
and brooms, rock-roses and often [Daboecia]. When the rock-waves and other
Mediterranean shrubs become dominant they should be classified under sclerophyllous
[Vaccinium] spp., [Calluna vulgaris]; Pal. 31.22 - [Calluna vulgaris], [Genista anglica], [Genista
germanica], [Genista pilosula], accompanied by [Empetrum nigrum] or [Vaccinium] spp.; Pal.
31.23 - [Ulex maritimus], [Ulex gallii], [Erica cinerea], [Erica mackaiana], [Erica vagans]; Pal.
31.24 - [Erica umbellata], [Erica aragonensis], [Erica cinerea], [Erica andevalensis], [Cistus
salvifolius], [Calluna vulgaris]; Pal. 31.25 - [Erica cinerea].


**Search Terms**

(heath OR heathland OR “wet heath” OR “dry heath”) OR moorland OR “Northern Atlantic wet
heaths with Erica tetralix” OR “Erica tetralix” OR Erica OR “European dry heaths” OR “Genistion
micrantho-anglicae” OR “Calluno-Genistion pilosae” OR “Ulicenion minoris” OR “Ulicion maritimae”
OR “Ericenion umbellatae” OR “Ericenion aragonensis” OR “Vaccinion vitis-idaeae” OR “Vaccinio
myrtilli-Callunetum s.l.” OR “Daboecion cantabricae” OR Calluna OR Vaccinium OR Genista OR “Ulex
europeaus” OR “Daboecia Cantabria” AND ecology AND management AND conservation AND
“conservation status” AND (threats OR pressures OR decline OR deterioration OR unfavourable OR
loss OR degrad*) AND (“climate change” OR “invasive alien species” OR eutrophication OR pollution
OR “resource management” OR exploitation OR “land abandonment” OR “land use intensification”
OR “land conversion” OR forestry OR fragmentation OR loss OR “protected area” OR “Natura 2000”
OR Natura2000 OR “commercial development” OR “industrial development” OR “infrastructure
development” OR “spatial planning” OR overgrazing OR undergrazing OR fire OR burning OR
hydrology OR drainage OR mining OR quarry OR “natural change” OR “anthropogenic change” OR
guidance OR “human disturbance” OR “energy production” OR biofuels OR bioenergy OR “wind farm”
OR “wind turbine” OR dam OR “economic valuation” OR “conservation finance” OR “protected area
finance”)

**Search Results**

A total of 1,242 references were retrieved for closer examination. The search was restricted to the
last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and
relevant subject categories, i.e. conservation biology not medicine. This was further reduced to 307
references through the evaluation of the paper titles and abstracts. An additional 22 references
were captured by searching on specific EU habitat terms and associated syntaxa with an unrestricted time range. The subject areas that were covered can be seen in figure 1.

Figure 1: Subject area summary for heathland habitat literature search.
Bibliography


Natura 2000 Seminars


Currey, P. M., et al. (2011) Five years of simulated atmospheric nitrogen deposition have only subtle effects on the fate of newly synthesized carbon in Calluna vulgaris and Eriophorum vaginatum. Soil Biology & Biochemistry, 43(3) Mar, pp.495-502.


Dorland, E., et al. (2003b) The success of restoring former species-rich heathlands can be increased by applying lime after sod cutting. Levende Natuur, 104(4) Juli, pp.144-147.


COASTAL HABITATS

Core Information Sources


BfN - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html [Accessed 2 April, 2012]


Estuaries (1130)

Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and sea water and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sand and mud flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary. Baltic river mouths, considered as an estuary subtype, have brackish water and no tide, with large wetland vegetation (helophytic) and luxurious aquatic vegetation in shallow water areas. Plant text: Benthic algal communities, [Zostera] beds e.g. [Zostera noltii] ([Zosteretea]) or vegetation of brackish water: [Ruppia maritima] (= [R. rostellata] ([Ruppieteae])); [Spartina maritima] ([Spartinetea]); [Sarcocornia perennis] ([Arthrocnemetea]). Both species of fresh water and brackish water can be found in Baltic river mouths ([Carex] spp., [Myriophyllum] spp., [Phragmites australis], [Potamogeton] spp., [Scirpus] spp.). Vertebrate text: Important feeding areas for many birds. Invertebrate text: Invertebrate benthic communities.

Pasted from: http://eunis.eea.europa.eu/habitats/10005

Atlantic salt meadows (Glaucoc-Puccinellietalia maritimae) (1330)

Salt meadows of Baltic, North Sea, English Channel and Atlantic shores. [Aster tripolium] can be present or abundant in most subdivisions. Plant text: Pal.:15.31 - [Puccinellia maritima]; Pal.:15.32 - [Halimione portulacoides], [Halimione pedunculata], [Aster tripolium]; Pal.:15.33 - [Armeria maritima], [Glaux maritima], [Plantago maritima], [Frankenia laevis], [Artemisia maritima], [Festuca rubra], [Agrostis stolonifera], [Juncus gerardi], [Carex rubra], [Carex rostrata], [Blysmus rufus], [Eleocharis] spp.; Pal.:15.34 - [Spergularia maritima], [Puccinellia maritima], [Puccinellia retroflexa], [Spartina maritima], [Triglochin maritima], [Potentilla anserina], [Halimione portulacoides]; Pal.:15.35 - [Spergularia maritima], [Salsola soda], [Cressa cretica], [Parapholis incurva], [P. strigosa], [Hordeum marinum], [Sphenopus divaricatus] colonising salt muds of the Mediterranean region, susceptible to temporary inundation and extreme drying. Pal. 15.12 - Mediterranean halo-nitrophilous pioneer communities ([Frankenion pulverulentae]): formations of halo-nitrophilous annuals ([Frankenia pulverulenta], [Suaeda maritima], [Salsola soda], [Cressa cretica], [Parapholis incurva].[P. strigosa], [Hordeum marinum], [Sphenopus divaricatus]) colonising salt muds of the Mediterranean region, susceptible to temporary inundation and extreme drying. Pal. 15.13 - Atlantic sea-pearlwort communities ([Saginion maritimae]): formations of annual pioneers occupying sands subject to variable salinity and humidity, on the coast, in dune systems and saltmarshes. They are usually limited to small areas and best

Pasted from: http://eunis.eea.europa.eu/habitats/10020

Salicornia and other annuals colonizing mud and sand (1310)

Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus [Salicornia] or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes. [Thero-Salicornietea], [Frankenietea pulverulentae], [Saginetea maritimae]. Subtypes: Pal. 15.11 - Grasswort swards ([Thero-Salicornietalia]): annual grasswort ([Salicornia] spp., [Microcenum coraloides]), seablite ([Suaeda maritima]), or sometimes salwort ([Salsola] spp.) formations colonising periodically inundated muds of coastal saltmarshes inland salt-basins. Pal. 15.12 - Mediterranean halo-nitrophilous pioneer communities ([Frankenion pulverulentae]): formations of halo-nitrophilous annuals ([Frankenia pulverulenta], [Suaeda splendens], [Salsola soda], [Cressa cretica], [Parapholis incurva], [P. strigosa], [Hordeum marinum], [Sphenopus divaricatus]) colonising salt muds of the Mediterranean region, susceptible to temporary inundation and extreme drying. Pal. 15.13 - Atlantic sea-pearlwort communities ([Saginion maritimae]): formations of annual pioneers occupying sands subject to variable salinity and humidity, on the coast, in dune systems and saltmarshes. They are usually limited to small areas and best
developed in the zone of contact between dune and saltmarsh. Pal. 15.14 Central Eurasian cryptsoid communities: Sparse solonchak formations of annual grasses of genus [Crypsis] ([Heleochloa]) colonizing drying muds of humid depressions of the salt steppes and saltmarshes (Pal. 15.A) of Eurasia, from Pannonia to the Far East. Plant text: Pal.:15.11 - [Salicornia] spp., [Microcnemum coralloides], [Suaeda maritima]; Pal.:15.12 - [Frankenia pulverulenta], [Suaeda splendens], [Salicornia spp.], [Cressa cretica], [Parapholis incurva], [Parapholis strigosa], [Hordeum maritinum], [Sphenopus divaricatus]; Pal.:15.13 - [Sagina maritima], [Sagina nodosa], [Cochlearia danica], [Gentiana littoralis], [Bupleurum tenuissimum]. Pal.:15.14 - [Crypsis] spp, [Cyperus pannonicus], [Spergularia media], [Spergularia marina], [Salicornia] spp., [Lepidium latifolium], [Chenopodium] spp., [Atriplex] spp.

Pasted from: http://eunis.eea.europa.eu/habitats/10018

Search Terms

(estuary OR estuaries OR “salt meadow” OR “salt marsh” OR mudflat) OR “Atlantic salt meadows (Glauco-Puccinellietalia maritimae)” OR “Atlantic salt meadows” OR “Glauco-Puccinellietalia maritimae” OR “Aster tripolium” OR “Puccinellia maritima” OR “Glauco-Puccinellietalia” OR “Salicornia and other annuals colonizing mud and sand” OR “Salicornia europaea” OR “Salicornia procumbens” OR “Salicornia pusilla” OR “Salicornia agg.” OR “Frankenietae pulverulentae” OR “Saginetetalia maritimae” OR “Thero-Salicornietalia” AND ecology AND management AND conservation AND “conservation status” AND (threats OR pressures OR decline OR deterioration OR unfavourable OR loss OR degrad*) AND (“climate change” OR “invasive alien species” OR eutrophication OR pollution OR “resource management” OR exploitation OR “land abandonment” OR “land use intensification” OR “land conversion” OR forestry OR fragmentation OR loss OR “protected area” OR “Natura 2000” OR Natura2000 OR “commercial development” OR “industrial development” OR “infrastructure development” OR “spatial planning” OR overgrazing OR undergrazing OR fire OR burning OR hydrology OR drainage OR mining OR quarry OR “natural change” OR “anthropogenic change” OR guidance OR “human disturbance” OR “energy production” OR biofuels OR bioenergy OR “wind farm” OR “wind turbine” OR dam OR “economic valuation” OR “conservation finance” OR “protected area finance”)

Search Results

A total of 930 references were retrieved for closer examination. The search was restricted to the last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. This was further reduced to 278 references through a two-tier evaluation of titles and abstracts. An additional 49 references were captured by searching on specific EU habitat terms and associated syntaxa with an unrestricted time range. The subject areas that were covered can be seen in figure 2.
Figure 2: Subject area summary for coastal habitat literature search.
Bibliography


Esteves, E. and Andrade, J. P. (2008) Diel and seasonal distribution patterns of eggs, embryos and
larvae of Twait shad Alosa fallax fallax (Lacepede, 1803) in a lowland tidal river. Acta Oecologica-

Fernandez-Tajes, J., et al. (2011) Use of three bivalve species for biomonitoring a polluted estuarine
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Figueroa, M. E., et al. (2003) Facilitated invasion by hybridization of Sarcocornia species in a salt-

Fuzy, A., et al. (2008) Drought, but not salinity, determines the apparent effectiveness of halophytes

the Tagus estuary, Portugal. Fisheries Research, 63(3) Sep, pp.423-427.

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Corophium orientale. Ecological Modelling, 221(3) Feb 10, pp.459-466.


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hydrological and wastewater inputs through numerical modelling. Ecological Modelling, 221(8) Apr
24, pp.1194-1208.

estuaries. Ecological Indicators, 9(5) Sep, pp.856-865.


Gasperi, J., et al. (2009) Priority pollutants in surface waters and settleable particles within a densely
urbanised area: Case study of Paris (France). Science of the Total Environment, 407(8) Apr 1,
pp.2900-2908.


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BOG HABITATS

Core Information Sources


BfN - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html [Accessed 2 April, 2012]


Transition mires and quaking bogs (7140)

Peat-forming communities developed at the oligotrophic to mesotrophic water surfaces, with characteristics intermediate between soligenous and ombrogenous types. They present a large and diverse range of plant communities. In large peaty systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat type includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil. These mires and bogs belong to the [Scheuchzerietalia palustris] order (oligotrophic floating carpets among others) and to the [Caricetalia fuscae] order (quaking communities). Oligotrophic water-land interfaces with [Carex rostrata] are included. Plant text: [Eriophorum gracile, Carex chordorrhiza, Carex lasiocarpa, Carex diandra, Carex rostrata, Carex limosa, Scheuchzeria palustris, Hammarbya paludosa], #[Liparis loeselii, Rhynchospora alba, Rhynchospora fusca, Menyanthes trifoliata, Epilobium palustre, Pedicularis palustris, Sphagnum] sp. ([Sphagnum papillosum, Sphagnum angustifolium, Sphagnum subsecundum, Sphagnum fimbriatum, Sphagnum riparium, Sphagnum cuspidatum, Calliergon giganteum, Drepanoclados revolvens, Scorpidiunm scorpioides, Campylium stellatum, Aneura pinguis].


Active raised bogs (7110)

Acid bogs, ombrotrophic, poor in mineral nutrients, sustained mainly by rainwater, with a water level generally higher than the surrounding water table, with perennial vegetation dominated by colourful Sphagna hummocks allowing for the growth of the bog ([Erico-Sphagnetalia magellanici, Scheuchzerietalia palustris] p., [Utricularietalia intermediominoris] p., [Caricetalia fuscae] p.). Typically, pools may be present in western United Kingdom, Ireland, Finland and Sweden. The term "active" must be taken to mean still supporting a significant area of vegetation that is normally peat forming, but bogs where active peat formation is temporarily at a standstill, such as after a fire or during a natural climatic cycle e.g., a period of drought, are also included. Plant text: Erico-Sphagnetalia magellanici - [Andromeda polifolia, Carex pauciflora, Cladonia] spp., [Drosera rotundifolia, Eriophorum vaginatum, Odontoschisma sphagni, Sphagnum magellanicum, Sphagnum imbricatum, Sphagnum fuscum, Vaccinium oxyccocos]; in the Boreal region also [Betula nana, Chamaedaphne calyculata, Calluna vulgaris, Ledum palustre] and [Sphagnum angustifolium].

Pasted from: http://eunis.eea.europa.eu/habitats/10142

Alkaline fens (7230)

Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other [Cyperaceae] usually dominate the mire communities, which belong to the [Caricion davallianae], characterised by a usually prominent "brown moss" carpet formed by [Campylium stellatum, Drepanocladus intermedium, D. revolvens, Cratoneuron commutatum, Acrocladium cuspidatum, Ctenidium molluscum, Fissidens adianthoides, Bryum pseudotriquetrum] and others, a grasslike growth of [Schoenus nigricans, S. ferrugineus, Eriophorum latifolium, Carex davalliana, C. flava, C. panicea, Juncus subnodulosus, Scirpus cespitosus, Eleocharis quinqueflora], and a very rich herbaceous flora including [Tofieldia calyculata, Dactylorhiza incarnata, D. traunsteinerioides, D. russowii, D. majalis ssp. brevifolia, D. cruenta, #Liparis loeselii, Herminium monorchis, Epipactis palustris, Pinguicula vulgaris, Pedicularis sceptrum-carolinum, Primula farinosa, Swertia perennis]. Wet grasslands ([Molinietalia caerulescens], e.g. [Juncetum subnodulosi], Pal. 37), tall sedge beds ([Magnocaricion], Pal. 53.2), reed formations ([Phragmition], Pal. 53.1), fen sedge beds ([Cladietum mariscae], Pal. 53.3), may form part of the fen system, with communities related to transition mires (Pal. 54.5, 54.6) and amphibious or aquatic vegetation (Pal. 22.3, 22.4) or spring communities (Pal. 54.1) developing in depressions. The sub-units below, which can, alone or in combination, and together with codes selected from the categories just mentioned, describe the composition of the fen, are understood to include the mire communities sensu stricto ([Caricion davallianae]), their transition to the [Molinion], and assemblages that, although they may be phytosociologically referable to alkaline [Molinion] associations, contain a large representation of the [Caricion davallianae] species listed, in addition to being integrated in the fen system; this somewhat parallels the definition of an integrated class [Molinio-Caricetalia davallianae] in Rameau et al., 1989. Outside of rich fen systems, fen communities can occur as small areas in dune slack systems (Pal. 16.3), in transition mires (Pal. 54.5), in wet grasslands (Pal. 37), on tufa cones (Pal. 54.121) and in a few other situations. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most. Plant text: [Schoenus nigricans, S. ferrugineus, Carex spp., Eriophorum latifolium, Cincldium stygium, Tomentypnum nitens].

Pasted from: http://eunis.eea.europa.eu/habitats/10151
Search Terms

(bog OR mire OR “transition mire” OR “quaking bog” OR “raised bog” OR fen OR “alkaline fen”) OR peatland OR “transition mires and quaking bogs” OR Carex OR Sphagnum OR Eriophorum OR “Caricetalia fuscae” OR “Scheuchzerietalia palustris” OR “active raised bogs” OR “Utricularietalia intermedio-minoris” OR “Utricularietalia intermedio-minoris” OR “alkaline fens” OR “Caricion davallianae” OR Molinion AND ecology AND management AND conservation AND “conservation status” AND (threats OR pressures OR decline OR deterioration OR unfavourable OR loss OR degrad*) AND (“climate change” OR “invasive alien species” OR eutrophication OR pollution OR “resource management” OR exploitation OR “land abandonment” OR “land use intensification” OR “land conversion” OR forestry OR fragmentation OR loss OR “protected area” OR “Natura 2000” OR Natura2000 OR “commercial development” OR “industrial development” OR “infrastructure development” OR “spatial planning” OR overgrazing OR undergrazing OR fire OR burning OR hydrology OR drainage OR mining OR quarry OR “natural change” OR “anthropogenic change” OR guidance OR “human disturbance” OR “energy production” OR biofuels OR bioenergy OR “wind farm” OR “wind turbine” OR dam OR “economic valuation” OR “conservation finance” OR “protected area finance”)

Search Results

A total of 1,032 references were retrieved for closer examination. The search was restricted to the last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. This was further reduced to 75 references through a two-tier evaluation of titles and abstracts. An additional 27 references were captured by searching on specific EU habitat terms and associated syntaxa with an unrestricted time range. The subject areas that were covered can be seen in figure 3.
Figure 3: Subject area summary for bog habitat literature search.

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LAKE AND RIVER HABITATS

Core Information Sources


BfN - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html [Accessed 2 April, 2012]


Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea (3130)

Subtypes: Pal. 22.12 x 22.31: Aquatic to amphibious short perennial vegetation, oligotrophic to mesotrophic, of lake, pond and pool banks and water-land interfaces belonging to the [Littorelletalia uniflorae] order. Pal. 22.12 x 22.32: amphibious short annual vegetation, pioneer of land interface zones of lakes, pools and ponds with nutrient poor soils, or which grows during periodic drying of these standing waters: [Isoeto-Nanojuncetea] class. These two units can grow together in close association or separately. Characteristic plant species are generally small ephemerophytes. Plant text: Pal. 22.12 x 22.31: [Littorella uniflora], [Littorella uniflora],
Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation (3150)

Lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters, particularly rich in dissolved bases (pH usually > 7), with free-floating surface communities of the [Hydrocharition] or, in deep, open waters, with associations of large pondweeds ([Magnopotamion]). Plant text: [Hydrocharition] - [Lemma] spp., [Spirodela] spp., [ Wolffia] spp., [Hydrocharis morsus-ranae], [Stratiotes aloides], [Utricularia australis], [Utricularia vulgaris], #[Aldrovanda vesiculosa], ferns ([Azolla]), liverworts ([Riccia] spp., [Ricciocarpus] spp.);[Magnopotamion] - [Potamogeton lucens], [Potamogeton praelongus], [Potamogeton zizii], [Potamogeton perfoliatus].

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

Shallow oligotrophic waters with few minerals and base poor, with an aquatic to amphibious low perennial vegetation belonging to the [Littorelletalia uniflorae] order, on oligotrophic soils of lake and pond banks (sometimes on peaty soils). This vegetation consists of one or more zones, dominated by [Littorella], [Lobelia dortmanna] or [ Isoetes], although not all zones may not be found at a given site. Plant text: [Isoetes lacustris], [Isoetes echinospora], [Littorella uniflora], [ Lobelia dortmanna], [Deschampsia setacea], [Subularia aquatica], [Juncus bulbosus], [ Pilularia globulifera], #[Luronium natans], [Potamogeton polygonifolius]; in the Boreal region also [Myriophyllum alterniflorum], [Drepanocladus] spp., [Warnstorfia] spp. and [Fontinalis] spp.

Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation (3260)

Water courses of plain to montane levels, with submerged or floating vegetation of [Ranunculion fluitantis] and [Callitricho-Batrachion] (low water level during Summer) or aquatic mosses Plant text: Submerged or floating vegetation of [Ranunculion fluitantis] and [Callitricho-Batrachion] (low water level during Summer) or aquatic mosses. [Ranunculus saniculifolius], [Ranunculus trichophyllus], [Ranunculus fluitans], [Ranunculus peltatus], [Ranunculus penicillatus ssp. penicillatus], [Ranunculus penicillatus ssp. pseudofluitantis], [Ranunculus aquatilis], [Myriophyllum] spp., [Callitriches] spp., [Sium erectum], [Zannichellia palustris], [Potamogeton] spp., [Fontinalis antipyretica].
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) (91E0)

Riparian forests of [Fraxinus excelsior] and [Alnus glutinosa], of temperate and Boreal Europe lowland and hill watercourses (Pal. 44.3: [Alno-Padion]); riparian woods of [Alnus incanae] of montane and submontane rivers of the Alps and the northern Apennines (Pal. 44.2: [Alnion incanae]); arborescent galleries of tall [Salix alba, Salix fragilis] and [Populus nigra], along medio-European lowland, hill or submontane rivers (Pal. 44.13: [Salicion albae]). All types occur on heavy soils (generally rich in alluvial deposits) periodically inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated during low-water. The herbaceous layer invariably includes many large species ([Filipendula ulmaria, Angelica sylvestris, Cardamine] spp., [Rumex sanguineus, Carex] spp., [Cirsium oleraceum]) and various vernal geophytes can occur, such as [Ranunculus ficaria, Anemone nemorosa, Anemone ranunculoides, Corydalis solida]. This habitat includes several subtypes: ash-alder woods of springs and their rivers (Pal. 44.31 [Carici remotae-Fraxinetum]); ash-alder woods of fast-flowing rivers (Pal. 44.32 [Stellario-Alnetum glutinosae]); ash-alder woods of slow-flowing rivers (Pal. 44.33 [Pruno-Fraxinetum, Ulmo-Fraxinetum]); montane grey alder galleries (Pal. 44.21 [Calamagrosti variae-Alnetum incanae] Moor 58); submontane grey alder galleries (Pal. 44.22 [Equiseto hyemalis-Alnetum incanae] Moor 58); white willow gallery forests (Pal. 44.13 [Salicion albae]). The Spanish types belong to the alliance [Osmundo-Alnion] (Cantabric atlantic and southeast Iberia peninsula). Plant text: Tree layer - [Alnus glutinosa, Alnus incanae, Fraxinus excelsior; Populus nigra, Salix alba, Salix fragilis]; [Betula pubescens, Ulmus glabra]; herb layer - [Angelica sylvestris, Cardamine amara, Cardamine pratensis, Carex acutiformis, Carex pendula, Carex remota, Carex strigosa, Carex sylvatica, Cirsium oleraceum, Equisetum telmateia, Equisetum] spp., [Filipendula ulmaria, Geranium sylvaticum, Geum rivale, Lycopus europaeus, Lysimachia nemorum, Rumex sanguineus, Stellaria nemorum, Urtica dioica].

Pasted from http://eunis.eea.europa.eu/habitats/10198

Search Terms

(lake OR pool OR pond OR loch OR river OR stream OR "riparian woodland" OR "wet woodland" OR "wet forest" OR "riparian forest") OR "Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea" OR "Littorella uniflora" OR Juncus OR Cyperus OR "Isoëto-Nanojuncetea" OR "Littorelletalia uniflorae" OR "Isoetetum azorica" OR "Littorelletalia uniflorae" OR "Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation" OR Hydrocharition OR Magnopotamion OR "Potamogeton lucens" OR "Potamogeton perfoliatus" OR "Potamogeton praelongus" OR Utricularia OR "Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)" OR "Littorelletalia uniflorae" OR Isoetes OR Littorella OR "Lobelia dortmanna" OR "Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation" OR Ranunculus OR Myriophyllum OR Callitriche OR Potamogeton OR "Ranunculion fluitantis" OR "Callitricho-Batrachion" OR "Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)" OR "Alno-Padion" OR "Alnion incanae" OR "Salicion albae" OR "Alnus glutinosa" OR "Fraxinus excelsior" OR "Salix" OR "Populus" OR "Osmundo-Alnion" OR "Stellario-Alnetum glutinosae" OR "Ulmo-Fraxinetum" OR "Calamagrosti variae-Alnetum incanae" OR "Equiseto hyemalis-Alnetum incanae" OR "Pruno-Fraxinetum" OR "Alnenion glutinoso-incanae" OR "Carici remotae-Fraxinetum" AND ecology AND management AND conservation AND conservation status AND (threats OR pressures OR decline OR deterioration OR unfavourable OR loss OR degrad*) AND ("climate change" OR "invasive alien species" OR eutrophication OR pollution OR "resource management" OR exploitation)
OR “land abandonment” OR “land use intensification” OR “land conversion” OR forestry OR fragmentation OR loss OR “protected area” OR “Natura 2000” OR Natura2000 OR “commercial development” OR “industrial development” OR “infrastructure development” OR “spatial planning” OR overgrazing OR undergrazing OR fire OR burning OR hydrology OR drainage OR mining OR quarry OR “natural change” OR “anthropogenic change” OR guidance OR “human disturbance” OR “energy production” OR biofuels OR bioenergy OR “wind farm” OR “wind turbine” OR dam OR “economic valuation” OR “conservation finance” OR “protected area finance”)

Search Results

A total of 1,602 references were retrieved for closer examination. The search was restricted to the last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. More restrictive subject categories had to be applied in this search as initial results consisted of more than 35,000 references. Consequently only references associated with ecology, limnology and biodiversity conservation were selected. This selection was further reduced to 114 references through a two-tier evaluation of titles and abstracts. An additional 29 references were captured by searching on specific EU habitat terms and associated syntaxa with an unrestricted time range. The subject areas that were covered can be seen in figure 4.
Figure 4: Subject area summary for lake and river habitat literature search.
Bibliography


DUNE HABITATS

Core Information Sources

BFN - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html [Accessed 2 April, 2012]


Shifting dunes along the shoreline with Ammophila arenaria ('white dunes') (2120)

Mobile dunes forming the seaward cordon or cordons of dune systems of the coasts of the North Sea and the Atlantic in this BNP-region with as characteristic species Ammophilion arenariae and Zygophyllion fontanesii. Other characteristic plant species are Ammophila arenaria, Eryngium maritimum, Euphorbia paralias, Calystegia soldanella, Otanthus maritimus and Leymus arenarius.

Fixed coastal dunes with herbaceous vegetation (‘grey dunes’) (2130)

Fixed dunes stabilised and colonised by more or less closed perennial grasslands and abundant carpets of lichens and mosses, from the Atlantic coasts (and the English Channel) between the Straits of Gibraltar and Cap Blanc Nez, and the shores of the North Sea and the Baltic. In the case of the thermo-Atlantic coast, it is logical to include the associations *Euphorbio-Helichrysis* and *Crucianellion maritimae* (Strait of Gibraltar as far as the southern Atlantic near Cape Prior in Galicia). Subtypes are:

(i) Northern grey dunes: fixed dunes of the Baltic, North Sea, Channel and northern Atlantic, with grass communities and vegetation from the *Galio-Koelerion albescentis* association with *Koelerion albescentis* and *Corynephorion canescentis* and the *Sileno conicae-Cerastion semidecandri* association.

(ii) Biscay grey dunes, of the *Euphorbio-Helichrysis stoechadis* association: dunes on stabilised humus soil infiltrated by dwarf bushes, of Brittany and the coast of the Bay of Biscay, with *Helichrysum stoechas*, *Artemisia campestris* and *Ephedra distachya*.

(iii) Thermo-Atlantic grey dunes with *Crucianellion maritimae*: suffrutescent communities on more or less stabilised soils low in humus of the thermo-Atlantic coasts of Galicia, Portugal and south-western Spain (as far as the Strait of Gibraltar), with plant species *Crucianella maritima* and *Pancratium maritimum*.

(iv) Atlantic dune (Mesobromion) grasslands: various sandy coastal sites characterised by herbaceous vegetation in the form of calcicole mesoxerocline grasslands, poor in nitrogen, corresponding to the communities of Mesobromion found by the sea (penetration of aero haline species); dunal grasslands composed of species characteristic of dry calcareous grasslands.

(v) Atlantic dune thermophile fringes of the *Trifolio-Geranietea sanguinii* and *Galio maritimi-Geranion sanguinii* associations with *Geranium sanguineum* formations, incorporated within grey dune systems of the British Isles and Brittany, on neutro basic soils rich in calcium and poor in nitrogen.

(vi) Dune fine-grass annual communities: sparse pioneer formations of fine grasses rich in spring-blooming therophytes characteristic of oligotrophic soils (nitrogen poor sand or very superficial soils, or on xeroline to xeroophile rocks) of the *Thero-Airion* and *Nardo-Galion saxatile* and *Tuberarian guttatae* associations. Characteristic plant species are: *Aira* spp., *Anacamptis pyramidalis*, *Bromus hordeaceus*, *Carex arenaria*, *Cerastium* spp., *Corynephorus canescens*, *Erodium glutinosum*, *Erodium lebelii*, *Galium verum*, *Gentiana campestris*, *Gentiana cruciata*, *Koeleria* spp., *Milium scabrum*, *Myosotis ramosissima*, *Ononis repens*, *Phleum arenarium*, *Polygala vulgaris* var. *duensis*, *Silene conica*, *Silene otites*, *Trifolium scabrum*, *Tuberaria guttata*, *Viola curtisii*, *Viola rupestris* var. *arenaria*. Typical moss species is *Tortula ruraliformis*; and the lichen *Cladonia* spp.

Humid dune slacks (2190)

Humid depressions within the dunal system. Humid dune-slacks are extremely rich and specialised habitats very threatened by the lowering of water tables. Subtypes are:

(i) Dune-slick pools with *Charetum tomentosae*, *Elodeetum canadense*, *Hippuridetum vulgaris*, *Hottonietum palustris*, and *Potametum pectinati*.

(ii) Freshwater aquatic communities of permanent dune-slick water bodies.

(iii) Dune-slick pioneer swards of the *Juncenion bufonii*, *Gentiano-Erythraeetum littoralis* and *Hydrocotylo-Baldellion* associations: pioneer formations of humid sands and dune pool fringes, on soils with low salinity.

(iv) Dune-slick fens: calcareous and, occasionally, acidic fen formations, often invaded by creeping willow, occupying the wettest parts of dune-slacks.

(v) Dune-slick grasslands: humid grasslands and rushbeds of dune-slacks, also often with creeping willows (*Salix rosmarinifolia* and *Salix arenaria*).
“wind turbine” OR dam OR “economic valuation” OR “protected area finance” OR “Natura 2000” OR Natura2000 OR “protected area” OR reserve)

Search Results

A total of 56 references were retrieved for closer examination. The search was restricted to the last 12 years (2000-2012), the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. We added peer-reviewed case-studies with English abstracts as far as listed in Web of Science. To capture further world-wide leading references, a full search was conducted without year of publication and country restrictions (total 265 references); 14 relevant papers pre-2000 were selected from this list, which have 20 or more citations. Combined references were further reduced to 55 references (as below) through the evaluation of the paper titles and abstracts. Subject areas that were covered can be seen in figure 5.
Figure 5: Subject area summary for the dune habitat literature search.
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**DRY GRASSLAND HABITATS**

**Core Information Sources**

BNF - Bundesamt für Naturschutz. Natura 2000 Habitats in Germany. URL: [http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html](http://www.bfn.de/0316_typ_lebensraum+M52087573ab0.html) [Accessed 2 April, 2012]


**Species-rich Nardus grasslands, on silicious substrates in mountain areas (6230)**

Closed, dry or mesophile, perennial *Nardus* grasslands occupying siliceous soils in Atlantic or sub-Atlantic or boreal lowland, hill and montane regions of middle and northern Europe and western Iberia. Vegetation highly varied, but the variation is characterised by continuity. Associations are of the *Violo-Nardion* (*Nardo-Galax saxatilis* and *Violion caninae*) and the *Nardion*. Species-rich sites should be interpreted as sites which are remarkable for a high
number of species. In general, the habitats which have become irreversibly degraded through overgrazing should be excluded. Plant species include: Antennaria dioica, Arnica montana, Campanula barbata, Carex ericetorum, Carex pallescens, Carex panicea, Festuca ovina, Galiunum saxatile, Gentiana pneumonanthe, Hypericum maculatum, Hypochoeris maculata, Lathyrus pratensis, Leontodon helveticus, Leucorchis albida, Meum athamanticum, Nardus stricta, Pedicularis sylvatica, Platanthera bifolia, Polygala vulgaris, Potentilla aurea, Potentilla erecta, Veronica officinalis, Viola canina. Invertebrates include: Miramella alpina.


Lowland hay meadows with Alopecurus pratensis and Sanguisorba officinalis (6510)

Species-rich hay meadows on little to moderately fertilised soils of the plain to submontane levels, belonging to the Arrhenatherion and the Brachypodio-Centaureion nemoralis alliances. These extensive grasslands are rich in flowers and are not reaped before flowering of the grasses and then only one or two times per year. Characteristic plant species are: Arrhenatherum elatius, Trisetum flavescens ssp. flavescens, Pimpinella major, Centaurea jacea, Crepis biennis, Knautia arvensis, Tragopogon pratensis, Daucus carota, Leucanthemum vulgare, Alopecurus pratensis, Sanguisorba officinalis, Campanula patula, Leontodon hispidus, Leontodon nudicaulis, Linum bienne, Oenanthe pimpinelloides, Rhinanthus lanceolatus, Malva moschata and Serapias cordigera.


Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (6210)

Dry to semi-dry calcareous grasslands of the Festuco-Brometea. This habitat is formed on the one hand by steppic or subcontinental grasslands (Festucetalia valesiaca) and, on the other, by the grasslands of more oceanic and sub-Mediterranean regions (Brometalia erecti); in the latter case, a distinction is made between primary Xerobromion grasslands and secondary (semi-natural) Mesobromion grasslands with Bromus erectus; the latter are characterised by their rich orchid flora. Abandonment results in thermophile brushwood with an intermediate stage of thermophile fringe vegetation (Trifolio-Geranietea). Only considered as a priority habitat on "important orchid sites", by which one should understand the sites that are important on the basis of one or more of the following three criteria:

i. the site hosts a rich suite of orchid species;
ii. the site hosts an important population of at least one orchid species considered not very common on the national territory;
iii. the site hosts one or several orchid species considered to be rare, very rare or exceptional on the national territory.

Characteristic plant species are of the Mesobromion: Anthyllis vulneraria, Arabis hirsuta, Brachypodium pinnatum, Bromus inermis, Campanula glomerata, Carex caryophyllea, Carlina vulgaris, Centaurea scabiosa, Dianthus carthusianorum, Eryngium campestre, Koeleria pyramidata, Leontodon hispidus, Medicago sativa ssp. falcata, Ophrys apifera, Ophrys insectifera, Orchis mascula, Orchis militaris, Orchis morio, Orchis purpurea, Orchis ustulata, Orchis mascula, Polygala comosa, Primula veris, Sanguisorba minor, Scabiosa
columbaria, Veronica prostrata, Veronica teucrium. Characteristic plant species are of the Xerobromion: Bromus erectus, Fumana procumbens, Globularia elongata, Hippocrepis comosa. Characteristic plant species are of the Festucetalia valesiaca: Adonis vernalis, Euphorbia seguierana, Festuca valesiaca, Silene otites, Stipa capillata, Stipa joannis. Invertebrate include: Papilio machaon and Iphiclides podalirius (Lepidoptera); Libelloides spp. and Mantis religiosa (Neuroptera).


**Molinia** meadows on calcareous, peaty or clayey-silt-laden soils (**Molinion caeruleae**) (6410)

*Molinia* meadows of plain to montane levels, on more or less wet nutrient poor soils (nitrogen, phosphorus). They stem from extensive management, sometimes with a mowing late in the year or, they correspond to a deteriorated stage of draining peat bogs. Subtypes are:

(i) **Eu-molinion** on neutro-alkaline to calcareous soils with a fluctuating water table, relatively rich in species. The soil is sometimes peaty with a summer drying. Typical plant species are: Molinia coerulea, Dianthus superbus, Selinum carvifolia, Cirsium tuberosum, Colchicum autumnale, Inula salicina, Silaum silaus, Sanguisorba officinalis, Serratula tinctoria and Tetragonolobus maritimus.

(ii) **Junco-Molinion** (*Juncion acutiflori*) on more acid soils except species-poor meadows or on degraded peaty soils. Characteristic plant species are: Viola persiciflora, Viola palustris, Galium uliginosum, Cirsium dissectum, Crepis paludosa, Luzula multiflora, Juncus conglomeratus, Ophioglossum vulgatum, Inula britannica, Lotus uliginosus, Dianthus deltoides, Potentilla erecta, Potentilla anglica, Carex pallescens.


**Search Terms**

grassland” OR “subcontinental meadow steppe” OR “Central alpine arid grassland” OR “Perennial calcareous grassland and basic steppe” OR “Lowland hay meadow” OR “Arrhenatherion” OR “Brachypodio-Centaureion nemoralis” OR “hay meadow” OR “Boreal and sub-boreal meadow” OR “Boreal meadow” OR “Molinion caeruleae” OR “Molinia meadow” OR “Eu-molinion” OR “Junco-Molinion” OR “Molina caerulea” OR “Moist or wet oligotrophic grassland” OR “moorgrass meadow”) AND (ecology OR management OR conservation OR “conservation status”) AND (threat OR pressure OR deterioration OR unfavourable OR loss OR degrad* OR management) AND (“Biological Resource Use”*, OR Biogeography OR Botany OR “Climate Change” OR “Commercial Forestry” OR “Conservation Economics” OR “Conservation Management” OR “Conservation Status” OR “Ecological Measurement” OR “Ecological Processes” OR “Ecology” OR “Ecosystem Modification” OR “Ecosystem Services” OR “Energy Production” OR Mining OR Erosion OR Eutrophication OR “Exchange of Expertise” OR “Gaps in Knowledge” OR Grazing OR “Habitat Fragmentation” OR “Habitat Management” OR “Habitat Restoration” OR “Human Disturbance” OR “Hydrological Management” OR “Invasive Species” OR “Alien Species” OR “Land Abandonment” OR “Land Conversion” OR “Land Use Intensification” OR “Land Management” OR “Limnology” OR “N2K Ecological Coherence” OR “N2K Site Management” OR “N2K Site Protection” OR “Natural Change” OR “Nutrient Impoverishment” OR “Outside N2K Sites”, OR “Overgrazing” OR “Pollution” OR “Protected Area Financing” OR “Public Engagement” OR Stakeholder OR Training OR Experience OR Undergrazing OR “Valuation of N2K Services” OR “resource management” OR exploitation OR “commercial development” OR “industrial development” OR “infrastructure development” OR “spatial planning” OR fire OR burning OR drainage OR quarry OR “natural change” OR “anthropogenic change” OR “energy production” OR biofuels OR bioenergy OR “wind farm” OR “wind turbine” OR dam OR “economic valuation” OR “protected area finance” OR “Natura 2000” OR Natura2000 OR “protected area” OR reserve)

**Search Results**

A total of 385 references were retrieved for closer examination. The search was restricted to the last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. We added peer-reviewed case-studies with English abstracts as far as listed in Web of Science. To capture further world-wide leading references, a full search was conducted without year of publication and country restrictions (total 1,001 references); 24 relevant papers pre-2000 were selected from this list, which have 50 or more citations. References were further reduced to 207 references (as below) through the evaluation of the paper titles and abstracts. Subject areas that were covered can be seen in figure 6.
Figure 6: Subject area summary for the dry grassland habitat literature search.
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WET GRASSLAND HABITATS

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Siliceous Pyrenean Festuca eskia grasslands (6140)

Subalpine and lower alpine closed mesophile (Festuca eskia) grasslands of north-facing slopes (ubacs) and depressions in the Pyrenees with characteristic species: Arnica montana, Ranunculus pyreanaeus, Selinum pyreanaeum, Trifolium alpinum, Campanula barbata, Gentiana punctata, Leucorchis albida, and Phyteuma betonicifolium.

Alkaline fens (7230) - This was also grouped in the bog habitat literature search.

Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the Caricion davallianae association, characterised by a usually prominent "brown moss" carpet formed by the species *Campylium stellatum*, *Drepanocladus intermedium*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adiantoides* and *Bryum pseudotriquetrum* among characteristic species are grass-like growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich herbaceous flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *D. traunsteineroides*, *D. russowii*, *D. majalis* ssp. *brevifolia*, *D. cruenta*, *Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis szeptrum-carolinum*, *Primula farinose* and *Swertia perennis*.

Wet grasslands of the Molinietalia caerulea with subtypes Juncetum subnodulosi & Cirsietum rivularis), tall sedge beds of the Magnocaricion, and reed formations (Phragmition), and fen sedge beds (*Cladietum mariscae*), may form part of the fen system, with furthermore communities related to transition mires and amphibious or aquatic vegetation or spring communities developing in depressions. The sub-units, which can, alone or in combination describe the composition of the fen, are understood to include the mire communities sensu stricto (Caricion davallianae), their transition to the Molinion, and assemblages that, although they may be phytosociologically referable to alkaline Molinion associations, contain a large representation of the Caricion davallianae species listed, in addition to being integrated in the fen system; this somewhat parallels the definition of an integrated class Molinio-Caricetalia davallianae in Rameau et al., 1989. Outside of rich fen systems, fen communities can occur as small areas in dune slack systems, in transition mires, in wet grasslands, on tufa cones and in a few other situations. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most containing the species: *Schoenus nigricans*, *S. ferrugineus*, *Carex spp.*, *Eriophorum latifolium*, *Cinclidium stygium*, and *Tomentypnum nitens*.


Search Terms

("wet grass"* OR "acid grassland" OR "Siliceous Pyrenean Festuca eskia grasslands" OR "Acid alpine and subalpine grassland" OR "Pyrenean closed grassland" OR "Festuca eskia" OR Siliceous "Pyrenean Festuca eskia grassland" OR "raised bog" OR "mire" OR "calcareous fen" OR "alkaline fen" OR "peat" OR "tufa" OR "base-rich fen" OR "Caricion davallianae" OR "sedge fen" OR "sedge mire" OR "reed formation" OR "transition mire" OR Molinion OR "Molinio-Caricetalia davallianae" OR Flush OR "Calcareous dunal sedge fen" OR "Pyrenean fen" OR "calcareous flush" OR "calcareous soak" OR "Small herb alkaline fen" OR "Subcontinental fen" OR "Carex davalliana" OR "Mediterranean and Central Eurasian small seed fen" OR "Mediterraneo-Turanian small seed fen" OR "Alpine deer-sedge alkaline fen" OR Black bogrush fen" OR Black sedge alkaline fen" OR "Bottle sedge alkaline fen" OR British saxifrage-sedge flush" OR "Brown bogrush fen" OR "Calcareous dunal rush-sedge fen" OR...
“Deergrass alkaline fen” OR “Dioecious-flea-yellow sedge fen” OR “Ice sedge fen” OR “Mediterranean-Turanian flat sedge fen” OR “Middle European flat sedge fen” OR “Pyrenean Davall sedge fen” OR “Russet sedge fen” OR “Small herb alkaline fen” OR “Spike-rush fen” OR “Subcontinental Davall sedge fen” OR “Black bog-rush fen” OR “Black sedge alkaline fen” OR “Bohemio-Pannonic Davall sedge fen” OR “Boreal black sedge” OR “alkaline fen” OR “Bottle sedge alkaline fen” OR “British black bog-rush fen” OR “British dioecious-yellow sedge fen” OR “British saxifrage-sedge flushes” OR “Brown bog-rush fen” OR “Calcarnous duval rush-sedge fen” OR “Cantabrian yellow sedge fen” OR “Central European black bog-rush fen” OR “Davall sedge fen” OR “Deergrass alkaline fen” OR “Deergrass Davall sedge fen” OR “Dioecious-flea-yellow sedge fen” OR “Eastern Iberian rich fen” OR “Flea sedge fen” OR “Ice sedge fen” OR “Mediterranean-Turanian flat sedge fen” OR “Middle European black sedge alkaline fen” OR “Middle European flat sedge fen” OR “Middle European yellow sedge fen” OR “Northen brown bog-rush fen” OR “Northern Davall sedge fen” OR “Pannonic black bog-rush fen” OR “Peri-Alpine brown bog-rush fen” OR “Peri-Alpine Davall sedge fen” OR “Pyrenean rich fen” OR “Russet sedge fen” OR “Scandinavian brown moss sedge fen” OR “Scandinavian dioecious-yellow sedge fen” OR “Scandinavian russet sedge fen” OR “Scandinavian Sphagnum warnstorffii sedge fen” OR “cottish brown bog-rush fen” OR “Scottish russet sedge fen” OR “Small herb alkaline fen” OR “Spike-rush fen” OR “Tall herb fen” OR “Western continental black bog-rush fen”) AND (ecology OR management OR conservation OR “conservation status”) AND (threat OR pressure OR decline OR deterioration OR unfavourable OR loss OR degrad* OR management) AND (“Biological Resource Use”*, (Biogeography OR Botany OR “Climate Change” OR “Commercial Forestry” OR “Conservation Economics” OR “Conservation Management” OR “Conservation Status” OR “Ecological Measurement” OR “Ecological Processes” OR “Ecology” OR “Ecosystem Modification” OR “Ecosystem Services” OR “Energy Production” OR Mining OR Erosion OR Eutrophication OR “Exchange of Expertise” OR “Gaps in Knowledge” OR Grazing OR “Habitat Fragmentation” OR “Habitat Management” OR “Habitat Restoration” OR “Human Disturbance” OR “Hydrological Management” OR “Invasive Species” OR “Alien Species” OR “Land Abandonment” OR “Land Conversion” OR “Land Use Intensification” OR “Land Management” OR “Limnology” OR “N2K Ecological Coherence” OR “N2K Site Management” OR “N2K Site Protection” OR “Natural Change” OR “Nutrient Impoverishment” OR “Outside N2K Sites”, OR “Overgrazing” OR “Pollution” OR “Protected Area Financing” OR “Public Engagement” OR Stakeholder OR Training OR Experience OR Undergrazing OR “Valuation of N2K Services” OR “resource management” OR exploitation OR “commercial development” OR “industrial development” OR “infrastructure development” OR “spatial planning” OR fire OR burning OR drainage OR quarry OR “natural change” OR “anthropogenic change” OR “energy production” OR biofuels OR bioenergy OR “wind farm” OR “wind turbine” OR dam OR “economic valuation” OR “protected area finance” OR “Natura 2000” OR Natura2000 OR “protected area” OR reserve)

Search Results

A total of 503 references were retrieved for closer examination. The search was restricted to the last 12 years, the countries of the Atlantic Biogeographic Region, English language publications and relevant subject categories, i.e. conservation biology not medicine. We added peer-reviewed case-studies with English abstracts as far as listed in Web of Science. To capture further world-wide leading references, a full search was conducted without year of publication and country restrictions (total 9,065 references); 35 relevant papers pre-2000 were selected from this list, which have 50 or more citations. References were further reduced to 78 references (as below) through the evaluation of the paper titles and abstracts. Subject areas that were covered can be seen in figure 7.
Figure 7: Subject area summary for the wet grassland habitat literature search.
Bibliography


Krumbiegel, A. (2008) Socialization of Gentianella campestris ssp baltica at the east bank of the Muritz Lake (Mecklenburg-Western Pomerania) and near Ballenstedt at the north rim of the Harz Mountains (Saxony-Anhalt). Hercynia, 41(2) 2008, pp.219-238.


