



# Natura 2000 Seminars

## Atlantic Biogeographic Region

# Atlantic Natura 2000 Background Document (Draft)



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**Expert contributions highlighted**



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## Reader's guide

This background document ...

- is part of the New Biogeographic Process as organized by the European Commission, DG Environment in support of the management of the Natura 2000 network across the EU;
- covers the Atlantic biogeographic region and the EU member states that belong to that region (Belgium, France, Germany, Ireland, the Netherlands, Portugal, Spain, the United Kingdom);
- is meant for the Steering Committee of the Atlantic cycle, under lead of the Netherlands, to provide generic comments during the meeting of 27 April 2012;
- will inform the Atlantic preparatory workshop on 20 -22 June 2012;
- forms the basis, together with comments received from the preparatory workshop, for a Seminar Document to be produced prior to the Atlantic Seminar in November 2012. The seminar should draw conclusions and make recommendations regarding management and actions in relation to selected habitat types, possibly leading to a jointly agreed list of actions on the part of MS;
- presents:
  - a general introduction of the New Biogeographic Process (chapter 1)
  - a description of the drafting process of this background document (chapter 2),
  - an overview information on 20 priority habitat types (as selected by the MS during the Second Atlantic Steering Committee Meeting on 2 March 2012) (chapter 3),
  - a description of selected cases studies that illustrate the management issues that are covered in the habitat descriptions (Annex 1, separate document), and
  - a peer-reviewed literature bibliography for further details and reference (Annex 2, separate document).

## Introduction: the New Biogeographic Process (with specific reference to the Atlantic biogeographic region)

The purpose of the New Biogeographical Process is to help Member States to manage Natura 2000 as a coherent ecological network, whilst exchanging experience and best practice, addressing objectives and priorities and enhancing cooperation and synergies. The process should make a significant contribution to the achievement of Favourable Conservation Status-FCS for those habitats and species of community interest (listed in Annex 1, 2 and 4 of the Habitats Directive) that have been identified as having priority within the given biogeographic region, with a special focus on the contribution of the Natura 2000 network, but without ignoring horizontal measures where necessary. In the context of the viability of the Natura 2000 network it is also important to know how to ensure that habitats also achieve a level of favourable conservation status outside Natura 2000 site boundaries, and also how to address the major threats that occur there.

It is important to emphasise that the New Biogeographic Process: the “Natura 2000 Seminars” is not another reporting cycle. Article 17 reporting captures progress on the current status of Natura 2000; the Natura 2000 Seminars are designed to capture expert and policy-maker’s knowledge in relation to issues, solutions and actions that can deliver improved conservation status on Natura 2000 sites. In this respect, as well as written knowledge, through facilitated workshops and consultation on the background document content the process aims to capture the tacit knowledge that is represented by the experience of the experts, policy makers and practitioners. From this perspective the process is a unique opportunity to gather information within and between countries and to allow the establishment of dialogue between individuals and organisations.

The Atlantic Cycle is led by The Netherlands. The Steering Committee of the Atlantic cycle is composed of representatives of the nine Member States (NL, DE, DK, FR, UK, BE, IE, PT, ES) and the EEA, ETC/BD, and EC. Whilst the Netherlands is taking the lead for the Atlantic biogeographic cycle, the other MS should take an active role in the coordination of habitat working groups that work on one of the priority habitats selected for the biogeographic region. The role of the stakeholders in the process is of great importance. Member States should play an active role in the process and the lead countries approach is important.

Based on the scoping document and the discussions of the Steering Committee, four habitat groups were selected: coastal and dunes (including Estuaries); heaths and bogs; wet and dry grasslands; and lakes and rivers. Lead countries for each group, including the habitat codes included in each group are as follows:

Habitat groups	Habitats	Lead countries
Coastal (incl. dunes)	1130, 1310 2190, 2130, 2120	Belgium and Germany
Grasslands	6230, 6510, 6210, 6410, 1330	France
Heaths and bogs	4010, 4030 7110, 7140, 7230	United Kingdom and Ireland
Lakes and rivers	3110, 3150, 91E0, 3260, 3130	The Netherlands

Each biogeographic cycle consists of three milestone meetings:

- 1) **Steering Committee (meetings):** The Steering Committee has an essential role and each cycle of the process starts with a meeting of the Steering Committee. It is composed of representatives of the Member States that fall in the biogeographic region and in addition the following organisations are also represented: European Commission (EC), European Environment Agency (EEA), European Topic Centre on Biological Diversity (ETC/BD). Observers from other MS are also allowed to attend upon invitation. The Steering Committee reviews the pre-scoping document, and makes the final decision about the priority habitats and species, and the habitat groups.
  
- 2) **Preparatory Workshops:** The workshops are used to prepare the seminar. The workshop is a very informal working meeting that provides the basic material and preparation for the Seminar. It is informed by the Background Document but does not consider the content or technical detail of the latter; rather it provides a set of themes (crosscutting or unique to the individual habitat groups) whose elaboration in terms of solutions and actions will form the basis of the seminar document. The role of the contractor regarding the preparatory workshops is to work with the European Commission and to assist MS in preparation, minutes, proceedings, organising, leading discussions, and to decide with MS on themes.
  
- 3) **Seminars:** The Seminars will be based on the Seminar Document whose contents will be derived from the preparatory workshop. Central to this document are a list of habitat group related and crosscutting issues and problems whose solutions will directly contribute to achieving Favourable Conservation Status (FCS). The seminar should draw conclusions and make recommendations regarding management and actions in relation to selected habitat types (based on the habitat-specific and crosscutting issues). It is hoped that the conclusion of the seminar should result in a jointly agreed list of actions on the part of MS. As the seminar returns only once every five years, what happens in between is very important.
  - Ad Hoc Expert Group Meetings can be held between the workshop and the seminar in order to address specific issues (which may be raised during the workshop or may become clear after the workshop).
  - A first draft pre-scoping document with complete lists of priority habitats and species is drafted by the European Topic Centre on Biodiversity (ETC/BD). The pre-scoping document explains the selection of habitats and is posted on CIRCA.
  - For each biogeographic region the pre-scoping document (which can include well over 100 habitats) provides the basis for selection of a smaller and more manageable number of habitats and species: focusing on those habitat types where action is most needed. This first list is discussed and agreed with the Member States inside the biogeographic region during a Steering Committee meeting. The habitat groups and the habitats in the table above represent the 20 habitats agreed for inclusion by the Atlantic Steering Committee.
  - The second draft of the pre-scoping document is then produced, focussing in the Atlantic on the 20 selected habitats. This provides a description of each habitat together with a summary of the relevant Article 17 data (conservation status, pressures and threats, etc.). Annex 2 and 4 species linked to the habitat are also included, also with details of their status, etc.
  - The second draft of the pre-scoping document provides the basis for the Background Document. In preparing both documents there is no added burden to the Member States as the information is gathered from pre-existing sources. As well as selected references there

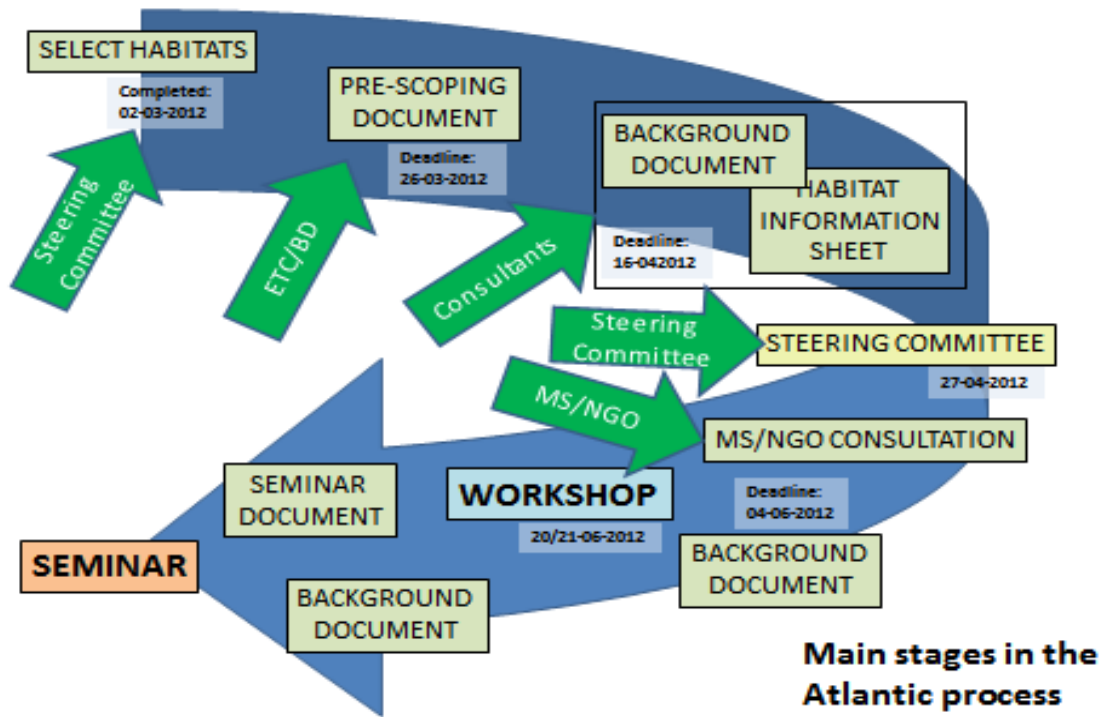
are lists of case studies provided as annexes to the document. The Background Document has a life beyond the seminar; it should therefore be continuously improved, modified and added to as each five-year cycle continues.

- The Seminar brings together key actors (including ministry and state Institute officials, NGOs and stakeholders) from different countries for the exchange of practice and should result in the creation of expert networks about similar habitats inside a biogeographic region. The Biogeographic Process is to be used to assess management practices and best practices and result in the formulation of recommendations based on the process.
- Internal Communication within the process for each biogeographic region is particularly important; thus:
  - CIRCABC is currently the main internal communication platform for the process;
  - In order to make the relevant documents easily accessible, special interest groups for each Biogeographic Region (BGR) are created on CIRCABC;
  - An Interest Group for the Atlantic Steering Committee has already been created and is composed of representatives of the European Commission (EC), the European Environmental Agency (EEA), the European Topic Centre on Biodiversity (ETC/BD) and member states (MS);
  - It is planned that at the level of the Biogeographic Interest Groups there will be no active involvement of NGOs (at least in relation to the Boreal process);
  - For the moment CIRCABC is to be used to store meeting agenda's, minutes, documents.

An internet based communication platform will be developed as part of the project for external and internal communication. The wider target audience for the internet platform should include the interested public; but also expert networks.

The objectives of the Atlantic Workshop, which will be held in The Hague, the Netherlands and hosted by the Dutch Ministry of ELI, will be to discuss the key conservation issues for each group of selected habitat types in the Atlantic biogeographic region and to prepare the ground for adopting conclusions and recommendations at the Pilot Natura 2000 Seminar for the Atlantic biogeographic region to be held in the Netherlands in November 2012. The process is given focus by the context provided by the EU Biodiversity Strategy to 2020 and the target to halt the deterioration in the status of all species and habitats covered by EU nature legislation and to achieve a significant and measurable improvement in their status by 2020.

The following diagram summarises the Atlantic biogeographic process and the points of input by different actors.



## 2. The drafting process of the background document

### Habitat descriptions

The Atlantic Natura 2000 Seminar Background Document compiles the readily available information regarding 20 selected habitat types, as selected by the member States for the Atlantic Seminar Process. Unlike the Boreal Seminar process, the information for the drafting of the Atlantic Background document has not proceeded by a prior consultation of the Member States and their experts. Instead it was decided at the Second Steering Committee Meeting that the consultant should integrate readily available information on the selected habitats, including reports submitted by the Member States in the framework of the last Article 17 reporting round. The structure of the chapters describing individual habitat types follows a slightly adapted structure of the Technical reports on the management of Natura 2000 habitats (EC 2008).

The consulted sources for this first draft of the Background Document include the following:

1. Pre-scoping Document for the Natura 2000 Seminar at the Atlantic region, prepared by the European Topic Centre on Biological Diversity and the EEA<sup>1</sup>
2. Technical reports on the management of Natura 2000 habitats (2008) (EC 2008)
3. The Interpretation Manual of European Habitats (EC 2007b)
4. A series of national documents on habitat ecology and management (see references)

The Pre-scoping document for the Atlantic Seminar prepared by the ETC/BD (EEA, 2012) provides the majority of figures, maps and tables in this document unless otherwise stated. The figures in maps and tables provided by the ETC BD in this Background Document and the Pre-scoping Document include all SCIs where the habitat type is mentioned including sites coded as D (habitat present but not qualifying).

For seven out of the 20 selected habitat types, the European Commission provides specific guidance which is available on the internet. These Technical reports on the management of Natura 2000 habitats (2008) were prepared in the framework of a service contract (7030302/2006/453813/MAR/B2 "Natura 2000 preparatory actions: Management Models for Natura 2000 Sites") and realized by the N2K Group eeg (EC 2008).

The habitats for which such a Technical report on the management of Natura 2000 habitats is available are:

- 1330 Atlantic Salt Meadows
- 2130 Fixed coastal dunes with herbaceous vegetation ("grey dunes")
- 2190 Humid dune slacks
- 4010 Northern Atlantic wet heaths with *Erica tetralix*
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (\* important orchid sites)

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<sup>1</sup> Available online at [http://circa.europa.eu/Public/jrc/env/natura\\_2000/library?l=/biogeographic\\_atlantic&vm=detailed&sb=Title](http://circa.europa.eu/Public/jrc/env/natura_2000/library?l=/biogeographic_atlantic&vm=detailed&sb=Title)



- 6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)
- 7230 Alkaline fens

In the following chapters, the information for these seven habitat types will tend to be more complete than that for other habitat types.

## Selected case studies

A selection of case studies has been captured from the LIFE Project database to provide practical, site-based information relating to the management of Natura 2000 sites in the Atlantic Region. Approximately 200 potentially suitable case studies were initially captured from which a sub-set has been selected for inclusion in the Annex 1 to this document (seperate file). The selection is intended to provide a biogeographically representative sample that maximises the number of target habitats and the range of threats and pressures acting upon those habitats within the Atlantic Region.

## Peer-reviewed literature bibliography

A systematic review of English language, peer-reviewed literature has been undertaken to provide a rigorous overview of the current state of knowledge relating to the habitats that have been chosen as the focus for the Atlantic process. More specifically the review provides background information on the ecology of these habitats as well as the threats and pressures that have been identified through independent research as opposed the Article 17 reporting. The bibliography should be interpreted a quantitative result of a structured, repeatable literature review rather than as a list to which further references should be appended. This is why the precise search terms, as well as a quantification of the results, have been included in the annex. This was not only done for the sake of transparency but also to enable replication of the same review in the different languages of the Atlantic region if Member States wish to generate comparative data.

### 3. Description of the selected Habitat types

#### Introduction

This chapter provides overview information for each of the 20 priority habitat types that have been selected by the member states for the Atlantic biogeographic region during the Second Atlantic Steering Committee Meeting on 2 March 2012. The background, the structure of the descriptions and the sources used are described in the previous chapter.

The habitat types are presented in ascending order of their Natura 2000 code as introduced in Annex I of the EC Habitats Directive.

The priority habitat types included in this report are:

- 1130 Estuaries
- 1310 *Salicornia* and other annuals colonizing mud and sand
- 1330 Atlantic Salt Meadows (*Glauco-Puccinellietalia maritimae*)
- 2120 Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")
- 2130 Fixed coastal dunes with herbaceous vegetation ("grey dunes")
- 2190 Humid dune slacks
- 3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
- 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
- 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation
- 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- 4010 Northern Atlantic wet heaths with *Erica tetralix*
- 4030 European dry heaths
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (\* important orchid sites)
- 6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)
- 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- 6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)
- 7110 Active raised bogs
- 7140 Transition mires and quaking bogs
- 7230 Alkaline fens
- 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

## Legends for the maps, figures and tables




Factual information for each habitat type is given in the form of standard tables, figures and maps presented in the Pre-scoping document (ETC BD 2012). Reading and interpreting the maps, figures and tables provided by the EEA / ETC/BD requires a legend for their clear understanding. The respective legends and explanations are presented here, with cross-references to the sections within each habitat type.

### Maps



For each habitat type, a map is presented as part of paragraph 1.2 Distribution. The following legend applies to all these maps throughout the document.

Legend

#### SCIs proposed for the habitat type

-  SCI
-  % SCI - centroid (for sites with reported area < 10 000 ha)
-  generalised Article 17 distribution

#### Biogeographical region

-  Atlantic
-  countries with the Atlantic biogeographical region

The maps cover all SCIs where the habitat type is mentioned including sites coded as D.

### Conservation status

For each habitat type, tables represent the conservation status of species and habitats in section 1.5 and 1.8 respectively.

code	status
FV	Favourable
U1	Unfavourable – inadequate
U2	Unfavourable – bad
XX	Unknown

## Tables

### Threats and pressures statistics

Pressures and threats are presented in section 1.10 of each description. Pressures/threats are driven by the habitat type and the species sharing the same pressures/threats are noted in the table as well. This means that a species may have other pressures/threats as well, which do not appear in the table. Only those pressures/threats for habitat types are taken into account when they are reported by more than 1/3 of MS where the habitat type/species is present. If a pressure/threat is reported by more than 2/3 of MS this is indicated in light blue colour. If a pressure/threat is reported by all MS where the habitat type or species occurs, it is indicated with darker blue colour.

### Habitat types and their associated species proposed by the ETC/BD

For each habitat type, a table in section 1.5 presents the species that have been identified as particularly associated to the habitat type. It shows linkage at European level according to data by the ETC/BD. Where available additional information on country level has been included.

<b>Explanation:</b>
Annex II & IV species in 7-9 MS
Annex II & IV species in 3-6 MS
Annex I birds & migratory birds in 7-9 MS
Annex I birds & migratory birds in 3-6 MS
Species occurring in 1-2 MS excluded

## 1130 - Estuaries

### Summary

**Estuaries are** partly enclosed, coastal water bodies that connect inland water bodies to the sea. They mark a transition, not only between rivers and the ocean but also between the terrestrial and aquatic environments. The influence of the terrestrial environment is not just restricted to the immediate area but typically extends along the catchments of the rivers that feed these highly complex, dynamic systems.

**Estuaries are characterised by** steep environmental gradients that determine the distribution of animal and plant communities. Vertical gradients from the sea to dry land lead to substantial differences in temperature and desiccation. Horizontal gradients of wave exposure, running from sheltered bays to exposed headlands, lead to substantial differences in mechanical stress and the erosion rates of substrate that determine which species can survive. Particle size gradients, created by wave action and river sediment load, create wide variation in the suitability of substrates for colonization by different species. Vertical and horizontal salinity gradients occur within the estuary itself as well as across the whole littoral zone which has had a profound evolutionary impact on species physiology within these zones.

These gradients interact with one another to create zones suitable for the development of a diverse mosaic of distinct habitats, such as intertidal mudflats and sandflats, saltmarshes and reefs. The biodiversity that this highly productive ecosystem can support, in combination with the significant threats posed by human activities, has led to their inclusion as habitats in their own right in Annex I of the Directive. However, one cannot exist without the other. Unless the natural processes that create a full range of environmental gradients are maintained within a whole-estuary context then the conservation of these constituent habitats is not possible.

**Estuaries are not** defined by the presence of particular species, nor are they structurally dependent upon particular species. However, they play an important role in key life cycle stages of many species listed in the annexes of the Birds and Habitats Directives which makes them critical to their continued survival.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable -bad' due to structural and functional issues as well as poor future prospects. Range and area, however, have been assessed as favourable in spite of losses to port developments in some countries.

**The main reported threats and pressures** to estuaries in the Atlantic Region are:

- changes in morphology, coastal development and coastal squeeze arising from the construction and operation of port and industrial installations (e.g. power stations) and the impacts of associated shipping (e.g. erosion) dike building, bank revetments;
- upstream modifications and impacts;

- declining water quality due to suspended matter, nutrient load and pollutants;
- climate change and subsidence;
- seafloor disturbance as a result of fisheries, dredging and other activities;
- fisheries including bait collecting and aquaculture;
- over-exploitation of species;
- invasive alien species;
- disturbance arising from tourism and recreation; and
- predation of coastal breeding birds.

**Management measures** to address these threats and pressures are not straight-forward as they involve a diverse range of actors; broadly management should focus on prevention and/or reduction of: threatening activities and developments on the site themselves (such as destruction of natural habitats, overfishing and disturbance; and negative effects from outside (such as the inflow of pollutants and release of invasive alien species). In addition to these management principles there should be adequate control of process; for example, Appropriate Assessment/Environmental Impact Assessments should be required before any engineering activities are carried out in order to avoid any significant impacts to the key biodiversity features of any estuary (and the latter should also include measures for habitat compensation such as the establishment of functioning fisheries and structures with barrier effect and the creation or improvement of aquatic structures in the floodplain, etc). Ideally management plans for estuaries should be established in order to manage the complexity of interaction between human interests and activities, the biodiversity and the hydrological aspects. Such plans should provide an interface with: national legislation governing (for example) pollution, the management of industrial sites, water flow, ballast water; the Water Framework Directive and other related directives; and spatial planning (at municipal and regional level).

The complexity of estuary ecosystems provides one of the most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status. Specifically the following factors contrive, together, to create the main problems:

- the external origin of certain pressures (e.g. inflow of contaminants in river water);
- the favourable geographical and morphological conditions of estuaries for various forms of development (ports, industry, infrastructure, agriculture, tourism, and housing);
- and the limited space available for these developments.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- comprehensive, integrated plans and policies, ideally at the level of water catchments (but certainly for the area of the estuary) that can integrate policy and good practice and which also consider funding, communication, research and knowledge management; and
- the establishment of effective working relationships and constructive dialogue with the key sectors involved (e.g. transport, fisheries, industry, hunting, recreation, tourism, etc).

## 1 Description of the habitat

*“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.” In situations “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.”(EC 2007b).*

An estuary forms an ecological unit with the surrounding terrestrial coastal habitat types. In terms of nature conservation, these different habitat types should not be separated, and this reality must be taken into account during the selection of sites (EC 2007b).

### 1.1. Distribution<sup>2</sup>

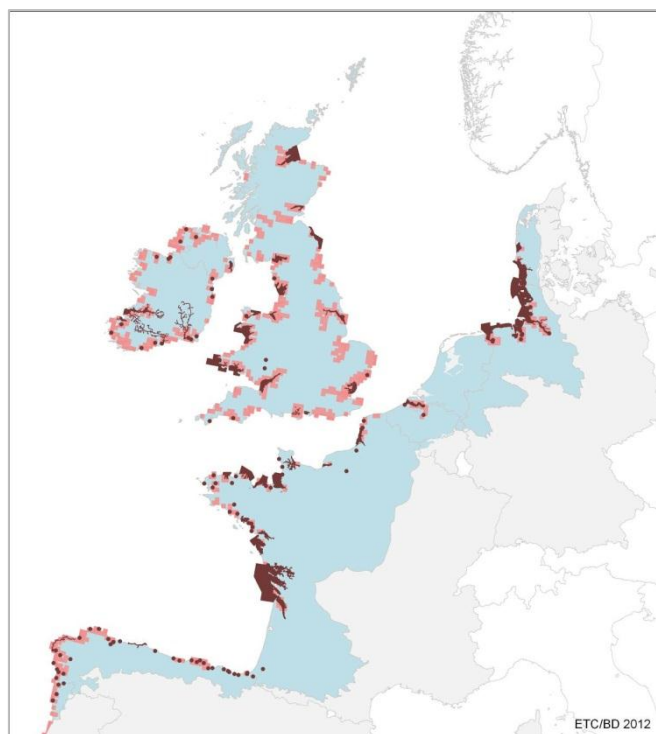
**Table 1 Number of SCIs and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL	PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	2			11	10	2	2		35		6		49		6	21	3	3		5	24
habitat area (ha)	4196			65269	67389	1624	2090		5354		2068		84287		2287	44441	50057	900		10418	254771

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>3</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>2</sup> Reference to the Baltic Sea estuaries seems unusual since it lies outside the Atlantic region [Kelly]

<sup>3</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 1 Map of SCIs proposed for the Estuaries & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

Estuaries are widespread throughout the Atlantic coasts of Europe. Approximately one-quarter of the area of estuaries in north-western Europe occurs in the UK (JNCC n.d.).

In France, this habitat can be found in all the major and smaller estuaries of the English Channel as well as on the Atlantic coast (Muséum national d'Histoire naturelle [Ed] 2003). Estuaries are present on all Spanish coasts, being more abundant in the Cantabric-Atlantic coast (Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.). Four important European rivers have their estuaries located in The Netherlands: The Scheldt, The Rhine, The Meuse and The Ems. However, major sea walls have stopped the natural estuarine development of the Meuse and Rhine. Therefore, only the Scheldt and the Ems retain their natural dynamics (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.).

In the United Kingdom estuaries are widely distributed around the coast but there are fewer to be found in Northern Ireland and Western Scotland (Jackson and McLeod 2000, updated 2002 in Joint Nature Conservation Committee n.d.). The UK has over 120 estuaries; the exact figure varies depending on the definition of an estuary, how these have been surveyed/mapped and how estuaries have been amalgamated into estuary complexes (i.e. where more than one river discharges into the same stretch of coast) (Joint Nature Conservation Committee n.d.).

In some estuaries of the Baltic, freshwater 'flow-through' bays have formed (e.g., Peene, Saaler Bodden). The major estuaries on the North Sea coast of Germany are those of the Elbe, Ems and Weser (Bundesamt für Naturschutz n.d.).



## 1.2. Main features

In Spain estuaries can contain a complex mosaic of habitats such as rocky walls and freshwater or brackish coastal lagoons. The complexity of habitat and gradient of the estuaries allows the existence of different biotic communities in a more or less interconnected state. Coastal and halophytic habitats of the Annex I of the Habitats Directive include (Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.):

- 11. Open sea and tidal areas
- 12. Sea cliffs and shingle or stony beaches
- 13. Atlantic and continental salt marshes and salt meadows
- 14. Mediterranean and thermo-Atlantic salt marshes and salt meadows

The typical vegetation sequence in Spanish estuaries moving from brackish to freshwater environments comprises (Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.):

- Zostera meadows in the subtidal zone (1110 and 1140)
- Spartina formations in the intertidal zone (1320)
- Succulent plant formations in the salty supratidal zone (1420)
- Halophilous and subhalophilous reed beds in the less salty supratidal zone (1330 and 1410)
- Giant reed and reed mace in freshwater

Insert descriptions from other countries here....

Estuaries have a very high biomass production, in particular very high primary production by phytoplankton. This habitat is essential as a stopover and feeding place for many species of migratory waders (birds). It also is the transition habitat between the marine and terrestrial life cycles of a number of fish such as salmon and eel. Finally it is also important for harbour seal. In spite of relatively low biodiversity, estuaries are habitats with a high biological stability. This is attributable to the low level of interspecific interactions and the species' high morphological variability and adaptation to harsh environments (Muséum national d'Histoire naturelle [Ed] 2003).

## 1.3. Ecological requirements

The main factors influencing the distribution and abundance of populations within estuaries are the steep environmental gradients. This habitat is also characterized by a high degree of dynamism. The most relevant parameters that determine the abiotic characteristics of estuaries in the Netherlands are (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.):

- tidal dynamics: tidal amplitude in estuaries is generally much larger than in coastal zones on the open sea;
- river dynamics: mainly determined by the inflow of fresh water;
- salinity dynamics: spatial and temporal variations in the freshwater / salt water gradient resulting from the interaction between tidal and river dynamics;
- morphological dynamics: erosion and sedimentation processes arising from local sand and silt transport, local composition of the substrate, gullies and channels etc;

- siltation dynamics: influencing turbidity as a result of tidal and river dynamics;
- nutrient dynamics: transformation, immobilisation and elimination of organic matter and nutrients.

An open contact to the sea and the river is essential to maintain these natural estuarine dynamics and this is the main environmental condition for maintaining a favourable conservation status (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.). There should be a continuous inflow of fresh water of sufficient quality with moderate nutrient load.

Insert descriptions from other countries here....

## 1.4. Main subtypes

Four main sub-types of estuaries have been defined in the United Kingdom (Jackson and McLeod, 2000, 2002 in Joint Nature Conservation Committee n.d.):

- Coastal plain estuaries: These estuaries have formed where pre-existing valleys were flooded at the end of the last glaciation. They are usually less than 30m deep, with a large width-to-depth ratio. This is the main sub-type of estuary, by area, in the UK.
- Bar-built estuaries: These characteristically have a sediment bar across their mouths and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.
- Complex estuaries: These have been formed by a variety of physical influences, which include glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this sub-type of estuary in the UK.
- Ria estuaries: Rias are drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by freshwater and typically conform to Annex I type 1160 Large shallow inlets and bays.

In France two main subtypes are recognized:

- Mudflats in tidal seas (Atlantic façade)
- Muddy sands mudflats in lagoons and estuaries (Mediterranean)

However, only the first occurs in the Atlantic region (Muséum national d'Histoire naturelle [Ed] 2003).

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species under the Habitats and Birds Directive associated with estuaries through expert judgment. They have also provided the conservation status for Annex II and IV species in the Atlantic Member States

(see tables below). When national documents or other relevant sources specifically mention a species that depends on the habitat, even if the species is not listed in the Habitats and Birds Directives Annexes, this species has been added to the list.

**Table 2 Species associated to Estuaries (for legend, see introduction of chapter 3)<sup>45</sup>**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Alosa fallax 1103	x									
Halichoerus grypus 1364	x									
Phoca vitulina 1365	x					x				
Phocoena phocoena 1351	x									
Alosa alosa 1102	x									
Anas acuta A054	x									
Acrocephalus schoenobaenus A295 (if reedbeds)	x									
Anas clypeata A056	x									
Anas crecca A052	x									
Anas penelope A050	x									
Anas platyrhynchos A053	x									
Anas strepera A051	x									
Anser anser A043	x									
Arenaria interpres A169	x									
Aythya ferina A059	x									
Aythya fuligula A061	x									
Aythya marila A062	x									
Botaurus stellaris A021 (if reedbeds)	x									
Branta leucopsis A045	x									
Calidris alba A144	x									
Calidris alpina A149	x									
Calidris canutus A143	x									
Charadrius hiaticula A137	x									
Cygnus columbianus bewickii A037	x									
Cygnus cygnus A038	x									
Gallinago gallinago A153	x									
Gavia arctica A002	x									
Gavia stellata A001	x									
Haematopus ostralegus A130	x									
Larus fuscus A183	x									
Larus melanocephalus A176	x									
Limosa lapponica A157	x									
Numenius arquata A144	x									
Numenius phaeopus A158	x									
Pandion haliaetus A094	x									
Phalacrocorax carbo A017	x									
Philomachus pugnax A151	x									
Pluvialis apricaria A140	x									

<sup>4</sup> Add: Oenanthe conioides, Luscinia svecica, Gelochelidon nilotica, Circus aeruginosus, Crex crex [Netz]

<sup>5</sup> For the NL as non-breeding bird A005, A026, A027, A034, A037, A040, A041, A043, A045, A048, A050, A051, A052, A053, A054, A056, A069, A075, A103, A130, A132, A137, A138, A140, A141, A142, A143, A144, A149, A157, A160, A161, A162, A164, A169, and as breeding birds A081, A084, A132, A137, A138, A176, A191, A193, A195, A272. [Schotman Alterra]

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Pluvialis squatarola A141	x									
Recurvirostra avosetta A132	x									
Sterna albifrons A195	x									
Sterna hirundo A193	x									
Sterna paradisaea A194	x									
Sterna sandvicensis A191	x									
Tadorna tadorna A048	x									
Tringa glareola A161	x									
Tringa nebularia A164	x									
Tringa totanus A162	x									
Vanellus vanellus A142	x									
Acrocephalus arundinaceus A298 (if reedbeds)	x									
Acrocephalus scirpaceus A297 (if reedbeds)	x									
Anas querquedula A055	x									
Ardea cinerea A028	x									
Calidris ferruginea A147	x									
Calidris minuta A145	x									
Charadrius alexandrinus A138	x									
Charadrius dubius A136	x									
Cygnus olor A036	x									
Larus argentatus A184	x									
Larus canus A182	x									
Larus marinus A187	x									
Larus ridibundus A179	x									
Limosa limosa A156	x									
Rallus aquaticus A118 (if reedbeds)	x									
Sterna caspia A190	x									
Sterna dougallii A192	x									
Tringa erythropus A166	x									
Anguilla anguilla					x	x				
Macoma baltica						x				
Scrobicularia plana						x				
Cerastoderma lamarcki						x				
Cerastoderma edule						x				
Abra tenuis						x				
Mya arenaria						x				
Hediste diversicolor						x				
Streblospio spp.						x				
Manayunkia aestuarina						x				
Hydrobia spp.						x				
Corophium volutator						x				
Corophium arenarium						x				
Cyathura carinata						x				
Zostera noltii						x				

Sources: ETC BD 2012; Muséum national d'Histoire naturelle [Ed] 2003; Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.

**Table 3 Annex II and IV species associated to Estuaries and their CS at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	FR	IE	PT	UK	REGION
1102	<i>Alosa alosa</i>	Fish	range	XX	U1	FV	FV	XX	XX
			population	U2	U2	XX	U2	U2	U2
			habitat	XX	U1	XX	U2	U1	XX
			future	U2	U1	XX	U1	U1	XX
			overall	U2	U2	XX	U2	U2	U2

N2K code	Species name	Group		BE	DE	FR	IE	NL	PT	UK	REGION	
1103	<i>Alosa fallax</i>	Fish	range	U2	FV	U1	FV	FV	FV	XX	U1	
			population	U2	U1	U1	U2	U2	XX	XX	XX	U2
			habitat	U2	U1	U1	XX	U2	U2	U1	U1	U1
			future	U2	FV	U1	U1	U1	U1	U1	U1	U1
			overall	U2	U1	U1	U2	U2	U2	U1	U1	U2

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1351	<i>Phocoena phocoena</i>	Mammals	range	FV	FV	FV	XX	FV	FV	FV	U1	FV	
			population	FV	U1	U2	XX	FV	FV	U2	U1	FV	U1
			habitat	U2	U1	FV	XX	XX	FV	U1	U1	FV	
			future	U1	XX	U1	XX	XX	FV	U1	U1	FV	
			overall	U2	U1	U2	XX	XX	FV	U2	U1	FV	U1

N2K code	Species name	Group		BE	DE	DK	FR	IE	NL	UK	REGION
1364	<i>Halichoerus grypus</i>	Mammals	range	FV	FV	FV	FV	XX	FV	FV	FV
			population	FV	U1	U2	FV	FV	FV	FV	FV
			habitat	U1	FV	U1	XX	FV	U1	FV	FV
			future	XX	FV	U1	XX	FV	FV	FV	FV
			overall	U1	U1	U2	XX	FV	U1	FV	FV

N2K code	Species name	Group		BE	DE	DK	FR	IE	NL	UK	REGION
1365	<i>Phoca vitulina</i>	Mammals	range	FV	FV	FV	FV	XX	FV	FV	FV
			population	U1	FV	FV	FV	FV	FV	U1	U1
			habitat	U1	FV	FV	XX	FV	FV	XX	XX
			future	XX	FV	FV	FV	FV	FV	XX	XX
			overall	U1	FV	FV	FV	FV	FV	U1	U1

Note: Three species were assessed in the Article 17 reports at the marine level: *Phocoena phocoena*, *Halichoerus grypus*, *Phoca vitulina*.

Estuaries are not defined by the presence of particular species, nor are they structurally dependent upon particular species. The intertidal and subtidal sediments of estuaries support biological communities that vary according to the type of sediment, tidal currents and salinity gradients within an estuary. The upper reaches of estuaries furthest away from the open sea are usually

characterised by soft sediments and are generally more strongly influenced by fresh water (Jackson and McLeod, 2000, 2002 in Joint Nature Conservation Committee n.d.). Here the sediment-living animal communities are typically dominated by oligochaete worms, with few other invertebrates. Where rock occurs, there may be communities characteristic of brackish flowing water, consisting of green unicellular algae, sparse fucoid seaweeds, and species of barnacle and hydroids (Jackson and McLeod, 2000, 2002 in Joint Nature Conservation Committee n.d.). The silt content of the sediment decreases towards the mouth of the estuary, and the water gradually becomes more saline. Here the sediment animal communities are dominated by species such as ragworms, bivalves and sandhopper-like crustaceans. In the outer estuary, closer to the open sea, the substrate is often composed of fine sandy sediment, and supports more marine communities of bivalves, polychaete worms and amphipod crustaceans. Where rock occurs, a range of species more characteristic of the open coast is found (Joint Nature Conservation Committee n.d.).

In addition to sedentary subtidal and intertidal communities, the water column of estuaries is an important conduit for free-living species, such as fish, and juvenile stages of benthic plants and animals. In particular, it is the means by which migratory fish species make the transition between the marine and freshwater environments to important breeding areas (Jackson and McLeod, 2000, 2002 in Joint Nature Conservation Committee n.d.).

## 1.6. Related habitats

The management of estuarine habitats cannot be considered in isolation from associated marine and terrestrial habitats. Towards the land the following habitats are found:

- 1310 - Salicornia and other annuals colonizing mud and sand
- 1320 - Spartina swards (*Spartinion maritimae*)
- 1330 - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

Towards the sea, estuaries support the following habitats:

- 1110 - Sandbanks which are slightly covered by sea water all the time
- 1140 - Mudflats and sandflats not covered by seawater at low tide
- 1160 - Large shallow inlets and bays
- 1170 – Reefs In the meso- to oligohaline zone, the habitat often occurs in association with 6430, 6510, 91E0\*, 91F0. [Netz]

In The Netherlands these habitats are taken to form a coherent landscape unit (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.).

## 1.7. Ecological services and benefits<sup>6</sup>

There is a clear potential for hunting and fishing activities, as well as for fish farming (e.g. oyster farms on the French Atlantic coast) (Muséum national d'Histoire naturelle [Ed] 2003).

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<sup>6</sup> I refer you to [http://www.nuigalway.ie/semru/documents/final\\_report\\_small.pdf](http://www.nuigalway.ie/semru/documents/final_report_small.pdf) as I feel the information contained in page 37 relating to non-market marine goods and services could enhance this section. [Kelly]

Estuaries are highly accessible and a wide range of fisheries such as salmon netting, collecting (seaweed, winkles, cockles, bait) and dredging (especially oysters) may take place, some of which may have been conducted for centuries (Sewell and Hiscock, 2005 in Joint Nature Conservation Committee n.d.). Aquaculture may also take place in suitable locations (McLusky and Elliott, 2004 in Joint Nature Conservation Committee n.d.).

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see start of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1130	Estuaries	range	U1	FV	FV	XX	U2	FV	U2	FV	FV	FV
		area	U2	FV	FV	XX	U2	FV	U2	FV	FV	FV
		structure	U2	U2	FV	XX	U2	XX	U2	XX	U2	U2
		future	FV	U2	XX	XX	XX	U1	U1	XX	U2	U2
		overall	U2	U2	FV	XX	U2	U1	U2	XX	U2	U2

Estuaries are complex habitats found on all of Europe's coastline and usually contain several other Annex I habitat types such as mudflats and saltmarshes, there is much variation, partly linked to tidal range which can vary from very little in the Baltic to very large as in parts of the Atlantic region where it can exceed 10m.

Very few countries have assessed this habitat as 'favourable' and it has been assessed as 'unfavourable -bad' in all regions except the Mediterranean (where the data does not allow an assessment but where it is probably also unfavourable). These assessments are mostly due to the 'structure and function' of the habitat although future prospects are also partly responsible.

Threats and pressures are numerous, mostly linked to development, use and water quality (Summary sheet of the online report on Article 17 of the Habitats Directive).

## 1.9. Trends

The area of estuaries with natural dynamics (see 1.3) have strongly declined, especially in The Netherlands, where the estuary of the IJssel River (Zuiderzee) was cut off in 1930 and the estuary of the Lauwersmeer in 1969 and large parts of the Rhine Meuse Delta (Zeeland) were cut off as part of the Delta works. In the remaining two open estuaries, environmental conditions have changed significantly over the last century (as a result of sea walls causing coastal squeeze, port extension, urbanization, dredging etc).

The current trend in this habitat is towards silting up of the (underwater) channels and pollution of waters and sediments, as a result of high anthropogenic pressures, in particular the sealing of the

banks. Port development is especially disruptive to natural processes as lateral water movements are impeded by linear, artificial constructions.

The water quality is threatened by the high nutrient load of waters flowing into the estuaries from the watersheds, by direct point chemical pollution from port and industry, as well as untreated sewage from urban areas giving rise to anoxia.

In addition, toxic micro-pollutants, such as heavy metals, pose serious environmental and health threats to the fauna in the estuaries, especially at higher trophic levels. . In the past, pesticides, polychlorinated biphenyl (PCB's) and biocides such as tributyltin (TBT) had a negative impact, but their concentration in animal tissues seems to have declined over recent years in the Netherlands (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.).

In the **UK**, while the physical area of some individual estuaries may have declined due to anthropogenic influences or through natural deposition/erosion, the geographic spread and distribution of this feature type has not declined (Joint Nature Conservation Committee n.d.).

**Dutch** estuaries are hotspots for (invasive) alien species. They are introduced with ships' ballast water. Some species do not pose significant management problems or disappear over time, while others can threaten the ecological balance and affect economic activities.

The high nutrient load of many rivers that flow into the estuaries results in high heterotrophic activity (breakdown of organic matter). Some estuaries in The Netherlands can thus be considered as heterotrophic environments. Only at the seaward side is the primary production rate higher than decomposition (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.).

While many estuaries in **Ireland** are regarded as having favourable future prospects some larger estuaries are considered to face significant pressures. Impacts arising from aquaculture, fishing, coastal development and water pollution are considered the principal threats. Their overall conservation status is considered to be poor (NPWS 2008).

## 1.10 Main pressures and threats

Human activities in coastal and estuarine areas include:

- navigation
- dredging
- aggregate and sand extraction
- fisheries
- aquaculture
- industry (including oil and gas extraction, wind farms development)
- drainage of sewage and waste water
- water extraction (e.g. for power stations and industry)
- safety (including sea defence and flood protection)
- recreation including bird watching and hunting
- urbanisation
- cover for cables, pipes and tunnels



- military activities
- research activities

All these activities taken individually or in combination can potentially generate significant effects on the nature conservation objectives of estuaries and coastal zones (EC 2011).

Pollution from contaminated silts carried by the rivers and from port and industrial facilities is the main pressure on French estuaries. Pollutants tend to accumulate at higher trophic levels through the process of bioaccumulation and thus reach high concentrations in bird species that depend on these areas.

Threats to Dutch and UK estuaries have been summarized by OBN (Kennisnetwerk Ontwikkeling en Beheer Natuurkwaliteit n.d.) and JNCC (Joint Nature Conservation Committee n.d.):

- **Morphology/coastal development/coastal squeeze:** The natural banks on the land side of estuaries have been altered by construction of sea walls, leading to coastal squeeze. Many former estuaries have been closed from the sea, leading to profound changes in the water flows and sedimentation patterns (leading to erosion in some places and increased accretion in others). Sedimentary areas protected by hard defences will suffer the greatest impact of sea level rise. Erosive forces would become more dominant and losses of fine sediment would produce narrower intertidal areas, with coarser sediment. The change of sediment characteristics would reduce the content of organic matter in the sediments and change the community structure accordingly. Taken to its conclusion, a greater proportion of estuaries on open coasts would become marine and sandy and the brackish section would move inland and up-river. In more sheltered areas there would be more deposition, extending areas of fine sediment and marsh.
- **Water quality - suspended matter:** In many places, suspended matter has increased. This is a threat to primary production (less light), and affects fishing success of seabirds such as terns. Changes in the morphology, infrastructure and dredging affect the suspended load.
- **Water quality - nutrient load:** Nutrient load in Dutch estuaries has increased between the 50s and 80s but decreased more recently. But it is still high and has a negative impact on ecosystem function. Primary production and biomass are high, but only .....
- **Water quality - pollutants:** The high load of carbohydrates led to spectacular crashes in the populations of Seal, Eider and Terns in some years, but the incidence of this has decreased in recent years. However, safe concentrations of pollutants have not been reached yet. In addition, some new pollutants such as hormonal disturbers are increasing.
- **Climate change and subsidence:** These will have an important impact on Dutch estuaries. Warmer temperatures might have a positive effect for the survival of many waders in winter. Warmer water temperatures will in general have an adverse effect on bivalves. The survival of sandbanks and mudflats, essential habitats for waders depends on the rate of sea-level rise. It is calculated that natural replenishment through accretion can continue up to a sea level rise of 60 cm per century. If the speed of sea level rise is higher, many mudflats and sandbanks might disappear forever. Subsidence speeds up the rate of relative sea level rise. In Dutch coastal areas, natural subsidence as a result of natural geological process, but also because of natural gas extraction. Atmospheric CO<sub>2</sub> increase leads to an increase in water acidity, which can affect shell growth. Acidification has not yet been observed in Dutch waters.

In the UK shoreline areas will be affected by increased storminess and windiness; the distribution of some shoreline habitats may be altered or reduced by these effects (Brooker and Young, 2005 in Joint Nature Conservation Committee n.d.). The greatest impact of sea level rise would be in sedimentary areas protected by hard defenses (Boorman et al., 1989 in Joint Nature Conservation Committee n.d.). This would lead to erosive forces becoming more dominant and considerable losses of fine sediment which would not be balanced by deposition elsewhere. Significant declines in wader populations resulting from climate change have already been noted in estuaries along the western UK coastline (ref).

- **Seafloor disturbance as a result of fisheries and other activities:** Fishing, shellfish, dredging, sand suppletions have a strong impact on the seafloor and its inhabitants.
- **Fisheries including bait collecting and aquaculture:** Fishing activities are the most widespread source of anthropogenic physical disturbance of benthic communities of Northern Europe. Aquaculture, as well as being a source of pollution has also been linked to the spread of non-indigenous species, such as *Sargassum muticum*, the escape of cultured species and possible displacement of native species (Sewell and Hiscock, 2005 in Joint Nature Conservation Committee n.d.).
- **Overexploitation of species:** Direct impact and changes in sedimentation strongly affect populations of shellfish. Overexploitation of certain crustaceans has a negative impact on the bird populations that feed on them. Also some larger sea animals, such as sturgeon and European oyster have (almost) disappeared from the Dutch estuaries.
- **Invasive alien species:** As a result of active or passive import, this can lead to the disappearance of native species, through better competition, absence of predators or better adaptation to changing conditions such as climate change. In Dutch estuaries such as the Eastern Scheldt, the Japanese oyster is a strong competitor for European oyster and mussel, and it changes the ecosystem conditions. They are more difficult to prey on by birds, but some birds such as the oystercatcher has already adapted.
- **Disturbance:** Many activities take place in and around estuaries, several of which can cause significant disturbance to animals. These activities are both commercial and recreational with the latter increasing in intensity.
- **Predation of coastal breeding birds:** Many coastal breeding birds nest on the ground and are an easy prey for animals such as the fox. Colonies of such birds are generally found on islands and sand plates. Increased infrastructure has connected many of these places to the mainland making them accessible to predators, while the decreasing dynamics results in few new isolated places.

The **German** Marine Monitoring Programme (Bund Länder Meeresprogramm Meeresumwelt n.d.) lists the following anthropogenic influences as potential threats:

1. Inputs of nutrients and pollutants
2. Changes in course and structure
3. Expansion and maintenance of navigational channels
4. Construction and operation of port and industrial installations (e.g. power stations)
5. Dike building, training dikes, bank revetements

6. Relocation of sediment, dumping, disposal sites for dredged materials
7. Alterations to characteristic hydrological variables, e.g. passability, due to structures built across the estuary and hydropower stations
8. Shifts in the brackish water limit upstream
9. Increases in current speeds
10. Tidal pumping effect: decline in areas of shallow water due to the silting up of side channels
11. Exploration and extraction of raw materials (gas and oil)
12. Drainage of the inundation area
13. Intensive agricultural and forestry use of the inundation area
14. Shipping traffic, e.g. erosion of banks caused by wave attack
15. Recreational use/tourism
16. Professional and sport fishing
17. Hunting
18. Rising sea levels
19. Encroachment of invasive species

For **Germany**, main threats that have been reported are expanding river port facilities, dams, bank protection, channel deepening, dikes, shipping, and pollutant and nutrient input. (Bundesamt für Naturschutz n.d.). Additional threats have been identified as follows:

1. Changes in the hydro-morphology and hydrodynamics (increased tidal range, loss of flood plains and shallow water zones and simultaneously increase in deep water areas and shoreline erosion), increased upstream sediment transport as well as accretion in side channels;
2. Unsustainable fisheries;
3. Water pollution with plastic litter;
4. Reclamation of land from sea, estuary or marsh: Most parts of the former estuary and adjacent marshes have been deeply altered by the construction of dams, leading to coastal squeeze;
5. Pollution to surface waters (limnic, terrestrial, marine & brackish): The high nutrient load of the water out of the catchment area leads to low oxygen levels in summer;
6. Estuarine and coastal dredging: Intense maintenance of shipping lanes causes negative alterations of characteristic hydrological variables such as sedimentation, erosion, currents, tidal amplitude and salinity dynamics;
7. Outdoor sports and leisure activities, recreational activities: The wide variety of human activities such as nautical sports, fishing, hunting, flying (planes and helicopters) and other forms of recreation can lead to a high level of disturbance.

**Ireland Kelly, pers.comm.:**

1. D03 shipping lanes, ports, marine constructions
2. F01.03 bottom culture
3. H01 Pollution to surface waters

**The Netherlands, Schotman, Alterra, pers.comm.:**

1. Estuarine and coastal dredging (J02.02.02)
2. Polderisation, reclamation of land from the sea, estuary or marsh (J02.01.01/02)
3. Waterpollution by industrial plants, urban en agricultural runoff (H01.01/04/05)

**United Kingdom, Manson, pers.comm.:**

1. J03.01 Reduction or loss of specific habitat features

2. H01. Pollution to surface waters (limnic, terrestrial, marine & brackish)
3. H03 Marine water pollution
4. J02.05.01 Modification of water flow (tidal & marine currents)
5. I01 Invasive non-native species

**Table 5 Main pressures to Estuaries as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see start of chapter 3)**

Region	Pressure description (2nd level)	Estuaries	<i>Alosa alosa</i>	<i>Alosa fallax</i>	<i>Phocoena phocoena</i>	<i>Halichoerus grypus</i>	<i>Phoca vitulina</i>
ATL	Professional fishing	x	x	x			
	Leisure fishing	x					
	Sand and gravel extraction	x	x	x			
	Urbanised areas, human habitation	x					
	Communication networks	x		x			
	Shipping	x					
	Outdoor sports and leisure activities	x					
	Pollution	x	x	x			
	Landfill, land reclamation and drying out, general	x		x			
	Removal of sediments (mud...)	x					
	Modification of hydrographic functioning, general	x	x	x			
	Dikes, embankments, artificial beaches, general	x					
	Biocenotic evolution	x	x	x			
MATL	Professional fishing		x	x	x	x	x
	Leisure fishing		x				
	Sand and gravel extraction		x	x		x	
	Urbanised areas, human habitation						
	Communication networks						
	Shipping				x		
	Outdoor sports and leisure activities					x	x
	Pollution		x	x	x	x	x
	Landfill, land reclamation and drying out, general			x			
	Removal of sediments (mud...)						
	Modification of hydrographic functioning, general		x	x			
	Dikes, embankments, artificial beaches, general			x			
	Biocenotic evolution			x			

**Table 6 Main threats to Estuaries as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Region	Threat description (2nd level)	Estuaries	<i>Alosa alosa</i>	<i>Alosa fallax</i>	<i>Phocoena phocoena</i>	<i>Halichoerus grypus</i>	<i>Phoca vitulina</i>
ATL	Professional fishing	x	x	x			
	Urbanised areas, human habitation	x					
	Communication networks	x					
	Shipping	x					
	Pollution	x	x	x			
	Modification of hydrographic functioning, general	x	x	x			
	Biocenotic evolution	x	x				
MATL	Professional fishing		x		x	x	x
	Urbanised areas, human habitation						
	Communication networks						
	Shipping						
	Pollution		x	x	x	x	x
	Modification of hydrographic functioning, general		x	x			
	Biocenotic evolution						

## 2 Conservation management

### 2.1. Main conservation requirements

Conservation requirements of estuaries include (Kennisnetwerk Ontwikkeling en Beheer Natuurkwaliteit n.d.)(Muséum national d’Histoire naturelle [Ed] 2003) :

- Maintaining habitats;
- Maintaining good water quality (in terms of pollutants, nutrient load, sediment load);
- Maintaining disturbance free and predator free zones.

1. To secure and, where applicable, develop the favourable conservation status of estuaries, the following measures may be required (Bund Länder Meeresprogramm Meeresumwelt n.d.):  
General targets:

- 1.1. Conservation and development/restoration of the estuary with its saline, brackish and fresh water zones, and adjoining areas as a large ecosystem and habitat complex in as natural as possible a state with all structures and functions;
  - 1.2. Conservation and development/restoration of the characteristic saline, brackish and fresh water zoning with its corresponding biotopes and species;
  - 1.3. Conservation and development/restoration of hydro chemical and hydro physical water conditions and processes of neritic zones and estuaries involved in the formation of biotopes;
  - 1.4. Conservation and development/restoration of largely natural sedimentation and current conditions, and largely natural dynamics in coastal, river and riparian areas affected by natural inundations;
  - 1.5. Conservation and development/restoration of a largely natural soil structure and morphodynamics;
  - 1.6. Conservation and development/restoration of sections of river that do not have hard structures along their banks, are unchannelised, have undergone few other modifications or have been regenerated without their banks and bed being stabilised or the construction of dams and water extraction systems;
  - 1.7. Conservation and development/restoration of ecological interrelationships with surrounding terrestrial, limnic and marine areas;
  - 1.8. Conservation and development/restoration of the estuary's function as a barrier-free migration route for water-bound organisms;
  - 1.9. Conservation, development, safeguarding and, if necessary, restoration of the estuary's general and specific functions for species for which special responsibilities exist (Annex II HD, Annex I BD and other international agreements).
2. Specific targets:
- 2.1. Extension of the areas subject to inundation and sedimentation;
  - 2.2. Increase in the proportion of shallow water zones;
  - 2.3. Increase in the proportions of alluvial forests, reed beds, tall herbaceous communities, salt meadows, species-rich grassland and other biotope types typical of estuaries;
  - 2.4. No action to maintain bank defences or construct new bank defences, where there are no compelling grounds for the bank to be stabilised;
  - 2.5. Restoration of passability for migrating fish and lampreys.

According to the **Spanish** Ministry of Agriculture (VV.AA. 2009), the main recommendations for the conservation of estuaries are:

- a) Determine a system of freshwater inputs to maintain salinity gradients within the natural range of variation;
- b) Restore the tidal regime when it is fully or partially altered by the presence of infrastructure;
- c) Restore the surrounding wetlands aiming to restore biodiversity and improve water quality in the estuary;
- d) Reduce pollutant inputs by implementing measures at source points (reduction of discharges) and by improving waste water treatment;
- e) Develop studies and control programmes for main invasive species;
- f) Develop environmental education programmes and awareness raising campaigns to involve local people in management and conservation of estuaries;
- g) Increase the protection status of those areas of the estuary that require it because of their biological values in order to minimize anthropogenic impacts;
- h) Control exploitation activities of estuary resources (seafood extraction, fishing, boating, hunting, etc.) and develop sectoral plans for their sustainable use.

**A number of additional conservation requirements have been identified through expert consultation:**

1. Restrict extensive agricultural use of grassland in the vicinity of estuaries, particularly on estuarine salt marshes;
2. Reduce artificial fertilizer inputs and other detrimental material inputs in associated catchment areas;
3. Integrated management plans to encourage near-natural development of shallow waters, river banks and marshlands and reduce the transport of sediments and suspended matter;
4. Improvement in knowledge about estuary functioning and fundamental processes;
5. Adjust Natura site boundaries to exclude fisheries and other human activities;
6. Reduce the negative impacts arising from dredging and other maintenance activities;
7. Balance the negative effects of human activities through a system of opportunities and restrictions;
8. A holistic and planned approach to the development of ports and other infrastructural needs of marine users;
9. Reduction of activities causing disturbance to seafloor ecology;
10. Depolderisation of previously reclaimed land;
11. Marine spatial planning and Integrated Coastal Zone Management plans;
12. Controls on released materials, effective water quality regulations and industry standards;
13. Emergency oil/chemical spill response strategies;
14. Invasive species pathway management.

## 2.2. Management measures<sup>7</sup>

In the **Netherlands**, the remaining open estuaries are considered natural ecosystems and little active management is foreseen (Kennisnetwerk Ontwikkeling en Beheer Natuurkwaliteit n.d.).

Management should focus on the prevention and/or reduction of:

- Threatening activities and developments on the sites themselves (such as destruction of natural habitats, over fishing and disturbance);
- Negative effects from outside (such as the inflow of pollutants and release of (invasive) alien species).

In **France**, management measures should focus on the reduction of pollutants as these are the main pressure (Muséum national d'Histoire naturelle [Ed] 2003). Therefore two main actions are considered in France:

1. Active reduction of the input of pollutants;
2. Maintaining a good hydrological circulation in order to avoid a concentration of pollutants.

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<sup>7</sup> This structure of this section is not well developed. It should follow the so-called hierarchical envelope Geomorphology, hydrodynamics, and so on, down to internal management and species management at the very last. It is now well mixed, and hard to digest. {Kleef}

Careful studies and impact assessments are required before any engineering activities (e.g. dredging) are carried out because of the high toxicity of certain contaminants (e.g. cadmium, lead, mercury,...).

Individual management plans for estuaries need to be established very carefully to reflect the many different interests and activities. Situations between the different estuary sites are very variable.

**Germany, Ackerman, pers. comm.:**

**Slightly corrected Google translation)**

1. Dismantling or at least decrease of artificial embankments or replacement by more natural bank protection measures with gradual land-water transition in the foreland
2. Enlargement of floodplains including through redeployment of the sea defense structures, opening of summer sea walls, local increase in flooding frequency and dynamics
3. Creation of shallow water and tidal habitats
4. Reconnecting cut off tributaries to the tidal areas
5. Creation or improvement of aquatic structures in the flood zone, encourage the development of tidal creeks and reduction of drainage
6. Creation of unused buffer strips, also along the tributaries, and allowing dynamic floodplain development
7. Establishment of functioning fishways in structures with barrier effect (sluices, pumping stations and tidal barriers) for the migratory fish
8. Only allowing cooling water outlets when substantial loss of fish is avoided; heat discharges only as specified by the current heat load plans, taking into account the special requirements of the Habitats fish species
9. Consider the migratory patterns of fish in the operation of sluices and pumping structures
10. Reducing sea defence operations to adapt to the natural hydrological conditions.
11. Suppression of invasive alien plants
12. Limitation of ship speeds in sensitive areas to reduce bank erosion by suction and surge
13. Development of new sites for softwood floodplain forests (91E0 LRT) and hardwood floodplain forests (91F0)
14. Conservation and development of floodplain meadows

**Germany, Hielscher, pers.comm.:**

1. Integrated management plans; improvement of knowledge about estuary functioning
2. Adjustment of nursery grounds

**Germany, Netz, pers.comm.:**

1. J 02.01.02: The best way to increase the area of tidal influence is realignment of dams. In addition there are possibilities in the creation of polders with tidal influence behind the existing dams.
2. H 01: The reduction of the inflow of nutrients into estuaries has to be organized on the level of the whole catchment area. This is a task for WFD.
3. J 02.02.02: It is necessary to establish a constant task to reduce the negative effects of maintenance activities step by step. This asks for a system of detailed monitoring, evaluation and research.
4. G 01: It is necessary to provide areas with no activities as well as areas with some



restrictions and (almost) no restrictions for human activities. This task will be eased, if the area of the estuary is as large as possible.

**Ireland**, Kelly, pers.comm.:

1. Perhaps this could usefully be progressed through improved commitments to marine spatial planning (MSP) models alongside a more flexible concept of 'baseline' in N2k sites.
2. Improved research and development and incentivisation by EU funding of more environmentally benign forms of aquaculture.
3. Achievable through ongoing implementation of WFD

**United Kingdom**, Manson, pers.comm.:

1. Case-by-case assessment of loss of habitat features, through EIA/HRA processes
2. Pollution regulations
3. Oil/chemical regulations
4. Case-by-case assessment of changes to water flow, through EIA/HRA processes
5. Ballast water regulations. Industry codes of practice.

### 2.3. Other measures (e.g. monitoring)

Important supporting activities for a good management of estuaries include careful monitoring of the levels of pollutants (in the water, but also in the sediments and the animal tissues). Ecological Quality Standards, indicators that allow the health of the habitat to be assessed need to be established at the highest possible organization level (e.g. ecosystem, population) (Muséum national d'Histoire naturelle [Ed] 2003).

In the **UK** condition assessments based on Common Standards Monitoring (CSM) provide a means to assess the structure and functioning of estuaries in the UK. The following attributes were examined for all CSM assessments relevant to the habitat (JNCC, 2004 in Joint Nature Conservation Committee n.d.):

- Extent of the entire feature
- Distribution/spatial pattern of habitats
- Salinity
- Nutrient status

Estuarine features of interest, their generic attributes and suggested techniques to monitor them are described in detail in (Davies et al. 2001).

### 2.4. Species specific measures

**Germany**, Ackerman, pers. comm:

Google translation

Northern migratory birds: Promotion on grassland and arable land through conservation agreement with the condition that from November to March to give up any management measures and concerns.

Hemlock water fennel (*Oenanthe conioides*): creation of new sites and possibly even pioneering implementation of resettlement activities, developing a concept for a temporary stepping stones, especially in the port of Hamburg as a contribution to the ecological network

Feint (*Allosa fallax*): relocation of dredged material outside the spawning and nursery period, no dredging during the spawning season, dredging under consideration on the spawning events

**Germany, Netz, pers.comm.:**

The endemic plant species *Oenanthe conioides*\* needs measures to improve the size of the population incl. establishing an ex situ population. The tern *Gelochelidon nilotica* needs measures to improve the breeding success of the last colony of the cimbric population.

**Ireland, Kelly, pers.comm.:**

This habitat is recognised as an important conduit for fish species and some marine mammals. These should be considered in the development of wider species measures.

## 2.5. Main constraints / bottlenecks and actual needs

Bottlenecks that are often encountered in the conservation or restoration of favourable conservation status in estuaries have to do with: 1. the external origin of certain pressures (e.g. inflow of contaminants in river water), and 2. the favourable geographical and morphological conditions of estuaries for various forms of development (ports, industry, infrastructure, agriculture, tourism, and housing) and the limited space available for these developments.

**Germany, Ackerman, pers. comm.:**

1. Complexity of the water balance makes it difficult to apply simple measures for water management
2. Diversity of habitat types and many different actors
3. Lack of land availability due to private landowners' limited readiness to sell

**Germany, Hielscher, pers.comm.:**

1. Not achievable objectives (see additional information)
2. Conflict of interests, economic and social requirements
3. Complexity of laws and framework directives
4. Increasing demands for fish, price pressure

**Germany, Netz, pers.comm.:**

1. J 02.01.02: Any change of the flood defence system provokes emotional fears and is difficult to communicate to local people. Measures are usually very expensive and land owners often do not cooperate.
2. H 01: A better policy framework, esp. in terms of agriculture (CAP), would ease this task.
3. J 02.02.02: This task needs sufficient funds for monitoring and research and a good cooperation of the stakeholders.
4. G 01: Existing restrictions need to be enforced.

**Ireland, Kelly, pers.comm.:**

1. Improved communication and knowledge transfer. Consistent development within Europe of explicit site conservation objectives and related favourable conservation condition measurables.
2. Funding coming from Europe doesn't seem to incentivise development of more benign forms of aquaculture. Further R&D may also be necessary to explore new more benign ways of cultivating mainstay species.
3. More consistent application of the directive on the ground across Europe. There is currently a stakeholder perception that some EU MS are more lenient in their implementation of directives thereby creating an inequitable playing field for economic development and opportunity.
4. No clear development of MSP

**The Netherlands, Schotman, Alterra, pers.comm.:**

1. Economic interest of harbours like Antwerpen and Emden
2. Non-cooperation to giving up precious land of local governors because of pressure from farmers and the public
3. Fear for flooding

**United Kingdom, Manson, pers.comm.:**

1. Lack of knowledge/understanding of impacts of activities
2. Lack of knowledge/understanding of value of habitats
3. Current lack of strategic spatial planning.

## 2.6. Recommendations

Management recommendations, habitat specific :

- Maintain or restore habitats;
- Maintain or restore good water quality (in terms of pollutants, nutrient load, sediment load);
- Maintain disturbance free and predator free zones;
- Restore natural dynamics (salinity gradient, tidal flows and regime);
- Restore other natural conditions, especially natural river(banks);
- Restore ecological interrelationships with the surrounding terrestrial habitats;
- Restore and/or maintain open access to sea and upstream river;
- Restore and link surrounding wetlands;
- Control exploitation activities (seafood extraction, fishing, boating, hunting etc);

Policy recommendations (i.e. removal of barriers), habitat specific:

- Solutions to the pressures, threats and bottlenecks are to be sought in comprehensive plans and policies at the level of water catchments and good negotiations with the sectors involved;

- Monitor and control invasive alien species;
- Develop plans for the sectoral use of the estuaries together with the sectors involved;
- Ensure a good monitoring of important environmental variables in estuaries, especially with respect to pollution (of water, sediments and animal tissues) and sediment transport (erosion, accretion).

**Germany (Ackerman, pers comm):**

1. Development and implementation of a nature-friendly water management concept (including winter floods, nature-friendly management of ditches)
2. Cooperation with the Federal Waterways Authority, the agencies responsible for maintaining the sites, the water management authorities and other stakeholders, in implementing the conservation objectives
3. Provision of sufficient funds for land acquisition, outsourcing of authorities: appointment of agents or foundations

**Germany (Hielscher, pers.comm.):**

1. Review of the valuation systems for habitat 1130. Which status is essential to fulfil the terms of Article 1 (e) Habitats directive (quality and quantity)?
2. Fishery quota, price policy, Agreements with nature conservation institutions

**Germany (Netz, pers.comm.):**

1. J 02.01.02: Communication, fund raising.
2. H 01: Influencing policies.
3. J 02.02.02: Communication between stake holders.
4. More staff (rangers) to communicate, raise awareness and enforce restrictions.

**Ireland, Kelly, pers.comm.:**

1. Greater communication and knowledge transfer through development of sectoral and/or methodological guidance.
2. Greater focus on divergences in practical implementation of conservation requirements and possible related economic consequences.
3. Greater connectivity or alignment between aims of directives and wider EU funding priorities.
4. Development of European MSP framework or policies

**The Netherlands, Schotman, pers.comm.:**

1. communication
2. Firm policy

**United Kindgom, Manson, pers.comm.:**

1. Better understanding of connectivity of habitats within estuaries – through education and awareness-raising
2. Better understanding of hydrographic processes within estuaries
3. Development of appropriate marine spatial plan.

## Cases / projects

## Sites

## 1310 – *Salicornia* and other annuals colonizing mud and sand

### Summary

**Pioneer saltmarsh vegetation with *Salicornia* and other annuals** colonises intertidal mud and sandflats in areas protected from strong wave action and is an important precursor to the development of more stable saltmarsh vegetation. It develops at the lower reaches of saltmarshes where the vegetation is frequently flooded by the tide and can also colonise open creek sides, depressions and pans within more developed saltmarshes. The main ecological requirements are the presence of salt water together with erosion by flooding and wind.

There is little variation in this habitat which is comprised of a small number of salt tolerant plant species and which has few vegetation subtypes; associated species with conservation status are generally mud wading birds like waders, snipe and plovers. Habitats are generally very open but plant densities can vary. The habitat does provide some ecological services as a gene pool for tolerance to salinity and historical and cultural soap production.

This form of saltmarsh vegetation is widely distributed throughout the coastal areas of the EU. In the Atlantic region it is widespread in the UK, Ireland and The Netherlands. Between 76-100% of the habitat area is included within the Natura 2000 network, making this an important framework for the management of the habitat type.

The **conservation status of this habitat type** has been assessed as unfavourable-inadequate. The available range is generally considered favourable but current human impacts on the habitats are unfavourable. In the UK and Ireland the area of this habitat type is declining, rates of 1% per year are suggested, whereas it is stable in The Netherlands.

The main reported **threats and pressures** to *Salicornia* habitats in the Atlantic zone include:

- erosion due to sea level rise in combination with land defence structures causing a decreased range;
- land claims and coastal changes such as dike constructions which affect the range directly and indirectly through decreasing available sediment supply; (this has been mentioned as major factor in The Netherlands, further affecting food supplies for the bird populations);
- the spread of the invasive common cord-grass, *Spartina anglica*, is seen as a foremost threat to the habitat's structure and functioning especially in England and Ireland.

The main **management measures** to address the threats and pressures include:

- the protection within designated sites as Special Areas for Conservation and/or biodiversity action plan schemes;
- to reduce active management to a regime of non-management or only seasonal grazing by cattle;
- the control and removal of invasive cord grass *Spartina anglica*.

**Bottlenecks** that can be encountered in the conservation or restoration of favourable conservation status in *Salicornia* habitats are:

- the lack of resources;
- continuing human activity;
- the pace of losses due to coastal squeeze associated with sea level rise (where the creation of new saltmarshes will need to/is struggling to keep up with the losses);
- the public perception of the value of this ecosystem might not be high as it lacks clear ecosystem services (e.g. for tourism and the habitat is considered to be “dirty and smelly”).

**Solutions** to the pressures and bottlenecks are found through the creation of space for new intertidal areas through the removal of coastal defence banks and assuring new sediment influx. However, to re-create or restore previous habitat area requires the right combination of topography, sediments and intertidal flooding. It is estimated that approximately 100 ha of saltmarsh needs to be created annually to keep up with coastal losses.

## 1 Description of the habitat

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 pulverulenta*, *Saginetea maritima*. (EC 2007a) (ETC BD 2012)

This pioneer saltmarsh vegetation colonises intertidal mud and sandflats in areas protected from strong wave action and is an important precursor to the development of more stable saltmarsh vegetation. It develops at the lower reaches of saltmarshes where the vegetation is frequently flooded by the tide, and can also colonise open creek sides, depressions or pans within saltmarshes, as well as disturbed areas of upper saltmarshes. (Joint Nature Conservation Committee 2006)

### 1.1. Distribution

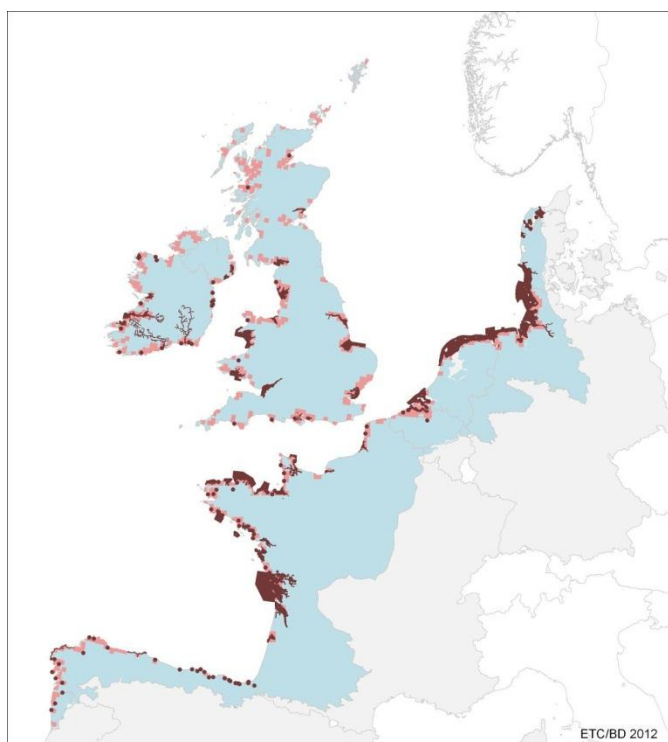
**Table 7 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States.**

**Note: The habitat is not fixed, but is spatially dynamic and may fluctuate from year to year. Figures should be interpreted accordingly [Kleef]<sup>8</sup>**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	3			8	6	7	29		26		73		59	1	21	23	12	3		8		21
habitat area (ha)	57			5061	19	2216	6214		1070		6034		15676	0	2953	1627	5261	127		3543		2255

<sup>8</sup> Update for NL (based on Dijkema et al. (2007) & Esselink et al. (2009)) : **5261 2100 [Kleef]**

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>9</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).



**Figure 2 Map of SCIs proposed for the Salicornia and other annuals colonizing mud and sand & Article 17 distribution (for legend, see introduction of chapter 3)**

This form of saltmarsh vegetation is widely distributed throughout coastal areas of the EU. In the UK there are over 2,300 ha of Salicornia and other annuals colonising mud and sand, and it is widespread in the saltmarshes of England and Wales. However, the area of the habitat type is restricted in Scotland and Northern Ireland because of a lack of new sediment for saltmarsh development. (Joint Nature Conservation Committee 2006)

In the Netherlands, Salicornia habitats can be found in all sheltered places of the Wadden area and in the delta's (Ministerie van Economische Zaken, Landbouw en Innovatie 2008). **It also very local can be found along the mainland coast of Holland. EG near the 'Zuidpier' near IJmuiden and behind the 'Hondsbosche Zeewering'". Which means that there is potent ion everywhere. [Schotman Alterra]**

The habitat can also occur inland on saline soils as in Poland, Spain and Romania.

## 1.2. Main features

There is little variation within this habitat type, which typically comprises a small number of species. The following NVC types are represented:

<sup>9</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



- SM7 *Arthrocnemum perenne* stands
- SM8 Annual *Salicornia* salt-marsh community
- SM9 *Suaeda maritima* salt-marsh community
- SM27 Ephemeral salt-marsh vegetation with *Sagina maritima*

The first three communities include open stands of perennial glasswort *Sarcocornia perennis*, glasswort *Salicornia* spp., or annual seablite *Suaeda maritima*. The density of these plants can vary and may be lower on sites with sandier substrates. Other species that may be found include common saltmarsh-grass *Puccinellia maritima*, common cord-grass *Spartina anglica* and sea aster *Aster tripolium*. *Sarcocornia perennis* has a restricted distribution in England and Wales, and is absent from Scotland. A further form of the habitat (SM27) consists of ephemeral vegetation colonising open pans in upper saltmarshes. Characteristic plants of this vegetation type include sea pearlwort *Sagina maritima* and knotted pearlwort *S. nodosa*.

(Joint Nature Conservation Committee 2006)

### 1.3. Ecological requirements

*Salicornia* habitats is present in coastal zones where salt water flooding occurs. The vegetation of this habitat type is also present in low-lying inland areas influenced by brackish or saline groundwater. [Kleef]

### 1.4. Main subtypes

#### Sub-types

15.11 - Glasswort swards (*Thero-Salicornietalia*): annual glasswort (*Salicornia* spp., *Microcnemum coralloides*), seablite (*Suaeda maritima*), or sometimes salwort (*Salsola* spp.) formations colonising periodically inundated muds of coastal saltmarshes and inland salt-basins.

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;

15.13 - Atlantic sea-pearlwort communities (*Saginion maritimae*): formations of annual pioneers occupying sands subject to variable salinity and humidity, on the coasts, in dune systems and saltmarshes. They are usually limited to small areas and best developed in the zone of contact between dune and saltmarsh. In Germany, this subtype is classified as subtype of H1330 (Esselink et al. 2009). [Kleef]

15.14 Central Eurasian crypsoid communities : Sparse solonchak formations of annual grasses of genus *Crypsis* (*Heleochoa*) colonizing drying muds of humid depressions of the salt steppes and saltmarshes (15.A) of Eurasia, from Pannonia to the Far East.

(EC 2007a) (Muséum national d'Histoire naturelle [Ed] 2003)

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with *Salicornia* and other annuals colonizing mud and sand, and provided their conservation status in the Atlantic Member States (see table below).

**Table 8 Species associated to *Salicornia* (for legend, see introduction of chapter 3)**<sup>10</sup>

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Calidris alpina</i> A149	X									
<i>Calidris canutus</i> A143	X									
<i>Charadrius hiaticula</i> A137	X									
<i>Gallinago gallinago</i> A153	X									
<i>Haematopus ostralegus</i> A130	X									
<i>Recurvirostra avosetta</i> A132	X									
<i>Tadorna tadorna</i> A048	X									
<i>Vanellus vanellus</i> A142	X									
<i>Calidris ferruginea</i> A147	X									
<i>Calidris minuta</i> A145	X									
<i>Charadrius alexandrinus</i> A138	X									
<i>Charadrius dubius</i> A136	X									

*Salicornia* is a genus of succulent plants typical of coastal muds and sands covered at high tide, the group includes plants such as marsh samphire (*Salicornia europaea*).

## 1.6. Related habitats

On the landscape level, the habitat is part of salt marshes (In the Atlantic region, habitats 1310, 1320 and 1330). [Kleef] 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 pulverulenta*, *Sagineteta maritima*. (Joint Nature Conservation Committee 2006)

## 1.7. Ecological services and benefits

This type of habitat and its associated plant species are a "gene pool" of plants tolerant to salinity. This is an important ecological and economic value (VV.AA. 2009).

<sup>10</sup> For the NL as non-breeding bird A149, A143, A137, A138, A153, A130, A132, A048, A142, A147, A145, A136 and as breeding birds A132, A137, A138 [Shotman Alterra]

The use of *Salsola*, *Salicornia*, and *Suaeda* was historically a powerful industry related to the manufacture of soaps, in which Spain was one of the main producers. This aspect gives an enormous cultural and anthropological value to this type of habitat and reinforces the criteria to encourage its conservation and to promote its values among society. (VV.AA. 2009)

Salicornia is at some places gathered as commercial resource (Muséum national d’Histoire naturelle [Ed] 2003)

## 1.8. Conservation status

**Table 9 Conservation status (CS) assessed at the Atlantic region and MS level (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1310	Salicornia and other annuals colonizing mud and sand	range	U2	FV	FV	XX	FV	FV	FV	FV	FV	FV
		area	U1	FV	FV	XX	U1	U1	U1	U1	U1	U1
		structure	U1	FV	XX	XX	U1	U1	FV	FV	U2	U1
		future	U1	FV	XX	XX	U1	U1	U1	FV	U2	U1
		overall	U2	FV	XX	XX	U1	U1	U1	U1	U2	U1

Few countries (EU25) have assessed this habitat as 'favourable' and it has been assessed as 'unfavourable -inadequate' in all regions except for the Mediterranean where it is 'unfavourable - bad'. Range is generally favourable but the other parameters are widely reported as unfavourable due to human impacts, sometimes noted as linked to land reclamation. (ETC BD 2012)

Although the habitat is clearly unfavourable in the Mediterranean region, there are many problems with the data reported by the member states and better data is required (Summary sheet of the online report on Article 17 of the Habitats Directive). In the 'Delta' in the southwest of the Netherlands the conservation status is bad because of erosion and sweetening of former parts of now dammed estuary branches. In the Waddenzee the status is favourable. [Schotman Alterra]

## 1.9. Trends

There has been a decline in area since 1994, with trends over 1% per year in **south east England**. While such extreme losses as a result of coastal squeeze may not be occurring in Scotland, the losses in England mean that there is a disproportionate loss of the habitat across its range of ecological

variation. The overall area has declined since 1994 but at rates averaging less than 1% per year. (Joint Nature Conservation Committee 2007)

The distribution in the **Netherlands** is more or less stable (Ministerie van Economische Zaken, Landbouw en Innovatie 2008) but there is a decrease in the south and an increase in the North. [Schotman Alterra]

In **Ireland**, the area of Salicornia flats may have contracted slightly in the past due to the infilling, reclamation and embankment of some former saltmarsh and intertidal areas for agricultural purposes at many sites around the country (NPWS 2008).

## 1.10 Main pressures and threats

The most obvious major future threats to Salicornia are listed below:

- The main pressure adversely affecting the H1310 pioneer habitat's structure and function is, especially in England, the presence of the negative indicator Cord grass *Spartina anglica*;
- Land claim (reclamation of land from sea, estuary or marsh) and coastal changes like dike constructions;
- (Direct) human influence such as discharges, heavy metal, water and soil pollution, drainage, flooding and military manoeuvres;
- Indirect anthropogenic or zoogenic influence;
- In the UK, recent losses are mostly a result of coastal squeeze where saltmarsh is eroding because it is trapped between rising sea levels and hard sea walls. As a result it is not able to adjust to the new circumstances, especially if there is not enough sediment available for the mud surface to keep up with the continuing sea levels rise.
- Climate change;
- Air pollution;
- Natural succession to low salt marsh (H1330). [Kleef]

(Joint Nature Conservation Committee 2007); (Bundesamt für Naturschutz 2011)

### Belgium, Herrier, pers. Comm.

1. J02 human induced changes in hydraulic conditions / J02.01.02 Reclamation of land from sea, estuary or marsh / J02.11 Siltation rate changes, dumping, depositing of dredged deposits / J02.12.11 sea defence or coast protection works, tidal barrages. The coastal tidal salt marshes of the Yzer estuary and the former sound of the Zwin were from medieval times until the end of the 19th Century (1872 for the Zwin) gradually reclaimed into agricultural polder land by the building of dikes (J02.01.02). Still in the years 1950 and 1970 the largest part of the then remaining tidal mud flats and salt marshes along the Yzer estuary at Nieuwpoort were used for dumping dredging sludge and excavated soil (J02.11). From the years 1960 on, the touristic and recreational sandy beaches in front of the bathing resort of Knokke, that were being eroded by the sea, have been regularly artificially nourished with sand. As this sand is each time rather rapidly being eroded away by the sea again, it is far from excluded that this sediment is transported

by the tidal currents into the sea inlet and creek system of the nearby tidal flood plain of the Zwin, where it could contribute to the rapid silting up of the lagoon, creeks, mud flats and salt marshes of this tidal area (J02.12.11). The superficies of the tidal flood plain of the Zwin has shrunken so strongly as a consequence of the 19th Century land reclamation, that, the superficies (about 150 ha) of the remaining tidal flood plain has become too reduced to allow sufficient tidal dynamics to maintain mud flats and salt marshes in a satisfactory status of conservation, even without the supply of sand from the beach nourishment in front of Knokke. Accelerated silting up, especially with coarse sandy sediments, of the flood plain of the Zwin diminishes the food supply for wading birds and can lead to the loss of the tidal character of the area. The planned storm flood barrier on the rivermouth of the Yzer at Nieuwpoort (Belgium) and breakwaters at Cadzand (Netherlands), nearby the sea inlet of the Zwin, could be expected to influence the sediment balances of both tidal salt marshlands (J0.12.11).

2. D03.01 Port areas. The development of the industrial port of Zeebrugge (D03.01.04) and of the industrial area (E02) in the hinterland of Ostend that is more or less connected to the industrial port of Ostend (D03.01.04), and probably also the expansion of the leisure port of Nieuwpoort, known as "Novus Portus" (D03.01.02), have caused the loss of quite important superficies of the inner dike types of salt marshes (the inner dike type of salt marshes occurs in the polders under the influence of seepage of salt or brackish ground water that is retained in peaty soil layers). These losses of inner dike salt marsh area were and are currently being compensated as implementation of article 6 of the European Habitat Directive by the Flemish Government and the port authorities by the development of new salt meadows on other locations in the maritime polders. It also must be acknowledged that the building of the 3,5 km long eastern groyne of the harbour of Zeebrugge stimulated sedimentation and initiated the spontaneous development of the "green beach" of the "Bay of Heist".
3. A02. Modifications in cultivation practices. The inner dike type of salt marshes in the polder region occur mostly in shallow depressions that were created by historical (often medieval) peat extraction and were traditionally used as meadows grazed by cattle or sheep. Since a couple of decades it often happens that those lower laying parts of relief rich meadows are incremented and then turned into more productive artificial grasslands or even arable land.
4. K02. Biocenotic evolution, succession. The traditional grazing by large herbivores of the tidal salt marshes of the Zwin was stopped some decades ago. This, together with the increasing silting up of the floodplain, resulted into a dense and rough sward dominated by *Elytrigia atherica*. This tall grass vegetation is very poor in plant species and unattractive for wading birds, ducks and geese.
5. I01. Invasive non-native species. Regularly, seedlings of the American salt tolerant shrub *Baccharis halimifolia*, that was introduced in Europe as an ornamental garden plant and already became a noxious weed in the salt marshes of south-western Europe, appears in the tidal salt marshes of "The Bay of Heist" or the Zwin. If not controlled this invasive alien shrub could become a serious threat for biodiversity, encroaching salt marshes into scrub.

**Ireland, Gaynor, pers.comm.**

1. K01.01 Erosion
2. A Agriculture
3. J02 Anthropogenic changes to hydrological conditions
4. I Invasive, other problematic species and genes
5. E Urbanisation, residential and commercial development

The location, character and dynamic behaviour of saltmarshes are governed by sediment supply, tidal regime, wind-wave climate and sea level change. Obviously erosion is one of the greatest threats/pressures on saltmarshes, but where this is a natural process it should not be managed but allowed to continue where possible. However, accelerated rates of erosion caused by human activities (e.g. coastal protection works, removal of sediment, etc.) need to be prevented. Common agricultural practices that can cause negative impacts on saltmarshes include agricultural improvement, fertilization, mowing and stock feeding. Overgrazing can create low closely cropped swards and areas damaged by poaching.

'Anthropogenic changes to hydrological conditions' incorporates infilling, land reclamation and removal of sediments, as well as flooding modifications, including canalisation. Maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system. Interruption to the sediment circulation through physical structures can starve the system and lead to accelerated rates of erosion. The spread of *Spartina anglica* is viewed as one of the biggest threats and management issues for Irish saltmarshes, although recent surveys have recorded natural die back at a number of sites and even suggested that the nationally rare *Sarcocornia perennis* may actually benefit from the presence of *Spartina* (McCorry & Ryle, 2009).

In Ireland, very few impacts or activities affect this habitat probably due to its inaccessible position in the lower zone of the saltmarsh. The main impact affecting this habitat is the spread of the invasive species common cord-grass (*Spartina anglica*). This habitat is short-lived in places, as it is so vulnerable to natural erosion and accretion cycles and storms (NPWS 2008).

**The Netherlands, Schotman, pers.comm.:**

1. Estuarine and coastal dredging (J02.02.02)
2. Polderisation, reclamation of land from the sea, estuary or marsh (J02.01.01/02)
3. The Damming of former estuaries

Due to land reclamation in the past in one of the estuaries that is still there the 'Westerschelde' the surface has shrunk to half the size in 1600. In The Oosterschelde is a lot of erosion because of the changed balance of sediment since the open dam has been build. The consequence is erosion of habitat types 1310 and 1330 among others. This causes deficiency of food for non-breeding migratory bird that stay here. In the other estuary that is spared from damming the 'Eems/Dollard' problems with dredging shipping lanes are not so severe and the quality of the water has improved after heavy pollution in the past.

**Table 10 Main pressures to Atlantic Region: *Salicornia* and their importance to associated species (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	<i>Salicornia</i> and other annuals colonizing mud and sand
Pollution	x
Landfill, land reclamation and drying out, general	x
Modification of hydrographic functioning, general	x
Dykes, embankments, artificial beaches, general	x
Biocenotic evolution	x

**Table 11 Main threats to Salicornia and their importance to associated species (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Salicornia and other annuals colonizing mud and sand
Pollution	x
Modification of hydrographic functioning, general	x
Erosion	x
Biocenotic evolution	x

**Other information**

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100% (see Appendix 1). This means that Natura 2000 network provides an important framework for the management of this habitat type.

## 2 Conservation management

### 2.1. Main conservation requirements

According to the Bundesamt für Naturschutz 2011 (**Germany**), the following conservation requirements are needed for the Salicornia habitat type:

- The presence of a natural dynamic flood system is essential;
- Large coastal landscape changes should not be carried out;
- Reduction of the input of harmful substances to the environment;
- Larger areas in this habitat type where no human activities occur.

VV.AA. 2009 (**Spain**) lists the following general recommendations for the conservation of this habitat:

- Avoid, as far as possible, the fragmentation of this type of habitat. For existing locations, increase connectivity between isolated sites.
- Avoid overgrazing and over-stocking. Particularly in clay soils, excessive trampling can cause serious damage to this habitat.
- Prevent circulation of motor vehicles in these areas and adjacent intertidal flats, especially on soils where soil moisture conditions are high or soils are waterlogged. [Kleef]
- Reduce, where possible, agricultural pressure on surrounding areas and try to encourage the sustainable use of irrigation and reduce overload of fertilizers.
- Conduct awareness raising campaigns of the value of this type of habitat and its ecological, functional and landscape importance.

**Belgium, Herrier, pers. comm.**

1. J02. Managed realignment by moving dikes landward to submit larger areas back to the marine tide. After thorough scientific and technical studies were carried out, the Flemish

and Dutch authorities decided that the International dike (erected in 1872), that constitutes the most recent phase in the land reclamation history of the Zwin region, will be moved landward to enlarge the present relic of the tidal flood plain (150 ha) with 120 ha of present day polder (mainly arable land), to restore tidal creeks, mud flats and salt marshes and provide more space for tidal flood dynamics. The tidal mud flats and salt marshes of the Yzer estuary were restored by the removal of the former dredging sludge dump. A rather small part of that dredging sludge dump has still to be removed.

2. D03.01. Compensation of the loss of salt marsh habitat area by development on judiciously chosen locations in the polders of new inner dike salt marshes by excavation of the superior soil layers, in order to lower the ground level into the reach of salt or brackish groundwater.
3. A02.: idem as 2. Or restoration of inner dike salt marshes by excavating back previously incremented areas.
4. K02. Reintroducing seasonal grazing by cattle (from 2007 on) in the Zwin has turned back the rough sward of *Elytrigia athica* into a more species rich type of salt marsh. After the removal of the dredging sludge dump at the Yzer estuary, the restored salt marsh was directly submitted to seasonal grazing by sheep. In the near future the most highly silted up part of the floodplain of the Zwin will be submitted to turf cutting until the bare mineral substrate to rejuvenate mud flats and salt marshes (LIFE+ Nature project ZTAR, 2011-2015). At the "Bay of Heist" mowing the swards at the end of summer all 2 years is applied.
5. I01. Systematic eradication of *Baccharis halimifolia* at the Yzer estuary, the Zwin and the "Bay of Heist" by pulling out all seedlings of this invasive alien shrub.

#### Ireland, Gaynor, pers. Comm.

1. Maintain the supply of sediment
2. Maintain the natural tidal inundation regimes
3. Maintain the natural creek and pan structure
4. Maintain structural diversity within the sward
5. Prevent and/or control the spread of *Spartina anglica*

Accretion and erosion are natural elements of saltmarsh systems and should be allowed to occur naturally. Sediment supply is particularly important for this pioneer saltmarsh habitat, as its distribution depends on accretion rates. The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and survival of saltmarshes. Creeks play an important role in distributing sediment throughout the saltmarsh and should be maintained.

## 2.2. Management measures

- Protection within designated sites. Around 87% of the resource of H1310 lies within SACs with management measures specifically aimed at maintaining and enhancing the features for which they are designated, and to address some of the pressures listed within section 4.1 and the future threats listed in section 5.1.2. A significant proportion of the resource of this habitat also lies within the SSSI/ASSI series where similar management measures are in place.
- UK BAP. The habitat is covered by the Coastal sand dunes action plan under the UK Biodiversity Action Plan (see <http://www.ukbap.org.uk>), as well as under country and local biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource.



(Joint Nature Conservation Committee 2007)

- In inland polderized situations with a lack of sufficient dynamics, the seasonal use of domestic grazing may be an important measure to maintain or restore the habitat (Van Uytvanck et al. 2010), but in intertidal salt marshes, domestic grazing of the pioneer zone is not recommended. [Kleef]
- For this type of habitat, management essentially needs to be reduced to non-intervention (Muséum national d'Histoire naturelle [Ed] 2003). When, as a consequence of a lack of grazing or other lack of dynamics, the vegetation of the concerned site has grown into a closed and rough sward that is dominated by competitively dominant grass species such as *Elytrigia atherica*, local mechanical removal of the turf ("cutting off sods"), leaving the mineral soil bare, can rejuvenate mud flats and salt marshes and give new opportunities to pioneer plants such as *Salicornia* div. spp. and *Sueda maritime*, so restoring habitat 1310. [Herrier]
- *Salicornia* is regulated in some departments, for reducing the risk of a massive commercial operation of unsustainable resource gathering (Muséum national d'Histoire naturelle [Ed] 2003).
- There was a trend to abandon the mainland salt marshes in the Wadden Sea. Which is a risk for erosion. A less intensive management of the ditches and brushwood groynes can favour the conditions for pioneer saltmarshes but it can also be a risk. There is a delicate balance between some management en no management at all. [Schotman Alterra]

Ireland, Gaynor, pers. comm.

1. Improved enforcement of planning regulations
2. Input into planning process
3. Control and/or removal of *Spartina*
4. Creation of new areas of saltmarsh by re-flooding areas that were formerly infilled or reclaimed

### 2.3. Other measures (e.g. monitoring)

- The main method of re-creating saltmarsh would rely on the flooding of low-lying land by tidal water; some of it previously reclaimed saltmarsh. To re-create or restore habitat area would require the right combination of topography or drainage, influx of sediments and intertidal flooding. [Kleef]
- Much of the potential area has been land claimed and now lies behind artificial flood banks that reduce the risk of flooding. Some of these flood banks protect built infrastructure such as power stations and industry. Any managed realignment would need to take account of this and also the dynamics of the estuary: therefore potential area of pioneer saltmarsh may be less than the extent of the flood plain overall. It has been estimated that approximately 100 ha of saltmarsh needs to be created annually to keep pace with losses to coastal squeeze, with an additional amount to account for losses since the Habitats Directive came into force (UK BAP 1999).
- Coastal engineering on intertidal mudflats in front existing salt marshes or seawall (e.g. construction of groynes) in order to create sheltered environment to stimulate the establishment of pioneer salt marsh (see also Section 2.2 under H1330). [Kleef]

(Joint Nature Conservation Committee 2007)

## 2.4. Species specific measures

Managed and unplanned realignments, and removal of coastal flood defence banks, creates space for new intertidal areas – both mudflat and saltmarsh. For saltmarsh, the pioneer communities will be first to respond to sufficient sediment being deposited to trigger vegetation growth. Where *S. anglica* is present within a process cell, it will usually be the first to establish, restricting the space available for the H1310 habitat to establish and expand. However, experience shows that on most sites, *S. anglica* does not completely exclude the other pioneer communities (i.e. the H1310 habitat). (Joint Nature Conservation Committee 2007)

## 2.5. Main constraints / bottlenecks and actual needs

The area of this habitat has declined greatly over the last 100 years due to human actions. This has compounded the impacts of previous land claims and changes in response to sea level rise and sediment availability. The current area is considered to be less than 10% below the favourable reference area.

The creation of saltmarshes is needed annually to keep pace with losses to coastal squeeze. (Joint Nature Conservation Committee 2007).

In some areas of the Netherlands, potential space for natural pioneer salt marshes to develop is limited. Existing salt marshes gradually develop to late-succession marshes (so-called ageing of salt marshes). A temporary and partial loss of existing salt marsh H1330 may be required in order to allow of rejuvenation of salt marshes including re-development of pioneer salt marsh.

An important area (c. 5,000 ha) of H1310 is found inside engineering or sedimentation works seaward of mainland salt marshes or seawall in the Wadden Sea of Netherlands, Germany and Denmark. These salt marshes have to a large extent been fixated by anthropogenic influences. On the mainland side, the landward boundary is fixed by the seawall, whereas on many coastal stretches the seaward boundary is fixed by these sedimentation works. In the sedimentation fields, the sheltered environment enhances the expansion of pioneer salt marsh, and the succession of the pioneer salt marsh to low salt marsh. Where this situation prevails, the position of primary pioneer vegetation will ultimately become delicate after the available space has been consumed by salt-marsh development. Since livestock grazing does not affect the fate of the pioneer zone, primary pioneer salt marsh may only be preserved if spatial dynamics become integrated in the management of sedimentation fields (Esselink et al. 2009). [Kleef]

**Belgium**, Herrier, pers. Comm.

1. J02. Opposition by farmers, wanting to continue their agricultural use of the polder (Belgium). Fear for soil salinization of the remaining agricultural polder land around the enlarged tidal flood plain (Belgium). Part of the public dislikes the idea to give back to

- the sea land “their ancestors” reclaimed (Netherlands).
2. D03.01. Private property, non-cooperating owners or other land users
  3. A02: idem as 2.
  4. K02. At the start some cattle holders were afraid that the salt environment would harm the health of their cattle, but this fear disappeared after the successful first years of practice. Now the economic added value of “pré salés”-meat encourages cattle and sheep holders to provide animals for the grazing of the salt marshes.
  5. I01. None, except the risk for encroachment of the salt marshes with Baccharis will continue to exist as long as this invasive alien shrub is kept as an ornamental plant in gardens and parks in the coastal region.

**Ireland, Gaynor, pers. Comm.**

1. Lack of resources
2. Enforcement difficulties
3. History of poor planning
4. Public perception of saltmarshes as dirty/smelly wasteland
5. Climate change

## 2.6. Recommendations

**Belgium, Herrier, pers. comm.**

1. J02. Awareness raising, communication, purchase of land, accompanying socio-economic measures in favour of the farmers that loose arable land, protective hydrological measures against salinization of surrounding agricultural land.
2. D03.01. Awareness raising, communication, purchase of land by nature conservation agency
3. A02. Awareness raising, communication, purchase of land by nature conservation ngo’s or agency.
4. K02. Awareness raising and demonstration with a cattle holder that has had practical experience with the grazing of salt marshes.
5. I01. Awareness raising: convincing people and public park managers not to keep Baccharis in their gardens/parks.

**Ireland, Gaynor, pers. comm.:**

1. Education
2. Raising public awareness
3. Influencing planning policy
4. Communication
5. Improved enforcement of planning regulations and wildlife legislation

**The Netherlands, Schotman, pers. comm.**

1. communication
2. Firm policy

## Cases / projects

### LIFE Nature projects:

- LIFE96 NAT/B/003032 "ICCI – Integral Coastal Conservation Initiative": restoration of tidal mud flats and salt marshes in the Yzer estuary at Nieuwpoort (1997 – 2001, Belgium, completed): see my completed form of case study [Herrier]
- LIFE09 NAT/B/000413 "ZTAR – Zwin Tidal Area Restoration": recently started project of restoration of tidal lagoon, mudflats, salt marshes and inlet by the Agency for Nature and Forests in Belgium and the Province of Zeeland in the Netherlands (2011 – 2015) [Herrier]

## Sites

### For Belgium (Flemish Region):

- SCI BE2500001 "Duingebieden inclusief IJzermonding en Zwin" (both subtypes of 1330) [Herrier]
- SCI BE2500002 "Polders" (subtype B, inside dikes of 1330) [Herrier]

## 1330 – Atlantic Salt meadows (*Glauco-Puccinellietalia maritimae*)

### Summary

**Atlantic salt meadows** (*Glauco-Puccinellietalia maritimae*) are widespread along the coasts of Western Europe, occurring in tidal estuaries and behind barrier islands as well as on open coast and in lagoons. The habitat depends strongly on tidal cycles, sediment transport and sedimentation and on the establishment of salt tolerant plants. The balance between erosion and accretion, which can be very local, plays a specific role in defining the extent of the habitat. Salt meadows are characterized by salt tolerant vascular species, mostly in successional zones of differentiating salt tolerance.

This habitat type is highly variable hosting a large plant and animal diversity occurring in different successional phases, ranging between pioneer marshes to habitat containing tree species on the upper tidal limits. There is also a North-South European gradient in accompanying plant communities caused by different grazing regimes. In general, the vegetation is sensitive to changes in grazing, which could have knock-on effects for other species. Hence species dependent management prescriptions can be very specific based on country and tidal zone. Many vegetation subtypes are described depending on the location on the tidal range as well as location inside or outside dikes. Associated species with conservation status include a wide range of migratory birds that use the salt meadows as feeding and breeding sites, as well as several toad species and specialized invertebrates. There is a range of ecological services associated with this habitat type that include its use as sea and flood defence, the provisioning of grazing habitat, as well as fish and shellfish collection. The habitat functions as a sink for pollutants and is therefore important for water quality improvement. Salt marshes also have a high scientific, landscape, recreational and cultural value.

This habitat is present in all member states of the Atlantic region, with exception of Belgium where it is rare. In the Atlantic region, this habitat type is widespread with between 76-100% of the habitat area included in the Natura 2000 network, making this an important framework for the management of the habitat type.

The **conservation status of this habitat type** in the Atlantic has been assessed as ‘unfavourable-bad’. The reasons for this negative status include changed coastal dynamics, agricultural activities and human impacts. The trends for this habitat are negative due to abandonment of intensity grazing, and the enclosure and reclaiming of salt meadows, especially in The Netherlands, France and the UK.

The exact pressures differ among member states: land claim, erosion and grazing are most important in the UK, Ireland and The Netherlands; additionally eutrophication and pollution are important in Germany and Denmark. The main **threats and pressures** to salt meadows in the Atlantic region include:

- changes in the grazing regime, which could have knock-on effects towards bird populations;
- since the habitats are maintained by a balance between erosion and accretion by sediment, they are threatened by changes in these dynamics, especially loss of sediment

transport and coastal squeeze through building embankments and enclosure of the salt meadows.

Because of the different threats **management measures** and activities are partly member state specific, but include:

- active management: changing the grazing pressure depending on the sub type ranging from heavily grazed to completely ungrazed (grazing could also be used as management tool for creating more diversity);
- management of invasive species such as *Spartina*
- control of the impact of predation on bird populations;
- the promotion of salt marsh accretion through plantings or building groynes (in order to prevent the loss of salt meadows and/or to restore them);
- erosion control through the creation of wave breaks and increasing available sediments;
- reintegration with the sea of former tidal land which is now enclosed.

The **bottlenecks** that are encountered in conservation and restoration of favourable conservation status in salt meadows are mainly:

- lack of resources;
- ongoing human activities;
- public perception of the value of this ecosystem is often low because they perceive it as “smelly and dirty”;
- since the habitat is often divided over many owners it is seen as difficult to agree on common management activities.

**Solutions** for the pressures and bottlenecks are found in:

- better education;
- good and early planning of management activities as well as improved enforcement of these activities;
- raising public awareness and improved communication about this habitat.

## 1 Description of the habitat

Salt meadows of Baltic, North Sea, English Channel and Atlantic shores. *Aster tripolium* can be present or abundant in most subdivisions (EC 2007b).

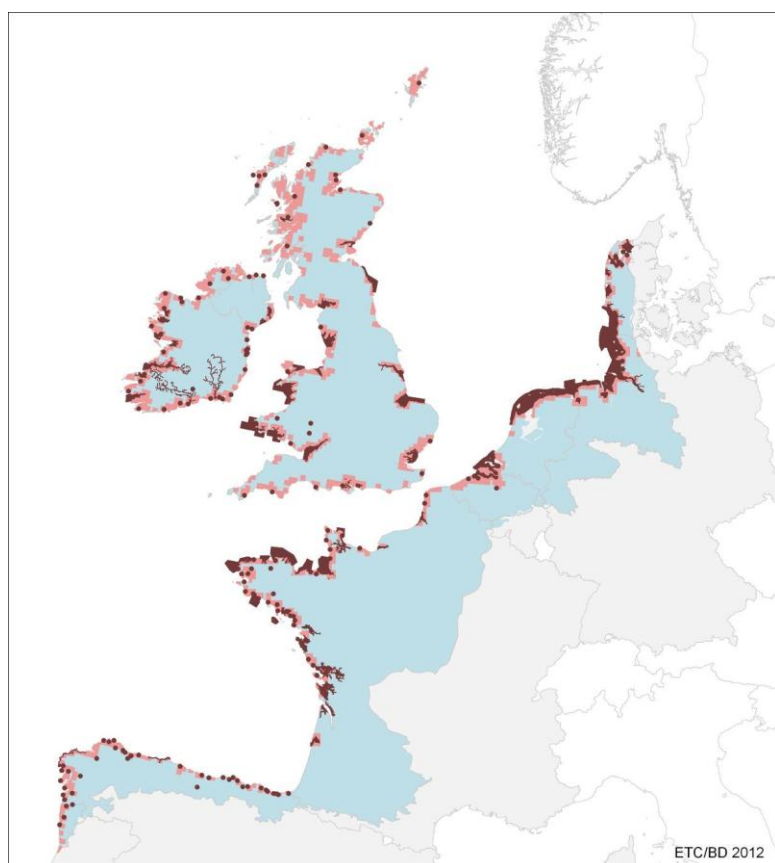
### 1.1. Distribution

**Table 12 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

*Note: coastal salt marshes normally are spatially dynamic: they either protrude or erode. Figures should be interpreted accordingly [Kleef]<sup>11</sup>*

	BE		DE			DK		ES				FR				IE	NL	PT		UK	
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	3			14	27	11	57		41				61			39	12	3		2	48
habitat area (ha)	353			16511	3756	12541	18009		2110				25380			3303	9181	309		103	24036

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>12</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type(ETC BD 2012).



**Figure 3 Map of SCIs proposed for the Atlantic salt meadows & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

<sup>11</sup> Update for NL (based on Dijkema et al. (2007) & Esselink et al. (2009)) : **9181 9100 [Kleef]**

<sup>12</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

Salt marshes and coastal meadows are widespread along the coasts of Western Europe and the Baltic Sea. Main features that distinguish the Baltic coastal meadows (\*1630) from the Atlantic salt meadows (1330) are lower salinity (>1.5‰) and a much smaller tidal range (Doody 2008).

In the UK, Estuaries that support salt meadows are widely distributed around the coast. Salt meadows can also be found on the open coast where conditions are suitable, e.g. the presence of a barrier beach allows sediment to accumulate to a level where halophytic vegetation can colonise (Joint Nature Conservation Committee n.d.).

In Spain Atlantic salt meadows are distributed along the Cantabric and the north western coasts (Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.).

On the German North Sea coast salt marshes are widely distributed in fine sediments with emphasis on the East Frisian and North Frisian islands, islets and close to river mouths (estuarine salt marshes). On the Baltic coast, the habitat type occurs in small areas such as at the 'Schlei', in the Wismar Bay or at the 'Darß Zingster Bodden' chain. (Bundesamt für Naturschutz n.d.)

In Flanders, this habitat type occurs in the polder area and is very rare, covering some tens of ha. (Van Uytvanck et al. 2010). It also occurs in the tidal salt marshes within the eco-region of the coastal dunes, more precisely in the tidal flood plain of the "Zwin" at Knokke, the green beach of the "Bay of Heist" near Zeebrugge and the Yzer estuary at Nieuwpoort. [Herrier] In the Netherlands this habitat type is mainly present in the Wadden Sea and the Delta in the Southwest. On the islands in the Wadden it is a type on sandy soils, along the mainland coast it is very silty. In the Delta along the Schelde they are also mainly silty. [Schotman Alterra]

## 1.2. Main features

Salt marshes and coastal meadows are characterized by communities of herbaceous salt-tolerant vascular plants, mostly in a zonation with the most saline-tolerant species closest to the sea.

Atlantic salt meadows are communities of herbaceous halophytic (salt-tolerant) plants growing on the margins of tidally inundated shores. They lie at the upper end of a succession between the early colonizing species such as *Salicornia europaea* and transitions to vegetation where tidal influence is limited. Colonization begins at Mean High Water of Neap tides extending to the upper limit of normal tides. Distributed along the eastern shores of the Atlantic and along the Baltic, there is a marked north-south variation in the plant community of salt marshes and coastal meadows. The main features that separate the Baltic coastal meadows (\*1630) from the Atlantic salt marshes are their lower salinity levels and the very limited impact of the tide but, otherwise, many of the management recommendations are relevant to both habitat types (Doody 2008).

Salt marshes and coastal meadows are wide spread, occurring in tidal estuaries and behind barrier islands, as well as on open coasts and in lagoons. They are at their most extensive in the macro-meso tidal estuaries (spring tidal range > 4 and 2-4m respectively) of Britain and in the Danish, German and Dutch Wadden Sea. Outside this geographical area individual estuaries can also support large



salt marshes (>50 0 ha) where physical conditions and sediment availability favour their development.

They are also present in the micro-tidal (<2 m spring tidal range) Baltic Sea. They extend into the rocky coasts in the north occurring as smaller scattered examples at the head of sea lochs, on rocky beach plains and on exposed cliffs where salt spray drenches the shallow soils on the cliff slopes and tops. The community rarely exists in isolation, and represents the upper part of the succession from open tidal flats to high-level salt marsh.

To some extent, a [Kleef] similar management approach is applicable for both the Atlantic salt meadows (habitat 1330) and the Boreal Baltic coastal meadows (habitat \*1 630). Boreal Baltic meadows differ in that they have a lower salinity (for Sweden, 1.5‰ is given as an indicative limit; Naturvårdsverket 1997), and are much less influenced by tides. In practice, it means that sites located along the Swedish coastline east of the southern mouth of the Sound (Öresund) are all classified as Baltic coastal meadows (Doody 2008). To a great extent, Baltic salt meadows are of anthropogenic origin. Reed beds dominated by Phragmites were transformed into salt meadows from c. 4000 B.C. onwards, when exploitation of the Baltic shores started by domestic grazing (Vestergaard 1998). [Kleef]

Atlantic salt meadows are communities of herbaceous halophytic (salt-tolerant) plants growing on the margins of tidally inundated shores. So long as there is a reasonable supply of sediment and a low energy wave environment, their development depends on the following (Doody 2008):

- normally, twice-daily tidal cycles;
- sediment transport across the shore;
- sediment accumulation;
- establishment of salt tolerant plants

The development of vegetation determines the nature and extent of the habitat in relation to (Doody 2008):

- tidal range and/or wave energy;
- sediment availability, type, method of deposition and cohesion;
- degree of protection (from storms and wave action);
- intertidal [Kleef] flat topography and extent;
- distance from coast/main estuary channel;
- distance from creek banks;
- relative sea level change.

Actively accreting marshes with annuals (Community 1310) or *Spartina* spp. (Community 1320) border the more mature Atlantic salt meadows. These in their turn may have the full sequence of community types represented within them depending on their age and freedom from enclosure. Atlantic salt meadows include species such as *Puccinellia maritima*, *Halimione portulacoides*, *Halimione pedunculata*, *Aster tripolium*, *Armeria maritima*, *Glaux maritima*, *Plantago maritima*, *Frankenia laevis*, *Artemisia maritima* (= *Seriphidium maritimum*) [Kleef], *Festuca rubra*, *Agrostis stolonifera*, *Juncus gerardii*, *Carex extensa*, *Blysmus rufus*, *Eleocharis* spp., *Spergularia marina*, *S. maritima*, *Limonium* spp [Kleef], *Puccinellia distans*, *P. fasciculata*, *P. retroflexa*, *P. maritima*, *Triglochin maritima*, *Potentilla anserina*, *Halimione portulacoides*, *Elymus pycnanthus* (= *Elytrigia atherica* = *Agropyron pungens*) or and *E. repens* [Kleef], *Atriplex littoralis*, *A. hastata*, *Beta maritima*,

*Matricaria maritime* (= *Tripleurospermum maritimum*) [Kleef], occurring at successively higher levels across the salt marsh transition (EC 2007 in Doody 2008). *In brackish tidal marshes" sybtypes of H1330 may be distinguished with a dominance of Bulboschoenus maritimus, Schoenoplectus tabermontani or Phragmites australis"*. [Kleef]

There is a marked north-south variation in the plant community on the Atlantic coast from southern Portugal to northern Norway. In northerly locations, they are often sheep-grazed and include *Salicornia europaea*, *Armeria maritima*, *Triglochin maritima* and *Blymus rufus*, as for example in northern Scotland. This community may include free-living fucoids and is characteristic of the northern geographical zone, extending from south west Scotland into Scandinavia. *Puccinellia maritima* and *Juncus maritimus* help to define the northern limit of temperate Atlantic salt meadows (Adam 1990 in Doody 2008).

In the south, the native *Spartina maritima* can be the main colonizing species. The shrub *Atriplex portulacoides* is also prominent in the ungrazed Atlantic salt meadow community. Both species are frost sensitive and reach their northern limit in southern Denmark and northern England.

The vegetation can be highly modified when grazed by high densities of domestic stock, which has a knock-on effect on other species utilising the habitat. As a result, there are different management prescriptions for the conservation of some plant species, birds and invertebrates, dealt with below.

### 1.3. Ecological requirements

The establishment of salt-tolerant plants on sheltered tidal flats is the first stage in the colonization of this highly specialized community. Sedimentation, aided by the presence of plants, raises the shoreline such that progressively fewer inundations of the tide take place. Atlantic salt meadows lie at the upper end of a succession between the early colonizing species such as *Salicornia europaea* and transitions to vegetation where tidal influence is limited. Colonization begins at Mean High Water of Neap tides when seedlings of the annual, salt-tolerant colonizing species remain free from tidal agitation for several days on neap tides.

These communities belong to the EU Habitat group 1310 *Salicornia* and other annuals colonizing mud and sand and 1320 *Spartina* swards (*Spartinion maritimae*). Succession leads to the development of 1330 Atlantic salt meadow (*Glauco-Puccinellietalia maritimae*) and in the absence of human interference, merges at higher levels into transitions with *Phragmites australis* [Kleef] swamp, willow scrub and very occasionally, woodland. *In the absence of grazing, other human interference or natural erosion, the vegetation succession leads the habitat 1330 Atlantic salt meadow into a state of dense vegetation coverage dominated by Elytrigia atherica, that is botanically very poor in species and not attractive as foraging ground for wading birds, ducks and geese.* [Herrier] The height of the shoreline determines the number of tidal submergences, which in turn influences the plant species that occur along the shore (Doody 2008).

The physical structure of the salt marsh varies considerably. Under favourable conditions (abundant sediment and a sheltered shoreline), salt marsh can accrete rapidly both vertically and horizontally. Some of the largest examples occur where abundant sediment is swept into estuaries and bays; such

as the Bay of Saint Michel (France), the Wash (England) and in the Wadden Sea (Netherlands, Germany and Denmark).

Once established, although rates of vertical accretion decrease, sediment deposition can still be several mm per year. On rocky and exposed coasts, sediment may be much less plentiful and locations where salt marshes become established are more restricted. These tend to develop as small fringing salt marshes in narrow drowned river valleys (rias) such as those in south west England and on the coast of Brittany, at the head of sea lochs (fjords, in Scotland and Scandinavia) and along other predominantly cliffed coastlines.

Erosion of established salt marsh begins when the balance of the forces promoting accretion is reversed, such as an increase in wave action, reduced sediment availability or decrease in the degree of protection from storms. Both accretion and erosion may naturally occur on the same site responding to changes in the forcing factors. Human activities may initiate and/or accelerate erosion and at many sites have done so, see below the 'salt marsh squeeze'.

Atlantic salt meadows are intimately associated with other coastal habitats, in some cases their existence depends on the shelter they provide. Thus, salt marshes also occur on open coast high-level beach plains, behind sand dune or shingle spits, bars or barrier islands and in the lee of islands and other protective structures.

Sediment availability is a key requirement. It is derived from land-based sources (erosion of uplands), erosion of coastal cliffs and re-mobilization of sediment in salt marshes and sand dunes or erosion of offshore sand banks. Rivers transport the sediment to the coast. Tidal movement and wave energy drive the sediment along the shore and landward. The final position of the salt marsh depends on the balance between these forces and the amount of sediment available for deposition (Doody 2008).

## 1.4. Main subtypes

In the United Kingdom, there are no less than 12 recognized community types within Atlantic salt meadows. Together with the pioneer and transitional communities, they include up to 28 distinct types (Rodwell 2000 in (Doody 2008). In the Wadden Sea, on a trilateral level of the Netherlands, Germany and Denmark, salt-marsh typology has harmonized, in which 23 community types of H1330 are distinguished, or 33 when pioneer plant communities and transitions to other habitats are included (Esselink et al. 2009). [Kleef]

In France, according to ecological criteria, the generic habitat is divided in five elementary habitats (Muséum national d'Histoire naturelle [Ed] 2003):

- Salt marshes from the low tidal marsh
- Salt marshes from the medium tidal marsh
- Salt marshes from the upper tidal marsh
- Salt marshes in contact with upper tidal marsh/dune
- High prairies of upper level reached by the tides

Subtypes in the Netherlands (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.):

- H1330\_A Salt marshes and salt meadows (outside the dikes)

This subtype concerns the habitat type of the outer dike area. It includes tide-based (more or less frequently) flooded grasslands of the intertidal area (island and mainland marshes) and the Dunes (in creeks, wash-overs, beach plains behind dunes and green beaches). These habitat types are flooded by seawater from the tidal creeks (sometimes penetrating far into the marshes).

- H1330\_B Salt marshes and salt meadows (inside the dikes)

This subtype concerns the habitat type of the inner dike area. It includes grassland with a marine background that remain salty due to a continuous influx of brackish or saline groundwater. These salty grasslands are very local in the Peat area (brackish bogs), but especially in the Sea clay area (along creeks and closed bays) and inlets (former salt marshes). The species composition is very similar to those of subtype A, especially in closed bays or recently diked areas, the brackish bogs comprise only a small part of the ecological variation.

Both subtypes also occur in Belgium (Flemish Region). [Herrier]

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified through expert judgment a number of species under the Habitats and Birds Directive associated with estuaries and provided conservation status for Annex II and IV species in the Atlantic Member States (see tables below). When national documents or other relevant sources specifically mention a species that depends on the habitat, even if the species is not listed in the Habitats and Birds Directives Annexes, this species has been added to the list.

**Table 13 Species associated to Atlantic salt meadows (for legend, see introduction of chapter 3)<sup>1314</sup>**

SPECIES	ETC/BD	Doody	BE	DE	DK	ES	FR	IE	NL	PT	UK
Anas acuta A054	x										
Anas clypeata A056	x										
Anas crecca A052	x										
Anas penelope A050	x										
Anas platyrhynchos A053	x										
Anas strepera A051	x										
Anser anser A043	x										
Arenaria interpres A169	x										
Branta leucopsis A045	x										
Calidris alba A144	x										
Calidris alpina A149	x										
Calidris canutus A143	x										
Charadrius hiaticula A137	x										
Cygnus columbianus bewickii A037	x										

<sup>13</sup> missing amongst others: *Asio flammeus* A222, *Circus cyaneus* A082 *Egretta garzetta* A026, and *Platalea leucorodia* A034. [Herrier]

<sup>14</sup> Most birdspecies associated in ETC/BD also are associated with Salt meadows in the Netherlands, except A028, A145, A189. Salt meadows are also important area's for breeding: A034, A063, A081, A082, A132, A137, A138, A183, A191, A193, A194, A195, A222 (Roomen at al. 2000) [Schotman Alterra]

SPECIES	ETC/BD	Doody	BE	DE	DK	ES	FR	IE	NL	PT	UK
Cygnus cygnus A038	x										
Gallinago gallinago A153	x										
Haematopus ostralegus A130	x										
Larus fuscus A183	x										
Limosa lapponica A157	x										
Numenius arquata A144	x					x					
Numenius phaeopus A158	x										
Philomachus pugnax A151	x										
Pluvialis apricaria A140	x										
Pluvialis squatarola A141	x										
Recurvirostra avosetta A132	x										
Tadorna tadorna A048	x										
Tringa glareola A161	x										
Tringa nebularia A164	x										
Tringa totanus A162	x										
Vanellus vanellus A142	x										
Anas querquedula A055	x										
Anthus pratensis A257	x										
Ardea cinerea A028	x										
Branta bernicla A046	x										
Calidris ferruginea A147	x										
Calidris minuta A145	x										
Charadrius alexandrinus A138	x										
Charadrius dubius A136	x										
Cygnus olor A036	x										
Gelochelidon nilotica A189	x										
Larus argentatus A184	x										
Larus canus A182	x										
Larus marinus A187	x										
Larus ridibundus A179	x										
Limosa limosa A156	x										
Lymnocyptes minimus A152	x										
Tringa erythropus A166	x										
Bufo calamita		x									
Bufo viridis		x									
Liza ramada		x									
Dicentrarchus labrax		x									

Sources: (ETC BD 2012)Doody 2008

### Vegetation

In Europe lightly grazed or ungrazed salt meadows support a rich community of halophytic plants. The geographical variation of the main vegetation communities provides the basis for the selection of Special Areas of Conservation. Sub divisions within national boundaries modify the selection, reflecting local climatic and physical conditions. In the United Kingdom, there are no less than 12 recognized community types within Atlantic salt meadows. Together with the pioneer and transitional communities, they include up to 28 distinct types (Rodwell 2000 in (Doody 2008).

The specialist flora also includes rare species with distinct geographical distributions. Amongst those are *Blymus rufus*, a species of northern latitudes and Shrubby Sea-blite *Suaeda vera* and several species of Sea Lavender such as Matted Sea-lavender *Limonium bellidifolium* with a much more southerly distribution, including the Mediterranean.

### Birds

Salt marshes and coastal meadows are key habitats for several bird species listed in Annex I of the EU Birds Directive. Their occurrence is often the main justification for their designation as Special Protected Areas (SPAs).

Stop-over and wintering sites: the grassy salt marshes are a main food resource for many wildfowl birds during autumn or spring migration such as *Branta bernicla* (brent goose) or *Cygnus columbianus bewickii* (tundra swan). Both are judged to have an unfavourable conservation status in Europe (BirdLife International 2004 in (Doody 2008).

Breeding sites: The salt marshes play an equally important role as breeding sites for a number of wader species listed in Annex I of the EC Birds Directive:

- *Charadrius alexandrinus* (kentish plover) breeds in coastal areas in western and southern Europe. The species has suffered a moderate continuing decline and is considered to have an unfavourable conservation status in Europe (BirdLife International 2004 in Doody 2008). In connection to salt meadows, it also breeds on shell and mud banks, sandy shores and coastal lagoons and may temporarily appear at land-fill sites. Habitat decline and increased predation pressure at salt meadow areas in south Sweden and Denmark has contributed to its negative trend (e.g. Jönsson 2007a in Doody 2008).
- *Calidris alpina schinzii* (dunlin): Taking Europe as a whole, this species has a large breeding population, but the subspecies *C.a. schinzii* is more restricted in its distribution and salt marshes along the coasts of the North Sea, Kattegat, Skagerrak and the Baltic Sea is one of its main habitats inside EU. The subspecies has been declining for a long period during the 20th century, and although there has been a recent increase in the UK, the overall trend is still negative. The decline is clearly linked to changes in the management (primarily grazing regime) on salt marshes and inland wet meadows.
- *Philomachus pugnax* (ruff) is considered to have an unfavourable conservation status in Europe (BirdLife International 2004 in Doody 2008). Nowadays, salt meadows (outside the UK and Ireland) are one of the few habitats where this species is found breeding outside the mires and peatlands of the Boreal region where the main part of the breeding population in Europe is normally found. Although the decrease is thought to be primarily related to factors affecting the migration and wintering sites, it is clear that inappropriate grazing, both with reference to grazing pressure and grazing too early during the breeding season, has contributed to its decline at a local and regional level (Widemo 2007 in Doody 2008).

In addition, the salt meadows still host viable populations of various widespread bird species not listed in Annex I of the EU Birds Directive but with an unfavourable conservation in Europe due to recent declines in the agricultural landscape. They include wader birds such as *Vanellus vanellus* (Northern lapwing), *Gallinago gallinago* (common snipe), *Limosa limosa* (black-tailed godwit) and *Tringa totanus* (common redshank). At least at a local and regional level, salt meadows are sometimes the only remaining habitats where these birds can still be found in important numbers.

### Amphibians

For some endangered amphibians (listed in Annex IV of the EC Habitats Directive), salt meadows represent an important refuge:

- *Bufo calamita* (natterjack toad) is associated with breeding in warm, shallow seasonal pools that can be found in the upper part of salt marshes and coastal meadows at single sites all over its distribution range. Reproduction can take place in pools with salinities of up to 5-6 ‰; eggs and tadpoles may survive in salinity levels up to 10 ‰. The surrounding terrestrial environment is of equal importance, and needs to be kept open with short vegetation. This facilitates movement on land between pools and adjacent hibernation sites etc (e.g. Andrén & Nilsson 2000 in Doody 2008).
- *Bufo viridis* (green toad) has a south-eastern distribution range and is found in coastal habitats in Denmark, southernmost Sweden and along the south-eastern Baltic coast up to Estonia. Here, it is dependent on warm and shallow pools with an inflow of ground-water (e.g. Andrén 2007 in Doody 2008). There has been a marked decline in numbers along the northernmost range during the latest decades.

### Invertebrates

Various invertebrate species inhabit salt marshes. They range from highly specialised species tolerant of rapid and prolonged tidal inundation to terrestrial species. The higher Atlantic salt meadows are especially favoured and have an especially good structural diversity in areas with low levels of domestic grazing. Several grazing-sensitive species such as Sea Purslane *Atriplex portulacoides*, Sea Lavender *Limonium vulgare* and Sea Wormwood *Seriphidium maritimum* provide an important food resource and shelter for a wide variety of species.

## 1.6. Related habitats

Salt marshes and coastal meadows often occur in a complex with other shore-line habitats, such as 1210 Annual vegetation of drift lines, 1310 *Salicornia* and other annuals colonising mud and sand and 1320 *Spartina* swards (*Spartinion maritimae*). They are also closely related to 1130 Estuaries, 1140 Mudflats and sandflats not covered by seawater at low tide, 1150\* coastal lagoons, where mean water level and absence of vegetation are often used as a somewhat arbitrary demarcation line. [Herrier] Further away from the shoreline, the salt marshes may merge into semi-natural humid meadow habitats (mostly 6410 or 6430), with fewer halophytic (salt-tolerant) vascular plants. In the absence of human interference, Atlantic salt meadows merge at higher levels into transitions with *Phragmites communis* swamp, willow scrub and very occasionally, woodland (Doody 2008). In the absence of grazing, other human interference or natural erosion, the vegetation succession leads the habitat 1330 Atlantic salt meadow into a state of dense vegetation coverage dominated by *Elytrigia atherica*. [Herrier]

The main features that separate the Baltic coastal meadows (\*16 30) from the Atlantic salt marshes are their lower salinity levels and the very limited impact of the tide but, otherwise, many of the management recommendations are relevant to both habitat types (Doody 2008).

## 1.7. Ecological services and benefits

Tidal salt marshes rarely exist in isolation, forming an integral part of many estuaries, other tidal inlets and bays and deltas. In this context, they contribute to (Doody 2008):

- natural processes and geomorphological patterns;
- the trophic energy of the system through estuarine food chains and support for estuarine food webs;
- the ability of the ecosystem to support recycling mechanisms for nutrients and other organic/inorganic compounds contributing to the healthy functioning of the ecosystem.

As such, they have a number of different values associated with economic, cultural and environmental qualities.

### **Economic values**

Salt marshes have been valued for the following (Doody 2008):

Sea and flood defence. Salt marshes provide protection of the hinterland from waves and storms, through their contribution to sea defence. Part of this value derives from the way salt marshes attenuate waves. This can be as much as 92% with most of the attenuation, > 40% taking place in the first 10m of permanently vegetated marsh (Möller *et al.* 2002, Möller & Spencer 2002 in Doody 2008). Wave height and wave energy are similarly reduced, by 71% and 92% respectively in North American salt marshes (Frey & Bason 1978 in Doody 2008). The type of vegetation and season may also be important. More robust plants particularly in the autumn when vegetation growth has reached a maximum, provide the highest wave attenuation (Bouma *et al.* 2005, Möller 2003 in Doody 2008).

Grazing. The use of salt marshes for grazing by domestic stock (cattle and sheep) is a long established practice. In northwest England, where some of the most extensive and intensively grazed sites in Europe occur, stocking densities up to 6.5 sheep (year round) or 2 cows (summer) per ha have been recorded (Gray 1972 in Doody 2008). Similar stocking levels occur in the Wadden Sea and on the French coast. The salt marshes of Normandy coast of France in particular, produce 'Pré-Salé lamb' long regarded as a delicacy in French restaurants.

Fish and shellfish. A few detritus-feeding species such as species of Grey Mulletts (e.g. *Liza ramada*) feed directly on material derived from the salt marsh. More significant is shelter from predation for juvenile Sea Bass *Dicentrarchus labrax*, which spend the first three or four years of their lives in estuaries. The salt marshes of the Wadden Sea are also vital for the reproduction and life cycle of other fish species such as the Atlantic Herring *Clupea harengus*, European Plaice *Pleuronectes platessa* and Dover Sole *Solea solea*. The mudflats and creeks associated with a salt marsh in the Mira Estuary in Portugal act as a nursery area for more than 40% of the fish species present in the estuary (Costa *et al.* 1988 in Doody 2008). **Creeks associated with tidal mud flats and salt marshes along the North sea coasts and the Scheldt-estuary are considered as a nursery area for Grey shrimp (Crangon crangon) (Vlaamse – Nederlandse Scheldecommissie). [Herrier]**

Water quality improvement. Salt marshes act as a nitrogen interceptor, especially where they lie adjacent to highly permeable uplands. As well as being sources and sinks of mineral nutrients and organic matter, salt marshes also function as a sink for pollutants that would otherwise be damaging



to the environment. Through these and other functions, they act as dynamic living filters for various, ecologically important materials (Boorman 1999 in Doody 2008).

Other more localised economic values include (Doody 2008):

- pipeline landfall sites;
- military training;
- samphire gathering;
- reed for thatching;
- shooting areas.

### Cultural and environmental values

Salt marshes have high scientific, landscape, recreational and cultural values. It is difficult to assign monetary values to many of these; more often, their worth is intangible. In this context, they can provide inspiration for literature, paintings or music. This value has no monetary equivalence, even if the outputs have. Other uses have a more direct value, as for example (Doody 2008):

- research and teaching;
- recreation;
- tourism and landscape;
- archaeological conservation;
- nature conservation
- bird watching.

## 1.8. Conservation status

**Table 14 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1330	Atlantic salt meadows ( <i>Glauco-Puccinellietalia maritimae</i> )	range	U1	FV	FV	XX	FV	FV	FV	FV	FV	FV
		area	U1	FV	FV	XX	FV	U1	FV	U1	U1	U1
		structure	U2	U1	U2	XX	U1	U1	U1	U1	U2	U1
		future	U1	U1	XX	XX	U1	U1	U1	XX	U2	U1
		overall	U2	U1	U2	XX	U1	U1	U1	U1	U2	U1

These salt meadows occur along the coasts of the Atlantic and the western Baltic in the upper part of the intertidal zone on muds and sands. The vegetation is varied but always composed of salt tolerant plants. The vegetation varies with climate and the frequency and duration of tidal inundation; the species composition is often dependent on the grazing regime.

Assessed as 'unfavourable' by all member states (EU25) except Spain where it has been reported as 'unknown'. Assessed as 'unfavourable-inadequate' for the Atlantic region but this is based on using range for weighting due to missing data and the status may be 'unfavourable-bad' as in the Continental region.

Reasons for the unfavourable conservation status include altered coastal dynamics, agriculture and other human impacts. Better information required (Summary sheet of the online report on Article 17 of the Habitats Directive). In the Netherlands the objective of management is to preserve the present distribution over the management types: moderate grazing intensity, low intensity and no grazing, where every type has to cover at least 25% of the total surface. [Schotman Alterra]

## 1.9. Trends

Trends affect salt marsh in two principle ways:

1. The nature of the vegetation in relation to grazing management.
2. The physical structure of the habitat, notably whether it is eroding or accreting and with reference to impact of enclosures.

Grazing or no grazing. Grazing and haymaking are long established traditions on many salt marshes and coastal meadows in Europe. In absence of grazing the vegetation of salt marshes evolves into a dense and rough sward dominated by *Elytrigia atherica*, a type of vegetation that is very poor in plant species. [Herrier]

However, during the last decades there has been a general trend in most parts of Europe to abandon marginal agricultural land, including these kinds of habitats. For example, cattle and sheep grazed the majority of the mainland salt marshes in the Wadden Sea but since the 1960s grazing has started to wane [Kleef] on large areas, due to socio-economic developments [Kleef] (Dijkema & Wolf 1983 in Doody 2008). Similar trends occur across most of the Atlantic as well as Baltic coastal meadows. This habitat has also been exploited for other purpose, including land-fill for harbour construction as well as dredging for construction of marinas etc.

Enclosure of salt meadows. For the Atlantic salt marshes, human activities, probably since Roman Times, have caused direct loss through extensive enclosure for agriculture and infrastructure. The historical trend towards enclosure (building a sea bank to exclude the tide) affects upper levels of salt marsh habitat first. More robust engineering structures, such as concrete sea walls, allow enclosure to extend further down the shoreline. The loss of habitat and its effect on tidal lands is well documented (e.g. Allen 1997 in Doody 2008). In Great Britain an area, almost equivalent to the current extent of salt marsh (43000 ha, Burd 1989 in Doody 2008) has probably been enclosed in the last 300 years or so. Dijkema (1987) took a different approach for the Netherlands Wadden Sea. Based on historic maps, he compared the actual size of salt marshes since 1600. On the barrier islands, the construction of artificial dune ridges resulted in more shelter, and hence extension of salt marshes to an extent well above any historic reference value. On the mainland on the contrary, formation of new salt marshes could not keep pace with the rate of land claims through time, and the contemporary mainland marshes are well below historic reference levels. [Kleef]

It is the same in France, where during the last century over half the salt marshes of western France were enclosed (Géhu 1984 in Doody 2008). Géhu further reports that almost all salt marshes in France suffer from deterioration and 'nibbling', a process whereby small-scale enclosure, including dumping of rubbish slowly excludes the tide. In and around the estuaries of all the major harbours salt marshes are the first casualties of port and other infrastructure development. Atlantic salt

meadows are enclosed first, especially as they can be rapidly converted to intensive agricultural use (Doody 2008).

In the UK, the loss of Atlantic salt meadows over the past two centuries is a concern: between 1800 and 1950 there were significant changes as large areas of land were reclaimed for agriculture or developed on (Allen & Pye 1992 in Joint Nature Conservation Committee n.d.). In The Wash, for example, a total of 29,000 ha has been reclaimed, of which 3,000 ha was known to have been reclaimed during the 20th century (Doody 2001 in Joint Nature Conservation Committee n.d.). However, due to the fact that reclamation affects estuary processes and often results in the accretion of intertidal sediment on which saltmarsh can develop, there can still be saltmarsh present in areas where large past losses have occurred, although to seaward of the original distribution.

Although the Netherlands salt marshes (subtype A) with their current size represent a significant proportion of the total Atlantic area, over the centuries a substantial loss has occurred. The last major impacts were the closing off of the Zuiderzee, Lauwers Sea and some tidal inlets and estuaries in the Delta. At present, the size of island salt marshes is well above any historic reference value. This has been mainly the result of the construction of artificial dune ridges (Dijkema 1987; Dijkema et al. 2005). In the meantime on the mainland of the Netherlands, the size of clayey foreland marshes has diminished to an historic minimum due to the long history of land claims (Dijkema 1987). [Kleef]

Through land claim, natural increase and especially the planting of a sediment fixing species Common cordgrass (*Spartina anglica*) during the twentieth century salt marshes reached a maximum area of over 9,000 ha in southwestern Netherlands, but the implementation of the Delta works has caused a decline to about 3,000 ha (of which about 75% along the Westerschelde estuary). [Kleef]

Inner dike salt marshes (subtype B) represent only a modest share in the national area of salt marshes and grasslands. Their functioning is under pressure: much inner dike areas are getting less salty (partly because there is no salt water seepage from the Zuiderzee anymore). (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.) Inner dike salt meadows also occur in Flanders (Belgium), more precisely in the eco-region of the polders and the tidal Scheldt. [Herrier]

In the Netherlands there was a net loss in the last century in the Wadden Sea from 1000 ha (7000 to 6000 ha). In course of last century in the southwest the area increased to 9000 ha with the help of planting of *Spartina anglica*. Because of works for coastal defense the area has shrunk to 3000 ha from which 75% in the Wester Schelt. In the Wester Schelt there are problems with erosion caused by dredging and polderisation in the past. A recent problem is the ageing of Salt meadows. At the moment there is not enough rejuvenation. For more than 20 years the impact of subsidence due to gas production below the Wadden Sea island of Ameland is being monitored. In ecological terms subsidence has the same consequences as sea level rise. The soil subsidence is fully compensated at the salt meadow edge, but runs behind in the central and high salt meadow. To a certain extent the subsidence has a positive effect because it leads to rejuvenation. A big question is if in the future the amount of sediment in the Wadden Sea will be enough to compensate the rise of the sea level (Dijkema et al. 2011). [Schotman Alterra]

## 1.10 Main pressures and threats

**Table 15 Main pressures to Atlantic salt meadows as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Atlantic salt meadows ( <i>Glauco-Puccinellietalia maritimae</i> )
Cultivation	x
Grazing	x
Pollution	x
Landfill, land reclamation and drying out, general	x
Drainage	x
Modification of hydrographic functioning, general	x
Dikes, embankments, artificial beaches, general	x
Biocenotic evolution	x

**Table 16 Main threats to Atlantic salt meadows as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Atlantic salt meadows ( <i>Glauco-Puccinellietalia maritimae</i> )
Cultivation	x
Grazing	x
Pollution	x
Landfill, land reclamation and drying out, general	x
Drainage	x
Modification of hydrographic functioning, general	x
Dykes, embankments, artificial beaches, general	x
Biocenotic evolution	x

Main threats to Atlantic salt marshes are (Doody 2008):

### Grazing

Introduction of grazing by domestic stock on formerly ungrazed or lightly grazed salt marshes can have a deleterious effect on Atlantic salt meadows. Several of the typical and rare plants are susceptible to grazing and may be eliminated from the community. Loss of the upper parts of the plants will also remove potential food and shelter for a variety of invertebrates and breeding birds that reside there.

Conversely reduction or cessation of grazing on historically heavily grazed salt marshes and coastal meadows results in a dense overgrown, species-poor sward unsuitable for the grazing ducks and geese that often occur in considerable numbers, as well as for wader birds belonging to the breeding bird fauna of these habitats. Grazing with livestock is here thus being used from two perspectives. Firstly, exploitation of salt marshes by domestic grazing refers to land use and should be considered as a land-utilization type. Secondly, when nature conservation is the most important land use, depending on the conservation targets, grazing may be applied as management instrument or tool. A clear distinction between the two is required. [Kleef]

### **Invasive exotic species**

Invasive exotic species, such as *Baccharis halimifolia*, a shrubby ornamental specie from America that is often planted in gardens along the European coasts because of its salt tolerance and that spreads spontaneously into nearby salt marshes. In south western Europe parts of some salt marshes seem to have been transformed into scrubby woodland by *Baccharis halimifolia*. In the few salt marshes along the Belgian coast all appearing seedlings are eradicated systematically to prevent such an evolution of the vegetation. [Herrier]

### **Accretion versus erosion**

Changes in those processes that help promote salt marsh accretion (such as sea level movement, tides and tidal range, sediment availability, freshwater flows and channel movements) also cause erosion. The two often exist in a dynamic interaction, with accretion and erosion occurring within the same site. The balance between the two results in a landward or seaward progression of the salt marsh front. Depending on this balance, management to promote the former and control the latter are key elements in any management or restoration strategy. This management operates at a different scale to the manipulation of the vegetation (see below). It involves consideration of the salt marsh itself, as well as the effect on the wider estuarine environment.

Accreting salt marsh results from a number of interrelated processes. Areas with reduced tidal scour (sheltered), low intensity wave action and net sediment input will tend to support healthy vegetation. This will in turn help create net sediment deposition and a lateral expansion of the salt marsh. Associated factors such as drainage and tidal flushing help promote soil conditions that support vigorous vegetation and vertical accretion. An absence or reduction in these positive trends can cause reduced vegetation vigour, increase tidal scour resulting in undercutting and slumping, and lateral erosion.

Where the erosion of salt marsh represents a progressive and permanent loss, there is a corresponding loss in the values associated with the habitat. This affects the Atlantic salt meadow community to a greater extent than those lower in the tidal frame because they are easier to embank.

This process not only causes direct loss of habitat, but also has knock-on effects to seaward. As the land moves progressively seawards, it becomes more difficult for salt marsh to accrete and the intertidal zone becomes narrower. It is then less able to resist the erosive forces and slumping and landward movement of the salt marsh can occur.

### **Enclosure of salt meadows**

Building a sea wall or earth embankment to exclude the tide (described above) is much less prevalent than before. In a few places where there is abundant sediment, salt marsh may continue to accrete outside the enclosing structure. However, more frequently enclosure exacerbates the loss of salt marsh, especially in areas where there is a rise in sea level relative to the coast. This results in a salt marsh 'squeeze', which is particularly significant in areas where there is a reduced sediment supply. Many salt marshes throughout the European Atlantic region are in this state, especially in the southern North Sea where the land is sinking because of isostatic change. Factors such as an increase in wave energy or the incidence of storms and storm surges puts greater stress on the

depleted habitat, causing further erosion. In some cases, this can erode the salt marsh completely, exposing the sea wall or embankment to direct attack from the sea. For the Baltic coastal meadows exposed to land uplift, the 'squeeze' problem is less pronounced.

### **Climate change effects**

Against the background of long term global changes in relative sea level the physical conditions, tides and storms determine whether salt marsh develops or not. [Note that changes in sea level as they influence a salt marsh result from a combination of factors, including changes in sea level (eustatic) and/or land level (isostatic), consolidation of sediments within the salt marsh itself and rate of accretion]. Given an adequate supply of sediment, up to a point, salt marsh can keep pace with sea level rise. This requires that the rate of accretion minus any lowering of the surface due to compaction is greater than or equal to the rate of sea level rise.

In the early stages of colonisation, rates of vertical accretion can reach 10 mm per year or more, well in excess of the rate of sea level rise in most areas. For more mature Atlantic salt meadows there appears to be a limit, above which sea level rise outstrips salt marsh growth. This limit is around 6 mm per year in the Wadden Sea at least (Bakker *et al.* 2005 in Doody 2008). Thus, even in areas where land levels are sinking and the maximum rates of relative sea level rise approach 6 mm per year, as in parts of the southern North Sea, salt marsh accretion can theoretically keep pace.

It is clear however, that in many areas accreting salt marshes are not the norm. The salt marshes of Essex, south east England, have been eroding for a number of years. Recent studies have shown that the combined effects of enclosure and erosion, net of any accretion, amount to between 12% and 59% of the salt marsh present in 1973 when compared with 1998 (Cooper *et al.* 2001 Doody 2008). This is partly attributed to the fact that sea level is rising relative to the land at a rate of about 3 mm per year. This 'drowns' the salt marsh causing slumping of the salt marsh surface and erosion at the margins as a result of tidal scour and wave attack.

It is unclear if there are other influences affecting Atlantic salt meadows associated with climate change. It seems likely that increased storminess will put greater pressure on individual areas, which will in turn increase the rates of erosion. There is evidence to suggest that an individual storm can initiate erosion, after which the salt marsh enters a state where erosion continues through internal processes, which operate irrespective of any external driving forces (Van de Koppel *et al.* 2005 in (Doody 2008)).

Other factors such as changes in CO<sub>2</sub> concentrations are unlikely to affect this habitat because of the overriding influence of the tidal salt water.

### **Highlight of pressures in some MS: [Kleef]**

The main pressures affecting Atlantic salt marshes in the **UK** are listed below (Joint Nature Conservation Committee n.d.):

- Land claim
- Erosion and coastal squeeze
- Sediment dynamics
- Cord grass *Spartina anglica*

- Grazing
- Other human influences such as waste tipping, pollution, drowning by barrage construction and military activity
- Air pollution

The **German** Marine Monitoring Programme (Bund Länder Meeresprogramm Meeresumwelt n.d.) lists the following anthropogenic influences as potential threats:

- Input of nutrients
- Input of hazardous substances
- Exploration and extraction of raw materials (e.g. gas, oil, sediment, brine)
- Construction measures/installations, including energy pipelines (e.g. construction of port and industrial installations)
- Water engineering measures and installations (e.g. coastal defences)
- Dike building projects, hard structures along the coast
- Grazing, turf extraction
- Shipping traffic and water engineering measures (e.g. navigation channels, training dikes)
- Recreational use/tourism
- Disposal sites for sediment and dredgings/dumping activities

Salt marshes in **Germany** are threatened mainly by eutrophication and pollution. Other risk factors include the reclamation and turning salt marshes into polder, coastal reconstruction including the conversion of salt marsh into dikes and for intensive grazing and tourism. (Bundesamt für Naturschutz n.d.)

In **Ireland**, the most common impacts in the current assessment period were over-grazing by sheep or cattle, and erosion. Common cordgrass (*Spartina anglica*) is also present on many Irish saltmarshes and is considered an invasive species. There have been some minor losses of habitat during the current assessment period due to infilling and reclamation (NPWS 2008).

In **Denmark**, the most important threats against the habitat type are overgrowth by tall plant species due to ceased management, changed hydrological conditions due to drainage, and eutrophication. At the local level assessment of grazing pressure, overgrowth, drainage and indicators of eutrophication must be included in the assessment of favourable conservation status (Søgaard et al. 2007).

In the Netherlands the main threats vary depending on the local circumstances. In the Westerschelde estuary, coastal squeeze forms is the main threat as a result of both embankments and deepening of the shipping lanes. The remaining marshes rapidly develop here to late-succession stages. In the Oosterschelde, a former estuary, but now a semi-enclosed inlet with a reduced tidal regime, cliff erosion and the low availability of sediment form the main threat to the marshes. In the Wadden Sea, ageing, i.e. the increase of species-poor late-succession stages, is considered as the main threat in both the salt marshes on the mainland and on the barrier islands (Dijkema et al. 2007; Esselink et al. 2009). On the barrier islands, the presence of the artificial dune ridges leads to spatial fixation and restricts to a great extent the natural geomorphological processes of island salt marshes, especially in the washover complexes and island tails. In order to bend ageing, and to restore spatial diverse salt marshes, the removal, at least partially, of these dune ridges seems a prerequisite (van den Hoof & Grootjans 2011). The mainland were largely developed from sedimentation works (see

H1310). Their present state depends much on the presence and yearly upkeep of brushwood groynes. At the same time these marshes show an increase of late succession stages, especially at sites where domestic grazing has decreased. [Kleef]

**Germany, Ackermann (pers. comm.):**

1. Einschränkung oder Veränderung der natürlichen Dynamik, Entwässerung (Begrüpfung, Gräben, Drainage)
2. Nährstoffeinträge durch Gewässerverschmutzung oder Düngung
3. Nutzungsaufgabe und Sukzession zu Röhrichten oder artenarmen Grasfluren
4. Intensivierung der Beweidung

Änderung der natürlichen Dynamik (Ausbleiben der Überflutung durch Meerwasser), Entwässerung, Nährstoffeinträge oder Nutzungsaufgabe führen zunächst zu einer Verschlechterung des Erhaltungszustands und schließlich zu einer Veränderung der Vegetation (Röhrichte, artenarme Grasfluren, Queckenfluren) und damit zum Verlust des Lebensraumtyps.

**Ireland, Gaynor, pers.comm.:**

1. K01.01 Erosion
2. A Agriculture
3. J02 Anthropogenic changes to hydrological conditions
4. I Invasive, other problematic species and genes
5. E Urbanisation, residential and commercial development

The location, character and dynamic behaviour of saltmarshes are governed by sediment supply, tidal regime, wind-wave climate and sea level change. Obviously erosion is one of the greatest threats/pressures on saltmarshes, but where this is a natural process it should not be managed but allowed to continue where possible. However, accelerated rates of erosion caused by human activities (e.g. coastal protection works, removal of sediment, etc.) need to be prevented. Common agricultural practices that can cause negative impacts on saltmarshes include agricultural improvement, fertilization, mowing and stock feeding. Overgrazing can create low closely cropped swards and areas damaged by poaching.

'Anthropogenic changes to hydrological conditions' incorporates infilling, land reclamation and removal of sediments, as well as flooding modifications, including canalisation. Maintaining the sediment supply is vital for the continued development and natural functioning of a saltmarsh system. Interruption to the sediment circulation through physical structures can starve the system and lead to accelerated rates of erosion. The spread of *Spartina anglica* is viewed as one of the biggest threats and management issues for Irish saltmarshes, although recent surveys have recorded natural die back at a number of sites and even suggested that the nationally rare *Sarcocornia perennis* may actually benefit from the presence of *Spartina* (McCorry & Ryle, 2009).

**Netherlands, Schotman**

Due to land reclamation in the past in one of the estuaries that is still there the 'Westerschelde' the surface has shrunk to half the size in 1600. In The Oosterschelde is a lot of erosion because of the changed balance of sediment since the open dam has been build. The consequence is erosion of habitat types 1310 and 1330 among others. This causes deficiency of food for non-breeding migratory bird that stay here. In the other estuary that is spared from damming the 'Eems/Dollard'



problems with dredging shipping lanes are not so severe and the quality of the water has improved after heavy pollution in the past.

## 2 Conservation management

### 2.1. Main conservation requirements

In **Spain**, the main recommendations for the conservation of this type of habitat are the following (VV.AA. 2009):

- Prevent the deposition of aggregates and landfilling either directly at the sites or in basin areas close to the sites.
- Avoid construction on the coast. The presence of structures (buildings, boardwalks, marinas and jetties) that might hinder the displacement of populations of Atlantic salt meadow species considering sea level rise. Therefore, the protection of areas at the upper limit of the current distribution of the habitat is critical to ensure its long-term conservation.
- Avoid, as far as possible, the alteration of river-coastal dynamics (docks, piers, dredging) that could change the dynamics of sedimentation, erosion, and modify salinity because of variations in the proportion of freshwater and sea water.
- Avoid grazing and over-stocking. Particularly in clay soils, excessive trampling and increased nutrients can cause serious damage to this habitat.
- Evaluate potential risk due to the presence of invasive species. Special attention requires the presence of *Spartina* species and hybrids.
- Preserve the surface occupied by the habitat and avoid fragmentation of existing populations.
- Develop awareness raising campaigns about the value of this type of habitats, its ecological and functional importance and landscape values.

For **Germany**, important protective measures are to ensure natural coastal dynamics, and the reduction of nutrients and pollutants. New early stages of saltmarshes arise periodically from naturally generating sandy coasts and do not require maintenance. Extensive grazing by sheep or cattle is possible and necessary to maintain the habitat at secondary stages. (Bundesamt für Naturschutz n.d.)

In Flanders (**Belgium**) (Van Uytvanck et al. 2010): Management and restoration measures are fundamentally different depending on the baseline.

For the management are mainly two aspects:

1. sustaining well-developed salt marshes;
2. the recovery of the necessary dynamics and water management.

Salt marshes are semi-natural communities within a typical landscape where management / use consists of grazing. As this vegetation still occurs in mosaic form with productive grasslands (silverweed grassland) their management fits in a traditional livestock farm, where more extensively managed soils can be used for seasonal grazing.

**Germany**, Ackermann, pers. Comm.

Erhaltung bzw. Wiederherstellung der natürlichen Dynamik und des Wasserhaushalts

1. Vermeidung von Nährstoffeinträgen und Düngung
2. Fortführung einer extensiven Nutzung (Mahd, Beweidung), mit der das typische Vegetationsmosaik langfristig erhalten werden kann.

Ireland, Gaynor, pers. Comm.:

1. Maintain the supply of sediment
2. Maintain the natural tidal inundation regimes
3. Maintain the natural creek and pan structure
4. Maintain structural diversity within the sward
5. Prevent and/or control the spread of *Spartina anglica*

Accretion and erosion are natural elements of saltmarsh systems and should be allowed to occur naturally. Sediment supply is particularly important for this pioneer saltmarsh habitat, as its distribution depends on accretion rates. The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and survival of saltmarshes. Creeks play an important role in distributing sediment throughout the saltmarsh and should be maintained.

## 2.2. Management measures<sup>15</sup>

Management issues can be considered in two key categories associated with (Doody 2008):

1. The nature of the vegetation in relation to grazing management. The level of grazing pressure has a profound impact on the nature of the vegetation. These range from short, species-poor swards associated with heavily, often sheep-grazed salt marshes to lightly or historically ungrazed ones. The former may support large numbers of wintering herbivorous ducks and geese, and are preferred breeding sites for several species of wader birds. The latter, more structurally diverse swards have a higher diversity of plants and associated animals (especially invertebrates). They also provide habitat for passerines and other birds requiring nesting cover. Much depends on the historical grazing regime. In some cases, abandonment of grazing on sites that are historically grazed results in impoverishment, particularly of the avian fauna. Overgrazing on historically ungrazed or lightly grazed sites can also result in loss of interest with a reduction in biodiversity. A key question for the manager is whether to graze or not and if so the extent, number and type of animals, and period of grazing.
2. The physical structure of the habitat: notably whether it is eroding or accreting. This issue essentially concerns Atlantic salt marshes, which are highly influenced by tidal pressure and sea level rise.

There are many techniques to promote salt marsh accretion. Notable amongst these is planting of various species of native and non-native *Spartina*. Physical structures (polders) built to seaward of

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<sup>15</sup> **Missing topics: 1) Restoration of geomorphological processes** (NL barrier islands; see section 1.10). **2) Size.** The morphology of a salt marsh also includes size. In comparison with narrow salt marshes, wide or broad marshes have a greater, more complete internal hydrodynamic gradient which enhances internal variation in both vertical accretion rates and vegetation development (Esselink et al. 2009). **3) Drainage.** Numerous salt marshes have been disturbed by ditching. Restoration of natural drainage may increase natural dynamics, and retard ageing by rewetting of the salt marsh. A pilot project was conducted on the German barrier island of Norderney (Esselink et al. 2009). [Kleef]

existing salt marsh helped to promote accretion as well as protecting the embankments enclosing created land. Other methods designed to 'hold the sea defence line' include sediment recharge of the beach. In areas where this is uneconomic, managing a realignment of the coast to re-create salt marsh is an alternative option. These and other similar activities take place, especially where relative sea levels are rising or where there is a depleted sediment budget (Doody 2008).

For most of the values associated with Atlantic salt meadows preventing erosion or stimulating accretion are the principle options. However, it is becoming increasingly clear in some areas that the methods associated with these are unsustainable because of the combined impact of enclosure and sea level rise. Under these conditions a third option, managed realignment (re-integration - with the sea), is an important and growing alternative.

As far as grazing (and locally mowing) is concerned, the options are complex and include decisions on reducing or re-introducing grazing by domestic stock. The historical management of the site and existing nature conservation interest helps to determine the most appropriate form of ongoing management. Grazing by domestic stock can have an especially profound effect, which at higher intensities causes loss of structural diversity and decrease in the biodiversity of the salt marsh itself.

This is particularly important for Atlantic salt meadows where many of the interest features (rare and specialist plants, invertebrates and breeding birds) can be eliminated from the habitat. Conversely, sites with heavily grazed swards can support large populations of wintering and breeding wader birds favouring short open turf.

The balance between grazing pressure and nature conservation values is a particular issue for salt marshes and coastal meadows as grazing by domestic stock has diminished in recent years. This gives rise to an important management question, whether to graze the community or not and if so at what stock density and with what animals. The key to making sound decisions on management requires a good knowledge of historical patterns of grazing and changes to established grazing regimes.

The general management approach recommended for salt marshes along the Atlantic coast of France is non-intervention and to prevent over-grazing (Bensetitti *et al.* 2004 in Doody 2008).

The descriptions that follow consider management prescriptions concerned with the vegetative and physical condition of the salt marsh respectively. A simple model representing the pathways for change for each condition provides the basis for discussion.

## **Active management<sup>16</sup>**

### Grazing

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<sup>16</sup> A management measure that should be added to the list is: Eradication of invasive exotic species, especially *Baccharis halimifolia*, a shrubby ornamental species from America that is often planted in gardens along the European coasts because of its salt tolerance and that spreads spontaneously into nearby salt marshes. In south western Europe parts of some salt marshes seem to have been transformed into scrubby woodland by *Baccharis halimifolia*. In the few salt marshes along the Belgian coast all appearing seedlings are eradicated systematically to prevent such an evolution of the vegetation. [Herrier]

Different grazing pressures affect the salt marsh and its component nature conservation interests to create four main states. Each state has a different set of values according to the following levels of grazing:

1. Historically high levels, particularly sheep, support a low sward dominated by grasses such as *Puccinellia maritima* and *Festuca rubra*. These are favoured by avian herbivores such as wigeon and brent geese;
2. Moderate grazing by cattle and sheep provide a structurally more diverse sward and a range of interests combining avian herbivores, invertebrates, nesting birds and diverse plants;
3. Historically ungrazed or lightly grazed swards have high plant species diversity, provide passerines and waders e.g. redshank;
4. Formerly heavily grazed and abandoned salt marshes lose many attributes requiring intervention to reverse the process.

The key to assessing the need for intervention lies in understanding the historical pattern of management. The level of standing crop can help define current grazing management, as follows:

- State 1 heavily grazed - height <10cm, all standing crop removed;
- State 2 moderately grazed - standing crop almost completely removed;
- State 3 lightly grazed - most of the standing crop remains;
- State 4 abandoned - matted vegetation, no standing crop removed.

Taking each of these in turn, it is possible to identify the historical grazing regimes appropriate to each state. Deviations from the historical patterns may suggest intervention. If so then the following provide indicative values of stocking rates.

*Heavily grazed* (State 1) salt meadows have stock densities of up to 6.5 sheep per ha year round, 9-10 sheep or 2 cows per ha in summer, as for example on the heavily grazed salt marshes in northwest England (especially Morecambe Bay). They approach those of inland intensively grazed grassland. If this is the traditional use of the salt marsh and the site has important populations of avian herbivores, then the presumption should be one of maintaining the regime at or around these levels.

For Atlantic salt meadows as well as Baltic coastal meadows along the coasts of Sweden, a grazing pressure corresponding to 1-2 cattle per ha has been found to be required in order to maintain a breeding fauna of typical wader birds. At grazing densities >4 cattle per ha, damage to birds' nests due to trampling may also have an adverse effect (>50% of the nests destroyed, Johansson *et al.* 1986 in Doody 2008).

Thus, traditionally heavily grazed marshes, particularly with high sheep stocking rates, favour short swards and benefit winter grazing ducks and geese. A reduction in grazing levels will increase the potential value of the marsh for other interests but these must be set against the loss of suitable grazing for wildfowl and some breeding wading bird species. If no such interest exists or is of limited value then consideration of reducing levels to those suggested for moderately and lightly grazed salt meadows might be appropriate.

*Moderately grazed* (State 2) salt meadows have stocking densities of 5-6 sheep, 1.0-1.5 young cattle per ha from April - October (Beefink 1977 in Doody 2008) or 0.6 cattle year round (Kleyer *et al.* 2003). At these levels, the salt marsh has the best chance of supporting a wide range of species with reasonable structural diversity. On many salt marshes, this state occurs because of the physical

structure of the salt marsh with creeks forming wet fences allowing a mosaic of different grazing intensities across the site.

Salt marshes with stocking levels ranging from low intensity regimes to moderate stocking rates provide a range of opportunities for nature conservation interests, these can encompass both State 1 and State 3 salt marsh. Unless the salt marsh clearly belongs to the heavily grazed or lightly grazed categories then the moderate grazing stock densities provide a useful benchmark for management.

*Ungrazed* (State 3) salt meadows, when compared with grazed areas, probably represent a more natural form of the habitat.<sup>17</sup> They also tend to support some of the most biologically diverse examples of the habitat in Europe. Although locally native herbivores such as hares (in Great Britain) may change the species composition this is limited. There are very few salt marshes supporting Atlantic salt meadow communities, which are historically ungrazed. These tend to be associated with inaccessible offshore barrier islands such as those off the North Norfolk coast in the United Kingdom and in the Wadden Sea.

Historically ungrazed salt marshes should remain so. Do not introduce grazing, as it is likely that even low levels may have an adverse impact on some grazing sensitive species.

*Lightly grazed* (State 3) salt meadows are those with no more than 2.0 sheep or 0.3 cattle per ha grazing for 6 months of the year (Beeftink 1977 in Doody 2008).

As with historically ungrazed sites, maintaining the interest requires a continuation of the existing regime.

#### Reintroducing domestic stock

*Abandonment* (State 4) represents the most frequently encountered situation affecting salt marshes and coastal meadow communities. Abandoned, formerly grazed salt marsh becomes less suitable for grazing ducks and geese, as well as for breeding wader birds, often the main reason for their nature conservation designation. This represents a major trend in salt marsh management leading to a requirement to restore the vegetation through the reintroduction of grazing or mowing.

Intermediate, 'moderately' grazed salt marshes that combine elements of State 1 'Heavily' grazed and State 3 'Lightly' grazed might have the greatest nature conservation benefit.

This is referred to as 'mosaic grazing' and is being introduced as part of the restoration programme for the salt marshes in Groningen where the climax vegetation includes unpalatable 'woody' plants. A prudent restoration regime, therefore, might include reintroducing grazing levels appropriate to State 2 moderately grazed salt marsh. Open range, grazing regimes will help create a diverse nature conservation interest by virtue of the both the structural and species diversity of the vegetation.

In Sweden, burning during early spring has been tested in order to get rid of overgrowth at salt meadows left without grazing for some years. The method has turned out to be effective in order to control e.g. *Phragmites australis*, *Deschampsia cespitosa*, *Elytrigia repens* and *Filipendula ulmaria*,

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<sup>17</sup> I do not agree with this statement. Before human pastoral use of the salt marshes started, the salt marshes were probably already frequented by "wild" large herbivores such as aurochs and deer and omnivores such as Wild boar ... The presence of these large wild mammals would probably have had an impact on the vegetation structure. [Herrier]

but is highly dependent on weather conditions. The burnt areas can be opened for grazing by low densities of livestock the same season (e.g. Johansson *et al.* 1986 in Doody 2008).

The reintroduction of grazing on abandoned salt marshes is a necessary requirement for the successful reversal of adverse trends in species composition and structural diversity. High initial stocking levels help open up dense turf at long abandoned sites. Moderate to low-level open range grazing regimes,

thereafter, will help establish a diverse nature conservation interest. Note the importance of deciding on the desired end point before embarking on remedial treatment.

### Spartina management

The several species of *Spartina* pose an interesting dilemma for the conservationist and coastal manager alike. Native species of *Spartina* in their own environment provide a significant contribution to the functioning of the coastal ecosystem in which they occur.

In the Atlantic salt meadow community, the native *Spartina maritima* is an important colonising species, especially in the south. However, aggressive hybrids such as *Spartina anglica* can cause the rapid loss of tidal flats, posing a threat to the feeding ground of wintering waterfowl. This has often elicited a first response (adopted worldwide) to eradicate the colonising species. Given the speed and scale of invasion and the known effects on many features of nature conservation and economic interests this is entirely understandable. However, this initial response requires modification in order to avoid costly and ineffective management.

Introduced *Spartina* species can help create substantial areas of Atlantic salt meadows. In the Odiel Estuary, southern Spain *S. densiflora*, introduced from South America in the 16th century (Castillo *et al.* 2000 in Doody 2008) may have helped create the large expanse of salt marsh at this site. Today it dominates some 18% of the salt marsh community (Mateos Naranjo *et al.* 2006 in Doody 2008) but elsewhere it is scattered throughout the vegetation. The salt marshes form a significant component of this important site, which is a Natural Park, Ramsar Site and Special Protection Area designated under the European Union, Birds Directive.

In north west England expansion of *Spartina anglica* onto tidal flats between 1981 and 2005 has helped create typical Atlantic salt meadow communities. These form an important component of the Morecambe Bay, Special Area of Conservation. In Ireland, it is now an endemic 'native' in the *Atlas of the British & Irish Flora* (Preston *et al.* 2002 in Doody 2008). Thus, whilst control might continue to be the first response this should be tempered with consideration that the non-native species (including the hybrid *S. anglica*) may become an acceptable precursor to the Atlantic salt meadow community.

### Predator control

Problems with high losses of nests and chicks of nestling wader birds due to predation, primarily from foxes, ravens, crows, kestrels, harriers and gulls is a problem that has raised increased attention and concern during recent years, with reference the management of breeding populations of wader birds under decline in Denmark and Sweden (e.g. Asbirk & Pitter 2005, Widemo & Holmquist 2007 in Doody 2008). High predation losses have been recorded e.g. for *Philomachus*

*pugnax*, *Calidris alpina schinzii* and *Limosa limosa*, which all suffer from an unfavourable conservation status and breed only at a limited number of sites. This problem has to be tackled by managing salt meadows where high breeding success by wader birds is a main issue.

Proposed mitigation measures are primarily of three kinds (Doody 2008):

1. Adjustment of the management of a site, including a slightly reduced grazing pressure in combination with a delayed grazing start and/or shift from grazing to mowing (e.g. Widemo & Holmquist 2007 in Doody 2008).
2. Various kinds of non-lethal control of predation, including:
  - Protective cages over the nests. This has been found to work out for e.g. *Charadrius alexandrinus* (Jönsson 2007a in Doody 2008) but still needs to be tested if effective for other wader species.
  - Removal of trees and other perching sites for avian predators (may sometimes be contradictory with reference to other conservation targets), and not to erect nest-boxes or artificial nesting platforms in the vicinity of salt and coastal meadows with good population of breeding waders (in Denmark, a recommendation not to erect nest-boxes for kestrels *Falco tinninculus* within a zone of 1 km from salt marshes with breeding waders has been made, Asbirk & Pitter 2005 in Doody 2008).
  - In order to reduce predation from foxes, electric fencing as well as gates or other kinds of barriers along roads leading to islands with high numbers of breeding birds (e.g. Asbirk & Pitter 2005 in Doody 2008, tested in the Danish LIFE-Nature project on 'Restoration of meadow bird habitats', see below).
3. Active control of predators. A method using artificial fox dens that attract the foxes and where culling will be undertaken is currently being tested in the LIFE-Nature project on 'Restoration of meadow bird habitats'.

## Prevention of loss and restoration of salt marshes

### Promoting salt marsh accretion

Several different techniques promote salt marsh accretion. Historically these have been associated with land claim for agriculture. Notable amongst these is planting *Spartina anglica*, a hybrid between the European native species *S. maritima* and the American *S. alterniflora* introduced in ships ballast to southern England in the late 1880s. Physical structures (polders)<sup>18</sup> built to seaward of existing salt marsh helped to promote accretion as well as protecting the embankments enclosing newly created land.

The techniques involve building brushwood groynes, as for example in the Wadden Sea (southern North Sea). These helped to extend the salt marsh beyond the normal limits imposed by sediment availability, tides and waves. The processes involve creating a system of 'sediment fields' made of brushwood groynes and low earth embankments intersected by ditches dug in the tidal flats. The increase in sedimentation 'warping' resulting from the enclosed tidal flats with their restricted opening and planting salt marsh plants such as *Spartina anglica*, helped to promote the establishment of vegetation. Sediment fields continue to perform an important function by promoting the development of a pioneer zone in front of eroding cliffed Atlantic salt meadows, helping to maintain their sea defence function.

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<sup>18</sup> I wonder what is meant here with "polders", as "polders" is the Dutch word for "reclaimed (agricultural) land", land that is usually reclaimed at the cost of tidal salt marshes ... [Herrier]

Techniques to promote accretion in the Dutch part of the Wadden Sea are much less prevalent today and the labour intensive process all but ceased in many areas from the 1940s (Beeftink 1977 in Doody 2008). In areas where sea level is rising and/or there is sediment depletion, the approach is not sustainable. Experiments using techniques borrowed from those used in the Wadden Sea to combat erosion on the Essex coast, England during the 1980s had mixed results and were abandoned.

#### Erosion control

Coastal salt marshes are normally spatial dynamic; they either protrude or erode. Consequently, cliff erosion in salt marshes is a natural process, and should not automatically be interrupted by counter measures. In an extended salt marsh, natural processes should be given space, and one should refrain from intervention. In case, cliff erosion has to be stopped, the counter measure should be adapted to the local circumstances (Adnitt et al. 2007). Stone revetments should only be considered under very stressful conditions, as for instance around the Halligen in the Wadden Sea (Esselink et al. 2009). [Kleef]

Where salt marshes are retreating there are several measures that can be taken either separately or in combination. These include the promotion of pioneer salt marsh as described above as well as the following:

1. Creating wave breaks to seaward;
2. Use of dredged material to 'feed' the eroding shoreline and promote salt marsh accretion;
3. Planting salt marsh grasses on tidal mud/sand flats with or without protective groynes;
4. Protecting the eroding, often 'cliffed' edge of the salt marsh with 'rip rap' or other material.

All these methods have been used at locations along the Atlantic coast. At a few, several occur in combination. A case study at Horsey Island in Hamford Water on the Essex coast, England includes examples of the use of wave breaks, polders and sediment recharge. The wave breaks reduce the impact of onshore waves. The polder-like structures moderate the wave climate allowing fine sediment to deposit and accrete tidal flats. The deposition of additional sediment acts in combination with the other methods to encourage pioneer salt marsh, the precursor to the development of Atlantic salt meadows.

#### Reintegration (with the sea), managed realignment, regulated tidal exchange

Conditions may be unfavourable for salt marsh development because of relative sea level rise, a depleted sediment supply, increased wave attack or a combination of all three. The alternative considered here is to move landward, re-creating habitat on enclosed former tidal land, converted to agricultural use. The process involves giving up the created land to the sea by realigning the coast. Various terminology is used, 'managed retreat', 'set back' and more recently 'managed realignment' in the United Kingdom or in Continental Europe 're-integration' (with the sea) and 'depoldering' in the Netherlands.

The process can include regulated tidal exchange either as a precursor to a full realignment or as part of it. The methods employed are, in principle, relatively straightforward. They involve engineering a breach in the existing seaward sea wall. This may include building a new sea defence,



or reinforcing an existing one landward of the breach. Several important features help to secure successful realignment and salt marsh establishment, namely:

- an appropriate elevation in relation to the tidal regime. The limit of terrestrial vegetation (normally reached by species of *Spartina*) defines the lower vertical range for salt marsh; transitions to non-saline vegetation defines the upper limit (Hough et al. 1999 in Doody 2008);
- a degree of protection from wave exposure enables pioneer plants to become established;
- a supply of sediment and adequate drainage for the vertical and horizontal growth of the vegetation.

The location and size of the breaches help to establish former tidal conditions and creek patterns. In some instances, the breach may involve a reduction in height of the seaward bank to create a spillway similar to help regulate tidal flow. In a few locations, tidal flaps fulfil a similar role.

Examples from the **United Kingdom** range from the first experimental site at Northey Island, Essex, England, which was only 0.8 ha to the 400 ha Alkborough site, on the Humber Estuary. In 2005 there were over 50 realignment sites in the UK, about 9 in the Netherlands, 2 in **Belgium** and 9 in Germany either completed or planned. In the Netherlands, four of the schemes were abandoned due to local opposition and one of the two schemes in **Belgium** (Wolters *et al.* 2005 in Doody 2008). In the UK, the majority combine deliberate breaches with strengthening of a defence landward. Figure 6 illustrates an example of a recent scheme at Abbots Hall on the Essex coast, England.

Many of the former attributes of the enclosed salt marsh are re-created, developing within just a few years after the re-introduction of the tide. Sediment rates ranging from 8 mm to 258 mm have been recorded at Tollesbury in Essex, England. Although the most rapidly accreting lower mudflats had not colonised after 7 years of tidal influence, approximately 6 ha of the 21 ha site had salt marsh vegetation, mainly of *Salicornia europaea* with *Puccinellia maritima* and *Atriplex portulacoides*.

The last species was restricted to the highest elevations near the foot of the new sea wall. Invertebrate colonisation of the site was also rapid, with 14 species recorded after only two months of tidal inundation and between 18 and 19 species thereafter with the number remaining constant. The most abundant species was the Mud Snail *Hydrobia ulvae* recorded throughout 6 years after the breach (Garbutt *et al.* 2006 in Doody 2008). Standardised bird monitoring showed that after 5 years the range of species using the site was similar, but not identical to nearby 'natural' areas. Four years after inundation, the bird populations were still evolving (Atkinson *et al.* 2004 in Doody 2008).

Generally, it is possible to re-create salt marsh through managed realignment. Colonisation is rapid and whilst it may take several years for the re-created habitat to become equivalent to Atlantic salt meadow vegetation, communities approaching this are already developing at some sites. For a more detailed review of salt marsh restoration through managed realignment see Garbutt *et al.* 2006 in Doody 2008.

For Flanders (**Belgium**) (Van Uytvanck *et al.* 2010):<sup>19</sup>

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<sup>19</sup> The whole paragraph "For Flanders (Belgium) (Van Uytvanck *et al.* 2010): (...) – Recovery Management: sod cutting or digging" seems to me to apply rather on the subtype B "inner dike salt marshes" (that are not under tidal influence) than on tidal salt marshes outside the dikes (subtype A) ... [Herrier]

Location of the measures at landscape, area or parcel level

Source-oriented measures are located at the landscape level: reducing eutrophying nitrogen deposition from intensive livestock nearby. For targeted restoration of former agricultural land, however, phosphorus is a limiting factor. On former intensively used agricultural land in the polder area phosphorus in the soil can only adequately and successfully be removed by excavation. This measure can only be locally (plot level) used.

Measures at the regional level mainly concern the optimization of the hydrological conditions. This means that:

- Salty or brackish groundwater seepage at least periodically may come in contact with the root zone of vegetation. In most cases this will be the case in the depressions and trenches in the terrain.
- The salty surface water level fluctuates, which causes small periodic flooding of the riparian zones and low-lying areas of grassland. Permanent impoundment of fresh surface water should be avoided, so that above the salty groundwater no freshwater lens is formed. In winter, the groundwater should be kept to about ground level, so as to prevent desalination through infiltrating rain water.
- gradient rich environments are restored within an area so that on a small scale several hydrologically separate units can be maintained, causing gradients in salinity, water level and flood duration. Isolated creek arms, depressions, ponds or seepage areas are good examples. The often heavy soils in the polder ensure that such places also hydrologically often can remain independent. On the other hand, for larger-scale restoration of brackish vegetation water is required to allow colonization opportunities. Here, a good balance between small-scale management and large-scale restoration is needed.

If it is not possible to restore the hydrology, restoration measures can only have a local effect, ie one can only try to lower the surface level so that salt water can influence the vegetation.

Large-scale measures concern for example the dredging of salty creeks so salty seepage flows are restored, the intake of salty seepage through seepage pipes and the excavation of the topsoil over large areas.

Management measures and techniques in area or parcel level

- Grazing: Grazing is by far the most important measure to manage well-developed vegetation types or to repair situations with too little dynamics (eg for converting reedland into salt marshes);
- Mowing;
- Recovery Management: sod cutting or digging.
- 

**Germany, Ackermann, comm. (original in German translated with Google)**

1. Redesign of the drainage system, closure or removal of anthropogenic drainage and resolution of group structure;
2. Restoration or enhancement of the natural dynamics, such as by waiving Begrüppung / Schötung in newly created Lahnungsfeldern or by reducing the Begrüppung to ensure Deichfußentwässerung;

3. Improve the habitat structure by investing Blänken and reactivation of old tidal creek systems;
4. Increase in the salt water influence in summer polders by opening of summer dikes, or by salt water impounding or sewer management;;
5. Deconstruction of anthropogenic drainage structures formerly used in salt marshes.
6. Ensure extensive grazing using contractual nature protection.

**Ireland**, Gaynor, pers. Comm.:

1. Improved enforcement of planning regulations
2. Input into planning process
3. Control and/or removal of *Spartina*
4. Creation of new areas of saltmarsh by re-flooding areas that were formerly infilled or reclaimed

Accretion and erosion are natural elements of saltmarsh systems and should be allowed to occur naturally. Sediment supply is particularly important for this pioneer saltmarsh habitat, as its distribution depends on accretion rates. The regular ebb and flow of the tide brings salinity, but also nutrients, organic matter and sediment, which are central to the development, growth and survival of saltmarshes. Creeks play an important role in distributing sediment throughout the saltmarsh and should be maintained.

### 2.3. Other measures (e.g. monitoring)

It is clear from the situation in south east England that the combined effects of enclosure and sea level rise have resulted in the loss of considerable areas of Atlantic salt meadows. Lying at the upper levels of the succession they were the first to be enclosed to create agricultural land. The subsequent loss through erosion and the implications of salt marsh 'squeeze' came about because of surveillance using a series of aerial photographs taken at different dates. Satellite images could expand the frequency and geographical scale of surveillance.

From 2002 to 2004 a project called EURosion, financed by the European Commission looked at coastal erosion from a wide perspective. In particular, it concluded that the phenomenon was one that cannot be completely controlled, but can be managed in an economically and ecologically sustainable way. See <http://www.euroasion.org/index.html> for details. The final report emphasises the value of looking at coastal management within sediment cells. These help to define coastal resilience of low-lying coasts in the face of enclosure (of tidal land), sediment availability and sea level rise.

The reports provide key recommendations on the importance of allowing space for coastal systems to operate and, in the case of salt marshes, the availability of sediment of a suitable size and volume. The recommendations also include guidance on coastal erosion management practice based on lessons learned from a number of detailed case studies. Whilst these are not specifically aimed at salt marsh, the sites and ecosystems studied include the habitat. The reports also provide information on monitoring and surveillance techniques.

A LIFE-Nature project, 'Living with the sea' (LIFE99 NAT/UK/006081, 1998-2001) also looked at a number of case study areas in England. The purpose of this work was to determine how sea level rise would affect the coast and influence coastal management of Special Areas of Conservation over a 30-100 period.

Included within this study is a guide to the restoration of coastal habitats, including salt marsh. Seven individual case studies help provide information on management options and costs. These included a realignment of 38 ha site at Brancaster on the North Norfolk Coast, which cost approximately €865,000. Several of these schemes were part funded from this LIFE programme.

**Ireland, Gaynor, pers.comm.:**

1. Improved enforcement of planning regulations
2. Input into planning process
3. Control and/or removal of *Spartina*
4. Creation of new areas of saltmarsh by re-flooding areas that were formerly infilled or reclaimed

## 2.4. Species specific measures

Recreating or maintaining good conditions for foraging and breeding by various species of wetland bird is a main management objective for several salt and coastal meadow sites. Mostly, there are no specific requirements other than those described above in relation to grazing but sometimes species-specific consideration is needed with reference to grazing regimes (Doody 2008).

A moderate grazing pressure in combination with delayed grazing, until early summer (after mid-June for *Philomachus pugnax*) has been proposed to aid breeding for these species (Widemo & Holmquist 2007 in Doody 2008). Densities of grazing livestock have to be adjusted, taking local knowledge and traditions into account and need to be monitored and adjusted as required. For *Calidris alpina schinzii* a grazing pressure >2 cattle/hectare and grazing during the nestling period should be avoided (Jönsson 2007b in Doody 2008), to give just one example of the kind of local adjustments that might be needed.

It is also important to recognise the good structural diversity of historically ungrazed (by domestic stock) or lightly grazed salt marsh vegetation to breeding waterfowl and other bird species that require nests to be hidden from predators. This and the plant species diversity often associated with it not only include breeding birds but also invertebrates.

Conversely more heavily grazed sites lack this structural diversity, however as already stated they may have important wintering avian herbivores and a few open-ground nesting birds such as the *Haematopus ostralegus* (oystercatcher). - Generally, larger estuarine salt marshes, especially in the southern North Sea are truncated by land enclosure. The upper levels, less frequently inundated by the tide and hence suitable for nesting waders, are absent. Where species such as *Tringa totanus* (common redshank) nest these may be flooded on Spring tides.

Atlantic salt meadows also support a range of other animals, some of which are rare and/or confined to this vegetation type. Towards the upper salt marsh levels, including those offering transitions to brackish and freshwater conditions there are a wide variety of species. For example, upper estuary reed beds or freshwater seepages, which dilute tidal seawater provide habitat for *Botaurus stellaris* (bittern). The endangered natterjack toad *Bufo calamita* lives in open pools on upper salt marsh at a few sites.

Several upper Atlantic salt meadow plant species, such as sea wormwood *Seriphidium maritimum* and sea lavender *Limonium* spp. are especially attractive to phytophagous (plant eating) invertebrates that feed on different above ground parts of the plant. At least 15 species feed on sea wormwood in the United Kingdom, 11 are monophagous (feed only on this species). Rare invertebrates found in this habitat include the ground beetles *Amara strenua* and Saltmarsh shortspur *Anisodactylus poeciloides* and the Narrow-mouth whorl snail *Vertigo angustior*. The bee *Colletes halophilus* nests in the high transition zone but forages for pollen and nectar on sea aster *Aster tripolium* out on the salt marsh. A key requirement for most of these species is that the transitional zones to upper salt marsh remain intact, unenclosed and ungrazed or lightly grazed by domestic stock (Doody 2008).

## 2.5. Main constraints / bottlenecks and actual needs

**Germany, Ackermann, pers.comm.:**

1. Schwierigkeit der Abstimmung von Maßnahmen und Bewirtschaftung mit verschiedenen Eigentümern (außerhalb des Nationalparks Wattenmeer, NI)

**Ireland, Gaynor, pers.comm.:**

1. Lack of resources
2. Enforcement difficulties
3. History of poor planning
4. Public perception of saltmarshes as dirty/smelly wasteland
5. Climate change

Main constraints in **The Netherlands** are:

- Ageing because of lack of natura dynamic in the ecological system
- Sea level rise with the risk of drowning of the Wadden sea en erosion of salt meadows.

At the moment the system locally can compensate for a relative rise of 9-11 mm per year (Ameland subsidence study). [Schotman Alterra]

An increasing problem seems to be an increase in frequency and scope of flooding due to storm surges. The risk of flooding of nest on salt meadows increased in the years 1971 -2008 for several birds ( vogelbalans 2010, SOVON Vogelonderzoek Nederland, Van de Pol et al. 2010. Journal of Applied Ecology 47:720-730.) [Schotman Alterra]

## 2.6. Recommendations

**Germany, Ackermann, pers.comm.:**

1. Kooperation bei der Erstellung von Vorlandmanagementplänen

**Gaynor:**

1. Education
2. Raising public awareness
3. Influencing planning policy
4. Communication
5. Improved enforcement of planning regulations and wildlife legislation

## Cases / projects

Within a LIFE-Nature project in Denmark, 'Restoration of meadow bird habitats' (LIFE06NAT/DK/000158, started in 2005), restoration and grazing will be carried out on more than 900 ha of salt meadows, with the aim to reverse the declining trend in wader birds including *Philomachus pugnax* (Ruff) and *Calidris alpina schinzii* (Dunlin). Measures include clearing of tree and scrub encroachment, overgrowth of reeds and restoration of hydrology at four Natura 2000 sites and it is based on a previous nationwide action plan for threatened meadow birds (Asbirk & Pitter 2005 in Doody 2008).

**LIFE Nature projects:**

- LIFE96 NAT/B/003032 "ICCI – Integral Coastal Conservation Initiative": restoration of tidal mud flats and salt marshes in the Yzer estuary at Nieuwpoort (1997 – 2001, Belgium, completed): see my completed form of case study [Herrier]
- LIFE09 NAT/B/000413 "ZTAR – Zwin Tidal Area Restoration": recently started project of restoration of tidal lagoon, mudflats, salt marshes and inlet by the Agency for Nature and Forests in Belgium and the Province of Zeeland in the Netherlands (2011 – 2015) [Herrier]

An interesting case is the Ameland subsidence study (reports are available from WL I Delft Hydraulics, Alterra Wageningen-UR, Nature Centre Ameland). [Schotman Alterra]

## Sites

**For Belgium (Flemish Region):**

- SCI BE2500001 "Duingebieden inclusief IJzermonding en Zwin" (both subtypes of 1330)
- SCI BE2500002 "Polders" (subtype B, inside dikes of 1330)
- SCI BE2500006 "Schelde- en Durmeëstuarium van de Nederlandse grens tot Gent" [Herrier]

## 2120 - Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")

### Summary

**Shifting dunes** along the shoreline with *Ammophila arenaria* ('white dunes') encompasses most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-binding marram, *Ammophila arenaria*, is always a prominent feature of the vegetation and is usually dominant. This is a dynamic vegetation type maintained only by change. It can occur on both accreting and eroding dunes, but will rapidly change and disappear if stability is imposed. It rarely occurs in isolation because of its dynamic nature and because it is successional related to other dune habitats.

Shifting dunes are less salty than embryo dunes and are constantly replenished with fresh sand. The habitat type excludes the low, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram and where plants of the strandline mingle with salt-tolerant, sand-binding grasses; such vegetation falls within Annex I type H2110 Embryonic shifting dunes.

**Shifting dunes are characterized by** a varied species composition. The most marked floristic variation relates to the degree of instability. Where sand accretion is extremely rapid it is possible to find vegetation that consists only of *A. arenaria*. As rates of sand deposition decline the marram is joined by more species, first by other specialised dune plants, then by less specialised grasses, drought-tolerant annuals and a restricted number of specialised bryophytes such as the moss *Tortula ruralis* ssp. *ruraliformis*. This moss plays an important part in completing the stabilisation of the sand surface. Towards the seaward edge of the zone of shifting dunes, salt-tolerant plants such as sea sandwort *Honckenya peploides* may be prominent, along with the sand-binding sand couch *Elytrigia juncea*. Further inland these species are rarely prominent.

Overall the **conservation status of this habitat type** in the Atlantic region has been assessed as 'unfavourable-bad'. Many countries note threats from tourism related activities and from works to control coastal erosion. In several countries (including France, the Netherlands and Belgium) the area of the habitat type is regressing due to (i) the spontaneous encroachment which fixes the initially un-vegetated mobile sand dunes, (ii) relative sea level rise and (iii) a shortage of sediment.

**The main reported threats and pressures** to shifting dunes in the Atlantic region are:

- Sand extraction (both on shore and off shore).
- Intensive recreation (outdoor sports and leisure activities): trampling, erosion, fragmentation, sand compaction caused by (non-) motorised vehicles, walking and horse riding.
- Construction of sea defence work and coastal protection works, including afforestation, tidal barrages, sea defences.
- Fixation of the coastline and dune stabilisation (by planting marram grass, setting up reed screens, beach nourishment and building up 'stuifdijken', sand trap fences, etc).
- Intensive agriculture and built-up areas (roads and buildings) directly behind the dune area.
- Beach nourishment which uses sand that differs in chemical composition from the original sand.
- Invasive non native species (e.g. infestation by *Phomopsis juniperovora*, *Rosa rugosa*, *Senecio inaequidens*, *Populus candicans* and *Populus alba*).

- Atmospheric N-deposition; which speeds up succession and leads to the fixation of shifting dunes.
- Increase of spontaneous colonization and fixation of 'white dunes' by *Ammophila arenaria* and *Hippophaë rhamnoides*, probably caused by climate change (increased precipitation, mild winters) and atmospheric nitrogen deposition.

Most of the threats lead to fixation of the white dunes. The typical species, marram grass, is dependent on a constant aeolian supply of fresh sand. If the supply stops, the species will decrease and succession will proceed towards grey dune (2130).

The most important **management measure** in this habitat type is to stop fixing the sand by using artificial structures and to simulate the drifting of sand where it has become too much stabilized in the past. The replenishments will stimulate the growth of embryonic dunes which can change to shifting dunes by natural succession. When shifting dunes become dynamic again this will help them to recover from (too much) nitrogen deposition, which can cause a rapid succession to shrubs. Other relevant management measures to address the threats and pressures are:

- Removal of exotic invasive species.
- Control of public access (construction of walkways through dunes, information boards, fence off dunes, etc).
- Grazing by large herbivores can create rather small scale bare sand patches and, under aeolian influence, blowouts.
- Encouraging the use of soft protection measures over hard coastal protection works.
- A new development in the Netherlands is the 'sand engine' concept (beach nourishment) which may result in a more or less natural advection of fresh blown sand.(pilot project – started in 2011).

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are that with marram (mobile) dunes there is a public perception that moving sand is bad and needs to be prevented. Climate change and the fear of flooding from sea level rise can cause panic among the public whenever there is any erosion at the coast and authorities come under pressure to 'fix' the 'problem' urgently. This has led to an increase in the number of schemes for coastal protection works and dune stabilisation measures being carried out. This has resulted in a number of inappropriate works being carried out and has led to over-stabilisation of some dune systems. Lack of resources (time and funds) has limited the removal of invasive species such as sea.

**Solutions** to the pressures, threats and bottlenecks may include:

- Awareness raising, communication, influencing policies (e.g. to stop planting of invasive aliens in or near dune sites, etc)
- Experiments of re-mobilisation of the dunes on small as well as large scale with the necessary attention for debris and root material.
- In the long run: extended use of natural processes to ensure coastal safety under a scenario of sea-level rise.



## 1 Description of the habitat

Mobile dunes forming the seaward cordon or cordons of dune systems of the coasts (16.2121, 16.2122 and 16.2123). *Ammophilion arenariae*, *Zygophyllion fontanesii*. (EC 2007b)

Mobile ('white' or 'yellow') dunes are unstable dunes where there is active sand movement. They are less salty<sup>20</sup> than the embryo dunes and are constantly replenished with fresh sand (Joint Nature Conservation Committee n.d.).

The name 'white dunes' refers to the color of the sand: since no soil development has taken place, the color is still white instead of grey (as in H2130) (Kennisnetwerk Ontwikkeling en Beheer Natuurkwaliteit n.d.).

The habitat type excludes the low, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram and where plants of the strandline mingle with salt-tolerant, sandbinding grasses; such vegetation is referable to Annex I type H2110 Embryonic shifting dunes (Joint Nature Conservation Committee n.d.). This habitat type is a succession stage after embryotic dunes.

### 1.1. Distribution

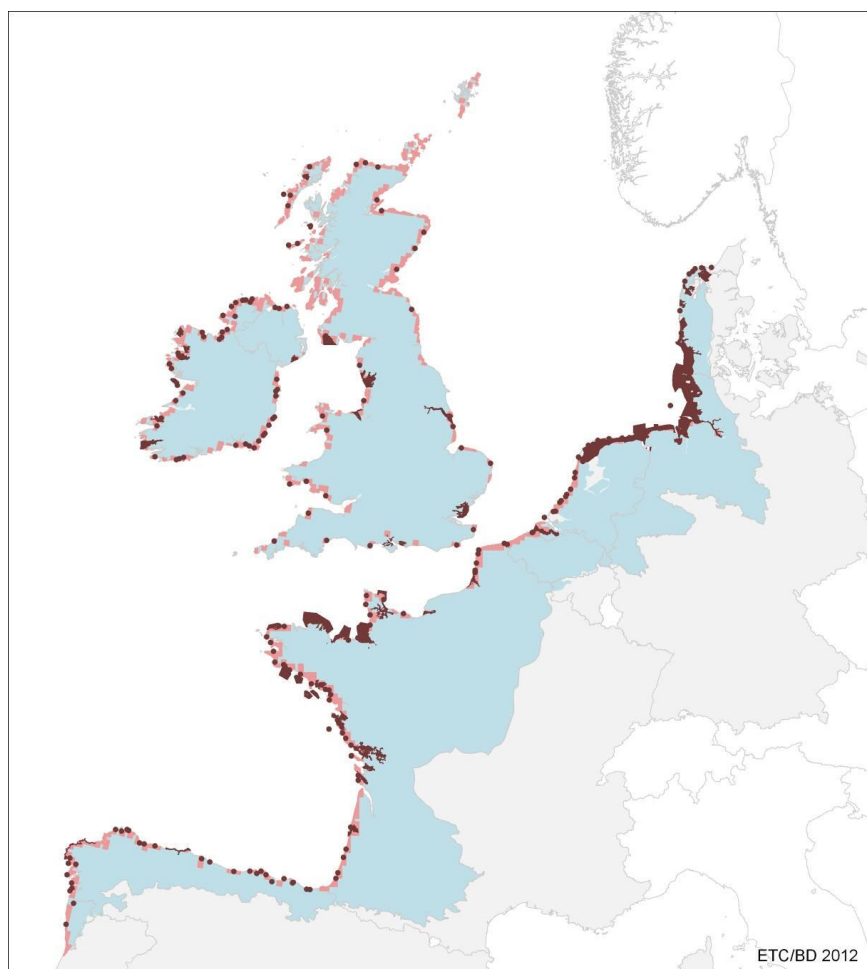
**Table 17 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	1			10	25	14	30		31		50		63		26	46	17	1		10	43	
habitat area (ha)	454			1445	252	2839	8006		900		4078		9011		2708	2597	4252	140		5031	1592	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>21</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>20</sup> Remark on this point by Rees (UK): This needs more explanation.

<sup>21</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 4 Map of SCIs proposed for Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') encompasses most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-binding marram *Ammophila arenaria* is always a prominent feature of the vegetation and is usually dominant. This is a dynamic vegetation type maintained only by change. It can occur on both accreting and eroding dunes, but will rapidly change and disappear if stability is imposed. It rarely occurs in isolation because of its dynamic nature and because it is successional related to other dune habitats.

The species composition of shifting dunes is constrained by the harsh conditions, but the vegetation is by no means uniform. The most marked floristic variation relates to the degree of instability. Where sand accretion is extremely rapid it is possible to find vegetation that consists only of *A. arenaria*. As rates of sand deposition decline the marram is joined by more species, first by other specialised dune plants, then by less specialised grasses, drought-tolerant annuals and a restricted number of specialised bryophytes such as the moss *Tortula ruralis* ssp. *ruraliformis*. This moss plays

an important part in completing the stabilisation of the sand surface. Towards the seaward edge of the zone of shifting dunes, salt-tolerant plants such as sea sandwort *Honckenya peploides* may be prominent, along with the sand-binding sand couch *Elytrigia juncea*. Further inland these species are rarely prominent (Joint Nature Conservation Committee n.d.).

### 1.3. Ecological requirements

### 1.4. Main subtypes

### 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") and provided their conservation status in the Atlantic Member States (see tables below).

**Table 18 Species associated to Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	DK	FR	NL	UK	REGION
1261	<i>Lacerta agilis</i>	Reptiles	range	FV	FV	U2	U1	U1	U2
			population	U1	XX	U2	U1	U1	U2
			habitat	U1	XX	U2	U1	U1	U2
			future	U1	XX	U2	FV	FV	U2
			overall	U1	XX	U2	U1	U1	U2

In addition, the Habitats Manual lists the following Annex II/IV plant species: *\*Convolvulus caput-medusae*, *\*Androcymbium psammophilum*. (EC 2007a) (ETC BD 2012).

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Eryngium maritimum</i>						x				
<i>Elymus arenarius</i>						x				
<i>Lolium parabolicae</i>						x				
<i>Crambe maritima</i>						x				
<i>Linaria thymifolia</i>						x				
<i>Galium arenarium</i>						x				
<i>Galium neglectum</i>						x				
<i>Hieracium eriophorum</i>						x				
<i>Astragalus bayonensis</i>						x				
<i>Silene vulgaris subsp. Thorei</i>						x				
<i>Galerida cristata</i>						x				

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Polyphilla fullo</i>						x				

## 1.6. Related habitats

Related habitats located at the Atlantic coast in France (Muséum national d’Histoire naturelle [Ed] 2003):

- annual vegetation of foreshore (EU 1210)
- mobile embryonic dune (EU: 2110)

fixed dunes of the Mediterranean coast, Crucianellion maritimae (EC 2007b)

## 1.7. Ecological services and benefits

**Belgium:** pers. comm. Herrier:

The seaward dune cordon provides protection of the land against marine flood

## 1.8. Conservation status

**Table 19 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
2120	Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes")	range	FV	FV	FV	XX	FV	FV	FV	FV	FV	FV
		area	U1	FV	XX	XX	U1	U2	FV	U1	U1	U2
		structure	U2	FV	XX	XX	U1	U2	U1	U1	U2	U2
		future	U1	U1	XX	XX	U1	U2	FV	XX	U1	U2
		overall	U2	U1	XX	XX	U1	U2	U1	U1	U2	U2

These are mobile dunes dominated by marram grass (*Ammophila arenaria*) which are normally found as part of a dynamic assemblage of several dune habitats, most of which have been assessed as unfavourable throughout the European Union. The habitat is found on coastlines throughout the European Union except in Macaronesia.

Assessed as 'unfavourable-bad' in all regions in which it occurs, range is generally favourable but the other parameters are mostly reported as unfavourable although both Denmark and Spain report most parameters as 'unknown'. Many countries note threats from tourism related activities and from works to control coastal erosion (Summary sheet of the online report on Article 17 of the Habitats Directive).(ETC BD 2012).

## 1.9. Trends

In France, the shifting dunes (H2120) are regressing (Muséum national d'Histoire naturelle [Ed] 2003)

### The Netherlands, Schotman, pers. comm.:

In the Netherlands, a regression coast is natural due to relative sea level rise and a shortage of sediment. Since 1990, the policy is to compensate for this shortage with the supply of extra sand transported from the deeper North Sea. The plan is to continue this policy in the coming century in the course of the 'Deltaprogramma'. One of the principles of this plan is to leave as much space as possible for natural morphological coastal processes. A result will be a larger area and portion of shifting dunes of vital dunes.

### Belgium, pers. comm. Herrier:

In Belgium, for about the last 17 years, the area of really mobile dunes is regressing, due to the spontaneous encroachment of the initially un-vegetated mobile sand dunes with *Ammophila arenaria* and *Hippophaë rhamnoides*. The increasing vegetation fixes the dunes. This process could be caused by climate change (increased precipitation, mild winters) and atmospheric nitrogen deposition.

## 1.10 Main pressures and threats

**Table 20 Main pressures to Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes")	<i>Lacerta agilis</i>
Sand and gravel extraction	x	x
Urbanised areas, human habitation	x	x
Outdoor sports and leisure activities	x	
Trampling, overuse	x	
Dykes, embankments, artificial beaches, general	x	
Erosion	x	
Biocenotic evolution	x	x

**Table 21 Main threats to Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes") and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes")	<i>Lacerta agilis</i>
Sand and gravel extraction	x	
Urbanised areas, human habitation	x	x
Outdoor sports and leisure activities	x	
Trampling, overuse	x	
Dykes, embankments, artificial beaches, general	x	
Erosion	x	
Biocenotic evolution	x	x

The major pressures and threats to UK and German coastal habitats (including humid dune slacks 2190, fixed coastal dunes 2130 and shifting dunes 2120) are (Joint Nature Conservation Committee n.d.) (Bund Länder Meeresprogramm Meeresumwelt n.d.):

- Changing agricultural practice, including grazing (UK)
- Sediment supply/dynamics (UK)
- Recreation (German, UK)
- Coverage with flotsam and cut material (German)
- Coastal protection, including afforestation (UK)
- Dune reinforcement, dune stabilisation, sand trap fences (German)
- Infestation by *Phomopsis juniperovora* (UK)
- Air pollution: the Habitat Action Plan (HAP) for coastal sand dunes considers atmospheric nutrient deposition as a factor affecting the habitat (UK)
- Falling water tables (*is this ok, vegetation is independent from groundwater?*) (UK)

In France (Muséum national d'Histoire naturelle [Ed] 2003), the shifting dunes are regressing due to:

- a change from natural sediment dynamics to more artificial conditions
- frequently visited areas due to trampling
- oil pollution
- period of high tides associated with storm (due to oil spill from the sinking of oil tankers)<sup>22</sup>
- The spread of sludge from sewage from on mobile dunes
  - promotes the establishment of nitrophilous or ruderal species
    - difficult to remove

In Ireland, threats to this habitat include natural and man-made pressures. A regular supply of blown sand is essential to maintain the natural mobility of marram dunes and this can be depleted by removal of beach materials, construction of coastal protection works or by sand compaction caused by motorised vehicles on the beach. High visitor pressure on dunes causes trampling, which damages the plant cover. Interference with the supply of sand at a number of sites has negatively impacted on the natural functioning of this habitat, leading to a loss of area (NPWS 2008).

<sup>22</sup> Remark on this point by Rees, UK: = overall pollution from the sea? This needs more explanation.

Gouguet, pers. comm.:

1. K.01.01. Erosion (Sea erosion)
2. J.02.12.01 sea defense or coast protection works, tidal barrages
3. E.01 'Urbanised areas, human habitation.
4. G 01: outdoor sports and leisure activities, recreational activities.
5. I 01. invasive non native species

These threats can appear during storms and can change sediment dynamics, which can lead to the disappearance of the habitat type.

### **Ireland:**

In **Ireland**, threats to this habitat include natural and man-made pressures. A regular supply of blown sand is essential to maintain the natural mobility of marram dunes and this can be depleted by removal of beach materials, construction of coastal protection works or by sand compaction caused by motorised vehicles on the beach. High visitor pressure on dunes causes trampling, which damages the plant cover. Interference with the supply of sand at a number of sites has negatively impacted on the natural functioning of this habitat, leading to a loss of area (NPWS 2008).

Gaynor, pers.comm.:

1. C01.01 Sand and gravel extraction
2. J02 Anthropogenic changes to hydrological conditions
3. G01 Sport, leisure and recreational activities
4. I Invasive, other problematic species and genes
5. K01.01 Erosion

A supply of sand is fundamental to the development of a dune system. Therefore sand extraction (both onshore and offshore) can negatively impact on this habitat. Historically the removal of sand from beaches was common practice and was even subsidised.

Anthropogenic changes to hydrological conditions includes the impacts of sea defence works and coastal protection works which can affect the circulation of sediment and organic matter, thus altering natural erosion and accretion processes.

Recreational activities such as walking, horse riding and use of both motorised and non-motorised vehicles can cause habitat losses and damage through trampling, erosion and fragmentation.

Obviously erosion is one of the greatest threats/pressures on dunes, particularly the habitats found on the seaward side including marram dunes, but where this is a natural process, it should not be managed but allowed to continue where possible. However, accelerated rates of erosion caused by human activities (e.g. coastal protection works, removal of beach material, etc.) need to be prevented.

### **The Netherlands**

van Dobben, pers. comm.

1. The most important threat to habitat type 2120 is the **fixation of the coastline**. For this habitat type the supply of fresh sand is essential. By a political decision Dutch coastline

is fixed at its state in 1986 and as a result, sand blowing is prevented as much as possible. Fixation is mainly achieved by planting of marram grass, setting up of reed screens, beach nourishment, and building of 'stuifdijken' (most of them in the period 1850-1950 but many still presently). Beach nourishment is less destructive to the habitat than marram grass, reeds screens and stuifdijken, especially if it is carried out below the shoreline and with the right type of sand (chemical composition, grain size distribution). A new development is the 'sand engine' concept which may result in a more or less natural advection of fresh blown sand.

2. **Intensive recreation** may be a threat to habitat type 2120, although the most vulnerable sites are excluded from tourism nowadays. However, in The Netherlands beaches are used for recreation almost everywhere, resulting in less formation of embryonic dunes (2110, a precursor of 2120) because of (a) compaction of sand, (b) beach cleaning actions that remove shoreline material that act as precursors for embryonic dunes, (c) destruction of embryonic dunes by trampling and car traffic. Less formation of embryonic dunes leads to less formation of white dunes and ultimately to fixation and disappearance of white dunes. Also, recreation is extremely destructive to the fauna of beach and embryonic and white dunes (e.g. beach breeding birds, plovers and terns).
4. In general, the presence of **intensive agriculture and built-up areas directly behind the dune area** is a threat to white dunes. The presence of such areas creates the need for coastline fixation and will eventually lead to the loss of all dynamic dunes. In The Netherlands certain coastal areas where the hinterland has no economic importance are set aside as 'dynamic management' areas where no measures are taken to fix dunes in their 1986 position. In principle such areas have a high potential for biodiversity.
5. If **beach nourishment** takes place, use of sand that differs in chemical composition from the original sand (e.g. Ca-poor instead of Ca-rich) is a potential threat.
6. **Atmospheric N-deposition** is a threat because it speeds up succession and leads to the fixation of shifting dunes.

Most of the treats lead to fixation of the white dunes. The typical species marram grass is dependent on a constant aeolian supply of fresh sand. If the supply stops, the species will decrease and succession will proceed towards grey dune (2130). Although 2130 is a valuable habitat in itself, a decrease of the dynamics of 2120 (and before that, 2110) will ultimately also lead to the loss of 2130 because in this type succession proceeds towards dune forest.

Schotman, pers. comm.

In the Netherlands the dunes are suffering from a nitrogen deposition that is higher than the critical load of 1400 mol N/ha/jr. The policy is to drive back the deposition, but it will take a lot of time to do so.

## Belgium

pers. comm. Herrier:



1. E01 Urbanised areas, human habitation: In Flanders urbanisation in the 20th Century has caused a dramatic shrinking of the superficies of the coastal dunes (from 6.000 ha to 3.800 ha). As most of the remaining dune sites along the Flemish coast are fragmented by roads (D01.02) and surrounded by suburban habitation, there is no sufficient space left anymore for large scale sand drift. Mobile dunes that are threatening adjacent buildings or roads are being fixed by plantation of Marram grass and the placing of brushwood.
2. K02 Biocenotic evolution, succession: for about 17 years mobile “white” dunes have been increasingly spontaneously colonized and fixed by *Ammophila arenaria* and *Hippophaë rhamnoides*. One of the most dramatic example is the “central wandering dune” of the Flemish Nature Reserve “De Westhoek” at De Panne, once, with its 80 ha of bare drifting sand, one of the largest shifting dunes of north-western Europe. Fixation of the “white dunes” means also that the formation of new humid dune slacks by Aeolian sand drift has stopped.
3. H04.02 Nitrogen input and M Climate change. The increasing “spontaneous” fixation of the shifting dunes by the vegetation could be the consequence of an increase of Nitrogen input and an increase of precipitations and mild winters.
4. I01 invasive non-native species (*Rosa rugosa*, *Senecio inaequidens*, *Populus candicans* and *Populus alba*, the latter 2 species especially by vegetative reproduction through root offshoots).
5. G01.02 “walking, horse riding and non-motorised vehicles”, G05.01 “Trampling overuse”. Although trampling can locally maintain bare patches of sand, it also destroys the larvae of invertebrates that are linked to shifting dunes (*Cicindela maritima* ...) and recreation can disturb nesting birds (*Galerida cristata* and *Anthus pratensis*).

## 2 Conservation management

### 2.1. Main conservation requirements

Maintenance of Habitat Type 2120 requires (Bund Länder Meeresprogramm Meeresumwelt n.d.):

- Conservation and development/restoration of natural habitat dynamics involving denudation and the wind deposition of lime-rich sand as a precondition for the emergence and conservation of the habitat type.
- Conservation and development/restoration of the complete zoning of typical vegetation with younger and older developmental stages, including patches of open sand
- Conservation and development/restoration of natural transitions to grey dune habitats
- Conservation and development/restoration of biotope-typical species composition with stable populations of the characteristic species
- Allowing no or minor impairments (above all due to coastal protection measures and tourism)

## France

Gouguet, pers. comm.:

1. Have a large site where dunes can recede
2. Sweet way to protect : contribution in sand.... (? = Supply of sand)
3. Strict regulation (law, ...)
4. Control foothpath and practices (? = Control of public access and recreational activities)
5. Removing non native species

## The Netherlands

Schotman, pers. comm.:

In the Netherlands since 1990, the government policy has been that the coastal position of 1990 will be maintained. The coastal position is maintained through coastal replenishments. Up to recent, the replenishments were carried out in the foredunes and on the beach. In recent years, the coastal replenishments have been carried out as shoreface replenishments. The replenishments are necessary to compensate for the shortage of sediment due to relative sea level rise and the limited transport of sediment to the Dutch coast by rivers and the sea. The policy also is to 're-dynamise' the shifting dunes zone. As a result of the government policy, the area of vital shifting dunes has increased.

van Dobben, pers. comm.

1. In general this type **does not require management!** Rather, the intensive management applied after c. 1900 is a threat to this type.
2. Most important is the **restoration of natural dynamics**, e.g. by removal of 'stuifdijken', removal of vegetation, re-activation of 'stuifkuilen', etc.
3. The **creation of beach reserves**, where recreation (incl. car traffic) is excluded, will favour the development of the whole succession series shoreline (1210), embryonic dunes (2110), white dunes (2120), grey dunes (2130).
4. **Reduction of N emission** will decrease N deposition and thereby slow down succession and fixation. N emissions from (a) sea shipping and (b) seawater pollution are important sources of N and acidity in this habitat.
5. **The sand engine** is an experimental concept, but it may contribute to the preservation of 2120.

## Belgium

pers. comm. Herrier:

1. E01. Removal of obsolete infrastructures and buildings to offer space to sand drift.
2. K02. Remobilizing the dunes by the mechanical removal of vegetation, although this large scale measure could be doomed to failure in the actual climatic

circumstances... Grazing by large herbivores can create rather small scale bare sand patches and under aeolian influence blowouts.

3. H.4.02 and M. Reducing emissions of Nitrogen and greenhouse gasses ...
4. I01 and I02. Removal of exotic invasive species, but it is not clear at the moment with which technical means (mechanical ? chemical ?) for some species (especially *Rosa rugosa*) this can be achieved in an efficient and effective way.
5. G01.02 and G05.01. Control of public access.

A dynamic approach of coastal protection consisting in beach nourishment by supplying sand seaward from the existing high tide line could possibly contribute to expand significantly the area of the habitat 2120 (and also the related habitat type "2110 Embryonic shifting dunes"), for example the Dutch experiment of the "Zandmotor" in South Holland.

## Ireland

Gaynor, pers.comm.:

1. Maintain the sediment supply and prevent removal of beach material
2. Maintain the natural circulation of sediment and organic matter
3. Monitor and where necessary control the recreational use of dunes
4. Prevent and/or control the spread of invasive species
5. Prevent accelerated rates of erosion caused by human activities

Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Sediment supply is especially important in the embryonic and mobile dunes, as well as the strandline communities where accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. The construction of physical barriers such as sea defences can interrupt longshore drift, leading to beach starvation and increased rates of erosion. Plant species of these mobile dunes have adapted to and in some cases respond positively to sand accumulation. Marram grass reproduces vegetatively and requires constant accretion of fresh sand to maintain active growth, thus encouraging further accretion. The construction of physical barriers (e.g. revetments and sea walls) can lead to increased rates of erosion on adjacent areas and can also interfere with the sediment circulation by cutting the dunes off from the beach resulting in fossilisation or over-stabilisation of dunes. Therefore, maintaining the natural circulation of sediment and organic matter is the main requirement for mobile dune habitats. Recreation has long been a major land use on Irish dune systems and it is likely to continue to do so. Excessive pedestrian traffic, horse riding and off-road vehicle use can cause significant damage to the vegetation cover. A large number of Irish dune systems have been developed as golf courses and while they generally avoid the mobile areas, there is a tendency to want to stabilise these areas to prevent wind blown sand. The main invasive species recorded on Irish marram dunes is sea buckthorn (*Hippophae rhamnoides*), which is highly invasive and needs to be controlled or removed.

## 2.2. Management measures

Following management practices are applied in France to protect / restore the vegetation of mobile dunes (Muséum national d'Histoire naturelle [Ed] 2003):

- preservation of other habitats must be included
  - foreshore
  - embryonic dunes with Quackgrass.
- There must be maintenance after each storm so that the dune barrier is restored<sup>2324</sup>
- For areas of great importance, specific measures have to be implemented
- Restrict visitation of sensible areas for the public
- Information to the public about the restoration efforts
- Restoration of mobile dunes by planting *Ammophila arenaria* to trap sand
- Prevent the transfer of seeds from other areas during restoration efforts

#### France, Gouguet, pers. comm.:

Each site is particular, and management of dunes is often submit to local policy

UK BAP: The habitat is covered by the Coastal sand dunes action plan under the UK Biodiversity Action Plan (see [\\_http://www.ukbap.org.uk](http://www.ukbap.org.uk))<sup>25</sup>, as well as under country and local biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource.

#### Ireland

##### Gaynor, pers.comm.:

1. Improved enforcement of planning regulations
2. Input into planning process
3. Construction of walkways through dunes, fence off dunes, Information boards etc.
4. Scrub control by active removal of sea buckthorn
5. Encouraging the use of soft protection measures over hard coastal protection works

#### The Netherlands

##### van Dobben, pers. comm.

At present, management of 2120 focuses on the fixation of the shoreline and is almost entirely driven by safety considerations, with negative effects on the habitat type 2120. However, in areas with a dynamic coastline management, 2120 is allowed to develop in a more natural way. There are a few projects in a planning phase to remove stuifdijken in dynamic management areas. The sand engine is a pilot project (started in 2011) that may give rise to new, large-scale concepts in shoreline management

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<sup>23</sup> Remark on this point by Herrier (Belgium): *This is certainly true from the "coastal defense" point of view, but not from the perspective of the habitat 2120. Breaches through the seaward dune cordon can initiate new aeolian dynamics in the dune system and sometimes also the formation of tidal sea-inlets (Dutch: "sluifters") and the appearance of the habitat "1310 Salicornia and other annuals colonizing mud and sand".*

<sup>24</sup> Remark on this point bij Rees (UK): *"Is this for flood defence rather than the dune system? Natural breaches of dune ridges can self-heal if enough sediment"*

<sup>25</sup> Remark on this point bij Rees (UK): *"Needs updating"*

Schotman, pers. comm.

The most important management measure in this habitat type is to stop fixing the sand by artificial structures and to simulate the drifting of sand where it became too much stabilized in the past. The replenishments will stimulate the growth of embryonic dunes which can change to shifting dunes by natural succession. When shifting dunes become dynamic again this will help to recover from too much nitrogen deposition which can cause a fast succession to shrubs.

## Belgium

Herrier, pers. comm.:

1. E01. Removal of obsolete infrastructures and buildings to offer space to sand drift.
2. K02. Remobilizing the dunes by the mechanical removal of vegetation, although this large scale measure could be doomed to failure in the actual climatic circumstances... Grazing by large herbivores can create rather small scale bare sand patches and under aeolian influence blowouts.
3. H.4.02 and M. Reducing emissions of Nitrogen and greenhouse gasses ...
4. I01 and I02. Removal of exotic invasive species, but it is not clear at the moment with which technical means (mechanical ? chemical ?) for some species (especially *Rosa rugosa*) this can be achieved in an efficient and effective way.
5. G01.02 and G05.01. Control of public access.

## 2.3. Other measures (e.g. monitoring)

The purpose of a monitoring program is an evaluation of the trends or status quo in:

- Occurrence, range and area
- Typical species spectrum and ecological structural diversity

The sampling strategy must make it possible to obtain evidence about the ecological status of the habitat type. In German, this occurs by measuring the following parameters (Bund Länder Meeresprogramm Meeresumwelt n.d.):

- Area of the 2120 Habitat Type
- Biotope types according to the mapping keys issued by the Länder
- Dune and vegetation structure
- Fern and flowering plant species
- Impairment and threat factors
- Impairments
- Manifestation of the biotope complex (representation of all characteristic vegetation types/successional stages)
- Range and area

- Selected characteristic animal species (e.g. breeding birds) as well, if possible
- Typical spectrum of structures, species and vegetation types

## 2.4. Species specific measures

### Belgium

Herrier, pers. comm.:

Ensuring the necessary rest for the breeding birds (*Galerida cristata*, *Anthus pratensis*, ...) during the nesting season.

### The Netherlands

Zollinger, pers.comm.:

See Action Plan for the conservation of Sand lizard (*Lacerta agilis*) in northwest Europe : <https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=1304260&SecMode=1&DocId=1437092&Usage=2>

## 2.5. Main constraints / bottlenecks and actual needs

### Ireland

Gaynor, pers.comm.:

1. Public perception of erosional 'problem'
2. Climate change
3. History of poor planning
4. Lack of resources
5. Non-cooperation of public to restricted access etc.

The main management problem with marram (mobile) dunes is the public perception that moving sand is bad and needs to be prevented. Climate change and the fear of flooding from sea level rise can cause panic among the public whenever there is any erosion at the coast and authorities come under pressure to 'fix' the 'problem' urgently. This has led to an increase in the number of schemes for coastal protection works and dune stabilisation measures being carried out. Some of these have been carried out without any planning permission or appropriate assessment. This has resulted in a number of inappropriate works being carried out and has led to over-stabilisation of some dune systems. Lack of resources (time and funds) has limited the removal of invasive species such as sea buckthorn.

### France

Gouguet, pers. comm.:

1. Climate change
2. Inappropriate / lack of policy.
3. Lack of knowledge.
4. Insufficient funds

### The Netherlands

van Dobben, pers. comm.:

1. Safety regulations.
2. Presence of built-up or agricultural areas behind the dunes.
3. Presence of stuifdijken in front of white dunes; or replacement of original white dunes by stuifdijken.
4. Lack of societal support for novel approaches (removal of stuifdijken, sand engine, establishment of beach reserves, prohibition of car traffic on beaches).
5. For atmospheric deposition: lack of emission regulation for (sea)shipping; and too high N-load from rivers to the sea.

### Belgium

Herrier, pers. comm.:

1. E01 Urbanised areas, human habitation: In Flanders urbanisation in the 20th Century has caused a dramatic shrinking of the superficies of the coastal dunes (from 6.000 ha to 3.800 ha). As most of the remaining dune sites along the Flemish coast are fragmented by roads (D01.02) and surrounded by suburban habitation, there is no sufficient space left anymore for large scale sand drift mobile dunes that are threatening adjacent buildings or roads are being fixed by plantation of Marram grass and the placing of brushwood.
2. K02 Biocenotic evolution, succession: for about 17 years mobile "white" dunes have been increasingly spontaneously colonized and fixed by *Ammophila arenaria* and *Hippophaë rhamnoides*. One of the most dramatic examples is the "central wandering dune" of the Flemish Nature Reserve "De Westhoek" at De Panne, once, with its 80 ha of bare drifting sand, one of the largest shifting dunes of north-western Europe. Fixation of the "white dunes" means also that the formation of new humid dune slacks by aeolian sand drift has stopped.
3. H04.02 Nitrogen input and M Climate change. The increasing "spontaneous" fixation of the shifting dunes by the vegetation could be the consequence of an increase of Nitrogen input and an increase of precipitations and mild winters.
4. I01 invasive non-native species (*Rosa rugosa*, *Senecio inaequidens*, *Populus candicans* and *Populus alba*, the latter 2 species especially by vegetative reproduction through root offshoots).
5. G01.02 "walking, horseriding and non-motorised vehicles", G05.01 "Trampling overuse". Although trampling can locally maintain bare patches of sand, it also destroys the larvae

of invertebrates that are linked to shifting dunes (*Cicindela maritima* ...) and recreation can disturb nesting birds (*Galerida cristata* and *Anthus pratensis*).

## 2.6. Solutions and recommendations

### 2.6.1 Solutions

#### The Netherlands

van Dobben, pers. comm.:

1. In the long run: extended use of natural processes to ensure coastal safety under a scenario of sea-level rise.
2. Small pilot projects on removal of stuifdijken, accompanied by education and communication programs, to create societal support.
3. Measures to reduce N-emission; agriculture greatest priority, but in coastal habitat also shipping and nutrients discharged by rivers.

In general, less management leads to more natural values. However, in many areas this is unacceptable because of safety requirements and land claims. And if such conditions do not apply, lack of societal acceptance of a less intense management is a bottleneck.

#### Belgium

Herrier, pers. comm.:

1. E01. Awareness raising, communication
2. K02. Experiments of re-mobilisation of the dunes on small as well as large scale with the necessary attention for debris and root material.
3. H.4.02 and M. Awareness raising, influencing policies
4. I01. Awareness raising and influencing policies to stop planting of invasive aliens in or near dune sites; practical scientific experiments to control these invasive aliens.
5. G01.02 and G05.01. Awareness raising, influencing policies (of local authorities)

#### Ireland

Gaynor, pers. comm.:

1. Education
2. Raising public awareness
3. Influencing planning policy
4. Communication
5. Improved enforcement of planning regulations and wildlife legislation

The most important requirement is to educate the public and try to change their perception so that they stop viewing the natural processes in a dune system as something negative that needs to be 'fixed' and 'stabilised'. Recreational pressures need to be managed but the public needs to be kept informed of the reasons why for example, access may need to be restricted etc.



## France

Gouguet, pers. comm.:

1. Education
2. Strong policies
3. Awareness raising

### 2.6.2 Recommendations

## Belgium

Herrier, pers. comm.:

Re-dynamisation of fixed dune landscape by the mechanical removal of vegetation. Aeolian sand pulverization is the motor of the mobile dunes that constitutes the matrix of the habitat 2190 Humid dune slacks.<sup>26</sup> Although it could be argued that in the current climatic circumstances the attempts to re-mobilizing dune-systems could be doomed to failure.

## Cases / projects

### Belgium

Herrier, pers. comm.:

LIFE02 NAT/008591 'FEYDRA – Fossil Estuary of the Yzer Dunes Restoration Action': removal of scrub and its litter up to the bare mineral 'white' sand to reactivate Aeolian dynamics

## Sites

### Belgium

Herrier, pers. comm.:

Belgium: SCI BE2500001 'Duingebieden inclusief IJzermonding en Zwin', especially the nature reserves of 'De Westhoek' at De Panne and 'Ter Yde' at Koksijde, on a smaller scale the seaward cordon of dunes in front of the tidal flood plain of the Zwin at Knokke.

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<sup>26</sup> See literature: Arens, B.; Geelen, L.; Slings, R.; Wondergem, H. (2005). Restoration of dune mobility in the Netherlands, in: Herrier, J.-L. et al. (Ed.) (2005). Proceedings 'Dunes and Estuaries 2005': International Conference on nature restoration practices in European coastal habitats, Koksijde, Belgium 19-23 September 2005. VLIZ Special Publication, 19: pp. 129-138.

**The Netherlands**

Kooijman, pers. comm.:

Dynamic sea wall at Heemskerk (person to contact for more info: Rienk Slings)

## 2130 - Fixed coastal dunes with herbaceous vegetation ("grey dunes")

### Summary

**Fixed and semi-fixed dunes** are generally stable and colonised, at first, by herb-rich and, in later successional stages, by more or less closed perennial grasslands and abundant carpets of lichens and mosses. The content of lime (Ca<sup>2+</sup>) may vary greatly, generally diminishing with age and succession. Fixed dunes develop as part of a succession from mobile dunes; the decaying tussocks of *Ammophila arenaria* (marram grass), *Calamophila x baltica* (hybrid marram) and *Leymus arenarius* (lyme-grass) provide a substantial source of nitrogen in the early stages of grey dune development.

**Fixed dune landscapes are usually characterised by** undulating dune forms giving many variations of aspect, slope and micro-climate. On most sites there will be differences in the plant communities between north and south facing slopes, some species being generally confined to specific zones; for example *Corynephorus canescens* (grey hair-grass) on south facing slopes and *Empetrum nigrum* (crowberry) and *Polypodium vulgare* (common polypody) on north facing slopes.

Soil humidity is a main determining factor in germination and seedling establishment, biomass production, and soil development. Groundwater exceeding a depth of about 2 m under the soil surface is not accessible to most grassland plants. The organic matter content, calcium content and sand-grain size are the main factors determining the capacity of the sand to retain water and these factors vary considerably across Europe. Stabilised dune soils decalcify due to continuous carbonate leaching. Nitrogen and phosphorus are key elements and partly co-limiting in the nutrient dynamics of grey dunes.

This habitat type is a main component of the extensive dune systems along the exposed Atlantic coasts of Portugal and France and also from north France to Denmark and much of the southern Baltic Sea. Grey dunes are found in almost all dune systems in the Atlantic region.

Except for Atlantic Germany which has reported the status as 'favourable', the overall the **conservation status of this habitat** type in the Atlantic region has been assessed as 'unfavourable-bad'.

**The main reported threats and pressures** to fixed coastal dunes ("grey dunes") are:

- Decreased grazing pressure and loss of traditional grazing management (undergrazing) practices which leads to: (1) succession to scrub development and dune woodland, (2) over-stabilisation of the dunes and loss of bare sand patches, (3) loss of heterogeneity at local and landscape level and (4) loss of species diversity, especially of typical dune species.
- Intensification of grazing (overgrazing) by horses and cattle, with feeding supplementation and indirect/direct manuring, especially in transition areas between dunes and polders.
- The impact of nitrogen deposition which leads to: (1) further grass and moss encroachment, (2) spread of ruderal species and (3) loss of calciphilous species in dry dunes.
- The consequences of coast erosion: fixed, and especially semi-fixed dune habitats become squeezed between advancing mobile dunes and dune scrub, and often built or other human related development on the back dunes.

- The direct and indirect impact of human activities: (1) coast protection and dune stabilization, (2) urbanisation and infrastructure development, (3) land uses including golf courses and military training areas, (4) tree plantations (of pines, Eucalyptus and Acacia), (5) invasion of non-indigenous trees, shrubs, vascular plants and mosses in open dune areas, (6) introduction of large numbers of exotic species arising as escapes from gardens, (7) off-road driving, (8) rubbish dumping and (9) impact of recreation pressure (including dogs).
- Climate change effects: (1) increased aridity and prolonged growing season could influence dune vegetation and soil, (2) favour the establishment of exotic species and (3) increase erosion of dune systems by an increase in sea level.

The principal **management measures** for this habitat include:

- Extensive year-round grazing by large herbivores (optionally combined with cautious removal of scrub and litter).
- Sod-cutting of the tall grasses (also referred to as turf-cutting or turf-stripping).
- Mechanical removal of the scrub.
- Soil reversal (deep ploughing and turning over the soil).
- Removal of invasive species and plantations of non-native woodlands.
- Mowing of dune grasslands with removal of the mowed material (management measure used in Belgium and Denmark).
- Control of public access (construction of walkways through dunes, fence off dunes, information boards, etc).

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Non-cooperating owners or other stakeholders.
- Lack of knowledge about efficient ways of controlling invasive alien species.
- Dislike of the public for deforestation.
- Lack of awareness of the public.
- Lack of cooperation from the local authorities.
- Species return is limited due to dispersal problems.
- Insufficient funds.
- Large number of people leaving farming leading to site abandonment (removal of grazing stock).

**Solutions** to the pressures, threats and bottlenecks:

- Purchase of land by nature conservation agencies or NGOs.
- Awareness raising, purchase of land, influencing policies (e.g. to stop planting of invasive alien species in or near dune sites).
- Improved enforcement of planning regulations and wildlife legislation.

## 1 Description of the habitat

Fixed and semi-fixed dunes occupy a zone between the mobile dunes and the dune scrub and woodland habitats of coastal dune systems<sup>27</sup>. Fixed dunes are stabilised and colonised by more or less closed perennial grasslands and abundant carpets of lichens and mosses. They appear 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. Also similar dunes occur along the coasts of the Black Sea. In the case of the thermo-Atlantic coast, it is logical to include Euphorbio Helichryson (code 16.222 - thermo Atlantic as far as Brittany) and Crucianellion maritimae (code 16.223 - Strait of Gibraltar as far as the southern Atlantic near Cape Prior in Galicia).

The vegetation may be a closed cover of grassland, sparse annual grassland on sand or dominated by mosses and lichen; the content of limestone (Ca<sup>2+</sup>) may vary greatly and is generally diminishing with age and succession towards brown dune systems (dune heathland).

There is a transition towards communities of Mesobromion (34.31 - 34) in the following cases: old mesophile grasslands of dune slacks and inner dunes (Anthyllido Thesietum), frequently in mosaic with communities of Salix repens and particularly developed on the west face of the dunes; grasslands with Himantoglossum hircinum of the dunes in the De Haan area. Dune scrubs (16.25) and humid dune slacks (16.3) with distinct vegetation form closely knit complexes with grey dunes devoid of ligneous vegetation. (EC 2007a) (ETC BD 2012).

### 1.1. Distribution

Fixed and semi-fixed dunes (grey dunes) are principally found along the Atlantic coast from the Straits of Gibraltar to the North Sea coasts and the Baltic Sea (European Commission 2007). However, as the thermophilous dune sub-type Crucianellion maritimae is also included in the description, a fixed dune type more associated with the Mediterranean, Adriatic and Ionian coasts, examples of the habitat have been identified across a wider geographical area (J. Houston 2008).

<sup>27</sup> Remark on this point by Herrier (Belgium): *In the vegetation succession scrub does not necessarily develop from fixed or semi-fixed "grey" dunes. Hippophaë - scrub and herbaceous vegetations (eventually dominated by mosses and lichens) develop simultaneously from semi-fixed white dunes dominated by Ammophila arenaria, and in the case of Hippophaë and/or Salix div spp scrub also often from open pioneer situations in humid dune slacks. Hippophaë rhamnoides is a pioneer shrub specie with an associated micro-organism making him able to fix atmospherous nitrogen, allowing Hippophaë to colonize pure mineral sandy soils. This explains that in some dynamic dune systems "White mobile dunes with Ammophila arenaria" and "Dunes with Hippophaë rhamnoides" (scrub) can occur together in the absence of "fixed dunes with herbaceous vegetations". It also happens that, depending of exposition and grazing (by rabbits ...) and human intervention, "fixed dunes with herbaceous vegetations" or "grey" dunes" develop directly from embryonic shifting dunes (eg in the 'Bay of Heist' near Zeebrugge), resulting in a landscape initially lacking scrub or other woodland. Finally dune grasslands (belonging to the habitat type 2130) can develop under influence of grazing by large herbivores from dominant grass (Calamagrostis epigejos, Arrhenatherum elatius, Holcus lanatus ...) swards in deteriorating scrub after the gregarious mortality of short living pioneer Hippophaë or Salix div spp shrubs. My general conclusion is that there is no spatial or temporal zonation for the occurrence of the habitat types "2130 Grey dunes" and "2160 Dunes with Hippophaë rhamnoides" within the dune systems or within the vegetation succession.*

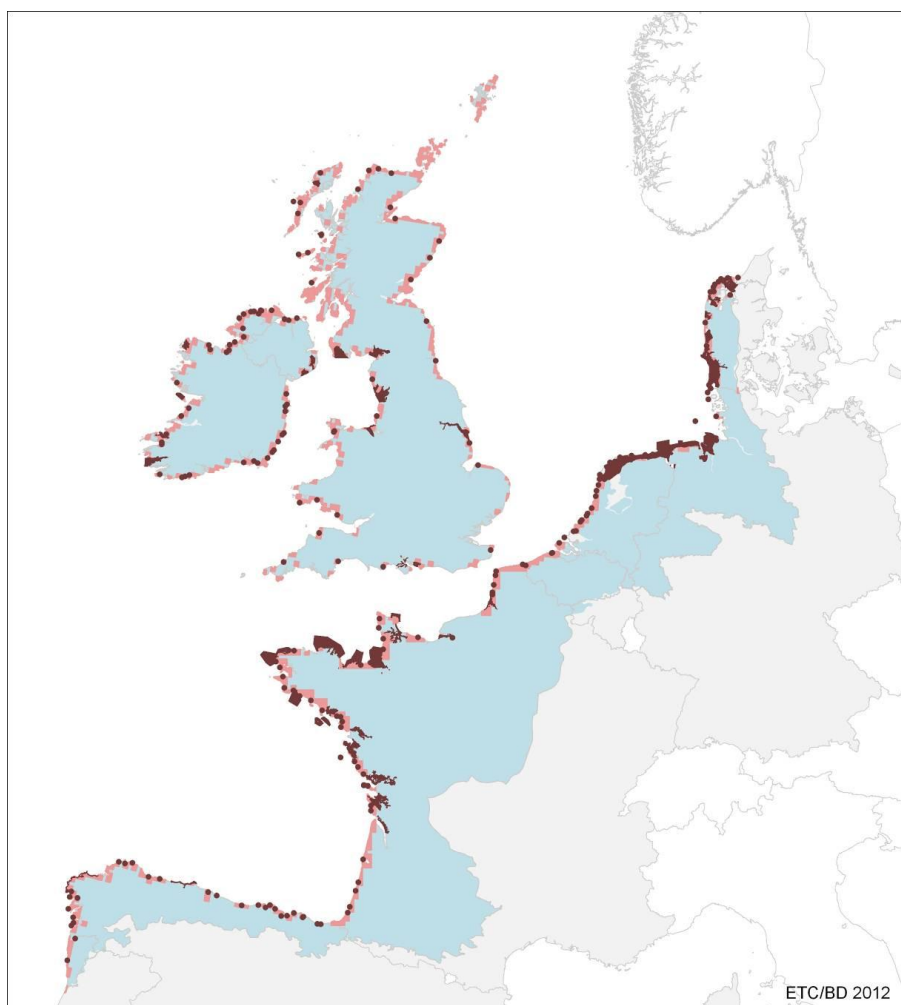
The largest dune areas in Europe are found along the exposed west and north coasts of Denmark (Jutland), the Netherlands, the Wadden Islands, France (Aquitaine) and Portugal. In eastern Denmark and along the Baltic coasts, in the United Kingdom and Ireland, along the Spanish Atlantic coasts and the Mediterranean region dune systems are frequent but do not form a continuous dune coastline. Large systems are also found along parts of the southern Baltic coast in Germany (the Darß – Western Pomerania), Poland (Słowiński dunes) and Lithuania (the Curonian spit). Extensive dune systems are also found along the Black Sea coast (Doody 1991) (J. Houston 2008).

**Table 22 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL	PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	1			10	29	19	43		31	12	10		65			43	20	1	1	11	45
habitat area (ha)	681			3727	664	4750	12152		1741	647	1290		11396			7082	15224	280	4	11859	9935

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>28</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>28</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 5 Map of SCIs proposed for the Fixed coastal dunes with herbaceous vegetation ("grey dunes") & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

Fixed and semi-fixed dunes are generally stable and colonised, at first, by herbaceous rich and, in later successional stages, by more or less closed perennial grasslands and abundant carpets of lichens and mosses. The content of lime (Ca<sup>2+</sup>) may vary greatly, generally diminishing with age and succession (Salisbury 1925). The habitat generally lies between the mobile element of the dune system and the scrub and woodland of later succession.

Fixed dunes develop as part of a succession from mobile dunes; the decaying tussocks of *Ammophila arenaria* (marram grass), *Calamophila x baltica* (hybrid marram) and *Leymus arenarius* (lyme-grass) provide a substantial source of nitrogen in the early stages of grey dune development (Provoost et al. 2004, Isermann, pers.comm.).

Fixed dune landscapes are usually characterised by undulating dune forms giving many variations on aspect, slope and micro-climate. On most sites there will be differences in the plant communities on north and south facing slopes, some species being generally confined to specific zones, for example

*Corynephorus canescens* (grey hair-grass) on south slopes and *Empetrum nigrum* (crowberry) and *Polypodium vulgare* (common polypody) on north slopes. (J. Houston 2008)

### 1.3. Ecological requirements

Fixed dunes are harsh environments which favour xerophytic (drought tolerant) plants and thermophilous (heat loving) invertebrates. Soil humidity is a main determining factor in germination and seedling establishment, biomass production, and soil development. Groundwater exceeding a depth of about 2 m under the soil surface is not accessible to most grassland plants (Provoost *et al.* 2004).

The organic matter content, calcium content and sand-grain size are the main factors determining the capacity of the sand to retain water and these factors vary considerably across Europe. Where dune systems overlie shingle formations these are referred to as 'dry core systems' where the rate of leaching is more rapid and acidic conditions can develop close to the foredunes (Rhind *et al.* 2006). Acidic conditions may also be near the foredunes on eroding coasts, reflected in the grain size composition of the sand and the composition of vegetation (Isermann, pers. comm.).

Soil development is countered by several processes. In young moss-dunes physical humus erosion can be considerable, but in more stable grassland the main losses of soil organic matter are due to biochemical decomposition.

Stabilised dune soils decalcify due to continuous carbonate leaching. The process can be slowed by the mobilisation of calcareous sand, from sand sheets, blowouts and 'sand spray' (the light 'rain' of sand characteristic of dunes on exposed coasts) (Provoost *et al.* 2004). Nitrogen and phosphorus are key elements and partly co-limiting in the nutrient dynamics of grey dunes (Kooijman *et al.* 1998). Nitrogen is mainly supplied by the decomposition of plant residues<sup>29</sup>. This partly explains why grass encroachment, probably stimulated by atmospheric deposition of nitrogen, is, once established, self-maintaining due to increased nitrogen mineralization. Moreover soil below *Hippophaë rhamnoides* (sea buckthorn) contains high amounts of nitrogen due to nitrogen fixing bacteria (Pearson and Rogers 1962, Isermann *et al.* 2007).

(J. Houston 2008)

### 1.4. Main subtypes

Fixed dunes are an extremely complex habitat type. For the purposes of the Habitats Directive, Fixed dunes with herbaceous vegetation ("grey dunes") has been divided into a series of sub-types (European Commission DG Environment 1999):

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<sup>29</sup> Remark on this point by Rees(UK): "What about air pollution? See APIS <http://www.apis.ac.uk/node/972>"



- 16.221 - Northern grey dunes with grass communities and vegetation from Galio-Koelerion albescentis (Koelerion albescentis), Corynephorion canescentis p., Sileno conicae-Cerastion semidecandri.
  - 16.222 - Biscay grey dunes (Euphorbio-Helichryson stoechadis): dunes on stabilised humus soil infiltrated by dwarf bushes, with Helichrysum stoechas, Artemisia campestris and Ephedra distachya.
  - 16.223 - Thermo-Atlantic grey dunes (Crucianellion maritimae): suffrutescent communities on more or less stabilised soils low in humus of the thermo-Atlantic coasts with Crucianella maritime and Pancratium maritimum.
  - 16.225 - 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 (34.32).
  - 16.226 - Atlantic dune thermophile fringes: Trifolio-Geranietaea sanguinei: Galio maritimi-Geranium sanguinei, Geranium sanguineum formations (34.4) on neutro basic soils rich in calcium and poor in nitrogen.
  - 16.227 - Dune fine-grass annual communities: sparse pioneer formations (35.2, 35.3) of fine grasses rich in spring-blooming therophytes characteristic of oligotrophic soils (nitrogen poor sand or very superficial soils, or on xerocline to xerophile rocks) (Thero-Airion p., Nardo-Galion saxatile p.,Tuberarion guttatae p.)
  - 16.22B - Pontic fixed dunes - fixed dunes of the coasts of the Black Sea.
- ((ETC BD 2012)

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Fixed coastal dunes with herbaceous vegetation ("grey dunes") and provided their conservation status in the Atlantic Member States (see tables below).

**Table 23 Species associated with Fixed coastal dunes with herbaceous vegetation ("grey dunes") (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Lacerta agilis 1261	x									
Anthus campestris A255	x									
Anthus pratensis A257	x									
Burhinus eodicnemus A133	x									
Calandrella brachydactyla A243	x									
Charadrius alexandrinus A138	x									

**Table 24 Species associated to Fixed coastal dunes with herbaceous vegetation ("grey dunes") and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group	DE	DK	FR	NL	UK	REGION
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1261	<i>Lacerta agilis</i>	Reptiles	range	FV	FV	U2	U1	U1	U2
			population	U1	XX	U2	U1	U1	U2
			habitat	U1	XX	U2	U1	U1	U2
			future	U1	XX	U2	FV	FV	U2
			overall	U1	XX	U2	U1	U1	U2

The EU guidance for Fixed coastal dunes with herbaceous vegetation (J. Houston 2008) mentions the following characteristic dune species as supported by the habitat, and more importantly, by the habitat mosaic of dune systems:

- *Lacerta agilis* (sand lizard) and *Bufo calamita* (natterjack toad): depend on the open character of the fixed dune habitat for at least part of their range.
- Bare sand is a vital component of grey dunes for many invertebrates such as aculeate hymenoptera, dune tiger beetles (*Cicindela maritima* and *C. hybrida*) and some spiders such as the wolf spider *Arctosa cinerea* and crab spider *Philodromus fallax*.
- Small patches of bare sand throughout the fixed dune habitat in France provide a niche for *Omphalodes littoralis* (Habitat Directive Annex II species).
- *Anthus campestris* (tawny pipit, listed in Annex I of Birds Directive) confined to habitats characterised of dry, sandy soil with bare patches, often early succession stages dependent on continuous disturbance (Elfstrom 2007)

## 1.6. Related habitats

Grey dunes (\*2130) are part of the mosaic of habitats in dune systems. It is often difficult to map precisely where ‘grey dunes’ (2130) blend into decalcified dunes (\*2140), dune heaths (\*2150) and Mediterranean dune grasslands and juniper scrub (2210, 2220, 2230, 2240 and 2250). Fixed dunes also merge with dry slack habitat types (2170 and 2190).

They lie, in the sequence of vegetation community succession, between the more dynamic communities of the mobile and mainly shifting dune zone (yellow dune) and the scrub and dune woodland zone. They form the matrix within which the humid dune slacks sit and erosion of fixed dunes may lead to secondary slack formation<sup>30</sup>. The broad habitat type (\*2130) includes both calcareous and acidic dune grasslands and overlaps with humid dune slack habitats particularly through the habitat ‘dunes with *Salix repens* ssp.*argentea*’ (2170). (J. Houston 2008)

## 1.7. Ecological services and benefits

A broad fixed dune zone, together with the first high, mostly mobile dune ridges, forms the main coastal defence along much of the coast from the Netherlands to Denmark and along the Baltic from Denmark to Poland and eastwards. Where the dune zone is high and broad this will also hold a

<sup>30</sup> Remark on this point by Herrier (Belgium): “Although I do not deny that erosion of fixed dunes with herbaceous vegetations or “grey dunes” can occur and result in the formation of blowouts, it seems to me that rather the most mobile variant of “shifting dunes with *Ammophila arenaria*” or “white dunes” is (one of) the matrices in which humid dune slack develop.”

freshwater aquifer and, along low-lying coasts this will prevent salt-water intrusion into the polder-land.

The dune aquifer along much of the North Sea coasts has been exploited for water supply. Extraction continues to be a significant source of fresh drinking water in the Netherlands, Germany, Denmark and Belgium. Care needs to be taken not to over-extract. In the Netherlands pre-treated river water is infiltrated into the dune system where the filtration properties of the sand are used to provide clean drinking water.

The fixed dune landscape gives scale to the dune coast and, in addition to the beaches, can provide an important recreational resource, especially for walking, cycling and horse-riding. In countries such as the Netherlands, Denmark and Latvia the open dune landscape is a vital element for outdoor recreation. Almost all dune managers will have an element in their work to provide for access and recreation: in the 1980s the focus of management was often on recreation rather than nature. (J. Houston 2008)

## 1.8. Conservation status

**Table 25 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see start of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	range	FV	FV	FV	XX	U2	FV	FV	FV	FV	U1
		area	U2	FV	FV	XX	U2	U1	U1	U1	FV	U1
		structure	U2	FV	U1	XX	U1	U2	U2	U1	U2	U2
		future	FV	FV	U1	XX	U1	U2	U2	U1	U2	U2
		overall	U2	FV	U1	XX	U2	U2	U2	U1	U2	U2

'Grey' dunes form the immobile, grassy part of a dune system behind the mobile dunes (habitat types 2110 and 2120) and are normally found as part of a dynamic assemblage of several dune habitats, most of which have been assessed as unfavourable throughout the European Union. The habitat is found on Atlantic and Baltic coastst. In the Mediterranean basin other habitats occupy a similar position in the dune complex although Italy has reported this habitat from the Adriatic and Spain has indicated part of the distribution in Valencia which is most likely an error.

Assessed as 'unfavourable-bad' for the Atlantic and Macaronesia regions and 'unfavourable-inadequate' elsewhere. Reported as 'favourable ' only for Atlantic Germany and for Estonia, 'structure & function' and 'future prospects' are particularly unfavourable. Spain & Italy have reported several parameters as unknown (Summary sheet of the online report on Article 17 of the Habitats Directive)(ETC BD 2012).

## 1.9. Trends

The general trend from an ecological and geomorphological perspective is towards increasing stabilisation and succession towards rank grasslands, heathlands, scrub and woodland.

To take the example of the United Kingdom, there is little doubt that large losses have occurred due to agricultural (including afforestation), industrial and urban developments. Overall, however, there has probably been a trend over the past 50 years of increasing grey dune habitat, but mainly to old stable, acidic stages. This relates to the fact that dunes have become much more stable over this period. Newborough Warren in Wales, for example, was much more mobile in the 1950s with mobile dunes occupying over 70% of the site as opposed to just 6% today (Rhind *et al.* 2001). Similar trends are seen in the German Wadden Sea Island of Spiekeroog, where semi-fixed grey dunes (the younger succession stages) have decreased, and heathlands, dominant grasslands, scrub and woodland have increased (Isermann and Cordes 1992).

However, significant areas of grey dune habitat have also been lost to the development of conifer plantations, particularly in **Denmark**. In Wales, for example, plantations cover approximately 21% (1700 ha) of the dune resource, and of this, a large proportion would have included grey dunes (JNCC 2007) (J. Houston 2008).

In **Ireland**, fixed dunes were once widespread on sandy coasts but many sites have been significantly modified in the past for developments such as sports pitches, golf courses, caravan parks, coniferous plantations, housing, roadways and airstrips (NPWS 2008).

## 1.10 Main pressures and threats

Across Europe fixed dunes have been, and still are, the most threatened and exploited part of the dune system. A significant part of the resource has been lost to tourism and residential development and sites are often fragmented by infrastructure and impacted by coast defence works.

The Technical report from the EC on the management of habitat type \*2130 (J. A. Houston 2008) identifies the following problems:

### **Decreased grazing pressure and loss of traditional grazing management practices can lead to:**

- Succession to scrub development and dune woodland (on sites where this is a negative development)
- Over-stabilisation of the dunes and loss of bare sand patches
- Loss of heterogeneity at local and landscape level
- Loss of species diversity, especially of typical dune species

**Belgium, Herrier, pers. comm**

**Intensification of grazing by horses and cattle, with feeding supplementation and indirect/direct manuring, especially in transition areas between dunes and polders**

**The impact of nitrogen deposition adds to the problems above and leads to:**

- Further grass encroachment in dry dunes and the expansion of common grassland species
- Moss encroachment, for example *Campylopus introflexus*
- Spread of ruderal species
- Loss of calciphilous species in dry dunes

**The consequences of coast erosion:**

- Fixed, and especially semi-fixed dune habitats become squeezed between advancing mobile dunes and dune scrub, and often development on the back dunes
- Direct loss of habitat
- Fragmentation of habitats

**The direct and indirect impact of human activities:**

- Coast protection and dune stabilisation
- Urbanisation and infrastructure development
- Land uses including golf courses and military training areas
- Tree plantations (of pines, Eucalyptus and Acacia)
- Invasion of non-indigenous trees, shrubs, vascular plants and mosses in open dune areas
- Introduction of large numbers of exotic species arising as escapes from gardens
- Off-road driving
- Rubbish dumping
- Impact of recreation pressure (including dogs)

**Climate change effects:**

The possible effects of increased aridity and prolonged growing season, due to increased temperatures are expected to influence dune vegetation and soil by:

- Favouring xerophytes in competition with mesophytes. For example, deep-rooted xerophytes such as *Ammophila arenaria* may be less influenced by increased aridity than species with superficial root systems such as *Corynephorus canescens*
- Changing the phenological relationships between the plant species which in turn affect the food supply for animals
- Causing immigration of southern species and depression of more northern and Atlantic species
- Causing a decrease in soil leaching and increase in litter decay rate and mineralization, improving the nutrient economy of the dune habitat

The scenario may also favour the establishment of exotic species and could have effects on primary production (Isermann, pers. comm.).

An increase in sea level could affect dune systems by stimulating the erosion of dune systems (even those which are currently accreting) leading to greater instability and also by changing the groundwater regime. There may be a balance between a decline in groundwater level caused by the

narrowing of the dune system due to erosion and a rise in groundwater caused by the rising sea level (Vestergaard 1991). (J. Houston 2008)

The major pressures and threats to **UK** coastal habitats (including humid dune slacks 2190, fixed coastal dunes 2130 and shifting dunes 2120) are (Joint Nature Conservation Committee n.d.):

- Changing agricultural practice, including grazing
- Sediment supply/dynamics
- Recreation
- Coastal protection, including afforestation
- Infestation by *Phomopsis juniperovora*
- Air pollution
- Falling water tables

**Table 26 Main pressures to Fixed coastal dunes with herbaceous vegetation ("grey dunes") and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	<i>Lacerta agilis</i>
Grazing	x	x
General Forestry management	x	x
Sand and gravel extraction	x	x
Urbanised areas, human habitation	x	x
Communication networks	x	x
Sport and leisure structures	x	x
Outdoor sports and leisure activities	x	
Pollution	x	
Trampling, overuse	x	
Biocenotic evolution	x	x

**Table 27 Main threats to Fixed coastal dunes with herbaceous vegetation ("grey dunes") and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	<i>Lacerta agilis</i>
Grazing	x	x
Urbanised areas, human habitation	x	x
Communication networks	x	x
Sport and leisure structures	x	x
Outdoor sports and leisure activities	x	
Pollution	x	x
Trampling, overuse	x	
Biocenotic evolution	x	x

In **Ireland**, this habitat continues to suffer intense pressure from development. Many sites, particularly those along the east coast, suffer from the impacts of recreation. Pedestrian traffic and vehicle use can lead to the destruction of the vegetation cover, eventually leading to the exposure of bare sand, which becomes mobile. Perhaps the greatest impacts on fixed dunes today are overgrazing and undergrazing: overgrazing can lead to a reduction in species diversity, nutrient enrichment of the soil and destruction of the vegetation cover, while undergrazing can lead to

development of species-poor grassland and eventual scrub encroachment. The introduction of non-native plant species, particularly Sea Buckthorn (*Hippophae rhamnoides*), also threatens fixed dune communities (NPWS 2008).

The most important threats to this habitat type in **Denmark** (Søgaard et al. 2007) are wear and tear, eutrophication and too little, or wrong, management, which, among other things has caused scrub invasion. Indeed, in many localities the type is under pressure of change from subdued dynamism, due to coast protection and the prevention of sand drifts, and scrub invasion due to the grazing being stopped. Previously, the sheep grazing has maintained the dynamism by means of grazing, and through wear and tear caused by the “sheep paths” on steep slopes, and shelters in the hollows between the dunes.

### **Belgium:**

Herrier (pers. comm.)

1. K02 Biocenotic evolution, succession: K0202 accumulation of organic material: dune grasslands tends to evolve into dense and rough swards of dominant grasses, such as *Arrhenatherum elatius*, *Holcus lanatus*, and even without accumulation of organic material are susceptible for encroachment by scrub, especially *Hippophaë rhamnoides* (by vegetative reproduction by root offshoots)
2. A4.01.01 intensive cattle grazing, A401.02 intensive sheep grazing and A4.01.03 intensive horses grazing. Especially in the transition zones between coastal dunes and polder hinterland (para-) agricultural use of the dunes has replaced the former traditional extensive grazing that was maintaining the habitat in a satisfactory state of conservation. The actual too intensive grazing needs supplement feeding of the cattle, livestock or horses and eventually active fertilizing or even the use of herbicides. All this results in turning the former "grey dunes" into species poor, banal meadows.
3. I01 invasive non native species (*Mahonia aquifolium*, *Rosa rugosa*, *Senecio inaequidens* ...) and I02 problematic native species (*Hippophaë rhamnoides*), the latter especially by vegetative reproduction through root offshoots.
4. B01 Forest planting on open ground. Artificial afforestation with mainly *Pinus nigra*, *Pinus pinaster*, *Populus x Canadensis*, *Populus alba* and *Acer pseudoplatanus* took place from the end of the 19th Century up until the year 1992 (sic), causing the loss of important superficies of “\*2130 Grey dunes” as well as “2120 White dunes”.
5. G05.01 Trampling overuse. Recreational use (by mountainbikers and others) destroys treading sensitive xerophile “grey dunes”-vegetations, dominated by mosses and lichens and disturbs the quietness needed by some associated bird species.

### **The Netherlands**

Kooijman (pers. comm.)

1. N-deposition (H04.02) and acid rain in the past (H04.01): Atmospheric deposition of N and acidifying components leads to more rapid acidification in the soil. In lime-rich grey dunes increased acidification leads to dissolution of calcium phosphates (Kooijman et al. 1998, Kooijman and Besse 2002), increased availability of both N and P, and thus grass-encroachment. In lime-poor grey dunes, chemical mechanisms to reduce P-availability are lacking, unless they are iron-rich (Kooijman et al. 1998, Kooijman and Besse 2002, Kooijman et al. 2009). When P-availability is high, high N-input leads to grass-encroachment. In both lime-rich and lime-poor dunes, pH of the soil decreases, which leads to loss of calcicole species.
2. Lack of grazing, especially rabbits (A04.03): Rabbits can counteract grass-encroachment to some extent by biomass removal, but if population density is low, this will not happen.
3. Lack of aeolian dynamics (no number found): Blow outs in the grey dunes are necessary to counteract acidification and rejuvenate grey dunes, but most blow outs are stabilized nowadays. Also, aeolian dynamics decrease because high N-deposition leads to high growth of algae, which reduces erodibility of the sand
4. Invasive species (I01): Invasive species such as *Prunus serotina* and *Campylopus introflexus* especially endanger lime-poor grey dunes, because they overgrow open dune grasslands or open sandy habitats.

#### **Ireland:**

Gaynor (pers. comm.)

1. Agriculture (A): agricultural use of dunes includes stock grazing, forestry, cropping of vegetation and cultivation. The majority of Irish west coast sites are largely agricultural and are held in private ownership or managed as commonage. While grazing is an important management tool both overgrazing and undergrazing can lead to problems. Overgrazing can lead to eventual destruction of the vegetation cover and increased nutrient levels, while undergrazing, or the removal of grazers can lead to the development of a rank coarse grassland and eventual scrub encroachment.
2. Human intrusions and disturbances (G), incorporates G01 (Outdoor sports and leisure activities, recreational activities) and G02 (Sport and leisure structures). Recreation has long been a major land use on Irish dune systems and it is likely to continue to do so. Recreational activities such as walking, horse riding and use of both motorised and non-motorised vehicles can cause habitat losses and damage through trampling, erosion and fragmentation. A large number of Irish dune systems have been developed as golf courses and there is continued pressure on the few remaining 'intact' sites for further developments.
3. Urbanisation, residential and commercial development (E)
4. Sand and gravel extraction (C01.01): a supply of sand is fundamental to the development of a dune system. Therefore sand extraction (both onshore and offshore) can negatively



impact on this habitat. Historically the removal of sand from beaches was common practice and was even subsidised.

5. Invasive, other problematic species and genes (I). The main invasive species recorded on Irish dunes is sea buckthorn (*Hippophae rhamnoides*), which is highly invasive and needs to be controlled or removed.
6. Obviously erosion is one of the greatest threats/pressures on dunes, but where this is a natural process it should not be managed but allowed to continue where possible. However, accelerated rates of erosion caused by human activities need to be prevented

## 2 Conservation management

### 2.1. Main conservation requirements

The management choice is either to intensify the management or accept the gradual move towards an ecologically and geomorphologically stable situation. There are biodiversity and landscape considerations here; the dynamic dune is richer in biodiversity of different scales and is also a 'wilder' landscape. On the other hand, some older stable dunes preserve medieval landscapes and the agricultural fields associated with early settlement patterns. A wider regional or national context may be an important consideration in developing a vision for the site. Managers need also to remember that dunes are often cultural landscapes, formed through centuries of interaction with local land uses. This cultural link can also perceive blown sand as a threat and communities are often divided in their views on the desirability of mobile sand. (J. Houston 2008)

#### Belgium:

Herrier, pers. comm

1. K02. Adapted grazing by large herbivores (without supplement feeding) and mowing of the scrub (re-)growth. If the encroachment with tall grasses and scrub is too strong, mechanical removal of the scrub and its litter or turf cutting of the tall grasses can be needed to obtain satisfactory results. These initial measures have to be followed by a recurring management consisting in adapted grazing and/or mowing (with removal of the mowed material).
2. A4.01.01, A4.04.02 and A4.01.03: extensification of the grazing by large herbivores, excluding supplementary feeding, direct or indirect fertilizing and use of herbicides. This extensification can be insufficient to obtain good satisfactory result. In this case cutting off sods up until the bare mineral substrate is needed. This initial measure has to be followed by a recurring management consisting of adapted grazing.
3. I01 and I02. Removal of exotic invasive species, but it is not clear at the moment with which technical means (mechanical ? chemical ?) this can be achieved in an efficient and

effective way and without damaging too much the “grey dune” – habitat. Removal of the problematic native species *Hippophaë rhamnoides* scrub and its litter. Young *Hippophaë rhamnoides* scrub in dry or mesophilic circumstances is difficult to get under control as mowing is stimulating regrowth ... Older, decaying *Hippophaë rhamnoides* scrub is easier to get under control to restore "grey dune" habitat by mechanical removal and grazing.

4. B01. Removal of artificially planted forest, if financially feasible including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a regular management, consisting of control of regrowth (especially of Poplar div. spp) mowing and/or adapted grazing.
5. G05.01. Control of public access.

### **The Netherlands:**

Kooijman, pers. comm

1. Reduction of atmospheric N-deposition
2. Reduction of atmospheric acid deposition
3. Grazing by rabbits and/or large herbivores
4. Stimulation of small scale blow outs
5. Removal of *Prunus serotina* (for *Campylopus introflexus*, this is not possible)

### **Ireland:**

Gaynor, pers. comm

1. Maintain structural variation within the sward
2. Maintain some bare ground
3. Maintain natural circulation of sediment
4. Prevent and/or control spread of invasive species
5. Monitor and where necessary control the recreational use of dunes.

The habitat 2130 is a very diverse habitat with a wide range of sub-communities that are determined by a combination of geomorphologic, edaphic, climatic and anthropogenic factors. Species diversity and plant distribution is determined by a range of factors including grazing intensities, moisture levels, nutrient gradients and the nature of the sediment. Consequently, a range of management strategies need to be employed on different sites in order to maintain the regional variations and different successional stages. The main management tool is grazing. Moderate grazing regimes lead

to the development of a species-rich cover. The animals increase biodiversity by creating micro-habitats through their grazing, dunging and trampling activities. Grazing slows down successional processes and in some cases reverses them, helping to achieve a diverse and dynamic landscape. The effects of trampling assist the internal movement of sand through the development of small-scale blowouts, while dunging can eutrophicate those dune habitats whose nutrient poor status is crucial for the survival of certain vegetation types. Many species, from plants to invertebrates, benefit immensely from the open and diverse system created by a sustainable grazing regime. Many dune species are small in size and have relatively low competitive ability. Consequently, the maintenance of high species diversity on a dune system is dependent on the existence of some control to limit the growth of rank coarse vegetation (Gaynor, 2008).

## 2.2. Management measures

**Grazing:** Extensive year-round grazing is probably the most appropriate management technique across most of the fixed dune resource from the lush dune grasslands of the Atlantic fringe to the more sparsely vegetated grey dunes of the Continental and Mediterranean climates. Grazing can be used both as a recurring management tool and as a restoration tool with different grazing regimes applied for different objectives. (J. Houston 2008)

**Burning:** There is a need for further studies on the value of burning as a management tool for the conservation of fixed dunes. It is a practice which would appear to present most opportunity in the calcium-poor dunes of the Wadden Sea area (Vestergaard and Alstrup 2001). (J. Houston 2008)

**Mowing:** Mowing as a recurring management practice is more commonly associated with dune slacks. Mowing of dune grasslands has been used in **Belgium** (Provoost *et al.* 2004) and on the Danish dune heaths (Final report LIFE-Nature project LIFE02/NAT/DK/8584). Elsewhere, the mowing of 'semi-rough' is part of the management of 'links' (dune) golf courses and maintains fixed dune grassland in favourable condition (many golf courses lie within the Natura 2000) network. (J. Houston 2008)

**Sod-cutting:** There is increasing interest in sod-cutting (also referred to as turf-cutting or turf-stripping) both as a restoration tool and a recurring activity. From a restoration perspective it can be used to remove the build up of below-ground biomass stimulated by Nitrogen deposition. Soil removal is often associated with scrub removal actions but the large volumes involved can be expensive to move and there is a risk that it may encourage further scrub invasion. However, if the problem being addressed is the build up of nutrient-rich top-soil then the action may be appropriate. (J. Houston 2008)

**Soil reversal:** A more disruptive technique which has potential benefits is deep ploughing and turning over the soil to some depth. (J. Houston 2008)

**Scrub cutting:** Scrub is a natural component of dune systems and is a resource which has been exploited for centuries. Cautious removal of scrub and litter and the introduction of extensive year-round grazing may be successful in restoring and maintaining fixed dune habitats. (J. Houston 2008)

**Removal of invasive species:**

- The most common ‘problem’ species of fixed dunes in northwest Europe is *Hippophaë rhamnoides*. It has been introduced as part of 19th Century dune stabilisation problems, often in association with conifer plantations<sup>31</sup>.
- *Rosa rugosa* (Japanese rose) is a widespread problem on many North Sea and Baltic dune systems. It became popular in the early 20th Century as an ornamental shrub and has been widely planted. It was also planted to stabilise dunes.
- The invasion of the exotic moss *Campylopus introflexus* is a particular concern on the more acidic dunes of the Wadden Sea area where it threatens the lichen-rich fixed dunes (van der Meulen *et al.* 1987, Biermann and Daniels 1997, Ketner-Oostra and Sykora 2004, Hassel and Soderstrom 2005). (J. Houston 2008)

**Removal of plantations:** Probably the most significant interference with natural dune evolution across Europe has been the planting of non-native woodlands, principally conifer plantations. The main reason for afforestation was to stop long-standing problems caused by sand-drift and the ‘wandering dunes’ (J. Houston 2008). **In the Netherlands it is also recommended to take measures to stimulate the drifting of sand again, eg. by sod-cutting. Partly in natural situations fixed dunes are not completely fixed but form ‘sifting mosaics’ (The Netherlands, Schotman, pers. comm)**

#### **Belgium:**

Herrier, pers. comm

1. K02. Adapted grazing by large herbivores (without supplement feeding) and mowing of the scrub (re-)growth. If the encroachment with tall grasses and scrub is too strong, mechanical removal of the scrub and its litter or turf cutting of the tall grasses can be needed to obtain satisfactory results. These initial measures have to be followed by a recurring management consisting in adapted grazing and/or mowing (with removal of the mowed material).
2. A4.01.01, A4.04.02 and A4.01.03: extensification of the grazing by large herbivores, excluding supplementary feeding, direct or indirect fertilizing and use of herbicides. This extensification can be insufficient to obtain good satisfactory result. In this case cutting off sods up until the bare mineral substrate is needed. This initial measure has to be followed by a recurring management consisting of adapted grazing.
3. I01 and I02. Removal of exotic invasive species, but it is not clear at the moment with which technical means (mechanical ? chemical ?) this can be achieved in an efficient and

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<sup>31</sup> Remark on this point by Herrier (Belgium): “*Hippophaë rhamnoides* is considered an indigenous species along the sandy coasts of France, Belgium and the Netherlands. Although it tends to expand rapidly at the cost of mobile dunes, humid dune slacks and grey dunes and must therefore be contained, it also provides nesting opportunities to lots of birds, such as *Streptopelia turtur*, *Luscinia megarhynchos*, *Sylvia curruca*, *Locustella naevia* and *Phylloscopus trochilus* ... These avifaunistically valuable scrubs (habitat 2160 Dunes with *Hippophaë rhamnoides*) are nowadays themselves threatened by invasion by *Acer pseudoplatanus* and *Prunus serotina* that fundamentally change the structure of the vegetation from dense low scrub to high ascending forest, which is inappropriate as nesting habitat for the birds species mentioned above.”

effective way and without damaging too much the “grey dune” – habitat. Removal of the problematic native species *Hippophaë rhamnoides* scrub and its litter. Young *Hippophaë rhamnoides* scrub in dry or mesophilic circumstances is difficult to get under control as mowing is stimulating regrowth ... Older, decaying *Hippophaë rhamnoides* scrub is easier to get under control to restore "grey dune" habitat by mechanical removal and grazing.

4. B01. Removal of artificially planted forest, if financially feasible including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a regular management, consisting of control of regrowth (especially of Poplar div. spp) mowing and/or adapted grazing.
5. G05.01. Control of public access.

### **The Netherlands:**

Kooijman, pers. comm

1. Only slight reduction of atmospheric N-deposition
2. Strong reduction of acid rain
3. Grazing with large herbivores
4. Stabilization of blow outs no longer done, stimulation of new ones only rarely
5. Removal of *Prunus serotina* in some Dutch dune areas

### **Ireland:**

Gaynor, pers. comm

1. Improved enforcement of planning regulations
2. Input into planning process
3. Construction of walkways through dunes, fence off dunes, Information boards etc.
4. Scrub control by active removal of sea buckthorn
5. Grazing control through agri-environment schemes.

## **2.3. Other measures (e.g. monitoring)**

- Positive management of golf courses and military sites
- Recreation management
- Monitoring of habitat quality

(J. Houston 2008)

## 2.4. Species specific measures

Reptiles, such as *Lacerta agilis* and *Coronella austriaca* (smooth snake): Although reptiles undoubtedly benefits from the landscape mosaic created by traditional grazing some care needs to be taken to avoid known breeding sites. Intensive grazing can also reduce the micro-diversity of the vegetation and the habitat for reptiles. (J. Houston 2008)<sup>32</sup>

During the last decades grey dunes in **the Netherlands** have undergone shrub encroachment and are being overgrown by grasses which have been encouraged by soil enrichment caused by atmospheric deposition. To counteract the affects of encroachment, management has been carried out on a too large scale and too intensively (grazing, mowing). The Sand lizard can be encouraged by a careful and small scale management of grey dunes as well as by restoration of natural dynamics in dune landscapes (Creemers, R.C.M. & J.J.C.W.van Delft (RAVON) (redactie) 2009. De amfibieën en reptielen van Nederland. Nederlandse Fauna 9. Nationaal Natuurhistorisch Museum Naturalis, European Invertebrate Survey – Nederland, Leiden).

*Bufo calamita*: The management should focus on both the aquatic and terrestrial habitat. Terrestrial habitat has to be open, un-shaded with extensive areas of un-vegetated or minimally vegetated ground (Beebee and Denton 1996). Management effort for the terrestrial habitat of *Bufo calamita* should therefore been directed to the restoration of over-fixed dunes, creation of new yellow-dune habitat and maintenance of suitable dune habitat (Beebee and Denton 1996). (J. Houston 2008)

Breeding birds: Ensuring the necessary rest for the breeding birds (*Oenanthe oenanthe*, *Lullula arborea*, *Anthus pratensis*, *Anthus campestris* ...) during the nesting season. (Belgium, Herrier, pers. comm)

## 2.5. Main constraints / bottlenecks and actual needs

### Belgium:

Herrier, pers. comm.

1. K02. Private property, non-cooperating owners or other stakeholders
2. A4.01.01, A4.01.02, A4.01.03. Financial motivation and hobby of cattle, sheep or horse holders
3. I01. Lack of knowledge about efficient ways of controlling invasive alien species.

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<sup>32</sup> Remark on this point by Zollinger (The Netherlands): "See Action Plan for the conservation of Sand lizard (*Lacerta agilis*) in northwest Europe : <https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=1304260&SecMode=1&DocId=1437092&Usage=2>

4. B01. In case the dune site is owned by a nature conservation agency or NGO: dislike of the public for deforestation. In case the dune site is privately owned: non-cooperation of private owners.
5. G05.01. Lack of awareness of the public. Lack of cooperation from the local authorities.

### **The Netherlands:**

Kooijman, pers. comm.

1. National problem, policy framework
2. Grazing is possible and effective to counteract grass-encroachment, but species return is limited due to dispersal problems,
3. High N-deposition limits aeolian dynamics
4. Insufficient funds

### **Ireland:**

Gaynor, pers. comm.

1. Lack of resources
2. Enforcement difficulties
3. Large number of people leaving farming leading to site abandonment (removal of grazing stock)
4. History of poor planning
5. People will always want to live at the coast – will always be focus of development plans

## **2.6. Solutions and recommendations**

### **Belgium:**

Herrier, pers. comm

1. K02. Purchase of land by nature conservation agencies or ngo's
2. A4.01.01, A4.01.02, A4.01.03. Awareness raising, purchase of land, influencing policies

3. I01. Awareness raising and influencing policies to stop planting of invasive alien species in or near dune sites; practical scientific experiments to build up knowledge about efficient techniques to control these invasive aliens
4. B01. Awareness raising of the public and purchase of land by nature conservation agencies and NGOs.
5. G05.01. Awareness raising, influencing policies (of local authorities)

### **The Netherlands:**

Kooijman, pers. comm

1. influencing policies, technical solutions in agricultural areas
2. no bottleneck any more
3. less fragmented dune landscapes
4. lower N-deposition
5. fund raising

### **Ireland:**

Gaynor, pers. comm.

1. Education
2. Raising public awareness
3. Influencing planning policy
4. Communication
5. Improved enforcement of planning regulations and wildlife legislation

## **Cases / projects**

Projects in Belgium (Herrier, pers. comm.):

- LIFE96 NAT/B/0030032 "ICCI Integral Coastal Conservation Initiative"
- LIFE02 NAT/B/008591 "FEYDRA Fossil Estuary of the Yzer Dunes Restoration Action"
- LIFE06 NAT/B/000087 "ZENO Zwindunes Ecological Nature Optimisation"



- ANDREA: Ancient Dunes Restoration Action, project of the Agency for Nature and Forests (without EC funding) to restore dozens of hectares of the habitat types '\*2130 Grey dunes' and '\*2140 Atlantic decalcified fixed dunes (Calluno-Ulicetea)' on the fossil dune systems of "D'Heye" at Bredene and De Haan and "Cabour – Garzebekeveld" at Adinkerke
- SCI BE2500001 "Duingebieden inclusief IJzermonding en Zwin"

## Sites

## 2190 – Humid Dunes Slacks

### Summary

**Humid dune slacks represent** the wetland component of dune systems, usually where the underlying water table reaches the surface. There are two main types, distinguished on the basis of their geomorphological history. Primary dune slacks run parallel to a dune coastline and are formed when a developing sand ridge cuts off a portion of beach. Secondary dune slacks are formed by wind eroded depressions in the dune system or in eroding systems by the landward movement of dune ridges over stable wet sand at the water table.

Dune slacks appear as flat valleys in the dune system, usually rich in species and associated with other wetland habitats. European vegetation classifications recognise a succession of slack types from bare damp sand to wet slacks dominated by trees and shrubs. The characteristic species of slacks are forms of dwarf willow, most commonly creeping willow. A number of rare species are associated with dune slacks including the fen orchid, petalwort (a bryophyte) and the natterjack toad.

In general, sand is initially calcareous (from the input of shelly material) and the groundwater is more or less base-rich. Low nutrient levels deter the establishment of competitors and lead to high species diversity. Slack features may be maintained at least partly by disturbances, including fluctuations in the water table, blown sand, the effects of nutrient limitation and grazing. Vegetation development is strongly associated with the average depth and seasonal fluctuation of the water table, the water-holding properties of the sand, the water flow and the water chemistry.

Overall the **conservation status of this habitat type** in the Atlantic region has been assessed as 'unfavourable-bad' due to human impact, including drainage and tourism. Range however has been assessed as favourable.

**The main reported threats and pressures** to humid dune slacks in the Atlantic region are:

- Water over-abstraction and drainage leading to salt water infiltration under the dune aquifer and lowering of phreatic groundwater level with desiccation of dune slacks as consequence.
- Lack of natural dynamics: the fixation of dunes by planting *Ammophila arenaria*, scrub and trees has reduced dune mobility and, as a consequence, the formation of secondary slacks.
- Atmospheric nitrogen deposition: the growth of most pioneer species is limited by nitrogen.
- Afforestation: an indirect effect by drawing down the overall water table.
- Under-grazing: leads to the development of coarse grasses, scrub and woodland.
- Over-grazing.
- Shoreline management (sea defences, shoreline management and harbour management activities): limits the opportunities for the spontaneous formation of new primary slack features.
- Encroachment with scrub, especially *Hippophaë rhamnoides* and *Salix cinerea*, *Salix alba* and tall grasses (*Calamagrostis epigejos*).
- Recreation (eg. golf course developments).
- Proximity of/isolation due to urbanised areas leading to: (1) deficit of infiltration by precipitation water caused by the built up and paved surfaces; and (2) permanent drainage of the precipitation and groundwater.

- Climate change effects.

The principal **management measures** for this habitat include:

- Mechanical removal of scrub and tall grasses, including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare.
- Mowing: prevents grasses, *Salix repens* and tree species from dominating.
- Extensive grazing with herbivores (such as cattle, horses and sheep).
- Sod-cutting to restore the slack to an earlier stage of succession.
- Re-wetting via changes/interventions to the hydrological regime.
- Restoration and creation of dune slacks:
- Removal of obsolete infrastructures and buildings to increase the infiltration surface for precipitation water.
- Reducing the draining of groundwater from building pits by imposing re-infiltration of the pumped up groundwater to a nearby dune site or imposing hydrological isolation of the building pit
- Further reduction of the abstraction of (natural) groundwater from the phreatic aquifer of the dunes by increasing alternative water supply.
- Removal of artificially planted forest
- Construction of walkways through dunes, fence off dunes, Information boards etc.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Lack of willingness to demolish infrastructure and buildings.
- Economic feasibility and lack of resources.
- Non-cooperation of private owners.
- Public resistance to deforestation (often because of a lack of awareness).
- In cases where the dune sites are privately owned, non-cooperation of private owners.
- Lack of knowledge, particularly at the level of an individual site.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Awareness raising, communication, influencing policies of licensing authorities.
- Stakeholder participation.
- Experiments in relation to the re-mobilisation of the dunes.
- Purchase of privately owned dune sites by nature conservation agencies or NGOs to provide the required management.
- Influencing planning policy towards an integrated, strategic approach.

## 1 Description of the habitat

Humid dune slacks are a component of most large, dynamic or previously dynamic, dune systems. They are damp or wet hollows left between dunes where the groundwater reaches or approaches the surface of the sand. Their most distinguishing feature is a seasonally fluctuating water table which usually reaches a maximum in winter and spring and drops in summer (J. A. Houston 2008). Humid dune-slacks are extremely rich and specialised habitats very threatened by the lowering of water tables (EC 2007b)

It is recommended that this document is read in conjunction with that for fixed dunes (\*2130) as some of the issues and management advice are common to both.

Humid dune slacks consist of various type of terrain: open water, wet meadows, marsh vegetation's en reed beds. (The Netherlands, Schotman, pers. comm.)

### 1.1. Distribution

Humid dune slacks are found throughout the coastal zone of the EU but are only locally abundant. They form an integral part of the extensive dune systems of the Atlantic biogeographical region. (J. A. Houston 2008).

Mainly owing to the cool wet climate of the UK, Humid dune slacks are a more prominent feature of dunes in the UK than in many other European countries, and the UK has a significant proportion of the EU resource. Dune slacks are widespread but local in the UK and the habitat type exhibits considerable ecological variation (Joint Nature Conservation Committee n.d.)

In the Netherlands Humid Dune Slacks can be found all along the coast. In the Wadden area they are developed very well. Along the mainland coast a large area is destroyed in the past for the production of drinking water. Thanks to good management there can be found well developed examples too. (The Netherlands, Schotman, pers. comm.)

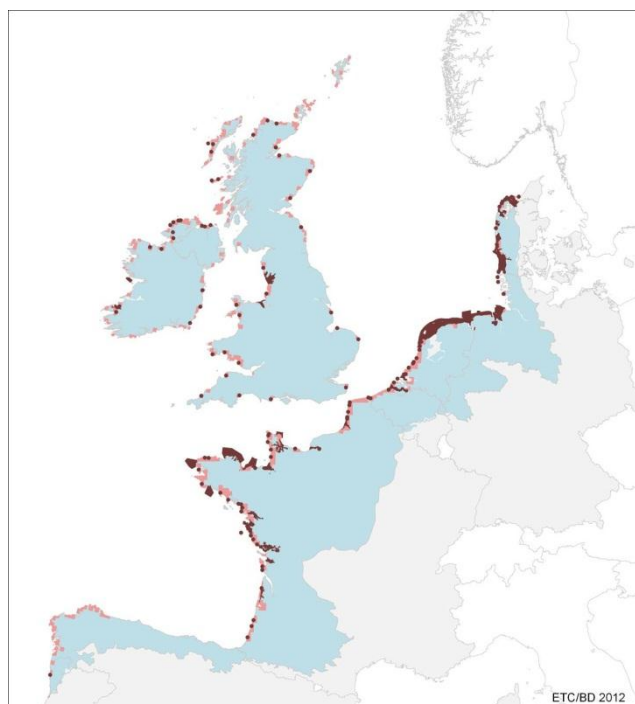
**Table 28 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL	PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	1			6	14	17	25				19		52		1	15	18	1		6	33
habitat area (ha)	38			514	136	4512	7920				1534		5431		1137	648	1987	0		4109	1276

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>33</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>33</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

**Figure 6 Map of SCIs proposed for the Human dune slacks & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**



## 1.2. Main features

Two types of dune slack are distinguished on the basis of their geomorphological history. Primary dune slacks may be formed in accreting conditions when an area of the upper beach is enclosed by the development seaward of a new dune ridge. Slacks thus formed are often long and narrow and run parallel to the shore. Primary dune slacks may also be open-ended retaining a connection to the sea which allows flooding on the highest tides. Such slacks display a gradient of habitat types relating to salinity and frequency of tidal incursion.

Secondary dune slacks are formed by wind eroded depressions in the dune system or in eroding systems by the landward movement of dune ridges over stable wet sand at the water table. Although formed by the same process the scale may vary from a few square metres of damp ground to large parabolic blowouts covering many hectares. (J. A. Houston 2008).

Vegetation succession in dune slacks, described in literature from the Netherlands and the United Kingdom (see Davy *et al.* 2006)<sup>34</sup> starts with the open conditions of bare wet sand some of which may be affected by salinity and tidal flooding. Microbial mats can be important at the pioneer stage and, by fixing nitrogen, may facilitate colonisation by higher plants. *Salix* spp. (e.g. *Salix repens* creeping willow) usually colonise early in the succession but at this stage do not dominate. A species-rich phase of typical dune slack species (including *Liparis loeselii* (fen orchid), *Dactylorhiza incarnata* (early marsh-orchid) and *Epipactis palustris* (marsh helleborine)) develops, often rapidly.

<sup>34</sup> See recent guidelines at <http://publications.environment-agency.gov.uk/PDF/GEHO0310BSGV-E-E.pdf>

Without the disturbance of grazing, or damage caused by anaerobic conditions in very wet slacks, the biomass increases, organic matter accumulates and the nutrient status (particularly nitrogen and phosphorus) of the soil increases. This results in increasing dominance of tall grasses and shrubs (including *Calamagrostis epigejos* (wood small-reed) and *Salix repens*) and the decline of the typical slack specialists of the species-rich phase<sup>35</sup>. The shift from pioneer stage to more mature stages usually takes about 20-30 years with *Salix repens* often becoming dominant.

### 1.3. Ecological requirements

In general, sand is initially calcareous (from the input of shelly material) and the groundwater is more or less base-rich. The infiltration of rainwater leads to base-rich conditions, since calcium carbonate (CaCO<sub>3</sub>) is dissolved in the rooting zone almost immediately. However, where initial lime content is low (e.g. on the Wadden Islands) the rapid decalcification will lead to more acid conditions.

Low nutrient levels deter the establishment of competitors and lead to high species diversity. Slack features may be maintained at least partly by disturbances, including fluctuations in the water table, blown sand, the effects of nutrient limitation and grazing.

Vegetation development is strongly associated with the average depth and seasonal fluctuation of the water table and the water-holding properties of the sand. The depth and duration of winter flooding, and the severity of summer drought, are likely to be important determinants of slack community structure (Davy *et al.* 2006). (J. A. Houston 2008). Also the water flow and water chemistry are critical for the vegetation development (UK, Rees, pers. comm.)

### 1.4. Main subtypes

In a general conceptual model based on existing information, mainly from the Netherlands, Davy *et al.* (2006) identified five types of dune slack (J. A. Houston 2008):

- A. Seaward, young dune slack in reach of the transition zone between the circulation of fresh and saline ground-waters and so may be subject to brackish conditions.
- B. Precipitation-fed slack situated in a dune hollow formed by a blow-out. Groundwater flow is directed towards the slack and water is lost by evapotranspiration.
- C. Precipitation-fed flow-through slack. Groundwater flows into the up-gradient edge of the slack, flows through the slack and then exits the slack at the down-gradient edge before continuing to flow in the direction of the hydraulic gradient.
- D. Slack at boundary between the dune system and inland area. Slacks are fed by both the regional and local groundwater flow systems and may also receive some surface run-off.

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<sup>35</sup> Remark on this point by Herrier (Belgium): "This reasoning goes on for the tall grasses such as *Calamagrostis* sp. etc., but not for *Salix repens*. *Salix repens*, other *Salix* species and *Hippophaë rhamnoides* appear already in the early pioneer phase of the humid dune slacks, as they (being pioneer shrub and tree species) germinate on bare mineral soils and not on vegetated soils that are covered with litter. *Hippophaë rhamnoides* tends also to invade humid dune slacks from the surrounding of these slacks, thanks to its ability of vegetative propagation via root offshoots. Encroachment by scrub of dune slacks has therefore to be contained from the earliest stages of the formation of the dune slack on. As young shoots of *Hippophaë rhamnoides* are little or not being eaten by herbivores and mowing stimulates regrowth, the seedlings of this species have to be pulled out manually."

- E. Moist dune slack situated at a high elevation in the main dune area. Moisture in the capillary fringe above the water table keeps the base of the dune slack moist with only occasional flooding when the water table is high in wet years.

The typology has been prepared by a multi-national (United Kingdom, Netherlands, Germany) research group but would benefit from further field testing (Davy *et al.* 2006)<sup>36</sup>.

Humid dune slacks are also classified on the basis of their vegetation ecology. The European Commission recognizes five subtypes of the habitat, each with its own flora:

- 16.31 - Dune-slack pools (*Charetum tomentosae*, *Elodeetum canadense*, *Hippuridetum vulgaris*, *Hottonietum palustris*, *Potametum pectinati*): fresh-water aquatic communities (cf. 22.4) of permanent dune-slack water bodies.
- 16.32 - Dune-slack pioneer swards (*Juncenion bufonii* p.: *Gentiano-Erythraeetum littoralis*, *Hydrocotylo-Baldellion*): pioneer formations of humid sands and dune pool fringes, on soils with low salinity.
- 16.33 - Dune-slack fens: calcareous and, occasionally, acidic fen formations (cf. 54.2, 54.4, in particular 54.21, 54.2H, 54.49), often invaded by creeping willow, occupying the wettest parts of dune-slacks.
- 16.34 - Dune-slack grasslands: humid grasslands and rushbeds (see 37.31, 37.4) of dune-slacks, also often with creeping willows (*Salix rosmarinifolia*, *S. arenaria*).
- 16.35 - Dune-slack reedbeds, sedgebeds and canebeds: reedbeds, tall-sedge communities and canebeds (cf. 53.1, 53.2, 53.3) of dune-slacks.

(EC 2007a) (ETC BD 2012).

## 1.5. Associated species

The number of plant species in any slack may be correlated to the size of the slack (large slacks hold more species). Slacks, however, have few endemic species; many slack species are also found in calcareous fens and other wetlands. *Carex trinervis* (three-nerved sedge) is probably the only plant species which is largely confined to western European dune slacks (Foley 2005). (J. A. Houston 2008).

Dune slacks are often rich in plant species, particularly rare and local species. Several species, such as the Annex II **1395 Petalwort** *Petalophyllum ralfsii*, **1903 Fen orchid** *Liparis loeselii*, and round-leaved wintergreen *Pyrola rotundifolia*, are found mainly in this habitat type.

Other species which could be considered to be dependent on humid dune slack habitat are (J. A. Houston 2008):

- *Quickella arenaria* (syn. *Catinella arenaria*) (snail): occurs in Western-European dune slacks but also in the Alps
- *Bufo calamita* (natterjack toad): the dune slacks, especially seasonally flooded pools within the slacks, are one of the main breeding sites
- several species of *Bryum* (thread-mosses).

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<sup>36</sup> See recent guidelines at <http://publications.environment-agency.gov.uk/PDF/GEHO0310BSGV-E-E.pdf>

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Humid dune slacks and provided their conservation status in the Atlantic Member States (see tables below).

**Table 29 Species associated with Humid dune slacks (ETC BD 2012) (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Anthus pratensis A257										
Gallinago gallinago A153										

## 1.6. Related habitats

*Salix repens* is commonly found in dune slack vegetation and the boundaries between humid dune slacks and habitat type 2170 dunes with *Salix repens* ssp. *argentea* are often difficult to define on the ground (J. A. Houston 2008). While humid dune slacks include *Salix repens*, the Annex I type excludes those sites where the species is dominant (Joint Nature Conservation Committee n.d.).

A range of other wetland types, especially swamp, mire and tall herb fen community, occur within the 'slacks' on some dunes. Although not confined to dunes they comprise an important part of the mosaic. Slacks characterised by a prominence of *Cladium mariscus* (great fen sedge) may be of the habitat type 7210 calcareous fens with *Cladium mariscus* and species of the *Caricion davilliana*.

Dune slack habitats do not always fit to the definition of 2190 humid dune slacks and can range from temporary water bodies to mature wetland communities lying within the larger dune systems (J. A. Houston 2008).

## 1.7. Ecological services and benefits

Large areas of dunes in the Netherlands provide drinking water for local use and to supply the main cities in North and South Holland. The exploitation of the dunes for drinking water began in the midnineteenth century. In the 1980s it accounted for 15% of all drinking water in the Netherlands (Koerselman 1992). Dune waterworks supply much of the drinking water needs of The Hague, Amsterdam and Leiden. On the Wadden Sea islands water abstraction is often connected with the increasing demands of tourism (J. A. Houston 2008).

## 1.8. Conservation status



**Table 30 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
2190	Humid dune slacks	range	FV	FV	FV	XX	FV	FV	FV	XX	FV	FV
		area	U2	FV	U1	XX	U2	U1	U1	U1	U1	U2
		structure	U2	U1	U1	XX	U1	U1	U1	U2	U2	U2
		future	FV	U1	U1	XX	U1	U2	FV	U1	U2	U2
		overall	U2	U1	U1	XX	U2	U2	U1	U2	U2	U2

Wetlands occurring as a part of a dune complex including both open water, fens and wet grasslands which can be species rich with specialised species of plant and animal and are sensitive to changes in water regime. This habitat is found along coastlines throughout the European Union although relatively rare in the Mediterranean.

Range is 'favourable' in all regions except the Mediterranean and in all countries except Greece where it is 'unknown'. However assessed as unfavourable in all regions with 'unfavourable-bad' in the Atlantic, Continental and Mediterranean regions and 'unfavourable-inadequate' in the Boreal region. Only Estonia has assessed this habitat as 'favourable' although Spain and France report 'unknown' for at least one region. Some of the member state assessments, either overall or for individual parameters, have been criticised by NGOs as being too optimistic..

The pressures and threats leading to the unfavourable conservation status are mostly due to human impact, including drainage and tourism related (Summary sheet of the online report on Article 17 of the Habitats Directive).

## 1.9. Trends

Dune slacks are a threatened habitat (European Commission 2007). Conifer plantations, surface drainage (on or adjacent to the dunes) and groundwater abstraction have all resulted in a lowering of the water table and less surface flooding at many sites, although the scale of these impacts in comparison to trends (or cycles) in climate is still controversial (JNCC 2007).

Furthermore, in part due to these impacts, most dunes in northwest Europe have become substantially more stable over the last 50 years, thus new secondary dune slacks are not being created. Loss of grazing pressure also causes accelerated succession to less valuable habitats. Where adverse impacts on the water table still occur, humid dune slack habitat has given way to mesotrophic grassland or scrub woodland. Embryonic dune slacks have disproportionately suffered from these processes, resulting in critically small remaining areas in some dune systems in the United Kingdom (JNCC 2007).

However, there are examples of new primary slack formation on accreting coasts in the United Kingdom (Smith 2007) and on the Wadden Island of Schiermonnikoog (Bakker *et al.* 2005) (J. A. Houston 2008).

## 1.10 Main pressures and threats

According to the Technical report from the EC on the management of habitat type 2190 (J. A. Houston 2008) the main causes of decline in humid dune slacks are loss, physical damage, eutrophication, overgrowth through lack of grazing<sup>37</sup> and interference with natural hydrological processes. Climate change also presents a significant threat to the status of dune water tables.

- **Water abstraction and drainage:** principal threat to dune slacks. Over-abstraction can lead to the lowering of the dune water table and to salt water infiltration under the dune aquifer.
- **Lack of natural dynamics:** the fixation of dunes by planting *Ammophila arenaria*, scrub and trees has reduced dune mobility and, as a consequence, the formation of secondary slacks.
- **Atmospheric nitrogen deposition:** increasing nitrogen deposition may accelerate the accumulation of organic matter in the substrate. The growth of most pioneer species is limited by nitrogen.
- **Afforestation:** may have a direct effect on dune slacks if they are targeted for planting (often linked to drainage activity) and an indirect effect by drawing down the overall water table in the vicinity of plantations.
- **Under-grazing:** leads to the development of coarse grasses, scrub and woodland
- **Shoreline management** (sea defences, shoreline management and harbour management activities): limits the opportunities for the spontaneous formation of new primary slack features.
- **Climate change effects:** Climate change could pose a significant threat to the already rare wet slacks habitats. Most dune slacks have been formed by natural sand movement but now lie within more stable dune systems. If water tables fall, as predicted in some areas, the habitat could be left 'high and dry'. Further work is required on climate change predictions for humid dune slacks in a number of different scenarios and including their geographical variability.

**Table 31 Main pressures to Humid dune slacks and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Humid dune slacks
Grazing	x
General Forestry management	x
Urbanised areas, human habitation	x
Trampling, overuse	x
Drainage	x
Modification of hydrographic functioning, general	x
Biocenotic evolution	x

**Table 32 Main threats to Humid dune slacks and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Humid dune slacks
Grazing	x
Trampling, overuse	x
Drainage	x

<sup>37</sup> Remark on this point by Herrier (Belgium): "Grazing was never sufficient to stop encroachment of humid dune slack with scrub ... A regular mechanical removal of scrub regrowth is needed to keep the humid dune slack "open". Around the early years 1900 coppicing *Hippophaë rhamnoides* and other shrub species to gather firewood and brushwood was a general practice in the Belgian dunes."

Modification of hydrographic functioning, general	x
Biocenotic evolution	x
Other natural processes	x

The major pressures and threats to **UK** coastal habitats (including humid dune slacks 2190, fixed coastal dunes 2130 and shifting dunes 2120) are:

- Changing agricultural practice, including grazing
- Sediment supply/dynamics
- Recreation
- Coastal protection, including afforestation
- Infestation by *Phomopsis juniperovora*
- Air pollution
- Falling water tables

(Joint Nature Conservation Committee n.d.)

Threats to **Dutch** humid dune slacks have been summarized by OBN ([www.natuurkennis.nl](http://www.natuurkennis.nl)):

- Accelerated succession by dehydration, scrub formation and acidification
- Drought
- Climate change

In **Ireland**, this habitat is under serious threat from a range of impacts including overgrazing, undergrazing, over-stabilisation of dunes, water abstraction and drainage, golf course developments, forestry and coastal protection works. Although the total area of the habitat is considered stable, the range of ecological variation is not. The two extreme communities (pioneer slacks and very wet slacks) are poorly represented in Ireland. Therefore, the future prospects for dune slacks, in terms of maintaining all of the ecological variation, are poor (NPWS 2008).

### Belgium:

Herrier (pers.comm.)

1. E01 Urbanised areas, human habitation: In Flanders urbanisation in the 20th Century caused a dramatic shrinking of the superficies of the coastal dunes (from 6.000 ha to 3.800 ha). As most of the remaining dune sites along the Flemish coast are fragmented and surrounded by (sub-)urban built up areas, there is: 1) a deficit of infiltration by precipitation water caused by the built up and paved surface and 2) a permanent draining of the precipitation water and even groundwater by the sewers. The dewatering of deep building pits (for underground parkings) also drains groundwater from the phreatic aquifer of the dunes. All these factors lead to a lowering of the groundwater level and the desiccation of dune slacks..
2. J02.07.02. Groundwater abstractions for public water supply. Although efforts have been made by the water supply companies in the last 2 decades to reduce groundwater extraction from the dunes, large dune areas along the Flemish coast still suffer a lowering of the phreatic groundwater level with desiccation of dune slacks as consequence.
3. K02 Biocenotic evolution, succession: encroachment of existing humid dune slacks with scrub, especially *Hippophaë rhamnoides* and *Salix cinerea*, *Salix alba* and tall grasses (*Calamagrostis epigejos*). The dominance of tall grasses can sometimes appear after the

gregarious mortality of the scrub. Scrub and tall grasses suppress the initial typical vegetation of alkaline marshes of the humid dune slacks. K02 Biocenotic evolution, succession: increasing colonization by *Ammophila arenaria* and *Hippophaë rhamnoides* of the shifting dunes, fixes the shifting dunes, reduces the aeolian sand drift and so prevents the formation of new dune slacks

4. B01. Forest planting on open grounds. Historical afforestation (during the 20<sup>th</sup> Century) with *Populus x Canadensis*, *Alnus glutinosa*, *Alnus incana*, *Salix* div. spp have caused losses of humid dune slack habitat.

#### **Ireland:**

Gaynor (pers. comm.)

1. Anthropogenic changes to hydrological conditions (J02)
2. Agriculture (A)
3. Human intrusions and disturbances (G), incorporates G01 (Outdoor sports and leisure activities, recreational activities) and G02 (Sport and leisure structures).
4. Forest and plantation management and use (B02)
5. Invasive, other problematic species and genes (I)

Dune slacks are highly sensitive to human influences on their hydrology, either through water abstraction or drainage works. Most slacks are fed by a range of water sources, including precipitation water, surface water and/or groundwater. Generally, the maintenance of a naturally functioning dune slack depends on both the amount of (a) precipitation and (b) groundwater discharge. Water abstraction interferes with the local hydrology, potentially having serious implications for the plant and animal communities of slacks. Abstraction can lower the level of the groundwater table, causing the slacks to dry out. It can also lead to saline infiltration in slacks formed close to the front of the dune system and particularly where the underlying substrate is highly permeable (e.g. shingle).

Scrub encroachment leads to reduction in dune biodiversity and needs to be controlled. The presence of scrub and trees which have deep roots can also lower the groundwater table which can have significant impacts on the slack communities. (Ireland, Gaynor, pers. comm.)

## **2 Conservation management**

### **2.1. Main conservation requirements**

The conservation of humid dune slacks requires either natural hydrological conditions or the careful manipulation of hydrological conditions to mimic the natural fluctuations in water levels, the water flows and the water chemistry which maintain the habitat.

In the natural situation the formation of humid dune slacks will be through geomorphological processes, including the development of active blow-outs. Where such processes are limited it is possible to create the habitat conditions by artificial means. For such interventions to be successful there has to be good knowledge of the hydrological conditions.

The species-rich stage of humid dune slack succession can be prolonged through active recurring management. In the long-term, however, the full expression of humid dune slack types requires active dune systems where new slack habitat can be formed to replace the loss of drier slacks to succession (J. A. Houston 2008).

**Belgium:**

Herrier (pers. comm.)

1. E01. Removal of obsolete infrastructures and buildings to increase the infiltration surface for precipitation water. Reducing the draining of groundwater from building pits by imposing in the building permits re-infiltration of the pumped up groundwater to a nearby dune site or imposing hydrological isolation of the building pit (preventing the groundwater to penetrate the pit).
2. J02.07.02. Further reduction of the abstraction of (natural) groundwater from the phreatic aquifer of the dunes by increasing alternative water supply.
3. K02. Mechanical removal of scrub and tall grasses, including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a recurring management, consisting of mowing and/or adapted grazing. In humid dune slacks, mowing of young vital *Hippophaë rhamnoides* can be successful when the mowing that took place in the autumn is followed by inundation of the dune slack during the following winter and or spring (the shrubs are then "drowned"). K02. Although the chances for success are doubtful: remobilizing the dune-system ?
4. B01. Removal of artificially planted forest, including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a recurring management, consisting of mowing and/or adapted grazing.

**Ireland:**

Gaynor (pers. comm.)

1. Maintain natural functioning of hydrological regime
2. Maintain some bare sand (particularly for pioneer slacks)
3. Maintain natural dynamism of entire dune system
4. Establish an appropriate grazing regime
5. Control invasive species.

The main requirement for dune slack management is to ensure that the hydrological regime continues to function naturally and that there are no increased inputs in the groundwater. The

frequency and duration of flooding or inundation determines the vegetation composition. The water table depth has been identified as the primary determining factor in vegetation variation, followed by weak trends in calcium and sodium availability. Other contributing factors include stage of development, precipitation, distance from the sea, the grazing regime, recreational pressure, nature of the sediment, soil pH and the porosity of the sediment. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. A varied vegetation structure is important for maintaining species diversity. (Ireland, Gaynor, pers. comm.)

## 2.2. Management measures

Most of the scientific research and published experience of management comes from the **Netherlands, Belgium, France** and the **United Kingdom** where there have been particular concerns about scrub invasion (especially by sea buckthorn) and the threats to rare plants. Applied techniques include scrub cutting, mowing, grazing, turf-stripping and re-wetting (J. A. Houston 2008):

**Scrub control:** A number of restoration techniques were already developed to counter the problem of invasion by scrub and rank grasses (case studies of restoration work at Ainsdale in northwest England, at De Westhoek in Flanders, at the Dunes de Merlimont,...). The experience derived from the LIFE Nature projects in Flanders (Leten *et al.* 2005) stresses the need for good preparation and for control and follow-up management.

**Mowing:** This management technique prevents grasses, *Salix repens* and tree species from dominating. The production of dead biomass is reduced leading to decreased nutrient cycling and possibly also a shift in the type of nutrient limitation from N-limitation to P-limitation (Koerselman 1992). Mowing, however, does not prevent the accumulation of organic matter in the top soil layer and it does not prevent acidification in decalcified soils. It is most useful for sustaining young calcareous slacks.

**Grazing:** Extensive grazing with herbivores such as cattle, horses and sheep is considered the ideal form of slack management (Simpson 1998, Leten *et al.* 2005, FitzGibbon *et al.* 2005). Monitoring records increased species diversity, reduced height of target species such as *Salix repens* and the development of a low structural mosaic of vegetation types with bare sand patches. Humid dune slacks provide excellent grazing material for rabbit populations. Warrens are often found near slacks or on high 'islands' within slacks.

**Sod-cutting:** Sod-cutting includes the removal of the black organic A-horizon leaving the mineral C-horizon intact. This type of management, carried out by hand, is traditional in many countries in northwest Europe (sod-cutting as a source of fuel and as a soil improver). Present-day sod-cutting has proved to be an effective technique if the objective is to restore the slack to an earlier stage of succession.

**Re-wetting:** There are some examples where water tables are being raised in dune areas to compensate for past drainage or abstraction. A large-scale restoration project has been completed

in the Amsterdam Waterworks Dunes (Geelen *et al.* 1995). Modelling is essential to get the levels of the to-be-formed slacks right. Too low and they would be flooded, too high and they would be dry.

**Restoration and creation of dune slacks:** Sand extraction to reinforce coastal defences, for example, could be designed in a way which creates 'slack' features. Slack features may result also 'by accident'. Studies in the Netherlands (Grootjans *et al.* 2002) found that the creation of new slacks was not very successful for maintaining populations of endangered species since projects were often carried out in areas where seed banks were depleted, while hydrological conditions and seed dispersal mechanisms were sub-optimal.

**Belgium:**

Herrier (pers. comm.)

1. E01. Removal of obsolete infrastructures and buildings to increase the infiltration surface for precipitation water. Reducing the draining of groundwater from building pits by imposing in the building permits re-infiltration of the pumped up groundwater to a nearby dune site or imposing hydrological isolation of the building pit (preventing the groundwater to penetrate the pit).
2. J02.07.02. Further reduction of the abstraction of (natural) groundwater from the phreatic aquifer of the dunes by increasing alternative water supply.
3. K02. Mechanical removal of scrub and tall grasses, including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a recurring management, consisting of mowing and/or adapted grazing. In humid dune slacks, mowing of young vital *Hippophaë rhamnoides* can be successful when the mowing that took place in the autumn is followed by inundation of the dune slack during the following winter and or spring (the shrubs are then "drowned"). K02. Although the chances for success are doubtful: remobilizing the dune-system ?
4. B01. Removal of artificially planted forest, including the litter layer and the soil layer that is enriched with organic material, leaving the mineral substrate bare. This initial intervention has to be followed by a recurring management, consisting of mowing and/or adapted grazing.

**Ireland:**

Gaynor (pers. comm.)

1. Improved enforcement of planning regulations
2. Input into planning process
3. Construction of walkways through dunes, fence off dunes, Information boards etc.

4. Scrub control by active removal of sea buckthorn

5. Grazing control through agri-environment schemes.

Moderate grazing regimes lead to the development of a species-rich cover. The animals increase biodiversity by creating micro-habitats through their grazing, dunging and trampling activities. Grazing slows down successional processes and in some cases reverses them, helping to achieve a diverse and dynamic landscape. The effects of trampling assist the internal movement of sand through the development of small-scale blowouts, while dunging can eutrophicate those dune habitats whose nutrient poor status is crucial for the survival of certain vegetation types. Many species, from plants to invertebrates, benefit immensely from the open and diverse system created by a sustainable grazing regime. Many dune species are small in size and have relatively low competitive ability. Consequently, the maintenance of high species diversity on a dune system is dependent on the existence of some control to limit the growth of rank coarse vegetation (Gaynor, 2008).

### 2.3. Other measures (e.g. monitoring)

**Research and monitoring:** Dune slacks are complex habitats. There is a need for ecological studies to be closely associated with hydrological and hydrochemical studies to gain a good understanding of how humid dune slacks work (J. A. Houston 2008).

### 2.4. Species specific measures

Bufo calamita (natterjack toad): Restoration actions have targeted both the terrestrial and aquatic habitats with scraping of dune slacks, digging new ponds, cutting back vegetation, grazing, mowing and burning of terrestrial habitat. *Bufo calamita* can exploit lagoon and young slack conditions where it retains a competitive advantage over other species. Care needs to be taken to avoid over-deepening of ephemeral dune pools.

Liparis loeselii (fen orchid): confined to early or mid-successional dune slacks (the water table regularly falls to more than 0.5m below ground level in August and September). Possible management techniques which target for the conservation of this orchid: mowing, scrub control, cutting and disturbance to the ground layer.

Rare mosses: A number of rare bryophytes are associated with the younger stages of coastal dune slacks in northwest Europe. The management advice for rare mosses and liverworts in coastal dune slacks is: open habitats (keep the dune system as dynamic as possible), light trampling, (rabbit) grazing, special attention when erecting fencing, avoid drainage, nutrient enrichment and local pollution.

Ensuring suitable aquatic habitats for *Bufo calamita*, *Triturus cristatus* and *Hyla arborea* (Belgium, Herrier, pers. comm.)



Petalwort (*Petallophyllum ralfsii*) is a pioneer species and therefore requires open ground (Ireland, Gaynor, pers. comm.)

## 2.5. Main constraints / bottlenecks and actual needs

### Belgium:

Herrier (pers. comm.)

1. E01. Lack of willingness to demolish infrastructure and buildings even when they became or can be made obsolete.
1. J02.07.02. Economic feasibility.
2. K02. In case the dune site is owned by a nature conservation agency or NGO: none. In case the dune site is privately owned: non-cooperation of private owners. K02: uncertainty about the results of attempts of remobilization of the dunes.
3. B01. In case the dune site is owned by a nature conservation agency or NGO: dislike of the public for deforestation. In case the dune site is privately owned: non-cooperation of private owners.

### Ireland:

Gaynor (pers. comm.)

1. Lack of resources
2. Lack of knowledge, particularly at the level of an individual site.
3. Enforcement difficulties
4. Large number of people leaving farming leading to site abandonment (removal of grazing stock)
5. History of poor planning

## 2.6. Solutions and recommendations

### 2.6.1. Solutions

#### Belgium:

Herrier (pers. comm.)

1. E01. Awareness raising, communication, influencing policies of licensing authorities

2. J02.07.02 Further awareness raising (of the public water supply companies), influencing the policies of the licensing authorities. Increasing economic feasibility. K02. Experiments of re-mobilisation of the dunes on small as well as large scale with the necessary attention for debris and root material.
3. K02. Purchase of privately owned dune sites by nature conservation agencies or ngo's to provide the required management. K02. Experiments with re-mobilisation of dunes.
4. B01. Awareness raising by communication. Purchase of privately owned dune sites by nature conservation agencies or ngo's to provide the required restoration measures and management.

#### **Ireland:**

Gaynor (pers. comm.)

1. Education
2. Raising public awareness
3. Influencing planning policy
4. Communication
5. Improved enforcement of planning regulations and wildlife legislation

#### 2.6.2. Recommendations

### Cases / projects

Projects in Belgium (Herrier, pers. comm):

- LIFE96 NAT/B/0030032 "ICCI Integral Coastal Conservation Initiative"
- LIFE02 NAT/B/008591 "FEYDRA Fossil Estuary of the Yzer Dunes Restoration Action"
- LIFE06 NAT/B/000087 "ZENO Zwindunes Ecological Nature Optimisation"

### Sites

Sites in Belgium (Herrier, pers. comm):

- SCI BE2500001 Duingebieden inclusief IJzermonding en Zwin

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

### Summary

The **habitat type 3110** covers shallow oligotrophic waters with few minerals and which are base poor, with an aquatic to amphibious low perennial vegetation belonging to the *Littorelletalia uniflorae* order, on oligotrophic soils of lake and pond banks (fine sands, coarse rocky sands and sometimes on peaty soils). The key process for the oligotrophic waters is carbon limitation. This habitat type may be primary or secondary if its occurrences are subject to (semi-)natural development; as a consequence many local variants exist, such as fishing ponds, moorland pools (isolated or not), isolated lakes, lakes fed by streams, etc.

The vegetation of this habitat type is **characterised by** the presence of *Littorelletalia*-type vegetation. Such vegetation is further characterised by the presence of water lobelia *Lobelia dortmanna*, shoreweed *Littorella uniflora*, or quillwort *Isoetes lacustris* or *Isoetes echinospora*. Typically the vegetation consists of zones in which the individual species form submerged, monospecific lawns. However, this is not always the case in the shallow waters of the north-west atlantic lowlands where isoetids inhabit the full lake and zonation is less evident.

The **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad' by each member state, except in Spain where it is 'unknown'. Pressures and threats include eutrophication and pollution in most countries.

The main reported **threats and pressures** to the habitat type 3110 in the Atlantic Region are:

- Eutrophication (ground water and surface water): nutrient enrichment from agricultural practices (including overgrazing and excessive fertilization), forestry activities and waste water from housing developments.
- Hydrological pressures: the high hydrological conductivity of sandy substrates has the result that this habitat type may be susceptible to changes to surface and groundwater hydrology (for example falling water tables caused by ground water abstractions for agriculture etc.).
- Recreation pressures: utilization for an increasing number of sport and leisure activities. Especially angling and the associated stocking of many lakes with benthic feeding fish is an important threat.
- Non-native invasive species: habitat type 3110 is particularly vulnerable to invasions by *Crassula helmsii* which occupies a similar niche to *Littorella uniflora* and to introductions of non-native fish species such as *Umbra pygmea* and *Lepomis gibbosus*.
- Grazing: the presence of large numbers of geese (for example Canada geese and Greylag Geese) can exert considerable grazing pressure on submerged vegetation and also import nutrients (especially when their external food supply is plentiful due to nearby agriculture).
- Air pollution: especially nitrogen-input, acidification arising from atmospheric deposition may be an issue for habitat type 3110 as there is limited buffering capacity in the acidic sandy soils.
- Artificial bank protection.

- Afforestation: planting of trees on heathland has resulted in increased evaporation and less groundwater flow towards the lakes resulting in a lowering of their water levels, drying out and subsequent desiccation.
- Climate change: increased CO<sub>2</sub> concentrations may shift the competitive advantage from isoetids towards other species.

The principal **management measures** for this habitat include:

- Restoration of the local hydrology: often this includes a package of measures which is dependent on the local situation; (for example: preventing or reducing the inflow of nutrients and pollutants (by setting up buffer zones and water catchment areas); stopping the outflow of water; removal of trees and shrubs in the direct surroundings that influences the local hydrology of the habitat; regulation of abstractions and impoundments; the re-creation of (natural) dynamics).
- Removal of high vegetation and organic sediments from the banks and bottom in order to restore mineral sands (necessary restoration measure before the isoetid vegetation can develop again), with taking into account the fauna populations.
- Cut sods and / or profiling of banks.
- Supply of alkalinity by liming, letting in of calcium-rich, nutrient poor water or liming of catchment.
- Depletion of the fish stock and setting up extensive fish farming management.
- Control of exotic invasive species (and water birds).
- Limit accessibility of nearby agricultural pastures (or change cultural practices in these fields) in order to prevent dominance of geese.

The most frequently encountered **bottlenecks** in the conservation or restoration of a favourable conservation status are:

- Insufficient funds for habitat restoration.
- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.
- Lack of knowledge about hydrology and groundwater.
- Agricultural policies.
- General environmental standards which are not taking into account the more sensitive receptors such as oligotrophic lakes.
- Climate change policies (pressure to increase the land area under trees).

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Stakeholder engagement and communication; including participative process and influencing policies, education and awareness raising, etc.
- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Maintenance of oligotrophic conditions. Reducing or eliminating nutrient inputs from local terrestrial and aquatic sources is a critical part of an overall approach to reduce or mitigate nutrient impacts.
- Effective control of air quality
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.

- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.

## 1 Description of the habitat<sup>38</sup>

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 (fine sands, coarse rocky sands and sometimes on peaty soils). This vegetation consists of one or more zones, dominated by *Littorella*, *Lobelia dortmana* or *Isoetes* (*Isoetes lacustris* and *Isoetes echinospora*)<sup>39</sup>, although not all zones may not be found at a given site.

The European Commission has clarified that - depending on the definition of the term 'natural' - this habitat type may be primary or secondary (e.g. ponds) if its occurrences are subject to (semi-)natural development (Bundesamt für Naturschutz n.d.)

Remark on this point by OBN (The Netherlands):

- In the document “Atlantic Natura 2000 Background Document (Draft 8 may)” large parts of the text were missing concerning H3110 and H3130. This makes a thorough review of both habitats impossible. The habitat documents concerning mitigation of N deposition effects (written for the Dutch government) should provide sufficient background information for these habitat types for that part of Europe. I suggest that the authors use this information to finish the missing texts.
- Please make sure that the finished text does not only describe the appearance of the habitat, but also the landscape and biogeochemical processes determine the occurrence and quality of the habitat.
- Definition: The current description is very general. No ranges are mentioned for water depth, water clarity, water level fluctuation, nutrient contents, alkalinity, pH, carbon dioxide content, substrate and altitude.
- Description: many local variants exist, which need to be described in more detail (see also definition). Possible variants: fishing ponds, moorland pools (isolated or not), isolated lakes,

<sup>38</sup> Addition to this point by van OBN (The Netherlands), pers.comm.

“In the introduction of the main text, the purpose is described as follows: “The purpose of the New Biogeographical Process is to help Member States to manage Natura 2000 as a coherent ecological network, whilst exchanging experience and best practice, addressing objectives and priorities and enhancing cooperation and synergies.”

In order to reach these goals, one needs to have fairly detailed knowledge on how ecosystems are functioning and how they respond to threats and to nature management. For example, the following steps could be addressed:

- 1) A definition of the ecosystem. Which systems are included and which are not? What are the reasons for this outline?
- 2) A description of the ecosystem. What are the general characteristics? What regional variants can be distinguished? What is the internal variation within a system?
- 3) A description of the ecosystem functioning. What are the key processes? What processes are responsible for the occurrence of regional variants? What causes and upholds internal variation?
- 4) How do threats interact with these key processes and, thereby, with characteristic biodiversity?
- 5) How does management interact with key processes and characteristic biodiversity?”

<sup>39</sup> Addition to this point by van Arts (The Netherlands), pers.comm.

lakes fed by streams. Furthermore, the internal variation is poorly described. The zonation in depth is shortly adressed, but not variation as a consequence of wave action, seepage of groundwater, instream of surfaced water and differences in accumulation of organic matter.

- **Functioning:** The key process for this type of lake is not mentioned: carbon limitation. As a consequence, many links to this process are missing. Such as alkalisation, rising carbon dioxide levels in the atmosphere and competition between isoetids and species as *Juncus bulbosus* and *Myriophyllum alterniflorum*. Is is essential to add a proper description of the process of carbon limitation, and the links to the macophyte composition, threats and opportunities for management.

## 1.1. Distribution

This is a rare habitat type throughout the Atlantic Biogeographical Region of Europe.

The only known high-quality examples of this habitat type in the UK occur on fluvio-glacial deposits in the New Forest and on the Cheshire Plain, and on more recent sand deposits of marine origin in the Outer Hebrides. (Joint Nature Conservation Committee n.d.)

**Table 33 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE		DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	13	2		14	7	14	12	5	27		19		69	13	1	38	4			5	4
habitat area (ha)	466	2		55	334	478	1120	261	4604		11572		20523	223	23	26471	139			526	404

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 51-75%<sup>40</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>40</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

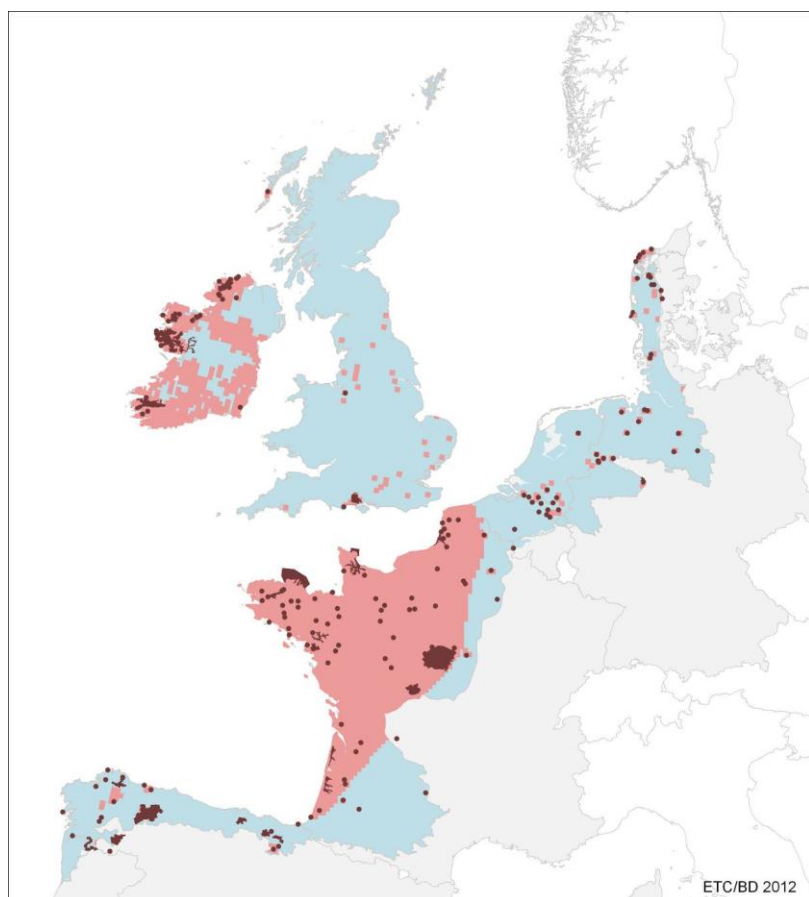


Figure 7 Map of SCIs proposed for the Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)<sup>41</sup>

## 1.2. Main features

The habitat type is characterised by the presence of *Littorelletalia*-type vegetation. Such vegetation is characterised by the presence of water lobelia *Lobelia dortmanna*, shoreweed *Littorella uniflora*, or quillwort *Isoetes lacustris* or *Isoetes echinospora*<sup>42</sup>. Typically the vegetation consists of zones in which the individual species form submerged, monospecific lawns (Joint Nature Conservation Committee n.d.), however this is not always the case in the shallow waters of the north-west atlantic lowlands where isoetids inhabit the full lake and zonation is less evident (Arts et al., 2002)<sup>43</sup>.

<sup>41</sup> Remark on this point by van Arts (The Netherlands), pers.comm.: "In Figure 7 I miss several sites in The Netherlands, the sites with *Lobelia dortmanna* in the Bergvennen, *Isoetes lacustris* (Staalbergven, southern part of The Netherlands) and several site with *Isoetes echinospora* in the southern provinces of The Netherlands."

<sup>42</sup> Addition to this point by van Arts (The Netherlands), pers.comm.

<sup>43</sup> Addition to this point by van Arts (The Netherlands), pers.comm. New reference to add: Arts, G.H.P., 2002. Deterioration of Atlantic soft-water macrophyte communities by acidification, eutrophication and alkalisation. *Aquat. Bot.* 1566: 1-21.

### 1.3. Ecological requirements

[text to be completed as a result of the consultation process]

### 1.4. Main subtypes

[text to be completed as a result of the consultation process]

### 1.5. Associated species<sup>44</sup>

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) and provided their conservation status in the Atlantic Member States (see tables below).

**Table 34 Species associated with Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) (ETC BD 2012) (for legend, see introduction of chapter 3)<sup>45</sup>**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Graphoderus bilineatus 1082										
Cottus gobio 1163										
Anas crecca A052										
Anas platyrhynchos A053										
Actitis hypoleucos A168										

<sup>44</sup> Remark on this point by OBN (The Netherlands), pers.comm.: "Striking is that the described accompanying species deviate immensely from the typical species found in the Dutch waterbodies belonging to H3110 and H3130. The described species are, in my experience, typical for different habitat types and the lists should be revised. Part of this discrepancy may be the result of variation within each of the habitat types. If this is the case, a detailed description of this variation is needed and should be related to variation in communities."

<sup>45</sup> Remark on this point by OBN (The Netherlands), pers.comm.: The species mentioned in table 34 do not occur in this habitat type in the Netherlands. *Aeshna viridis* and *Graphoderus bilineatus* live in more mesotrophic wetlands often with growth of *Stratiotes*. *Cottus gobio* is a species of streams. Suggestions for species associated with 3110: *Hygrotus novemlineatus*, *Dytiscus latissimus*, *Gyrinus minutus*, *Glaenocoris propinqua*, *Pagastiella orophila*, *Parakiefferiella bathophila*, *Limnephilus griseus*, *Holocentropus insignis*, *Molanna albicans*, *Limnephilus nigriceps*, *Podiceps nigricollis*, *Rana arvalis*



**Table 3 Species associated to Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)<sup>46</sup>**

N2K code	Species name	Group		DE	DK	NL	REGION
1048	<i>Aeshna viridis</i>	Invertebrates	range	U2	U1	U2	U2
			population	U2	U1	U2	U2
			habitat	U1	XX	U1	U1
			future	XX	FV	U1	XX
			overall	U2	U1	U2	U2

N2K code	Species name	Group		DE	FR	NL	REGION
1082	<i>Graphoderus bilineatus</i>	Invertebrates	range	FV	U2	U2	U2
			population	FV	U2	U2	U2
			habitat	FV	U2	U1	U2
			future	XX	U1	U1	U1
			overall	FV	U2	U2	U2

N2K code	Species name	Group		BE	DE	ES	FR	NL	UK	REGION
1163	<i>Cottus gobio</i>	Fish	range	FV	FV	XX	FV	U1	FV	FV
			population	U1	FV	XX	FV	XX	XX	XX
			habitat	U1	FV	XX	XX	U1	XX	XX
			future	FV	FV	XX	FV	FV	XX	XX
			overall	U1	FV	XX	FV	U1	XX	XX

The Habitats Manual lists the following Annex II/IV plant species: *Luronium natans*. (ETC BD 2012). The water is typically very clear and moderately acid (ETC BD 2012).

## 1.6. Related habitats

This habitat is found in association with heath (31.1) and *Nanocyperion*<sup>47</sup> (22.32) communities. In France and Ireland this habitat occurs, in particular, in heathland of sandy plains on podzols, where the water table occurs at the surface. (ETC BD 2012)

Remark on this point by OBN (The Netherlands), pers.comm.:

Transitions between H3110 and H3130 and towards H7110 and H7140, especially, are habitat of a variety of endangered animal and plant species. These transitions are inadequately dealt with and

<sup>46</sup> Remark on this point by OBN (The Netherlands), pers.comm.: suggestions for species associated with 3110: *Hygrotus novemlineatus*, *Dytiscus latissimus*, *Gyrinus minutus*, *Glaenocoris propinqua*, *Pagastiella orophila*, *Parakiefferiella bathophila*, *Limnephilus griseus*, *Holocentropus insignis*, *Molanna albicans*, *Limnephilus nigriceps*, *Podiceps nigricollis*, *Rana arvalis*

<sup>47</sup> Remark on this point by OBN (The Netherlands), pers.comm.: Mentioning of the Association with *Nanocyperion* communities might be confusing, as this is mentioned as a characteristic of 3130.

can be seriously endangered when the waters are managed as homogeneous habitats using the measures described in paragraph 2.2 of the chapters.

## 1.7. Ecological services and benefits

[text to be completed as a result of the consultation process]

## 1.8. Conservation status

**Table 35 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	UK	REGION
3110	Oligotrophic waters containing very few minerals of sandy plains ( <i>Littorelletalia uniflorae</i> )	range	U2	FV	FV	XX	FV	FV	U2	FV	FV
		area	U2	U2	U1	XX	U2	FV	U2	XX	U2
		structure	U1	U2	U2	XX	U2	U2	U2	U2	U2
		future	U2	U1	U2	XX	U1	U2	U1	FV	U1
		overall	U2	U2	U2	XX	U2	U2	U2	U2	U2

Nutrient poor lakes with vegetation dominated by shore weed (*Littorella uniflora*), water lobelia (*Lobelia dortmana*) and/or quillworts (*Isoetes* spp) are wide spread in north and west Europe in the Alpine, Atlantic, Boreal, Continental and Mediterranean region.

Assessed as 'favourable' for the Alpine region as 'favourable' in Finland which has more than 98% of the habitat area within this region. However the habitat is reported as 'unfavourable-inadequate' in Spain (Pyrenees) and 'unfavourable-bad' in Italy (Alps). 'Unfavourable -inadequate' in both the Boreal and Continental regions where all parameters have been assessed as 'unfavourable-inadequate' although in some countries the habitat has been assessed as 'unfavourable-bad'. In the Mediterranean region the habitat is only found in Spain and Portugal and the habitat has been assessed as 'unknown but not favourable' due to Spain reporting all parameters as 'unknown'.

In the Atlantic region the habitat has been assessed as 'unfavourable-bad', it has also been assessed as 'unfavourable-bad' by each country in the region except Spain where it is 'unknown'. 'Structure & function' and 'future prospects' are unfavourable in most countries for all regions.

Pressures and threats include eutrophication and pollution in most countries. Better information is required, particularly from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive) (ETC BD 2012).

## 1.9. Trends

[text to be completed as a result of the consultation process]

## 1.10 Main pressures and threats

Many of the factors affecting this habitat type are common to other standing water types in the UK and across Europe as a whole. The pressures may operate at the catchment level and hence largely be related to land use and management practices or be 'in-lake' pressures such as fish stocking and invasive plant species. The following overview indicates the key factors, highlighting particular issues for 3110 where appropriate (Joint Nature Conservation Committee n.d.):

- Pollution: Nutrient enrichment is the major factor affecting lakes in the UK with evidence that over 80% of lakes in England are affected (Carvalho and Moss 1995)<sup>48</sup>.
- Land use: Some areas of lowland heath are subject to land use activities other than agriculture (military uses, recreation) which cause erosion of sandy soils leading to the sedimentation issues.
- Hydrological Pressures: The high hydrological conductivity of sandy substrates has the result that H3110 may be susceptible to changes to surface and groundwater hydrology (for example falling water tables mentioned in (Bundesamt für Naturschutz n.d.). Global climate change may exacerbate these hydrological pressures.
- Recreation Pressures: The major recreational pressure affecting this habitat type in England is angling and the associated stocking of many lakes with benthic feeding fish, particularly carp, also in Germany, angling is a threat this Habitat Type (Bundesamt für Naturschutz n.d.)
- Non-native species: H3110 is particularly vulnerable to invasions by *Crassula helmsii* which occupies a similar niche to *Littorella uniflora*. *Crassula* is now widespread in much of England (>10,000 sites) and there are increasing numbers of records from Scotland and Wales. H3110 is also vulnerable to introductions of non-native fish species *Umbra pygmea* and *Lepomis gibbosus*. Both are increasing in the Netherlands and Flanders<sup>49</sup>.
- Grazing<sup>50</sup>: The presence of large numbers of feral geese is a localised issue which may be significant where it occurs. Large congregations of geese (usually Canada geese *Branta canadensis*) can exert considerable grazing pressure on submerged vegetation and also import nutrients when feeding elsewhere. Greylag Geese is becoming increasingly abundant on the European mainland (Netherlands, Germany and Belgium). Geese numbers can become high when food supply is large due to nearby agriculture<sup>51</sup>. Additionally, geese can cause considerable damage to marginal and emergent fringing vegetation.
- Air pollution: Acidification arising from atmospheric deposition may be an issue for H3110 as there is limited buffering capacity in the acidic sandy soils
- Artificial bank protection (Bundesamt für Naturschutz n.d.)
- Afforestation: Planting of trees on heathland has resulted in increased evaporation and less groundwater flow towards the lakes resulting in desiccation<sup>52</sup>.
- Climate change: increased CO<sub>2</sub> concentrations may shift the competitive advantage from isoetids towards other species. Increased deposition in winter results in increased runoff of

<sup>48</sup> Addition to this point by van Arts (The Netherlands), pers.comm.: "As in The Netherlands these habitats are mainly included in nature reserves and are part of the local hydrological systems there, pollution by nutrients is mainly a problem as atmospheric pollution."

<sup>49</sup> Addition to this point by OBN (The Netherlands), pers.comm.

<sup>50</sup> Addition to this point by van Arts (The Netherlands), pers.comm.: "Grazing: in The Netherlands many habitats are part of a grazing regime with cattle."

<sup>51</sup> Addition to this point by OBN (The Netherlands), pers.comm.

<sup>52</sup> Addition to this point by OBN (The Netherlands), pers.comm.

nitrogen. Whereas increased deposition in summer results in less air exposure of the shore, possibly resulting in P mobilisation and N retention<sup>53</sup>.

**Table 36 Main pressures to Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Oligotrophic waters containing very few minerals of sandy plains ( <i>Littorelletalia uniflorae</i> )	<i>Aeshna viridis</i>	<i>Graphoderus bilineatus</i>	<i>Cottus gobio</i>
Cultivation	x			
Grazing	x			
Pollution	x	x	x	x
Modification of hydrographic functioning, general	x	x		x
Biocenotic evolution	x			x

**Table 37 Main threats to Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Oligotrophic waters containing very few minerals of sandy plains ( <i>Littorelletalia uniflorae</i> )	<i>Aeshna viridis</i>	<i>Graphoderus bilineatus</i>	<i>Cottus gobio</i>
Urbanised areas, human habitation	x			
Pollution	x	x	x	x
Modification of hydrographic functioning, general	x	x		x
Biocenotic evolution	x			x

In **Ireland**, the principal threats to oligotrophic lakes include nutrient enrichment from agricultural practices, including overgrazing and excessive fertilisation, afforestation and waste water from housing developments in rural areas. Lakes may also be negatively affected by the introduction of invasive alien species, and their utilization for an increasing number of sport and leisure activities. While the range and area of this habitat are stable, significant areas are suffering from, or are at risk from nutrient enrichment (NPWS 2008).

Addition to this point by O Connor, pers.comm.:

1. J02, human induced changes in hydraulic conditions/ J02.07, Water abstractions from groundwater [LAND DRAINAGE]
2. H01, Pollution to surface waters (limnic, terrestrial, marine & brackish) [particularly H01.05, diffuse pollution to surface waters due to agricultural and forestry activities and H01.08, diffuse pollution to surface waters due to household sewage and waste waters]
3. J02.06, Water abstractions from surface waters

<sup>53</sup> Addition to this point by OBN (The Netherlands), pers.comm.

“It is important to note, firstly, that Ireland has not resolved the issue of the interpretation of the lake habitats 3110 and 3130 for the Irish context. Taking habitat descriptions that are effectively based on the phytosociological **classification** of lake margin/shoreline communities and applying those to a classification of Irish lake types has not been completed and presents a challenge. The wetlands section of NPWS are of the opinion that there is significant overlap between these two Annex I habitats in Ireland, but that there is a distinct gradient across 3110/3130 lakes that needs further elucidation. Without resolving this classification issue, it is not possible to correctly map these habitats, to identify habitat-specific pressures/threats or habitat-specific management recommendations. Land drainage is one of the most significant **pressures** acting on freshwaters in Ireland. None of the standard list appears to properly fit this issue. Land drainage is most frequently associated with agriculture (including forestry) and turf-cutting, but may also be linked to urbanisation, residential and commercial development (E). The main impacts associated with land drainage relate to changes to catchment hydrology and the creation of more direct pathways for pollutants to water. In Ireland, habitat 3110 is frequently found in catchments with large percentage areas under peat (blanket peat and wet heath) and other highly organic soils (e.g. peaty gleys, peaty podzols). Drainage for turf cutting, plantation forestry and agriculture is frequent. Drainage of peaty soils leads to decomposition of organic matter and associated losses of ammonia and dissolved organic carbon. It also leads to an increased fine sediment load to water (peat and mineral fractions). Where associated with agricultural uses, organic and chemical (frequently phosphorus) fertilisation is typical. The impacts on 3110 lakes can include decreased light penetration (increased colour and turbidity), which may lead to loss of submerged macrophytes from deeper areas of euphotic zone; increased sedimentation of littoral areas, which can also result in losses of macrophytes; and enrichment of the heterotrophic (fungal and bacterial) pathways, with increased DOC and ammonia loads. Increased heterotrophic activity, as well as fertilisation practices, may also result in increased autotrophic activity over time, but this may be moderated by the decreased light penetration. The impacts of hydrological changes, specifically changes in the timing and/or size of water fluctuations on the shoreline/shallow macrophyte communities of these lake types is poorly understood (exposure, turbidity, nutrient releases from sediments, etc.). Such hydrological change may result from abstractions and impoundments, as well as land drainage. In terms of pollution, nutrients, sediment and DOC have been mentioned above. Eutrophication remains amongst the greatest concerns for all freshwater habitats and most freshwater species. In Ireland, lakes that can be classified as oligotrophic using standard water quality methods (WFD standards/EQRs, S.I. 272 of 2009, Irish Statute Book) typically do not have any large point-source discharges, so eutrophication pressures are mainly from agricultural (including forestry) activities. Once-off houses, agglomerations and other developments and their associated wastewater treatment systems also contribute diffuse nutrients.”

### **The Netherlands**

Addition to this point by Arts, pers.comm.:

4. HO4.02 Air pollution, especially nitrogen-input. Concentrations of airborne nitrogen (resulting in nitrogen available in pore water and water layer as ammonium or nitrified as nitrate) are a problem in these habitats, because their sediments have a low buffering capacity and airborne nitrogen still exceed critical loads. Extra ammonium input will favour macrophyte species which can easily use ammonium

and are fast growers, like Sphagnum mosses and Juncus bulbosus, and result in other symptoms of acidification (Arts et al., 2002). These competitive species will outcompete the very slowly growing Isoetids, thereby producing high amounts of organic material. Moreover, nitrification of ammonium lowers pH. These changes in habitat are unfavourable to Isoetid macrophyte species (Arts et al., 2002). Critical loads for nitrogen are still exceeded in the Netherlands (Bobbink et al., 1997; 2011). Deposition of sulphate has decreased tremendously. Therefore direct acid deposition has already completely stopped, thereby contributing to a recovery of isoetid populations in The Netherlands.

5. M01.04 pH-changes and M02.01 Habitat shifting. Increase of airborne CO<sub>2</sub> concentrations can favour Myriophyllum and Fontinalis species at the expense of isoetids (Spierenburg et al. 2009). Increased winter precipitation will favour an increased load of nitrogen. Increased summer precipitation will keep the shallow parts of the soft-water lakes submerged, while those habitats normally run dry in summer time. This habitat change can stimulate the mobilization of phosphate and can hamper nitrification processes.
6. H01.05 and H02.06: diffuse pollution to surface water and local groundwater due to agriculture. In The Netherlands, most habitats are incorporated in nature areas / reserves. Often these areas are surrounded by agricultural land, from which the habitats are often influenced.
7. J02.07.01 Groundwater abstractions for agriculture. Lowered groundwater tables might influence the habitats resulting in decreased and more fluctuating water tables.

Addition to this point by OBN, pers.comm.:

Threats are merely mentioned, but the way in which key processes are affected and the consequences for biodiversity are not described. A sound knowledge of how threats are affecting the system is essential for a good management. Threats that need to be added are: alkalinisation, carbon-enrichment, nitrogen deposition, changes in groundwater quality (nitrate, sulphate, phosphate, iron, calcium etc.).

## 2 Conservation management

### 2.1. Main conservation requirements

Conservation of the Habitat 3110 occurs by preventing or reducing the inflow of nutrients and pollutants (for example by setting up buffer zones and water catchment areas). Also (negative) changes in water management, recreational use and angling should be avoided (Bundesamt für Naturschutz n.d.)

#### Ireland

Addition to this point by O Connor, pers.comm.:

1. Catchment management

## 2. Regulation of abstractions and impoundments

### The Netherlands

Addition to this point by Arts, pers.comm.:

3. Restore the local hydrology. Often this includes a package of measures which is dependent on the local situation, e.g. stop the inflow of nutrient-rich water; stop the outflow of water ; remove trees and shrubs in the direct surroundings that influences the local hydrology of the habitat.
4. Removal of organic sediments. Isoetid species are mainly growing on mineral sands. If the original sandy sediment has changed into an organic and sometimes even muddy sediment due to eutrophication and acidification processes, the original sediment first has to be restored before the isoetid vegetation can develop again (Arts et al., 1990a;b). These restoration measures must take into account the fauna populations in the habitat, e.g. by removal of the organic sediments in parts.
5. The inflow of buffered and nutrient-poor surface water or groundwater might be required after removal or dredging of these habitats (see 1 and 2). As the original sediments have a low buffering capacity, this might be necessary, depending on the situation and the atmospheric input of nitrogen (Brouwer et al., 1997; Van Kleef et al., 2010). Alternatively, calciumcarbonate (lime) can be supplied to the catchment of these habitats.
6. Removal of high vegetation and organic material from the banks in order to restore mineral banks and improve conditions for gradients in vegetation from aquatic to semi-aquatic and terrestrial.

## 2.2. Management measures

Relating to the management of habitat 3110 the following two aspects are of importance (Van Uytvanck et al. 2010):

- the re-creation of (natural) dynamics;
- improving the water quality and biotic conditions (substrate / water);

In Flanders, management of oligotrophic waters focus on (Van Uytvanck et al. 2010):

- isolate / restore hydrology
- dredging. This practice should be taken with care as it can seriously damage populations of endangered fauna species<sup>54</sup>
- cut sods and / or profiling of banks
- Thin out herbs / mowing
- remove trees and shrubs
- liming, letting in of calcium rich, nutrient poor water supply of alkalinity by liming, letting in of calcium-rich, nutrient poor water or liming of catchment. Directly applying lime to the lakes can result in a temporary dominance of undesirable species (*Juncus bulbosus*, *Sphagnum spec.*) and mobilization of ammonium<sup>55</sup>

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<sup>54</sup> Addition to this point by OBN (The Netherlands), pers.comm.

<sup>55</sup> Addition to this point by OBN (The Netherlands), pers.comm.

- depletion of the fish stock
- setting up extensive fish farming management
- control of exotic invasive species (and water birds)
- restore ponds/lakes that have been lost to land reclamation<sup>56</sup>
- limit accessibility of nearby agricultural pastures in order to prevent dominance of geese<sup>57</sup>

In the Netherlands there is extensive experience with identical measures.<sup>58</sup>

## Ireland

Addition to this point by O Connor, pers.comm.:

Water Framework Directive: In Ireland, the WFD measures for agricultural pressures are restricted to those required under the Nitrates Directive (Ireland's Good Agricultural Practice Regulations). In response to WFD requirements, legislation is in preparation by Ireland's Department of the Environment, Community and Local Government to control abstractions and impoundments. In terms of point sources, large discharges such as IPPC and UWWT discharges are regulated effectively by the Irish EPA. Smaller discharges are authorised by Local Authorities. The Department of Agriculture, Food and Marine operates a series of general guidelines for agriculture (under SPS scheme) and forestry (under grant-aid scheme and licensing responsibilities).

## The Netherlands

Addition to this point by Arts, pers.comm.:

The actual measures are identical to the management requirements (2.1), as these are already practice in The Netherlands.

1. Restore the local hydrology. Often this includes a package of measures which is dependent on the local situation, e.g. stop the inflow of nutrient-rich water; stop the outflow of water ; remove trees and shrubs in the direct surroundings that influences the local hydrology of the habitat.
2. Removal of organic sediments. Isoetid species are mainly growing on mineral sands. If the original sandy sediment has changed into an organic and sometimes even muddy sediment due to eutrophication and acidification processes, the original sediment first has to be restored before the isoetid vegetation can develop again (Arts et al., 1990a;b). These restoration measures must consider the fauna populations in the habitat, e.g. by removal of the organic sediments in parts.
3. The inflow of buffered and nutrient-poor surface water or groundwater might be required after removal or dredging of these habitats (see 1 and 2). As the original sediments have a low buffering capacity, this might be necessary, depending on the situation and the atmospheric input of

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<sup>56</sup> Addition by OBN (The Netherlands), pers.comm.

<sup>57</sup> Addition by OBN (The Netherlands), pers.comm.

<sup>58</sup> Remark on this point by OBN (The Netherlands), pers.comm.



- nitrogen (Brouwer et al., 1997; Van Kleef et al., 2010). Alternatively, calcium carbonate (lime) can be supplied to the catchment of these habitats.
4. Removal of high vegetation and organic material from the banks in order to restore mineral banks and improve conditions for gradients in vegetation.

Remark on this point by OBN, pers.comm.:

Transitions between H3110 and H3130 and towards H7110 and H7140, especially, are habitat of a variety of endangered animal and plant species. These transitions are inadequately dealt with and can be seriously endangered when the waters are managed as homogeneous habitats using the measures described in paragraph 2.2 of the chapters.

Description of suitable management measures is very concise and nearly complete. The described measures are not linked with specific bottlenecks and do not provide tools for the selection of measures. What is missing is a framework to support the choice of the right measures (see for an example <http://www.natuurkennis.nl/sleutel/paginas/detail.php>) and the text concerning mitigation of N deposition effects (PAS-documents written for the Dutch government)

Measures are merely mentioned, without motivation or link to key processes. Measures are mentioned only for some regions. It is not explained why measures vary for regions.

## 2.3. Other measures (e.g. monitoring)

[text to be completed as a result of the consultation process]

## 2.4. Species specific measures

[text to be completed as a result of the consultation process]

## 2.5. Main constraints / bottlenecks and actual needs

### The Netherlands

Addition to this point by Arts, pers.comm.:

1. Insufficient funds for habitat restoration
2. Lack of Knowledge

### Ireland

Addition to this point by O Connor, pers.comm.:

1. Agricultural policies
2. General environmental standards
3. Resources, both money and staff (time and expertise).

National and European agricultural policies promote and reward increased agricultural productivity and are based on utilisable agricultural area. This puts pressure on farmers to drain land and intensify activities generally (increased stock, supplementary feeding, conversion to silage, provision of winter housing for livestock, fertilisation, etc.) Similarly, climate change policies and protocols put pressure on MS to increase the land area under trees. In Ireland, that means there is pressure to reforest areas of coniferous plantation on peat and peaty soils, areas where the resultant carbon balance (storage/loss) has not been properly demonstrated. With pressure to increase agricultural productivity, afforestation is again being diverted towards 'marginal' lands including peaty soils.

The general environmental standards set under instruments such as the Nitrates and Water Framework Directives do not allow for the site-specific requirements of either the more sensitive receptors (e.g. oligotrophic lakes, freshwater pearl mussel) or more sensitive catchments (e.g. where steep slopes, high organic content in soil and/or high rainfall mean high risk of direct loss of fertilisers to water). While these standards may be appropriate for less sensitive (e.g. mesotrophic-eutrophic lakes) or in lower risk scenarios, they create a large and costly gap in terms of the required management measures that will require compensation to land-users – the lower the bar in terms of general environmental standards, the more costly will be the conservation of the most sensitive habitats and species. Catchment management is also costly owing to the large areas and numbers of land-users/other stakeholders that can be involved. It is also scientifically and socially challenging, and requires significant technical resources in terms of staff.

Matching of environmental standards for rivers to environmental standards for down-stream lakes (flux) requires further work. The regulation of smaller discharges to water by a large number of local authorities and the resulting inefficiencies and inconsistencies is also a concern, although the Irish EPA provides excellent guidance and advice.

## 2.6. Solutions and recommendations

### 2.6.1 Solutions

#### **The Netherlands**

Addition to this point by Arts, pers.comm.:

4. Influencing policies
5. Education
6. Communication

#### **Ireland**

Addition to this point by O Connor, pers.comm.:

1. Influencing policies.
2. Education and awareness.

Unfortunately policy change is likely to be such a slow process that many sensitive sites will be lost. It is impractical to expect sufficient funds to be available to provide the necessary resources to conserve all sites of all sensitive habitats and species (even just those within the Natura 2000 network). Consequently, the best solution may lie in increased education and awareness and reliance on the good-will and civic-responsibility of land-users and other stakeholders. Strategic planning and focussing of available resources is also key.

## 2.6.2 Recommendations

[text to be completed as a result of the consultation process]

## Cases / projects

### **The Netherlands**

Addition to this point by Arts, pers.comm.:

The Netherlands include one of the largest Lobelia dortmanna populations of the North-West Atlantic European lowlands (Nature Reserve The Bergvennen). I suggest here to include the case of The Bergvennen. I am willing to include this later.

## Sites

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

### Summary

The **Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* Habitat type** is comprised of both oligotrophic and mesotrophic waters, and includes intermediate types. While each type supports a characteristic plant community, the range of conditions to be expected in this habitat type is broad. Substrates of oligotrophic to mesotrophic waters include silt, sand, gravel, stones and boulders. Types of lake associated with this habitat are of low to moderate alkalinity and nutrient concentrations.

This habitat type can consist of two vegetation units which can grow in close association or separately:

1. 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
2. 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: *Isoëto-Nanojuncetea* class.

The vegetation community is characterised by amphibious, short, perennial vegetation, with shoreweed *Littorella uniflora* being considered as the defining component. This species often occurs in association with water lobelia, *Lobelia dortmanna*, bog pondweed, *Potamogeton polygonifolius*, quillwort, *Isoetes lacustris*, bulbous rush, *Juncus bulbosus*, needle spike-rush, *Eleocharis acicularis*, alternate water milfoil, *Myriophyllum alterniflorum* and floating water bur-reed, *Sparganium angustifolium*. Yellow water-lily, *Nuphar lutea*, amphibious bistort, *Persicaria amphibia*, stoneworts, *Chara* and *Nitella* spp., least bur-reed, *Sparganium natans*, and other pondweeds, *Potamogeton* spp., may be present in more mesotrophic conditions.

The **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad'. A wide range of threats and pressures are reported including drainage and pollution.

The main reported **threats and pressures** to oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* in the Atlantic Region are:

- Nutrient enrichment: diffuse pollution to surface water and local groundwater due to agriculture (overgrazing and excessive fertilization) and small point sources such as septic tanks (domestic households).
- Angling (fish stocking) and other recreational use.
- Colonisation by invasive, non-native species, e.g. *Crassula helmsii* and non-native fish species e.g. *Umbra pygmea* and *Lepomis gibbosus*.
- Alteration of the hydrological regime: abstraction for potable water supply and agriculture (lowered groundwater tables might influence the habitats resulting in decreased and more

fluctuating water tables), also hydroelectric schemes rely on impoundments and alter the hydromorphology of the water supply.

- Air pollution: acidification.
- Climate change: is considered a major threat to the future condition of this habitat especially in the long term.
- Afforestation: planting of trees on heathland has resulted in increased evaporation and less groundwater flow towards the lakes resulting in a lowering of the water levels, drying out and desiccation.
- Fixing of the banks (using concrete and other materials for stabilization) and other artificial structures, modifications, etc.
- Grazing: the presence of large numbers of geese (for example Canada geese and Greylag Geese) can exert considerable grazing pressure on submerged vegetation and also import nutrients (especially when external food supplies for the geese are plentiful due to nearby agriculture).

The principal **management measures** for this habitat include:

- Restoration of the local hydrology; including a package of potential measures that are dependent on the local situation: preventing or reducing the inflow of nutrients and pollutants (for example by setting up buffer zones and water catchment areas); removing trees and shrubs in the direct surroundings that influence the local hydrology of the habitat; re-creation of (natural) dynamics (for example re-establishing the seasonal variation of the water table).
- Restoration of degraded ponds which can include: removal of organic sediments, a process that is necessary before the isoetid vegetation can re-develop (which takes into account the fauna populations in the habitat); removal of rank vegetation and organic material from the banks.
- Ponds used for fisheries or hunting should be managed extensively; (e.g. no artificial feeding, no introduction of alien or burrowing species, no depletion of the fish stock).
- Cut sods and / or profiling of banks.
- Thin out herbs / mowing.
- Control of exotic invasive species and water birds (limiting accessibility of nearby agricultural pastures in order to prevent dominance of geese).

The most frequently encountered **bottlenecks** in the conservation or restoration of a favourable conservation status are:

- Insufficient funds for habitat restoration.
- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.
- Lack of knowledge about hydrology and groundwater.
- Agricultural policies.
- General environmental standards which are not taking into account the more sensitive receptors such as oligotrophic lakes.
- Climate change policies (pressure to increase the land area under trees).

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Stakeholder engagement and communication; including participative process and influencing policies, education and awareness raising, etc.

- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Maintenance of oligotrophic conditions. Reducing or eliminating nutrient inputs from local terrestrial and aquatic sources is a critical part of an overall approach to reduce or mitigate nutrient impacts.
- Effective control of air quality
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.

## 1 Description of the habitat

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.

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 .

This habitat type could also develop in wet dune slacks (see 16.32 in 2190, included in Annex I). In the Atlantic region, such lakes can shelter glacial relict species, e.g. fish such as *Salvelinus alpinus*. Areas with a variable hydrological system, periodically lacking vegetation due to trampling, should not be included (EC 2007b)

Types of lake associated with this habitat are of low to moderate alkalinity and nutrient concentrations, and support characteristic assemblages of plant species. The vegetation community is characterised by amphibious, short, perennial vegetation, with shoreweed *Littorella uniflora* being considered as the defining component. This species often occurs in association with water lobelia, *Lobelia dortmanna*, bog pondweed, *Potamogeton polygonifolius*, quillwort, *Isoetes lacustris*, bulbous rush, *Juncus bulbosus*, needle spike-rush, *Eleocharis acicularis*, alternate water milfoil, *Myriophyllum alterniflorum* and floating water bur-reed, *Sparganium angustifolium*. Yellow water-lily, *Nuphar lutea*, amphibious bistort, *Persicaria amphibia*, stoneworts, *Chara* and *Nitella* spp., least bur-reed, *Sparganium natans*, and other pondweeds, *Potamogeton* spp., may be present in more mesotrophic conditions. The marginal components of this community can be exposed on the shores of lakes during summer.(UK)

The Habitats Manual lists the following Annex II/IV plant species: *Luronium natans*, *Lindernia procumbens*.

Habitat 3130 is comprised of both oligotrophic and mesotrophic waters, and includes intermediate types. While each type supports a characteristic plant community, the range of conditions to be

expected in this habitat type is broad. Substrates of oligotrophic to mesotrophic waters include silt, sand, gravel, stones and boulders. (Joint Nature Conservation Committee n.d.)

The European Commission has clarified that - depending on the definition of the term 'natural' - this habitat type may be primary or secondary (e.g. ponds) if its occurrences are subject to (semi-)natural development (Bundesamt für Naturschutz n.d.).

## 1.1. Distribution

This habitat type occurs in the majority of EU Member States and is relatively abundant in the more mountainous areas of Europe. In the UK, it is widespread and frequent in the north and west; it also occurs more rarely elsewhere. The majority of the resource is in Scotland, but lakes of this type are also found in England, Northern Ireland and Wales. (Joint Nature Conservation Committee n.d.)

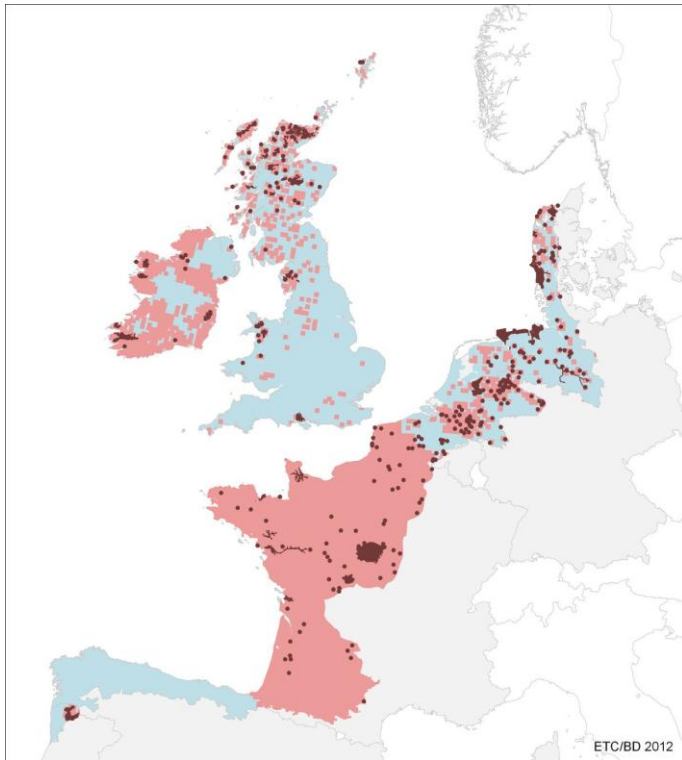
In The Netherlands the habitat is characteristic of the Pleistocene sandy regions in the eastern and southern provinces. (Arts, pers. comm.)

**Table 38 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	31	25	3	68	193	22	34				3	29	76	72	16	10	29	1	5	8	68	
habitat area (ha)	964	203	32	628	4134	2305	3360				5	2838	10065	4601	1914	3955	1558	888	697	2125	25368	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 0-50%<sup>59</sup>. This means that actions should be taken also outside the Natura 2000 network to reach the favourable conservation status for this habitat type.

<sup>59</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 8 Map of SCIs proposed for the Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

## 1.3. Ecological requirements

## 1.4. Main subtypes

PAL.CLASS.: 22.12 x (22.31 and 22.32)

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.

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: Isoëto-Nanojuncetea class.

These two units can grow together in close association or separately. Characteristic plant species are generally small ephemerophytes. (ETC BD 2012)



## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea and provided their conservation status in the Atlantic Member States (see tables below).

**Table 39 Species associated with Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Aeshna viridis 1048	X									
Cottus gobio 1163	X									
Graphoderus bilineatus 1082	X									
Najas flexilis 1833	X									
Anas acuta A054	X									
Anas crecca A052	X									
Anas penelope A050	X									
Anas platyrhynchos A053	X									
Aythya fuligula A061	X									
Bucephala clangula A057	X									
Fulica atra A125	X									
Mergus merganser A070	X									
Podiceps cristatus A005	X									
Sterna hirundo A193	X									
Actitis hypoleucos A168	X									
Cygnus olor A036	X									
Larus canus A182	X									

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Larus ridibundus A179 <sup>60</sup>	X									

**Table 3 Species associated to Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	DK	NL	REGION
1048	<i>Aeshna viridis</i>	Invertebrates	range	U2	U1	U2	U2
			population	U2	U1	U2	U2
			habitat	U1	XX	U1	U1
			future	XX	FV	U1	XX
			overall	U2	U1	U2	U2

N2K code	Species name	Group		DE	FR	NL	REGION
1082	<i>Graphoderus bilineatus</i>	Invertebrates	range	FV	U2	U2	U2
			population	FV	U2	U2	U2
			habitat	FV	U2	U1	U2
			future	XX	U1	U1	U1
			overall	FV	U2	U2	U2

N2K code	Species name	Group		BE	DE	ES	FR	NL	UK	REGION
1163	<i>Cottus gobio</i>	Fish	range	FV	FV	XX	FV	U1	FV	FV
			population	U1	FV	XX	FV	XX	XX	XX
			habitat	U1	FV	XX	XX	U1	XX	XX
			future	FV	FV	XX	FV	FV	XX	XX
			overall	U1	FV	XX	FV	U1	XX	XX

N2K code	Species name	Group		DK	IE	UK	REGION
1833	<i>Najas flexilis</i>	Vascular plants	range	FV	FV	FV	FV
			population	U2	U1	FV	U1
			habitat	XX	U1	U1	U1
			future	U2	FV	FV	FV
			overall	U2	U1	U1	U1

**Wallonia (DGARNE n.d.) (DGARNE n.d.):**

- *Littorella* L.
- *Juncus bulbosus*
- *Eleocharis acicularis*
- *Pilularia* L.
- *Helosciadium inundatum*

<sup>60</sup> Remark on this point by OBN (The Netherlands): "Until recently *Larus ridibundus* was nesting on many H3130 lakes in the Netherlands and Belgium. This was not because it is a characteristic species, but because the species benefitted from nearby garbage belts and the safety provided by the lakes. So it is associated only through human intervention. Suggest to remove it from the list."

- *Hypericum elodes*
- *Potamogeton polygonifolius*
- *Luronium natans*
- *Hydrocotyle* L.
- *Veronica scutellata* L.
- *Ranunculus flammula*
- *Elatine* L.
- *Scirpus* L.
- *Juncus tenageia*
- *Limosella* L.
- *Cyperus fuscus* L.
- *Centaurium pulchellum*
- *Lythrum hyssopifolia*
- *Crassula tillaea*
- *Illecebrum verticillatum* L

### **United Kingdom**

The characteristic plants listed in EU Interpretation Manual are *Littorella uniflora*, *Luronium natans*, *Potamogeton polygonifolius*, *Pilularia globulifera*, *Juncus bulbosus* ssp. *bulbosus*, *Eleocharis acicularis*, *Sparganium natans*. The typical species in oligotrophic to mesotrophic standing waters in the UK are presented in the CSM Guidance (JNCC 2006): *Littorella uniflora*, *Lobelia dortmanna*, *Isoetes lacustris*, *Isoetes echinospora*, *Subularia aquatica*, *Sparganium angustifolium*, *Luronium natans*, *Elatine hexandra*, *Baldellia ranunculoides*, *Potamogeton gramineus*, *Potamogeton perfoliatus*, *Potamogeton alpinus*, *Potamogeton x nitens*, *Potamogeton praelongus*, *Potamogeton rutilus*, *Najas flexilis*, *Pilularia globulifera*, *Utricularia* species and *Nitella* species. (Joint Nature Conservation Committee n.d.)

## **1.6. Related habitats**

## **1.7. Ecological services and benefits**

- several species of dragonflies<sup>61</sup>
- *Coenagrion lunulatum*
- *Ischnura pumilio*
- *Lestes dryas*
- *Epidalea calamita*
- *Alytes obstetricans*

(DGARNE n.d.)

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<sup>61</sup> Remark on this point by OBN (The Netherlands): “The occurrence of dragon flies hardly qualifies as an ecological service.”

- Recreation

(OBN, pers. comm.)

## 1.8. Conservation status

**Table 40 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	FR	IE	NL	PT	UK	REGION
3130	Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>	range	U2	U2	FV	XX	FV	FV	FV	FV	XX
		area	U1	U2	XX	U1	FV	U1	FV	XX	U1
		structure	U2	U2	U2	U2	U2	U1	XX	U1	U2
		future	U2	U1	U2	U1	U2	U1	XX	U1	U1
		overall	U2	U2	U2	U2	U2	U1	XX	U1	U2

This habitat includes two subtypes which can occur separately or together; aquatic and amphibious vegetation with perennial plants such as shore weed (*Littorella uniflora*) and bog pondweed (*Potamogeton polygonifolius*) and amphibious vegetation with annual plants. Wide spread in northern Europe in the Alpine, Atlantic, Boreal, Continental and Pannonic regions, present but rare in the Mediterranean region. Not reported from Spain where similar vegetation has probably been included in habitat type 3110.

Assessed as 'favourable' for the Alpine but unfavourable in all other regions with 'unfavourable-bad' for the Atlantic and Continental regions. In these two regions only Poland has assessed this habitat as 'favourable'. A wide range of threats and pressures are reported including drainage and pollution (Summary sheet of the online report on Article 17 of the Habitats Directive). (ETC BD 2012).

## 1.9. Trends

Lakes are rarely 'lost' in the conventional sense, although small water bodies may be in-filled or drained. However, many lakes have been severely degraded to the extent that they no longer support characteristic plant or animal communities. As a consequence area and range assessments show no significant change over time in spite of nutrient enrichment. Degraded sites are not considered lost because of the way in which lake types are defined. The range of H3130 is considered to have been broadly stable since 1994.

There may have been losses of lakes or ponds, which could have been offset by creation of water bodies on adequate substrate. It is possible that the area of individual lakes in some areas has been reduced through drainage and water abstraction. (Joint Nature Conservation Committee n.d.)

## 1.10 Main pressures and threats

**Table 41 Main pressures to Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>	<i>Aeshna viridis</i>	<i>Graphoderus bilineatus</i>	<i>Cottus gobio</i>	<i>Najas flexilis</i>
Fertilisation	x	x			x
Grazing	x				
Fish and Shellfish Aquaculture	x				
Pollution	x	x	x	x	x
Drainage	x	x		x	
Modification of hydrographic functioning, general	x	x		x	
Biocenotic evolution	x			x	x

**Table 42 Main threats to Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>	<i>Aeshna viridis</i>	<i>Graphoderus bilineatus</i>	<i>Cottus gobio</i>	<i>Najas flexilis</i>
Fertilisation	x	x			x
Grazing	x				
Pollution	x	x	x	x	x
Drainage	x	x		x	
Modification of hydrographic functioning, general	x	x		x	
Biocenotic evolution	x			x	x

The most common reasons for the unfavourable condition of habitat 3130 in the **United Kingdom** are (Joint Nature Conservation Committee n.d.)

- nutrient enrichment: whilst much has been achieved in tackling major point sources of pollution, many sites continue to suffer from nutrient enrichment from diffuse pollution sources, such as agriculture and small point sources such as septic tanks. Fish stocking may also put pressure on lake systems. **Also in the Walloon (Belgium) this is one of the major threats to habitat 3130.**
- colonisation by invasive, non-native species, e.g. *Crassula helmsii*. Presently there is no effective means of controlling this species.
- alteration of hydrological regime. Abstraction for potable water supply may have resulted in either an increase or decrease of extent of individual lakes. Similarly, hydroelectric schemes rely on impoundments and alter the hydromorphology of the water supply lake.

- Air pollution: acidification remains an issue in sensitive areas, where recovery may take 50 to 100 years. Whilst a reduction in SO<sub>x</sub> has been achieved, NO<sub>x</sub> pollution continues and there may be considerable impacts associated with this for oligotrophic, upland waters. Also in the Walloon (Belgium) this is one of the major threats to habitat 3130.
- Climate change: is considered a major threat to the future condition of this habitat especially in the long term.

It should be noted that in the United Kingdom many oligotrophic waters are likely to be in good condition, as a consequence of their distance from populated areas. It is therefore likely that the mesotrophic lakes in the wider countryside of the United Kingdom would be similarly or more at risk. Mesotrophic waters tend to be in more intensive agricultural catchments and closer to centres of population, which results in a greater risk of adverse anthropogenic impacts (Joint Nature Conservation Committee n.d.).

In **Ireland**, the principal threats to oligotrophic to mesotrophic lakes include eutrophication arising from agricultural practices such as overgrazing and excessive fertilisation, as well as afforestation and the introduction of invasive alien species (NPWS 2008).

In Germany, the principal threats to Habitattyp 3130 are the inflow of nutrients and pollutants, groundwater lowering, bank fixation and artificialisation, stabilisation of the sea level, angling and other recreational use (Bundesamt für Naturschutz n.d.).

### **The Netherlands:**

#### **OBN (pers. comm.)**

1. Non-native species: H3110 is vulnerable to introductions of non-native fish species *Umbra pygmaea* and *Lepomis gibbosus*. Both are increasing in the Netherlands and Flanders.
2. Greylag Geese is becoming increasingly abundant on the European mainland (Netherlands, Germany and Belgium). Geese numbers can become high when food supply is large due to nearby agriculture.
3. Afforestation: Planting of trees on heathland has resulted in increased evaporation and less groundwater flow towards the lakes resulting in desiccation.
4. Climate change: Increased deposition in winter results in increased runoff of nitrogen. Whereas increased deposition in summer results in less air exposure of the shore, possibly resulting in P mobilisation and N retention.

#### **Arts (pers. comm.)**

1. HO4.02 Air pollution, especially nitrogen-input. Concentrations of airborne nitrogen (resulting in nitrogen available in pore water and water layer as ammonium or nitrified as nitrate) are a problem in these habitats, because their sediments have a low buffering capacity and airborne nitrogen still exceed critical loads. Extra ammonium input will favour macrophyte species which can easily use ammonium and are fast growers, like

Sphagnum mosses and Juncus bulbosus, and result in other symptoms of acidification (Arts et al., 2002). These competitive species will outcompete the very slowly growing Isoetids, thereby producing high amounts of organic material. Moreover, nitrification of ammonium lowers pH. These changes in habitat are unfavourable to Isoetid macrophyte species (Arts et al., 2002). Critical loads for nitrogen are still exceeded in the Netherlands (Bobbink et al., 1997; 2011). Deposition of sulphate has decreased tremendously. Therefore direct acid deposition has already completely stopped, thereby contributing to a recovery of isoetid populations in The Netherlands.

2. M01.04 pH-changes and M02.01 Habitat shifting. Increase of airborne CO<sub>2</sub> concentrations can favour Myriophyllum and Fontinalis species at the expense of isoetids (Spierenburg et al. 2009). Increased winter precipitation will favour an increased load of nitrogen. Increased summer precipitation will keep the shallow parts of the soft-water lakes submerged, while those habitats normally run dry in summer time. This habitat change can stimulate the mobilization of phosphate and can hamper nitrification processes
3. I01 Invasive non-native species. Crassula helmsii and sediment-disturbing fish like ... can enter these habitats by inflowing streams that are in contact with other surface water (streams and ditches) and the local surface water system.
4. H01.05 and H02.06: diffuse pollution to surface water and local groundwater due to agriculture. In The Netherlands, most habitats are incorporated in nature areas / reserves. Often these areas are surrounded by agricultural land, from which the habitats are often influenced.
5. J02.07.01 Groundwater abstractions for agriculture. Lowered groundwater tables might influence the habitats resulting in decreased and more fluctuating water tables.

## 2 Conservation management

### 2.1. Main conservation requirements

The main conservation requirements for oligotrophic to mesotrophic standing waters of Wallonia are (DGARNE n.d.):

- Buffering zones where any use of fertilizers, pesticides and herbicides is prohibited.
- Logging : limiting the leaching of nutrients
- Ponds used for fisheries or hunting: usage of extensive farming practices (no feeding and no alien or burrowing species)
- Keep seasonal variation of the water table
- Preserving aquatic vegetation by alternating drainage of connected parts of water
- Limited public access
- Restore degraded ponds

Conservation of the Habitat 3130 occurs by preventing or reducing the inflow of nutrients and pollutants (for example by setting up buffer zones and water catchment areas). Extensive angling may be beneficial in some cases for the conservation of the dwarf rush vegetation. (Bundesamt für Naturschutz n.d.)

### The Netherlands:

OBN (pers. comm.)

- Restoration of ponds/lakes that have been lost to land reclamation
- Limiting accessibility of nearby agricultural pastures in order to prevent dominance of geese.

Arts (pers. comm.)

1. Restore the local hydrology. Often this includes a package of measures which is dependent on the local situation, e.g. stop the inflow of nutrient-rich water; remove trees and shrubs in the direct surroundings that influences the local hydrology of the habitat.
2. Removal of organic sediments. Isoetid species are mainly growing on mineral sands. If the original sandy sediment has changed into an organic and sometimes even muddy sediment due to eutrophication and acidification processes, the original sediment first has to be restored before the isoetid vegetation can develop again (Arts et al., 1990a;b). These restoration measures must take into account the fauna populations in the habitat, e.g. by removal of the organic sediments in parts.
3. The inflow of buffered and nutrient-poor surface water or groundwater might be required after removal or dredging of these habitats (see 1 and 2). As the original sediments have a low buffering capacity, this might be necessary, depending on the situation and the atmospheric input of nitrogen (Brouwer et al., 1997; Van Kleef et al., 2010). Alternatively, calciumcarbonate (lime) can be supplied to the catchment of these habitats.
4. Removal of high vegetation and organic material from the banks in order to restore mineral banks and improve conditions for gradients in vegetation from aquatic to semi-aquatic and terrestrial.

## 2.2. Management measures

Relating to the management of habitat 3130 the following two aspects are of importance (Van Uytvanck et al. 2010):

- the re-creation of (natural) dynamics;
- improving the water quality and biotic conditions (substrate / water);

In Flanders, management of oligotrophic to mesotrophic standing waters focus on (Van Uytvanck et al. 2010):

- isolate / restore hydrology



- dredging
- cut sods and / or profiling of banks
- thin out herbs / mowing
- remove trees and shrubs
- liming, letting in of calcium-rich, nutrient poor water
- depletion of the fish stock
- setting up extensive fish farming management
- control of exotic invasive species (and water birds)

### **The Netherlands:**

#### **Arts (pers. comm.)**

1. Restore the local hydrology. Often this includes a package of measures which is dependent on the local situation, e.g. stop the inflow of nutrient-rich water; remove trees and shrubs in the direct surroundings that influences the local hydrology of the habitat.
2. Removal of organic sediments. Isoetid species are mainly growing on mineral sands. If the original sandy sediment has changed into an organic and sometimes even muddy sediment due to eutrophication and acidification processes, the original sediment first has to be restored before the isoetid vegetation can develop again (Arts et al., 1990a;b). These restoration measures must take into account the fauna populations in the habitat, e.g. by removal of the organic sediments in parts.
3. The inflow of buffered and nutrient-poor surface water or groundwater might be required after removal or dredging of these habitats (see 1 and 2). As the original sediments have a low buffering capacity, this might be necessary, depending on the situation and the atmospheric input of nitrogen (Brouwer et al., 1997; Van Kleef et al., 2010). Alternatively, calciumcarbonate (lime) can be supplied to the catchment of these habitats.
4. Removal of high vegetation and organic material from the banks in order to restore mineral banks and improve conditions for gradients in vegetation from aquatic to semi-aquatic and terrestrial.

### **2.3. Other measures (e.g. monitoring)**

### **2.4. Species specific measures**

See for measures also Action Plan for the conservation of the crested newt (*Triturus cristatus*) in Europe:

<https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=1303090&SecMode=1&DocId=1437068&Usage=2>

## 2.5. Main constraints / bottlenecks and actual needs

### **The Netherlands:**

Arts (pers. comm.)

1. Insufficient funds for habitat restoration
2. Lack of knowledge

## 2.6. Solutions and recommendations

### 2.6.1. Solutions

#### **The Netherlands:**

Arts (pers. comm.)

1. Influencing policies
2. Education
3. Communication

### 2.6.2. Recommendation

## Cases / projects

## Sites

## 3150 - Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

### Summary

**The natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* type vegetation habitat are** lakes and ponds with a rather clear water layer in which phosphate concentrations are low in the water layer and moderately high in the sediment. The water is particularly rich in dissolved bases (pH usually > 6.5), with free-floating surface communities of the *Hydrocharition* or, in deep, open waters, with associations of large pondweeds (*Magnopotamion*).

The *Hydrocharition* vegetation-type occurs with watersoldier (*Stratiotes aloides*) or with greater bladderwort (*Utricularia vulgaris*). Watersoldier occurs on the edge of water and land in sheltered, moderately nutrient rich water with a moderately high phosphate content. The vegetation is important as habitat for several species, including the black tern (*Chlidonias niger*) which builds floating nests; the green darner dragonfly (*Aeshna viridis*) which lays its eggs in the Watersoldier; and many kinds of freshwater snails (who live between the dense vegetation in order to find protection from fish predation).

In deeper water aquatic plants with floating leaves (e.g. *Nymphaea alba*) form dense mats of vegetation, accompanied by large-leaved submerged aquatic plants (*Potamogeton lucens*, *P. perfoliatus*, *P. praelongus* and *P. compressus*). These submerged aquatic plants are an indicator of good water quality and provide shelter for fish.

Overall the **conservation status of this habitat type** in the Atlantic region has been assessed as 'unfavourable-bad', mainly due to pollution.

**The main reported threats and pressures** to natural eutrophic lakes in the Atlantic region are:

- Nutrient enrichment (eutrophication) and inflow of pollutants (eg. by sewage discharges).
- Changes in land use in adjacent areas.
- Abstraction of ground and surface water (eg. for agriculture).
- Large scale fluctuations in water levels: water-levels are controlled and fixed for agricultural purposes; high in summer and low in winter.
- Recreation: angling and the associated stocking of lakes with benthic feeding fish.
- Motorized water sports.
- Non-native, invasive species (eg. *Crassula helmsii*, *Myriophyllum aquaticum*, *Elodea canadensis*, *Eichornia crassipes*, *Hydrocotyle ranunculoides*).
- Fixing of the banks (using concrete and other materials for stabilization) and other artificial structures, modifications, etc.
- Grazing: Large congregations of geese can exert considerable grazing pressure on submerged vegetation and also import nutrients. Additionally, geese can cause considerable damage to marginal and emergent fringing vegetation.
- Air pollution.
- Climate change and increasing population growth, resulting in an increased demand for fresh water.

The principal **management measures** for this habitat include:

- Restoration of the local hydrology; preventing or reducing the inflow of nutrients and pollutants (for example by setting up buffer zones and water catchment areas); re-creation of (natural) dynamics (for example re-establishing the seasonal variation of the water table).
- Improve surface water quality and promote limitation of the aquatic ecosystem by phosphate (eg. extent of agricultural, urban and industrial waste water treatment).
- Removal of sediment-disturbing fish.
- Removal of organic material and nutrient-rich sediment.
- Installation of de-phosphoration traps between agricultural areas and nature areas.
- Control of exotic invasive species and water birds (limiting accessibility of nearby agricultural pastures in order to prevent dominance of geese).

The most frequently encountered **bottlenecks** in the conservation or restoration of a favourable conservation status are:

- Insufficient funds.
- Contrary interests by stakeholder groups (farmers, nature managers)
- Lack of knowledge related to restoration
- Insufficient funds for habitat restoration.
- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.
- Lack of knowledge about hydrology and groundwater.
- Agricultural policies.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Stakeholder engagement and communication; including participative process and influencing policies, education and awareness raising, etc.
- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Reducing or eliminating nutrient inputs from local terrestrial and aquatic sources is a critical part of an overall approach to reduce or mitigate nutrient impacts.
- Effective control of air quality
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.
- More research.
- More funding.

## 1 Description of the habitat

Lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters<sup>62</sup>, 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*) (EC 2007b).<sup>63</sup>

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<sup>62</sup> Remark on this point by Arts (The Netherlands): “Lakes and ponds with mostly dirty grey to blue-green, more or less turbid, waters”: this might be the current situation for many of these waters, but is however not the

The European Commission has clarified that - depending on the definition of the term 'natural' - this habitat type may be primary or secondary (e.g. ponds) if its occurrences are subject to (semi-)natural development (Bundesamt für Naturschutz n.d.).

## 1.1. Distribution

According to the ETC/BDestimation the percentage of the habitat area in the network falls into the class 76-100 %. This means that Natura 2000 network provides an important framework for the management of this habitat type.

Habitat 3150 is common in lowland regions of Wallonia but has widespread due to eutrophication of surface waters (DGARNE n.d.)

**Table 43 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012) (for legend, see introduction of chapter 3)**

	BE		DE		DK		ES				FR				IE	NL		PT		UK	
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	22	33		131	1108	36	120	9	35	1	162	10	130	73	18	11	16	1		21	16
habitat area (ha)	959	347		6649	47359	8306	21681	729	4157	103	33891	1521	26924	13728	4049	19674	5357	888		6489	5260

most optimal situation but a degraded one. For the nutrient status of this habitat, distinction has to be made in the nutrient status of the sediment and the nutrient status of the water layer. The phosphate concentrations of the water layer in this habitat are below 1 µmol P per liter, while the sediment might be rich in phosphate. The low phosphate concentrations in the water layer might be the consequence of use and growth by *Stratiotes* and *Potamogeton* species. Therefore I suggest the following text:

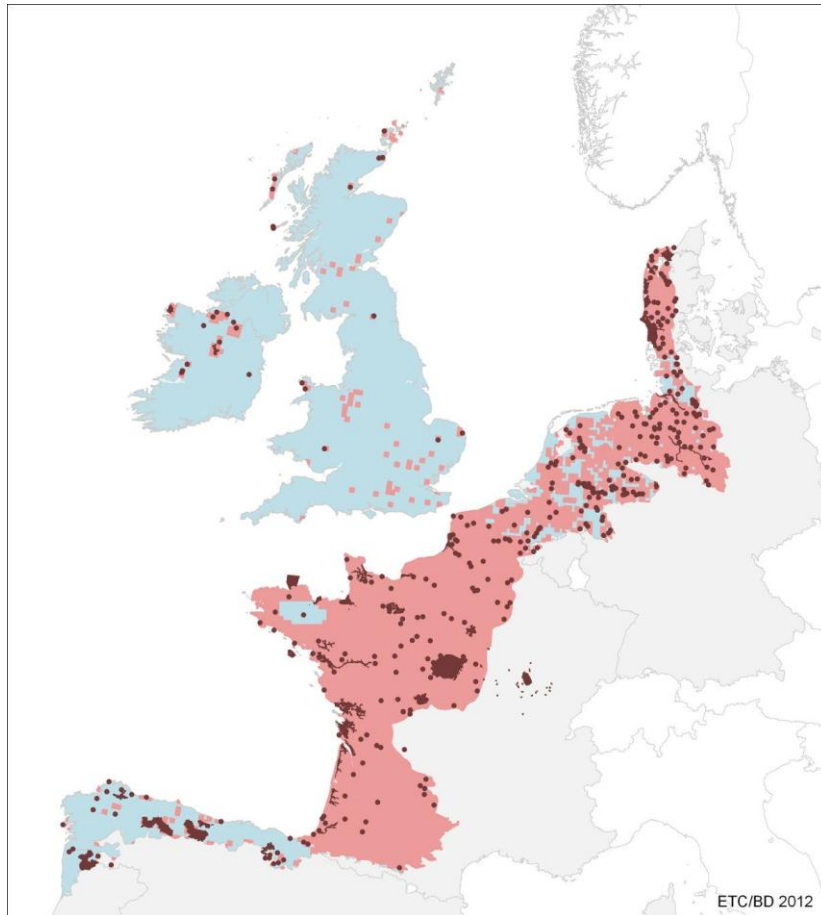
“Lakes with a rather clear water layer in which phosphate concentrations are low in the water layer and moderately high in the sediment.”

<sup>63</sup> Remark on this point by Schipper (The Netherlands): *The provided description is insufficient and has to be replaced fully.* “Lakes and ponds with more or less clear waters, particularly rich in dissolved bases (pH usually > 6,5), with free-floating surface communities of the *Hydrocharition* or, in deep, open waters, with associations of large pondweeds (*Magnopotamion*) (EC 2007b). The *Hydrocharition* vegetation-type occurs with watersoldier (*Stratiotes aloides*) or with greater bladderwort (*Utricularia vulgaris*). Watersoldier occurs on the edge of water and land in sheltered, moderately food rich water with a moderately phosphate content. The vegetation is important as habitat of several species, including the black tern (*Chlidonias niger*) building floating nests; Green Darner (*Aeshna viridis*); putting her eggs in Watersoldier and many kinds of fresh-water snails (who live between the dense vegetation to find protection against fish).

In deeper water aquatic plants with floating leaves (e.g *Nymphaea alba*) form dense vegetations, accompanied by big-leaved submerged aquatic plants (*Potamogeton lucens*, *Potamogeton perfoliatus*, *Potamogeton praelongus* and *Potamogeton compressus*). These submerged aquatic plants are an expression of good water quality and provide shelter for fish.

The Netherlands has internationally a central place concerning the *Hydrocharition* (both *Hydrocharition*-types of vegetation) because of their vastness and because their representative species composition.”

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>64</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).



**Figure 9 Map of SCIs proposed for Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

## 1.3. Ecological requirements

## 1.4. Main subtypes

<sup>64</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation and provided their conservation status in the Atlantic Member States (see tables below).

**Table 44 Species associated with Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Bufo calamita 1202	x									
Anisus vorticulus 4056										
Emys orbicularis 1220										
Graphoderus bilineatus 1082										
Leucorrhinia albifrons 1038										
Leucorrhinia pectoralis 1042										
Oxygastra curtisii 1041										
Rhodeus amarus 1134										
Stylurus flavipes 1040										
Triturus cristatus 1166										
Triturus marmoratus 1174										
Acrocephalus schoenobaenus A295										
Anas acuta A054										
Anas clypeata A056										
Anas crecca A052										
Anas penelope A050										
Anas platyrhynchos A053										
Anas strepera A051										
Anser anser A043										
Aythya ferina A059										
Aythya fuligula A061										
Aythya marila A062										

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Botaurus stellaris A021										
Calidris alpina A149										
Charadrius hiaticula A137										
Circus aeruginosus A081										
Circus cyaneus A082										
Circus pygargus A084										
Cygnus cygnus A038										
Fulica atra A125										
Gallinago gallinago A153										
Larus melanocephalus A176										
Mergus merganser A070										
Pandion haliaetus A094										
Philomachus pugnax A151										
Podiceps cristatus A005										
Porzana porzana A119										
Sterna albifrons A195										
Sterna hirundo A193										
Tachybaptus ruficollis A004										
Tadorna tadorna A048										
Tringa glareola A161										
Tringa nebularia A164										
Tringa totanus A162										
Vanellus vanellus A142										
Acrocephalus arundinaceus A298										
Acrocephalus scirpaceus A297										
Anas querquedula A055										
Ardea cinerea A028										
Ardea purpurea A209										
Ardeola ralloides A024										



SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Aythya nyroca A060										
Charadrius dubius A136										
Chlidonias niger A197										
Cygnus olor A036										
Egretta garzetta A072										
Emberiza schoeniclus A381										
Himantopus himantopus A131										
Ixobrychus minutus A022										
Larus argentatus A184										
Larus ridibundus A179										
Limosa limosa A156										
Locustella luscinioides A292										
Locustella naevia A290										
Mergus albellus A068										
Netta rufina A058										
Nycticorax nycticorax A023										
Phalacrocorax carbo sinensis A391										
Podiceps grisegena A006										
Podiceps nigricollis A008										
Porzana parva A120										
Rallus aquaticus A118										
Tringa erythropus A166										
Tringa ochropus A165										

**Table 45 Species associated to Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	FR	NL	REGION
1038	<i>Leucorhina albifrons</i>	Invertebrates	range	XX	FV	U2	FV
			population	XX	U1	U2	U1
			habitat	XX	U2	U2	U2

			future	XX	U1	U2	U1
			overall	XX	U2	U2	U2

N2K code	Species name	Group		BE	DE	FR	NL	REGION
1040	<i>Stylurus flavipes</i>	Invertebrates	range	FV	FV	FV	FV	FV
			population	U1	FV	FV	XX	XX
			habitat	U1	FV	FV	FV	FV
			future	FV	FV	FV	FV	FV
			overall	U1	FV	FV	FV	FV

N2K code	Species name	Group		ES	FR	PT	REGION
1041	<i>Oxygastra curtisii</i>	Invertebrates	range	XX	U1	XX	U1
			population	XX	U1	XX	U1
			habitat	XX	U1	XX	U1
			future	XX	U1	XX	U1
			overall	XX	U1	XX	U1

N2K code	Species name	Group		BE	DE	FR	NL	REGION
1042	<i>Leucorrhinia pectoralis</i>	Invertebrates	range	U2	U2	U2	U2	U2
			population	U2	U2	U2	U2	U2
			habitat	XX	U2	U2	U1	U2
			future	U1	U1	U2	U1	U1
			overall	U2	U2	U2	U2	U2

N2K code	Species name	Group		DE	FR	NL	REGION
1082	<i>Graphoderus bilineatus</i>	Invertebrates	range	FV	U2	U2	U2
			population	FV	U2	U2	U2
			habitat	FV	U2	U1	U2
			future	XX	U1	U1	U1
			overall	FV	U2	U2	U2

N2K code	Species name	Group		BE	DE	FR	NL	REGION
1134	<i>Rhodeus sericeus amarus</i>	Fish	range	FV	XX	FV	FV	XX
			population	FV	U1	FV	XX	XX
			habitat	FV	U1	XX	FV	U1
			future	FV	FV	FV	U1	U1
			overall	FV	U1	FV	U1	U1

N2K code	Species name	Group		BE	DE	DK	FR	NL	UK	REGION
1166	<i>Triturus cristatus</i>	Amphibians	range	U2	U1	FV	U1	U1	FV	U1
			population	U2	U1	XX	U1	U1	U1	U1
			habitat	XX	U1	XX	XX	U1	XX	XX
			future	U2	FV	XX	U1	U1	FV	U1
			overall	U2	U1	XX	U1	U1	U1	U1

N2K code	Species name	Group		ES	FR	PT	REGION
1174	<i>Triturus marmoratus</i>	Amphibians	range	XX	U2	FV	U2
			population	XX	U1	FV	U1
			habitat	XX	XX	FV	XX
			future	XX	U1	FV	U1
			overall	XX	U2	FV	U2

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION	
1202	<i>Bufo calamita</i>	Amphibians	range	FV	FV	FV	XX	U2	U2	FV	FV	U1	U2	
			population	FV	U1	U2	XX	U2	U2	U2	XX	U2	U2	
			habitat	XX	U1	U2	XX	U2	U1	U1	U1	U1	U1	U2
			future	FV	U1	U1	XX	U2	U1	U1	FV	FV	U2	
			overall	FV	U1	U2	XX	U2	U2	U2	U1	U2	U2	

N2K code	Species name	Group		ES	FR	PT	REGION
1220	<i>Emys orbicularis</i>	Reptiles	range	XX	U2	XX	U2
			population	XX	U2	XX	U2
			habitat	XX	U2	U1	U2
			future	XX	XX	U1	XX
			overall	XX	U2	U1	U2

N2K code	Species name	Group		BE	DE	FR	NL	UK	REGION
4056	<i>Anisus vorticulus</i>	Molluscs	range	XX	U2	U2	XX	FV	XX
			population	XX	U2	U2	U1	U1	U1
			habitat	XX	FV	U2	U1	U1	U1
			future	XX	U2	U2	U1	U1	U1
			overall	XX	U2	U2	U1	U1	U1

The Habitats Manual lists the following Annex II/IV plant species: *Aldrovanda vesiculosa* (ETC BD 2012).

## 1.6. Related habitats

## 1.7. Ecological services and benefits

## 1.8. Conservation status

**Table 46 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	UK	REGION
3150	Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> - type vegetation	range	U1	FV	FV	XX	FV	XX	U1	FV	FV
		area	U1	U1	FV	XX	XX	XX	U1	XX	XX
		structure	U2	U2	U2	XX	U2	XX	U1	U2	U2
		future	U1	U1	U2	XX	U1	U2	U1	U2	U1
		overall	U2	U2	U2	XX	U2	U2	U1	U2	U2

These are lakes which are naturally rich in nutrients, especially the sediment, and with many floating aquatic plants, this habitat is found in all biogeographical regions. Lakes which become eutrophic because of pollution are not included in this habitat type.

Although reported as 'favourable' in Italy (all three regions), Portugal (Mediterranean) and Alpine Sweden this habitat is assessed as unfavourable or unknown by most countries and for all regions, with 'unfavourable-bad' in the Atlantic and Continental regions. 'Structure & functions' and 'future prospects' are assessed as unfavourable (or unknown) in all regions.

The pressures and threats reported include changes in water quality due to pollution and it seems unlikely that Italian lakes have escaped the pollution found elsewhere in Europe. Better information required (Summary sheet of the online report on Article 17 of the Habitats Directive). (ETC BD 2012).

## 1.9. Trends

### 1.10 Main pressures and threats

**Table 47 Main pressures to Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation and their importance to associated species (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> - type vegetation	<i>Leucorrhinia albifrons</i>	<i>Stylurus flavipes</i>	<i>Oxygastra curtisii</i>
Cultivation	x			x
Use of pesticides	x			x
Fertilisation	x			x
Grazing	x			
Outdoor sports and leisure activities	x			
Pollution	x	x	x	x
Landfill, land reclamation and drying out, general	x	x		
Drainage	x	x		
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution	x	x	x	

Pressure description (2nd level)	<i>Leucorrhinia pectoralis</i>	<i>Graphoderus bilineatus</i>	<i>Rhodeus amarus</i>	<i>sericeus</i>	<i>Triturus cristatus</i>
Cultivation					x
Use of pesticides					x
Fertilisation	x				x
Grazing					
Outdoor sports and leisure activities					
Pollution	x	x	x		x
Landfill, land reclamation and drying out, general	x		x		x
Drainage	x		x		x
Modification of hydrographic functioning, general	x		x		x
Biocenotic evolution	x		x		x

Pressure description (2nd level)	<i>Triturus marmoratus</i>	<i>Bufo calamita</i>	<i>Emys orbicularis</i>	<i>Anisus vorticulus</i>
Cultivation	x	x	x	
Use of pesticides	x			x
Fertilisation				
Grazing		x		
Outdoor sports and leisure activities				
Pollution	x	x	x	x
Landfill, land reclamation and drying out, general	x	x	x	x
Drainage	x	x	x	
Modification of hydrographic functioning, general		x	x	
Biocenotic evolution	x	x		x

Table 48 Main threats to Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)

Threat description (2nd level)	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	<i>Leucorrhinia albifrons</i>	<i>Stylurus flavipes</i>	<i>Oxygastra curtisii</i>
Cultivation	x			x
Use of pesticides	x			x
Fertilisation	x			x
Urbanised areas, human habitation	x			
Pollution	x	x	x	x
Drainage	x	x		
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution	x	x	x	

Threat description (2nd level)	<i>Leucorrhinia pectoralis</i>	<i>Graphoderus bilineatus</i>	<i>Rhodeus sericeus amarus</i>	<i>Triturus cristatus</i>
Cultivation				x
Use of pesticides				x

Fertilisation	x			x
Urbanised areas, human habitation			x	x
Pollution	x	x	x	x
Drainage	x		x	
Modification of hydrographic functioning, general	x		x	x
Biocenotic evolution	x		x	

Threat description (2nd level)	<i>Triturus marmoratus</i>	<i>Bufo calamita</i>	<i>Emys orbicularis</i>	<i>Anisus vorticolus</i>
Cultivation	x	x	x	
Use of pesticides	x			
Fertilisation				
Urbanised areas, human habitation	x	x	x	
Pollution	x	x	x	x
Drainage	x	x	x	
Modification of hydrographic functioning, general		x	x	
Biocenotic evolution	x	x		x

Many of the factors affecting this habitat type are common to other standing water types in the UK and across Europe as a whole. The pressures may operate at the catchment level and hence largely be related to land use and management practices or be ‘in-lake’ pressures such as fish stocking and invasive plant species. The following overview indicates the key factors, highlighting particular issues for 3150 where appropriate (Joint Nature Conservation Committee n.d.):

- Pollution: Nutrient enrichment is the major factor affecting lakes in the UK with evidence that over 80% of lakes in England are affected (Carvalho and Moss 1995).
- Land use: Some areas of lowland heath are subject to land use activities other than agriculture (military uses, recreation) which cause erosion of sandy soils leading to the sedimentation issues.
- Hydrological Pressures: The location of many lakes of this type coincides with high population density and intensive arable land use. Consequently there is generally a high anthropogenic demand on already scarce water resources. Abstractions from ground and surface water can lead to reduced flushing rates and changes in water level fluctuations in some lakes.
- Recreation Pressures: The major recreational pressure affecting this habitat type is angling and the associated stocking of many lakes with benthic feeding fish, particularly carp.
- Non-native species: H3150 is particularly vulnerable to invasions by Australian swamp stonecrop (*Crassula helmsii*) and parrot’s feather (*Myriophyllum aquaticum*) are able to rapidly colonise and change the ecology of small standing water habitats.
- Grazing: The presence of large numbers of feral geese is a localised issue which may be significant where it occurs. Large congregations of geese (usually Canada geese *Branta canadensis*) can exert considerable grazing pressure on submerged vegetation and also import nutrients when feeding elsewhere. Additionally, geese can cause considerable damage to marginal and emergent fringing vegetation.
- Air pollution: this habitat is potentially sensitive to air pollution. Acidification arising from atmospheric deposition is unlikely to a major issue for H3150 as there is generally good buffering capacity within catchment soils.

- Climate change is considered a major threat to the future condition of this habitat especially in the long term. Global climate change and increasing population growth within the south-east of the UK are factors which are likely to increase in importance in the short –medium term and together these factors may have serious implications for the hydrological integrity of H3150 lakes. Increased demand for water (and for opportunities for recreation) in the south east may directly impact upon these lakes many of which are close to large urban areas.

Threats to Walloon (**Belgium**) natural eutrophic lakes are (D GARNE n.d.):

- construction of dikes
- removing
  - the vegetation in embedment
  - water until the embedment is dry
- lack of maintenance
- eutrophication of water
- invasive exotic species

In **Ireland**, the main threat to this lake type is nutrient enrichment (NPWS 2008).

Threats to this habitat in **Portugal** include (ALFA 2004):

- Invasive (plant) species;
- Changes in land use impact on water quality;
- Eutrophication of aquatic environments due to anthropogenic activities;
- Invasion of allochthonous flora (eg *Myriophyllum aquaticum*, *Elodea canadensis*, *Eichornia crassipes*).

In **Germany**, the principal threats to Habitattyp 3150 is the additional inflow of nutrients and pollutants (for example by sewage discharges), groundwater lowering, bank fixation and artificialisation, intensive angling, boat traffic and other recreational use. Very small water bodies (such as kettle holes) can also be a threatened by backfilling (Bundesamt für Naturschutz n.d.)

#### **The Netherlands:**

Arts (pers. comm.)

1. J02.07.01 Groundwater abstractions for agriculture.
2. H02.06 Diffuse groundwater pollution due to agriculture.
3. H01.05 Diffuse pollution to surface waters due to agricultural activities
4. I01 Invasive non-native species

Because of lowered groundwater tables, the influx of Iron-rich, relatively nutrient-poor and bicarbonate-poor groundwater has decreased tremendously. In order to compensate for this water

shortage in dry summer seasons, surface water – especially river water – is being supplied. This type of water is poor in Iron, however rich in nutrients, bicarbonate and sulphate. By direct eutrophication and internal eutrophication, phosphate becomes available in pore water and in the water layer of the habitat, causing a shift from submerged macrophytes to floating Duckweed layers and algae blooms (Roelofs, 1991; Smoldes et al., 1996; Smolders et al., 2003). Invasive crayfish species are invasive species that can have a tremendous impact on the aquatic vegetation. Also native species, like sediment-disturbing fish might disturb the sediment and cause less stabilized sediments which are not a good substrate for rooted submerged aquatic macrophytes and by causing floating sediment particles which decrease water clarity. (The Netherlands, Arts, pers. comm.)

Schipper (pers. comm.)

1. Altered water-quality due anthropogenic changes in salinity Water of the rivers Rhine and Meuse is used to supply the deficit of water in summer. This water fresh but has a high salinity.
2. diffuse pollution to surface waters due to agricultural and forestry activities Not only the diffuse pollution is a problem, but also the Phosphorus and Nitrogen stock in the sediments.
3. large scale water deviation In the low-lying areas of the Netherlands water-levels are controlled and fixed for agricultural purposes; high in summer and low in winter.
4. motorized nautical sports, (not necessarily jet skiing). The sediments in water-bodies often exist in the form of a very fine mud. Boats cause turbid water and therefore bad water-quality. The nautical recreation also disturbs breeding birds with nests on the edge of water and land.
5. invasive non-native species Introduced aquatic plants (*Hydrocotyle ranunculoides*) and crayfish can dominate and therefore create species poor water-bodies.

The first three threats are interconnected. The low water-levels in winter create a shortage of water in summer. Many lakes occur in relatively high lying bog-peat areas, drained by adjacent polders. Water from the rivers Rhine and Meuse is used to supply the artificial deficits. This water has a high content of Sulphur, that can induce the release of phosphorus from sediments. Clear meso-eutrophic water turns into gray water with a high content of algae. The submerged aquatic plants disappear at first and at the end only floating aquatic plants remain on sheltered places. The fish community changes, floor-dwelling species like bream, dominate. Their activities also influence the water quality in a negative way. These changes cause also the loss of natural heterogeneity, and provide opportunities for invasive species. (The Netherlands, Schipper, pers. comm.)

## 2 Conservation management

### 2.1. Main conservation requirements



Below the main conservation requirements are given for H3150 in Wallonia (D GARNE n.d.):

- Water quality
  - Amendments:
    - zones where fertilizers and pesticides are prohibited
  - Limit sedimentation
    - By having vegetation with permanent cover along water
- Ponds
  - Use of extensive fish farming practices
    - No feeding
    - No burrowing species
    - No exotic species
    - Limiting dry period during harvest
- Recreative areas
  - Limited access
    - Avoid trampling and disturbance
- Restoration of degraded ponds and sometimes redeveloped

In Germany, conservation of the Habitat 3150 occurs by preventing or reducing the inflow of nutrients and pollutants. Extensive angling (no feeding, no stocking) is possible in many water bodies. Intensive boat traffic should be avoided, as this riparian zones are damaged (Bundesamt für Naturschutz n.d.).

#### **The Netherlands:**

Arts (pers. comm.)

1. Restore the hydrology and restore groundwater influxes
2. Improve surface water quality and promote limitation of the aquatic ecosystem by phosphate;
3. Removal of organic material;
4. Isolation of areas with vulnerable habitats;
5. Removal of sediment-disturbing fish;

The most important management measure is to restore the hydrology. However, this is often not realistic, as the habitats are surrounded by agricultural land and hydrologically and physically isolated from these. Therefore, restoration of groundwater influxes is the most important restoration measure, however practically often not feasible. As compensation, water and nature managers supply surface water. In order to improve the water quality of this water, inlet water is being supplied via a long route, thereby using the self-purification capacity of the water systems and their inhabiting macrophytes. During this long route, the nutrient load is decreased, however sulphate and bicarbonate are not. Therefore, the macrochemical composition of the water is still different from groundwater. Nevertheless, improvements have been made by applying these

measures. Therefore, Hydrocharition and Magnopotamion habitats have shown increased occurrences. Removal of organic material has been applied as a measure in a number of situations. By dredging or removal of the organic material, nutrients and sulphide-compounds are removed from the habitats. However, this management was not successful under all circumstances, as macrophyte vegetation did not develop always. (The Netherlands, Arts, pers. comm.)

Schipper (pers. comm.)

1. Restoring the hydrological regime by using as much groundwater as possible, and water from small rivulets.
2. The water regime of nature area's should be disconnected from agricultural area's and water levels should follow the natural course: high in winter, low in summer.
3. Exclude areas from nautical recreation
4. Provide habitat differentiation; temporary water, peat formation, shallow water and deep water-bodies.

The majority of the Dutch lakes are not of natural origin but artificial; peat digging and wind erosion has formed most of the older lakes, recent sea defence works gave rise to the bigger lakes as the IJsselmeer. The lakes vary from very small to enormous. Often the lakes, especially in the peat-bog areas, are connected by canals to the surrounding arable land. The hydrology of these areas has completely changed and cannot be restored to a natural state. Management of the hydrology in order to improve water quality is essential, but can only be done in a semi-cultural context. (The Netherlands, pers. comm.)

## 2.2. Management measures

Following management practices are applied in the UK to protect / restore natural eutrophic lakes ((Joint Nature Conservation Committee n.d.):

- Water Framework Directive: adds considerable impetus for widespread action on issues affecting the resource of this habitat such as abstraction licences and pollution. Considerable progress has been made in reducing the contribution of large waste water treatment works to nutrient loading but diffuse sources and the cumulative effect of small discharges continue to cause problems for many sites. Tackling these remaining nutrient sources will require a shift in land management practices and the regulatory regimes for small point sources. Measures currently being developed to deliver the WFD in the UK will have some benefit for H3150 but the net benefit of these measures may depend upon how widely there are applied outside of the very limited WFD 'water body' network.

UK BAP: The habitat is covered by the *Standing open waters and canals action plan* under the UK Biodiversity Action Plan (see <http://www.ukbap.org.uk>), as well as under country and local

biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource.

Management measures in **Portugal** focus on (ALFA 2004):

- Control of exotic weeds;
- Control the dumping of untreated effluents;
- Increase the quality and extent of agricultural wastewater treatment, urban and industrial;
- Promotion of propagation and habitat enhancement projects in construction;
- Restricting the effect of land use changes on water quality in adjacent habitat areas;
- Promotion of scientific studies on the habitat.

### **The Netherlands:**

#### **Arts (pers. comm.)**

1. Improve surface water quality and promote limitation of the aquatic ecosystem by phosphate; In fact this measure is a surrogate for the restoration of the hydrology.
2. Removal of sediment-disturbing fish; This measure decreases the availability of nutrients in the water layer and improves water quality and water clarity. This contributes to a habitat development and improvement.
3. Removal of organic material; This measure decreases the availability of nutrients in the water layer and improves water quality and water clarity. This contributes to habitat development and improvement.

#### **Schipper (pers. comm.)**

1. Installation of de-phosphoration traps between agricultural area's and nature area's
2. By lengthening of water-supply routes the water is purified in a natural way. Partially hydrological isolation of water-bodies provides gradients in water quality
3. Remove the abundance of bream and other floor-dwelling fish
4. Removal of the recently formed nutrient-rich sediments. In peat-bog areas this management measure is not always successful, due to the presence of older phosphorus-rich peat layers.

## **2.3. Other measures (e.g. monitoring)**

## 2.4. Species specific measures

## 2.5. Main constraints / bottlenecks and actual needs

### The Netherlands:

#### Arts (pers. comm.)

1. Insufficient funds.
2. Contrary interests by stakeholder groups (farmers, nature managers).
3. Lack of knowledge related to restoration. The restoration of this habitat is still a topic of research.

## 2.6. Solutions and recommendations

### 2.6.1. Solutions

#### The Netherlands:

#### Arts (pers. comm.)

1. More research is needed.
2. More funding is needed.

### 2.6.2. Recommendations

## Cases / projects

## Sites

## 3260 - Water courses of plain to montane levels with the *Ranunculus fluitans* and Callitricho-Batrachion vegetation

### Summary

**Water courses of plain to montane levels are characterised by** the abundance of water-crowfoots *Ranunculus* spp., subgenus *Batrachium* (*Ranunculus fluitans*, *R. penicillatus* ssp. *penicillatus*, *R. penicillatus* ssp. *pseudofluitans*, and *R. peltatus* and its hybrids). Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals.

Functional aspects determine the heterogeneity of this habitat type. Five different types can be distinguished:

1. Fast running rivulets in hilly areas
2. Slow running rivulets in low lying areas
3. Fast running rivers in mountainous areas
4. Slow running rivers and disconnected meanders in low lying areas
5. Rivers in delta's

Overall the **conservation status of this habitat type** in the Atlantic region has been assessed as 'unfavourable-bad'.

The main reported **threats and pressures** to water courses in the Atlantic region are:

- Diffuse pollution (including organic pollution, eutrophication, siltation, acidification, and other forms of toxic pollution (industrial discharges, sheep dip and other agrochemicals). Pollution may arise from atmospheric sources, consented effluents, catchment land uses (particularly agriculture), or small point sources such as septic tanks.
- Extensive physical modification, including channel widening, channel deepening, channel straightening, major upland impoundments and the construction of in-channel structures that impound flows, enhance siltation and prevent movement of species.
- Non-native species (e.g. *Impatiens glandulifera*, *Fallopia japonica*)
- Water abstraction (either direct from the river habitat or from groundwaters supplying them) for agriculture, public water supply and industry.
- Dikes, bank fixation and flooding defence in inland water systems. The floodplains are reduced to a fraction of the original floodplains. Therefore natural sedimentation and erosion processes are nearly absent.
- Sand and gravel extraction: creation of very deep artificial lakes.
- Management of aquatic and bank vegetation for drainage purposes, these activities also often result in damaging dredging and the associated removal of limnic sediments.
- Electricity production (hydropower).
- Cooling water.
- Shipping.
- Intensive recreational use.

The principal **management measures** for this habitat include:

- Excavation: broadening the bed or bevel off the bank.
- Habitat sensitive dredging /thinning out of herb species.
- Restoration of the level regime and flow.
- Preventing eutrophication.
- Local habitat (restoration) measures (re-meandering parts of rivulets, etc).
- Control of exotic invasive species.
- Rewetting of infiltration areas.
- Reversing the effects of hydropower barriers.

The most frequently encountered **bottlenecks** in the conservation or restoration of a favourable conservation status are:

- Insufficient knowledge about the ecology and biogeography of fresh water communities included in this habitat in order to develop adequate management measures. There is therefore a need to increase research in this field.
- Insufficient funds for habitat restoration/management measures.
- Lack of any mechanism for enabling definition and management of local hydrology for nature conservation purposes (and lack of knowledge about hydrology and groundwater).
- Agricultural policies.
- Stakeholder awareness and a lack of integrated land use and management planning (e.g. in relation to hydroelectric power generation issues, spatial planning, etc).

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Stakeholder engagement and communication; including participative process and influencing policies, education and awareness raising, etc.
- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Targeting funds at restoration management.
- An increase research.

## 1 Description of the habitat

Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculon fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses.

This habitat is sometimes associated with *Butomus umbellatus* bank communities. It is important to take this point into account in the process of site selection. (EC 2007a).

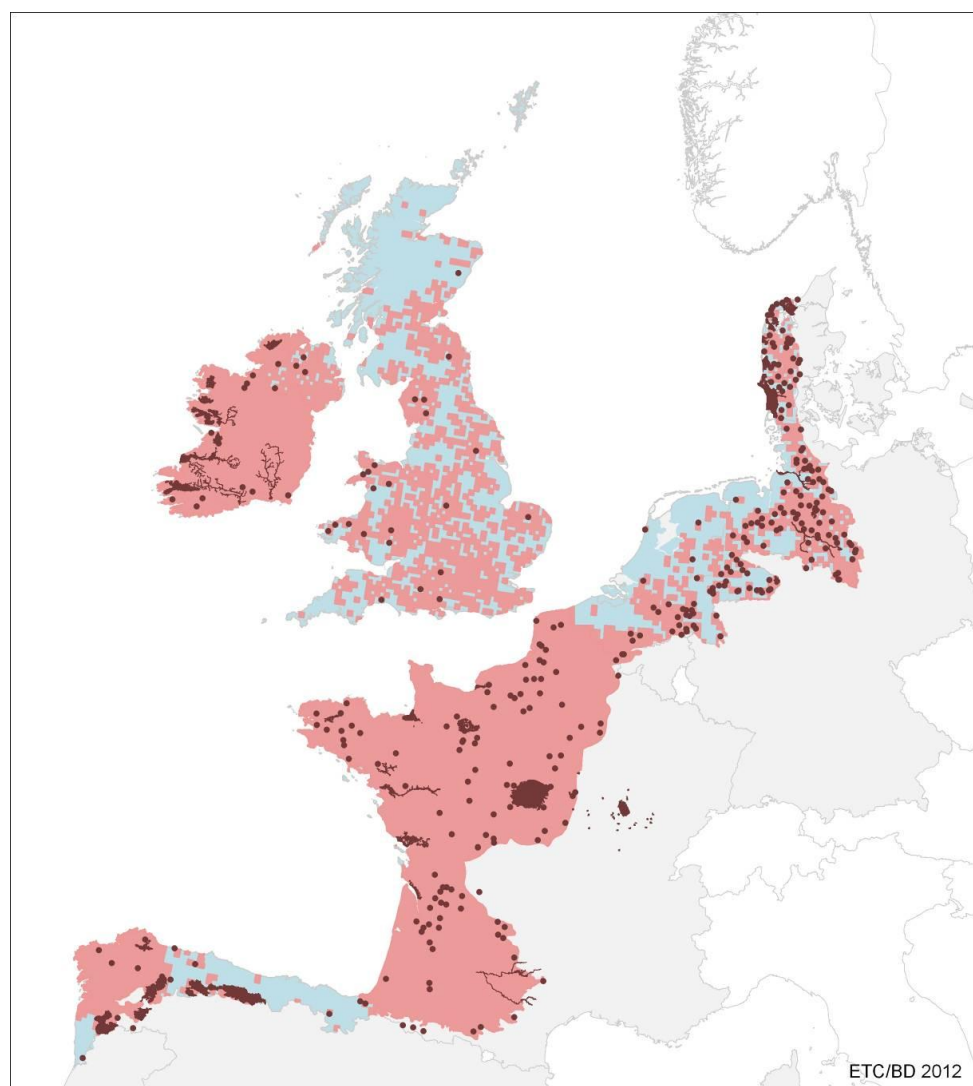
This habitat type is characterised by the abundance of water-crowfoots *Ranunculus* spp., subgenus *Batrachium* (*Ranunculus fluitans*, *R. penicillatus* ssp. *penicillatus*, *R. penicillatus* ssp. *pseudofluitans*, and *R. peltatus* and its hybrids). Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals. (Joint Nature Conservation Committee n.d.)

## 1.1. Distribution

**Table 49 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	IMAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	IMAC	MED	ATL	
number of sites	7	54	6	110	1241	44	78	6	23		106	8	119	145	25	21	10	2		29	28	
habitat area (ha)	136	625	25	2689	16654	3281	7947	93	4630		30839	1039	20496	9921	3294	4436	300	914		8131	2935	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 50-75%<sup>65</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).



<sup>65</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

Figure 10 Map of SCIs proposed for the Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)

## 1.2. Main features

## 1.3. Ecological requirements

## 1.4. Main subtypes

Functional aspect determine the heterogeneity of this habitattype. Five different types can be distinguished (The Netherlands, Schipper (pers. comm.):

1. Fast running rivulets in hilly areas
2. Slow running rivulets in low lying areas
3. Fast running rivers in mountainous areas
4. Slow running rivers and disconnected meanders in low lying areas
5. Rivers in delta's

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and provided their conservation status in the Atlantic Member States (see tables below).

**Table 50 Species associated to Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	DK	ES	FR	IE	PT	UK	REGION
1029	<i>Margaritifera margaritifera</i>	Molluscs	range	U2	XX	XX	U2	FV	U2	U1	XX
			population	U2	XX	XX	U2	U2	U2	U2	U2
			habitat	U2	XX	XX	U2	U2	U2	U2	U2
			future	FV	U2	XX	U2	U2	U2	U2	U2
			overall	U2	U2	XX	U2	U2	U2	U2	U2

N2K	Species	Group		BE	DE	FR	REGION
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code	name						
1032	<i>Unio crassus</i>	Molluscs	range	XX	U2	U2	U2
			population	XX	U2	U2	U2
			habitat	XX	U2	U2	U2
			future	XX	U2	U1	U2
			overall	XX	U2	U2	U2

N2K code	Species name	Group		DE	DK	FR	NL	REGION
1037	<i>Ophiogomphus cecilia</i>	Invertebrates	range	FV	FV	FV	U2	FV
			population	U1	FV	FV	U2	U1
			habitat	FV	FV	FV	U1	FV
			future	FV	FV	FV	U1	FV
			overall	U1	FV	FV	U2	U1

N2K code	Species name	Group		DE	ES	FR	UK	REGION
1044	<i>Coenagrion mercuriale</i>	Invertebrates	range	U1	XX	U2	FV	U2
			population	U1	XX	U2	U1	U2
			habitat	U1	XX	U2	U1	U2
			future	XX	XX	U2	FV	U2
			overall	U1	XX	U2	U1	U2

N2K code	Species name	Group		ES	FR	IE	UK	REGION
1092	<i>Austropotamobius pallipes</i>	Invertebrates	range	U2	U2	U1	U2	U2
			population	U2	U2	U1	U2	U2
			habitat	U2	U2	U1	U1	U2
			future	U2	U2	U1	U2	U2
			overall	U2	U2	U1	U2	U2

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	NL	UK	REGION
1096	<i>Lampetra planeri</i>	Fish	range	U2	FV	FV	XX	FV	FV	U2	FV	FV
			population	U1	U1	FV	XX	FV	FV	U2	XX	U1
			habitat	U2	FV	FV	XX	XX	FV	U2	U1	XX
			future	U1	FV	FV	XX	XX	FV	U1	FV	XX
			overall	U2	U1	FV	XX	XX	FV	U2	U1	U1

N2K code	Species name	Group		BE	DE	DK	FR	IE	NL	UK	REGION
1099	<i>Lampetra fluviatilis</i>	Fish	range	U2	FV	XX	U2	FV	FV	FV	FV
			population	U2	FV	XX	XX	FV	FV	XX	U1
			habitat	U1	U1	XX	U1	FV	U1	U1	U1
			future	FV	FV	XX	U1	FV	FV	U1	FV
			overall	U2	U1	XX	U2	FV	U1	U1	U1

N2K code	Species name	Group		DE	FR	IE	PT	UK	REGION
1102	<i>Alosa alosa</i>	Fish	range	XX	U1	FV	FV	XX	XX

			population	U2	U2	XX	U2	U2	U2
			habitat	XX	U1	XX	U2	U1	XX
			future	U2	U1	XX	U1	U1	XX
			overall	U2	U2	XX	U2	U2	U2

N2K code	Species name	Group		BE	DE	FR	IE	NL	PT	UK	REGION
1103	<i>Alosa fallax</i>	Fish	range	U2	FV	U1	FV	FV	FV	XX	U1
			population	U2	U1	U1	U2	U2	XX	XX	U2
			habitat	U2	U1	U1	XX	U2	U2	U1	U1
			future	U2	FV	U1	U1	U1	U1	U1	U1
			overall	U2	U1	U1	U2	U2	U2	U1	U2

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1106	<i>Salmo salar</i>	Fish	range	U2	U1	U2	XX	U2	FV	FV	FV	FV	FV
			population	U2	U2	U2	XX	U2	U2	U2	U2	U1	U2
			habitat	U1	U1	U2	XX	U2	U1	U1	U2	U1	U1
			future	FV	XX	XX	XX	U1	U1	U1	U2	U1	U1
			overall	U2	U2	U2	XX	U2	U2	U2	U2	U1	U2

N2K code	Species name	Group		BE	DE	DK	FR	NL	REGION
1145	<i>Misgurnus fossilis</i>	Fish	range	U2	U1	XX	U2	XX	XX
			population	U2	U1	XX	U2	XX	XX
			habitat	U2	XX	XX	U2	U1	XX
			future	U1	FV	XX	U2	U1	U1
			overall	U2	U1	XX	U2	U1	U1

N2K code	Species name	Group		BE	DE	ES	FR	NL	UK	REGION
1149	<i>Cobitis taenia</i>	Fish	range	FV	FV	XX	FV	FV	FV	FV
			population	U1	FV	XX	FV	XX	XX	XX
			habitat	U1	U1	XX	XX	FV	XX	U1
			future	FV	FV	XX	XX	FV	FV	FV
			overall	U1	U1	XX	XX	FV	XX	U1

N2K code	Species name	Group		BE	DE	ES	FR	NL	UK	REGION
1163	<i>Cottus gobio</i>	Fish	range	FV	FV	XX	FV	U1	FV	FV
			population	U1	FV	XX	FV	XX	XX	XX
			habitat	U1	FV	XX	XX	U1	XX	XX
			future	FV	FV	XX	FV	FV	XX	XX
			overall	U1	FV	XX	FV	U1	XX	XX

N2K code	Species name	Group		DE	FR	NL	REGION
1193	<i>Bombina variegata</i>	Amphibians	range	U2	U2	U2	U2
			population	U2	U2	U2	U2
			habitat	U1	FV	U2	FV
			future	U2	U2	U2	U2

			overall	U2	U2	U2	U2
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N2K code	Species name	Group		BE	DE	FR	NL	REGION
1337	<i>Castor fiber</i>	Mammals	range	FV	U1	FV	U1	U1
			population	U1	U1	FV	U1	U1
			habitat	XX	U1	FV	FV	U1
			future	U2	FV	FV	FV	FV
			overall	U2	U1	FV	U1	U1

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	PT	UK	REGION
1355	<i>Lutra lutra</i>	Mammals	range	U2	U1	FV	XX	FV	FV	FV	FV	FV
			population	U2	U1	FV	XX	FV	U1	XX	FV	U1
			habitat	U2	U1	FV	XX	FV	FV	FV	XX	XX
			future	U2	U1	FV	XX	FV	FV	FV	FV	FV
			overall	U2	U1	FV	XX	FV	U1	FV	FV	U1

N2K code	Species name	Group		BE	DE	DK	ES	FR	NL	UK	REGION
1831	<i>Luronium natans</i>	Vascular plants	range	FV	U1	FV	XX	U1	U1	XX	U1
			population	U2	U2	U1	XX	U1	U1	U1	U1
			habitat	U2	U2	U1	XX	U1	U1	U1	U1
			future	U2	U1	U1	XX	U1	U1	U1	U1
			overall	U2	U2	U1	XX	U1	U1	U1	U1

## 1.6. Related habitats

## 1.7. Ecological services and benefits

## 1.8. Conservation status

Table 51 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
3260	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation	range	U2	FV	FV	XX	XX	FV	U1	FV	FV	XX
		area	U2	U2	FV	XX	XX	FV	U1	U1	U1	XX
		structure	U2	U2	U1	XX	XX	U2	U1	U1	U2	U2
		future	U2	U1	U1	XX	U1	U2	U1	U1	U2	U2
		overall	U2	U2	U1	XX	U1	U2	U1	U1	U2	U2

Rivers of temperate and northern Europe with floating vegetation often dominated by water crowfoot (*Ranunculus* spp) and other aquatic plants including mosses. The habitat is very wide spread throughout Europe, although rare to the south.

Assessed as 'unfavourable-inadequate' in the Alpine and Continental regions, 'unfavourable-bad' in the Atlantic, Boreal and Pannonic regions while in the Mediterranean region it is 'unknown but not favourable'. Only in the Alpine regions of Finland and Sweden and in Greece is the habitat reported as 'favourable'. The former is probably a result of the low human impact in these areas while in Greece the habitat is naturally rare.

Reported threats and pressures mostly relate to human impact including modification of rivers (often related to navigation) and pollution.

Many countries (EU25) reported one or more parameters as unknown and better information is required, particularly from Austria, Luxembourg and Spain (Summary sheet of the online report on Article 17 of the Habitats Directive). (ETC BD 2012).

## 1.9. Trends

### 1.10 Main pressures and threats

**Table 52 Main pressures to Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation	<i>Margaritifera margaritifera</i>	<i>Unio crassus</i>	<i>Ophiogomphus cecilia</i>
Fertilisation	x	x	x	x
Pollution	x	x	x	x
Drainage	x	x	x	
Canalisation	x	x		x
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution	x			

Pressure description (2nd level)	<i>Coenagrion mercuriale</i>	<i>Austropotamobius pallipes</i>	<i>Lampetra planeri</i>	<i>Lampetra fluviatilis</i>	<i>Alosa alosa</i>
Fertilisation	x				
Pollution	x	x	x	x	x
Drainage	x	x	x	x	
Canalisation	x	x	x	x	
Modification of hydrographic functioning, general	x	x	x	x	x
Biocenotic evolution	x	x	x		x

Pressure description (2nd level)	<i>Alosa fallax</i>	<i>Salmo salar</i>	<i>Misgurnus fossilis</i>	<i>Cobitis taenia</i>

Fertilisation			x	
Pollution	x	x	x	x
Drainage		x	x	x
Canalisation		x	x	
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution	x	x	x	x

Pressure description (2nd level)	<i>Cottus gobio</i>	<i>Bombina variegata</i>	<i>Castor fiber</i>	<i>Lutra lutra</i>	<i>Luronium natans</i>
Fertilisation					x
Pollution	x			x	x
Drainage	x	x		x	x
Canalisation	x			x	
Modification of hydrographic functioning, general	x	x		x	x
Biocenotic evolution	x	x			x

**Table 53 Main threats to Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation	<i>Margaritifera margaritifera</i>	<i>Unio crassus</i>	<i>Ophiogomphus cecilia</i>
Fertilisation	x	x	x	x
Pollution	x	x	x	x
Drainage	x	x	x	
Canalisation	x	x		x
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution	x			

Threat description (2nd level)	<i>Coenagrion mercuriale</i>	<i>Austropotamobius pallipes</i>	<i>Lampetra planeri</i>	<i>Lampetra fluviatilis</i>	<i>Alosa alosa</i>
Fertilisation	x				
Pollution	x	x	x	x	x
Drainage	x		x	x	
Canalisation	x	x	x	x	
Modification of hydrographic functioning, general	x	x	x	x	x
Biocenotic evolution	x	x	x		x

Threat description (2nd level)	<i>Alosa fallax</i>	<i>Salmo salar</i>	<i>Misgurnus fossilis</i>	<i>Cobitis taenia</i>
Fertilisation			x	
Pollution	x	x	x	x
Drainage		x	x	x
Canalisation		x	x	
Modification of hydrographic functioning, general	x	x	x	x
Biocenotic evolution		x	x	x

Threat description (2nd level)	<i>Cottus gobio</i>	<i>Bombina variegata</i>	<i>Castor fiber</i>	<i>Lutra lutra</i>	<i>Luronium natans</i>
Fertilisation					x
Pollution	x			x	x
Drainage	x	x		x	x
Canalisation	x		x	x	
Modification of hydrographic functioning, general	x			x	x



Threats to **Walloon** water courses of plain to montane levels are (DGARNE n.d.):

- rectification of the riverbanks, dredging of sediment, deletion of meanders,...
- changes in hydraulic regime
- changes to physico-chemical quality of the water

The main pressures affecting H3260 in the **United Kingdom** are listed below (Joint Nature Conservation Committee n.d.):

- Pollution (including organic pollution, eutrophication, siltation, acidification, and other forms of toxic pollution (industrial discharges, sheep dip and other agrochemicals). Pollution may arise from atmospheric sources, consented effluents, catchment land uses (particularly agriculture), or small point sources such as septic tanks.
- Hydrological interventions: These include major upland impoundments, which have flooded the Annex 1 habitat and severely affected the hydrological and thermal regime of the habitat downstream, and abstractions (either direct from the river habitat or from groundwaters supplying them) that intensify ecological stress at times of natural low flows. Headwater impoundment is widespread in upland catchments, whilst abstraction stress is significant across most of lowland England.
- Physical interventions: The Annex I habitat resource has been subject to extensive physical modification, including channel widening, channel deepening, channel straightening, and the construction of in-channel structures that impound flows, enhance siltation and prevent movement of species. Overall, there has been a widespread loss of habitat niches for characteristic flora and fauna, involving loss of characteristic diversity in current velocities, water depth and substrates, direct loss of coarse substrates through dredging, loss of riparian hydrological transition zone and loss of floodplain connectivity.
- Biological interventions : A considerable proportion of the Annex I habitat is affected by non-native species. Himalayan balsam (*Impatiens glandulifera*) and Japanese knotweed (*Fallopia japonica*) are widespread along many river corridors falling under the Annex I habitat definition. Various species of non-native crayfish (but particularly signal crayfish) have overrun the calcareous component of the habitat type, having a devastating effect on the native white-clawed crayfish (itself an Annex II species) as well as serious consequences for the wider food web. Fish stocking is an issue on many rivers falling under the habitat definition, most notably in relation to brown and rainbow trout stocking into salmonid and rheophilic cyprinid fisheries.

In **Ireland**, there is little evidence of a significant decline in the primary pressures of eutrophication, overgrazing, excessive fertilisation, afforestation and the introduction of invasive alien species (NPWS 2008).

Main threats for the Habitattype 3260 in Germany are the construction of dams, bank fixation and artificialisation, artificialisation of the bank bottom, rectification of rivers, electricity production (hydropower) and the inflow of nutrients and pollutants. Other threats include water extraction, the cooling water, shipping, angling and intensive recreational use (Bundesamt für Naturschutz n.d.).

## The Netherlands:

### Arts (pers. comm.)

1. J02.03.02 Canalisation
2. H02.05 Diffuse surface water pollution
3. H02.06 Diffuse groundwater pollution

Morphologically intact streams are the most important pre-requisite for this habitat. If streams are not morphologically intact, water hydrology and currency might vary tremendously. Very high peaks are considered as important for the deterioration of this habitat. These very high water peaks combined with a less optimum sediment and rooting substrate for the macrophytes (e.g. loose detritus) might flush the stream and the macrophytes. Besides, water quality is hypothesized to play a role. However, further research is needed as this habitat is very rare in The Netherlands and very little is quantitatively known. (The Netherlands, Arts, pers. comm.)

## The Netherlands:

### Schipper (pers. comm.)

1. **Diffuse pollution to surface waters due to agricultural and forestry activities.** Catchment area's of small rivulets are in use for agricultural purposes. Especially the cultivation of intensive mown grassland and maize cause pollution, not only fertilisers but also by increasing alkalinity
2. **Large scale water deviation.** All rivers and nearly all rivulets are changed by channel deepening, straitening and lengthening. Especially the upper courses of the rivulets are recently lengthened and connected to new made ditches. Water is drained away very quickly for the infiltration area's, causing increasing flooding of the middle- and lower courses, also in summer.
3. **Groundwater abstractions for agriculture, public water supply and industry.** The summoned effects of these abstractions is often unknown, but is very likely that permanent wells and sources dry out in summer, sometimes in the whole catchment area of a rivulet. Upper courses can dry out in summer.
4. **Dykes and flooding defence in inland water systems.** All rivers are regulated by flooding defence systems and dykes. The floodplains are reduced to a fraction of the original floodplains, the discharge of rivers is manipulated and water-levels are influenced. Therefore natural sedimentation and erosion processes are nearly absent.
5. **Sand and gravel extraction.** Concentrated, large scale, extraction of sand and gravel along the rivers (especially Meuse and IJssel) has created very deep artificial lakes and therefore changed the hydraulic conditions in these sections.



6. **Management of aquatic and bank vegetation for drainage purposes, these activities also cause dredging/ removal of limnic sediments.** In order to ensure drainage in summer the aquatic vegetation is removed regular in a mechanical way. These activities also cause removal of limnic sediments, and prevent sedimentation. As result the natural heterogeneity of a rivulet is reduced.

## 2 Conservation management

Increase in water depth as a result of for example the damming water and the construction of dams or levees downstream.

Reduction of the water depth, and disturbance by runoff period increased emergence as a result, eg, deposition of sediment, reduced flow rate (water uptake for various uses), damming water through the construction of dams or levees upstream , etc..

Eutrophication of water;

### 2.1. Main conservation requirements

The main conservation requirements for logging practices in alluvial forest of Wallonia are (D GARNE n.d.):

- Preservation of natural water dynamics
- Preservation of the physico-chemical quality of the waters

Similar to the Walloon Region, in Germany, the following conservation requirements are pointed out (Bundesamt für Naturschutz n.d.):

- Preservation of natural water dynamics
- Preventing or reducing the inflow of nutrients and pollutants in the whole water catchment area
- In many cases, dismantling of the bed or bank stabilization or accumulation sections is required

The entire river complex should be protected and should, where possible, including large parts of the water catchment area.

#### **The Netherlands:**

Arts (pers. comm.)

1. Restore stream morphology
2. Restore stream hydrology

### Schipper (pers. comm.)

1. Establish buffer zones
2. Delay the discharge of water in upper courses, but stagnation of water should be avoided.
3. Preserve water in the catchment area's in order to restore local groundwater systems
4. Reconnect parts of the original floodplains
5. Fill the deep artificial lakes with sediment

## 2.2. Management measures

In Flanders (**Belgium**), management of water courses of plain to montane levels focus on (Van Uytvanck et al. 2010):

- Excavation: broadening the bed or bevel off the bank;
- Dredging / thin out herbs;
- remove trees and shrubs;
- restore the level regime and flow;
- prevent eutrophication;
- local habitat (restoration) measures;
- control of exotic invasive species.

In **Portugal**, management guidelines for this habitat focus on (ALFA 2004):

- Control the release of untreated effluents;
- Increase the quality and extent of agricultural wastewater treatment, urban and industrial;
- Restricting land use changes resulting in changes in water quality in areas adjacent to the habitat;
- Conditioning the reduction in flow rates;
- Conditioning water works;
- Conditioning water abstraction;
- Conditioning drainage;

### The Netherlands:

#### Schipper (pers. comm.)

1. re-meandering parts of rivulets
2. Rewetting of infiltration area's by filling ditches, especially forests, or transforming forests into heath-land in order to reduce the evaporation of the vegetation

## 2.3. Other measures (e.g. monitoring)

In **Portugal** (ALFA 2004) it is recognized that there is insufficient knowledge about the ecology and biogeography of fresh water communities included in this habitat in order to develop adequate management measures. There is therefore a need to increase research in this field.

## 2.4. Species specific measures

## 2.5. Main constraints / bottlenecks and actual needs

### **The Netherlands:**

Arts (pers. comm.)

1. Lack of knowledge

## 2.6. Solutions and recommendations

### **The Netherlands:**

Arts (pers. comm.)

1. More research needed into the deterioration and restoration of this habitat

## Cases / projects

## Sites

## 4010 - Northern Atlantic wet heaths with *Erica tetralix*

### Summary

**Wet heaths** are ericoid plant communities that occur on acidic, nutrient-poor soils, such as shallow **oligotrophic** peats (<0.5m), **peaty mineral soils [Sherry]** and sandy soils with impeded drainage. The soils that support these communities are typically waterlogged for at least part of the year and can be found in a variety of circumstances. For example in Belgium and the Netherlands wet heath is often situated in continental dunes within local depressions whilst in the UK it often occupies areas of impeded drainage on lower valley sides and less steeply-sloping ground. It's often found as a transitional community between dry heath and blanket mire within complex habitat mosaics. The degree of waterlogging is crucial in the formation and maintenance of this community.

**Wet heaths are characterised by** dwarf shrub species. Significant geographical variation in the composition and abundance of these species is observed across its biogeographical range. The community most often includes mixtures of *Erica tetralix* (cross-leaved heath), *Trichophorum cespitosus* (deer grass), *Calluna vulgaris* (heather) and *Molinia caerulea* (purple moor-grass), and in some cases an under-storey of mosses, often consisting of *Sphagnum* species (bog mosses). Other species, such as *Erica cinerea* (bell heather), *Racomitrium lanuginosum* (woolly fringe-moss), *Ulex minor* (dwarf gorse) and *Erica scoparia* can become frequent.

Although wet heath is a naturally occurring community, increasing human influence over the last 6000 years, in the form of grazing, burning and cutting, has removed the woodland component of the heathland mosaic and led to the development of the now characteristic open habitat of the modern era. Variation in the character of these communities is not only the product of past management history but also fundamentally controlled by local hydrological conditions and soil trophic status.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad' for all parameters except 'range'. No country has assessed this habitat as 'favourable' and this pattern extends beyond the Atlantic Region to the Boreal and Continental regions. The main threats and pressures responsible for its poor conservation status are mostly linked to inappropriate management or to habitat destruction, as is the case in Spain.

**The main reported threats and pressures** to wet heaths in the Atlantic Region are:

- Overgrazing resulting in the loss of dwarf shrubs, which are replaced by species more resistant to grazing; usually leading to an expansion of grassland habitats.
- Undergrazing leading to a degenerate phase where the dwarf shrubs become increasingly 'leggy' with gaps forming in the canopy that can allow invasion by other species and eventual succession to woodland.
- Uncontrolled Burning at an inappropriate frequency (too little or too much) leading to the loss of more sensitive bryophyte species and, at high intensities, causing significant peat erosion as well as the loss of dwarf shrub species.

- Artificial Drainage which lowers the water table, leading to the loss of species that require a high soil moisture content and the local extinction of this community.
- Nitrogen Deposition which favours more competitive grass species, such as *Molinia*, causing fundamental change in plant community composition.
- Afforestation which reduces the area of open habitat, leading to a loss of soil moisture and an increase in the predation rates of ground-nesting birds.
- Fragmentation increases patch isolation leading to the ecological extinction of remaining patches through inbreeding and a loss of recolonisation potential.
- Invasive Species such as *Pteridium aquilinum* and *Molinia caerulea* can become dominant through inappropriate management leading to the loss of wet heath communities.
- Recreation activities such as hiking and mountain-biking can lead to significant erosion problems and a loss of wet heath vegetation.
- Renewable Power Generation infrastructure associated with inshore wind farms and small-scale hydroelectric schemes cause significant hydrological disruption and loss of habitat.
- Artificial Fertilizers used on adjacent land leads to pollution of groundwater and an increase in dominant grass species.

The principal **management measures** for this habitat include:

- Grazing - prevents successional change and stops tree species from colonising heathland areas.
- Burning - stimulates the new growth of grasses and/or heather for agriculture, game rearing and wildlife conservation. Although an important conservation tool, it is not generally recommended as suitable for wet heath management in either the UK or France.
- Cutting - also prevents successional change and stops tree species from colonising heathland areas; however, can have a similar impact to burning and when heavy machinery is used can also cause serious compaction and erosion problems.
- Scrub Removal - is essential on wet heaths where grazing or regular cutting has failed to prevent the establishment of tree species. It should be used as part of a phased restoration programme where future management ensures that any recolonisation is ideally controlled through a sustainable grazing management system.
- Sod Cutting - is a traditional technique that can be used as a means to maintain conditions for pioneer vegetation that exploits early successional stages within the wet heath mosaics. Most importantly it can also be used to restore degraded.
- Restoration - is undertaken on degraded heaths and requires the removal or reduction of the factor(s) that led to the original degradation. Specific actions are determined by the circumstances of the individual sites but generally this will frequently involve hydrological restoration, removal of accumulated nutrients, re-introduction of plant species and the reinstatement of a suitable grazing regime.
- Spatial Planning - linked to the planting of new woodlands and forests/location of renewable energy sites/etc should be integrated with the needs of wet heath species and should ensure that areas of existing wet heath, outside Natura sites are not planted all built on, and that barriers to movement are not created at a landscape scale.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Landowners are not willing to adopt extensive management systems;
- Lack of knowledge related to local and regional eco-hydrological conditions;
- Lack of knowledge of habitat requirements and life histories of characteristic species to be able to determine the timing and effectiveness of measures;
- Value of habitat is not recognised by land managers or policy makers;
- Limited financial support to encourage appropriate management;
- Poor implementation of legislation and/or cross-compliance measures – reluctance to deal with difficult issues and take action;
- Lack of suitable policy frameworks to tackle cross-sectoral issues; and
- Insufficient funding to tackle diffuse pollution or to implement buffer zones.

**Solutions** to the pressures, threats and bottlenecks may include:

- Financial support schemes that encourage extensive, mixed grazing systems as well as the development and marketing of niche products;
- Purchase of land to improve management, establish buffer strips and restore habitat at strategic locations;
- Raising awareness of wet heath as a distinct habitat with its own characteristics and management requirements;
- Develop and implement specific management prescriptions; and
- Develop and implement specific measures within agri-environment schemes and ensure sufficient funding to encourage uptake (and meet demand).

## 1 Description of the habitat

Humid, peaty or semi-peaty heaths, other than blanket bogs, of the Atlantic and sub-Atlantic domains (EC 2007b).

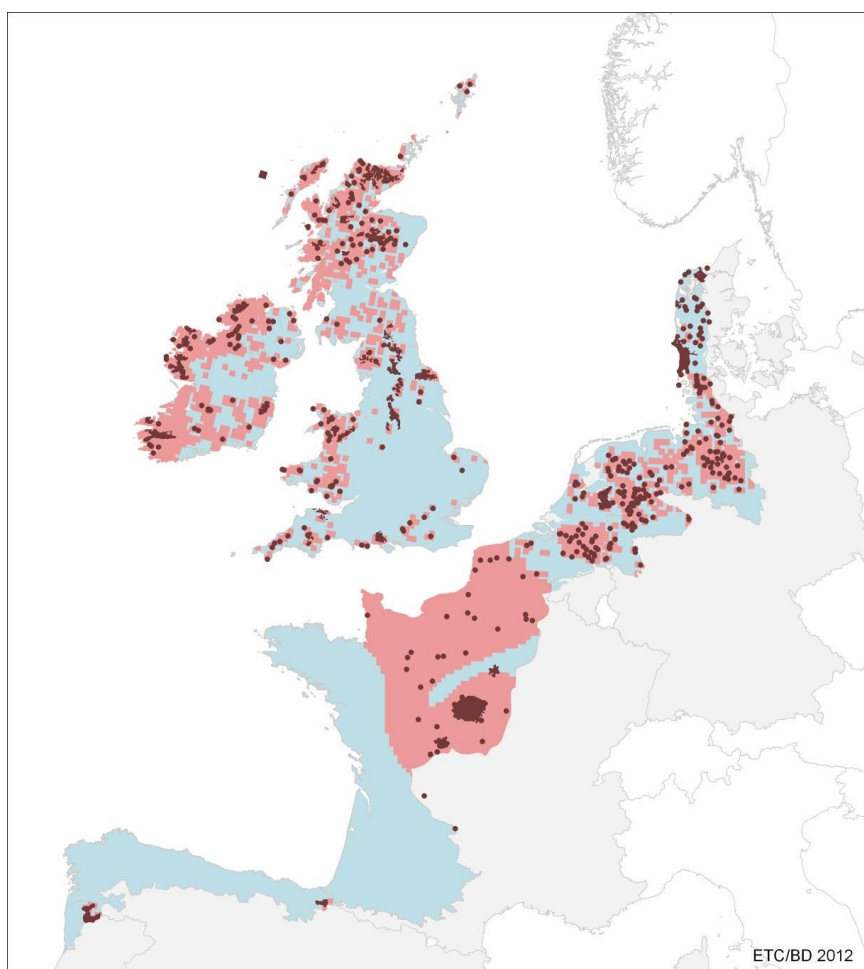
### 1.1. Distribution

**Table 54 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	24	43		110	54	31	29		1				37	19		45	52	1		2	135	
habitat area (ha)	1592	1985		1358	188	2734	2390		248				8469	580		40943	5172	888		888	103428	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 0-50%<sup>66</sup>. This means that actions should be taken also outside the Natura 2000 network to reach the favourable conservation status for this habitat type.

North Atlantic wet heath is restricted in its distribution to the Atlantic fringe between Scandinavia and Normandy. The majority of the wet heath resource in the EU is in the UK and Ireland (85%) and it spans upland (up to 600m) and lowland altitudes (below 300m). In the UK wet heath is usually found in the wetter climates of the north and west, and in Sweden it is restricted to regions in south-western parts of the country with similar climate conditions.



**Figure 11 Map of SCIs proposed for the Northern Atlantic wet heaths with *Erica tetralix* & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

North Atlantic wet heath is dominated by dwarf shrub species and usually occurs on acidic, nutrient-poor substrates, such as shallow peats (<0.5m) or sandy soils with impeded drainage. The

<sup>66</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

community includes mixtures of *Erica tetralix* (cross-leaved heath), *Trichophorum cespitosus* (deer grass), *Calluna vulgaris* (heather) and *Molinia caerulea* (purple moor-grass), and in some cases an under-storey of mosses, often including carpets of *Sphagnum* species (bog mosses) (JNCC 2008a, HC 2008).

Wet heath is a naturally occurring community, having been formed over millions of years, due, in part, to the interactions of abiotic factors such as climate and soil conditions, competition between species, and possibly also as a consequence of grazing from large herbivores (Tubbs 2001, Luxmoore & Fenton 2005 in Hampton 2008). Its present occurrence and variability is however related to human activities and much of the current extent of wet heath, particularly in the lowland, is anthropogenic in origin. [Sherry] In the eastern (pleistocene) part of the Netherlands wet heaths occur mainly on sites of former (reclaimed) raised bogs (Van Beek 2009). [Bijlsma]

The open heathland complex found across Europe is due to agricultural practices such as domestic grazing, burning and cutting, which began to be developed around 6000 years ago. These practices arrested succession to woodland once the areas were cleared. Without traditional forms of management some areas would no doubt have succeeded to scrub and then back to open woodland. However, the reduction of soil nutrient levels through removal of any former canopy, coupled with leaching of nutrients in areas of high rainfall means that many areas may no longer support significant tree growth. This situation does not occur in the Netherlands where all wet heaths are very prone to invasion by birch and Scots pine, enforced by nitrogen deposition. [Bijlsma]

In the UK, large areas of wet heath are found in western and northern Britain, although fragmented areas can be found in the south and east (Rodwell 1991 in Hampton 2008). It is defined by >25% cover of ericoid dwarf shrubs in wet situations and where peat depth does not exceed 0.5 m. It is often found as a transitional community within a mosaic of dry heath and blanket mire (Backshall et al. 2001 in Hampton 2008).

Details of interpretation may differ between countries; for example for Sweden, the borders are set at maximum 30% of shrubs and trees and a peat depth not exceeding 0.3m (Naturvårdsverket 1997 in Hampton 2008). In Flanders (Belgium), a maximum of 5% tree and shrub cover is required for good conservation status; and 5-30% tree and shrub cover is considered to be of moderate conservation status. In all situations, peat depth does not exceed 0.2m.

### 1.3. Ecological requirements

Wet heath is a community of acid, nutrient poor soils that are at least seasonally water logged; drainage and peat cutting have extended its range on to once deeper and wetter peat (Rodwell 1991 in Hampton 2008). Wet heath often occupies areas of impeded drainage on lower valley sides and less steeply-sloping ground. Clearly drainage is a key factor, and wet heaths can develop when there are layers of clay within sandy strata or when iron oxide is deposited in the B-horizons of podsoles to form impermeable iron-pans.



In the north of Belgium and the Netherlands,<sup>67</sup> wet heath is often situated in continental dunes within local depressions. These depressions are the result of former erosion by wind, and are often found where the water table is a ground level (then erosion stops). Under these conditions it is not necessary that an impermeable layer is present, although (when old enough) a podsol with iron-pan may have developed. **On cover sands and corresponding drift sands in northwestern Europe stagnating soil layers consist of amorphous humus, iron pans, till (ground moraine) or loam. Inland dunes with 'blown-over' soils sometimes provide local ground water even to an extent that bog development occurs (e.g. Veluwe site). [Bijlsma]**

Wet heath can occur naturally, due to abiotic factors such as the soil acidity ( $\text{pH} \leq 4.5$ ), low nutrient status and waterlogged soil conditions, with succession to woodland being potentially arrested by these factors (Gimingham 1992 in Hampton 2008). However, grazing, cutting and burning remain key requirements for the maintenance of wet heath within a wider heathland complex.

The habitat is restricted to the oceanic and sub-oceanic climates in the north of the Northern Atlantic region, below the alpine zone. These areas have relatively high rainfall (generally between 60 to 110 cm per year) and more importantly, an even spread of rainfall throughout the year, with a high number of rain days (typically above 115 per year - if a 'rain day' is defined as one in which there is at least 1 mm).

Relative humidity remains moderately high, even in the driest months. The proximity of the Atlantic Ocean (including the Gulf Stream influence) also has a buffering effect on temperatures, preventing winters from becoming very cold and summers from becoming very hot. Mild winter temperatures are undoubtedly important for many of the individual plant and animal species that characterise heaths in the south-west of England and in western Ireland (Gimingham 1972 in Hampton 2008).

## 1.4. Main subtypes

For the UK, key subtypes identified are based on the UK National Vegetation Classification for Mires and Heaths (Rodwell 1991 in Hampton 2008). These represent the Northern Atlantic wet heaths with *Erica tetralix* as described by habitat account for priority habitats in Europe (JNCC 2008a, EC 2007). The information below is taken from the website at:

<http://www.jncc.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H4010>.

M15 *Scirpus* – *Erica* wet heath is found in areas with a moderate to high rainfall, and is the typical form of wet heath in the north and west of the UK. *Erica tetralix* and *Calluna vulgaris* are typically accompanied by abundant *Trichophorum cespitosum* and *Molinia caerulea*. In the far north-west of Scotland, *Erica cinerea* (bell heather) and *Racomitrium lanuginosum* (woolly fringe-moss) are also characteristic, along with an abundance of Atlantic bryophytes. In the north, there may be a high cover of *Cladonia* lichens. At high altitude northern and montane species are represented. Where there is movement of mildly base-rich water through the peat, *Carex* spp. (sedges) and a wide range

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<sup>67</sup> this paragraph is confusing. Blown-out areas without impermeable layers never support wet heaths due to extreme fluctuations in water availability. [Bijlsma]

of species favoured by flushing occur. The latter includes distinctive variants that are often characterised by abundant *Myrica gale* (bog-myrtle), or *Schoenus nigricans* (black bog-rush).

M16 *Erica* – *Sphagnum* wet heath is characteristic of drier climates in the south and east, and is usually dominated by mixtures of *Erica tetralix*, *Calluna vulgaris* and *Molinia caerulea*. The bog-moss *Sphagnum compactum* is typically abundant, while on Orkney and at high altitude in the eastern Scottish Highlands, *Cladonia* lichens are abundant. In the south, species with a mainly southern distribution in Britain, such as *Gentiana pneumonanthe* (marsh gentian), *Rhynchospora fusca* (brown beak-sedge) and *Cirsium dissectum* (meadow thistle), enrich wet heaths. At high altitude in northern Scotland, forms of the community occur which are rich in northern and montane species, and often also have an abundance of *Cladonia* lichens.

On the Lizard Peninsula [Sherry] in Cornwall, *Erica vagans* (Cornish heath) growing with *Schoenus nigricans*, *Erica tetralix* and *Molinia caerulea* forms a distinctive and unique form of wet heath (H5 *Erica* – *Schoenus* heath), found nowhere else in Europe.

A further very local wet heath type is M14 *Schoenus* – *Narthecium* mire, which is mainly associated with transitions from heath to valley bog at a small number of lowland sites in southern Britain.

For France, three sub-types have been identified and related to geographical variation (Gaudillat & Haury 2002):

- A subtype dominated by *Calluna vulgaris* and *Ulex minor* in the northern parts of the country and in Normandy.
- A subtype dominated by *Erica tetralix* and *Ulex minor* located more inland than the above mentioned subtype.
- A subtype dominated by *Erica tetralix* and *Erica scoparia* in more central parts of the country.

Moreover, a variation exists according to the hydrological regime. For permanently waterlogged areas the presence of *Sphagnum* leads to bog formation. In accordance with the drier conditions the dominance of *Sphagnum* decreases and that of *Calluna* and *Erica* increase (Muséum national d'Histoire naturelle [Ed]. 2003-2012).

For Scandinavia, the 4010 sites are predominantly *Erica tetralix* heath with *Erica tetralix* and *Trichophorum cespitosum* as dominating species. Other characteristic species are *Calluna vulgaris*, *Carex panicea*, *Drosera rotundifolia*, *Gentiana pneumonanthe*, *Juncus squarrosus*, *Molinia caerulea*, *Myrica gale*, *Narthecium ossifragum*, *Pedicularis sylvatica* and various *Sphagnum* species (Påhlsson 1998).

In the Netherlands [Bijlsma] and Belgium subtypes are identified that are related to geographical position and to the nutrient status of the soil:

- subtype with *Empetrum nigrum*, *Carex trinervis*, *Salix repens* and *O. microcarpus* [Coupar] in acid coastal dune slacks with the groundwater near (or above in winter) the surface. Distribution: boreo-atlantic; southern part Baltic Sea – The Netherlands
- subtype with orchids, *Pedicularis sylvatica*, *Danthonia decumbens* on acidified, moderately nutrient rich loamy sand soils
- local subtypes, associated with successional phases and micro-climate (Schaminée et al. 1995).

In the Netherlands distinct subtypes occur in pleistocene (4010A) and holocene (4010B) areas. The former on stagnating sandy soils, the latter as late-successional stages in peat areas with a dominant rain water influence. [Bijlsma]

For Belgium (Flanders) Myrtle Bogs (*Myrica gale*) are also considered as part of this habitat (Van Uytvanck, J. & G. De Blust, 2010).

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified through expert judgement a number of species under the Habitats and Birds Directive associated with Northern Atlantic wet heaths with *Erica tetralix* and provided conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 55 Species associated with Northern Atlantic wet heaths with *Erica tetralix* (for legend, see introduction of chapter 3)<sup>68, 69, 70</sup>**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Geomalacus maculosus</i> 1024	X									
<i>Asio flammeus</i> A222	X									X
<i>Circus cyaneus</i> A082	X									X
<i>Circus pygargus</i> A084	X									
<i>Falco columbarius</i> A098 (hunting habitat)	X									X
<i>Gallinago gallinago</i> A153	X							X		X
<i>Numenius arquata</i> A144	X							X		X
<i>Numenius phaeopus</i> A158	X									
<i>Pluvialis apricaria</i> A140	X									X
<i>Anthus pratensis</i> A257	X									X
<i>Circaetus gallicus</i> A080 (hunting habitat)	X									
<i>Motacilla flava</i> A260	X									
<i>Tetrao tetrix</i> A409	X									X
<i>Drosera</i> spp		X						X		X
<i>Erica</i> spp		X						X		X
<i>Gentiana pneumonanthe</i>		X						X		X
<i>Hammarbya paludosa</i>		X								
<i>Lycopodiella inundata</i>		X						X		X
<i>Narthecium ossifragum</i>		X						X		X
<i>Rhynchospora alba</i>		X								X
<i>Rhynchospora fusca</i>		X						X		
<i>Sphagnum</i> spp		X						X		X

<sup>68</sup> the reference to “introduction of chapter 3” is not clear; this table should include all typical (characteristic) species used in the evaluation of Structure & Function for Article 17 reporting and SDFs. [Bijlsma]

<sup>69</sup> *Lagopus lagopus* (SHOULD BE CHECKED), *Euphydryas aurinia*. [Sherry]

<sup>70</sup> Additional associates species should be mentioned on the list: *Coronella austriaca*, *Lacerta agilis*, *Rana arvalis*, *Bufo calamita*, [Ravon]

**Table 56 Annex II and IV species associated to Northern Atlantic wet heaths with *Erica tetralix* and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)<sup>71</sup>**

N2K code	Species name	Group		ES	IE	PT	REGION
1024	<i>Geomalacus maculosus</i>	Molluscs	range	XX	FV	XX	XX
			population	XX	FV	XX	XX
			habitat	XX	FV	XX	XX
			future	XX	FV	XX	XX
			overall	XX	FV	XX	XX

## 1.6. Related habitats

Within the overall heathland complex, North Atlantic wet heaths occur in several types of ecological gradient. In the drier lowland areas, wet heaths are local and often restricted to the transition zone between 4030 European dry heaths and constantly wet valley mires. In the uplands they occur most frequently in gradients between dry heath or other dry, acid habitats and 7130 Blanket bogs. At high altitude in regions with warmer climates wet heaths occur in mosaics with 4060 Alpine and Boreal heaths. In Scandinavia, however, the distribution of wet heaths and Alpine/Boreal heaths do not overlap.

## 1.7. Ecological services and benefits

The diverse environmental, social and cultural ecosystem services provided by wet heaths include carbon storage, biodiversity, water provision, flood protection, aesthetic/recreational value, archaeological/historical value, [Sherry] and economic value from tourism, sporting enterprises and grazing.

Good quality, semi-natural wet heaths play an important role in carbon sequestration, as a habitat which often overlies peat. Peat plays a vital role regulating carbon levels in the atmosphere by acting as a carbon sink. Alongside this, if wet heaths become degraded through loss of vegetation or drainage, flood risk may be exacerbated, and pollutants may be released that were held within soils (MF 2006). Wet heaths also provide habitat for plant and animal species found nowhere else, adding to valuable biodiversity across northern Europe.

Wet heaths, as part of the heathland complex, create valuable economic, recreational and sporting services. As grazing land, heathland supports different forms of livestock such as sheep, cattle and ponies. Heathland is also a beautiful aesthetic landscape, and provides tourism for local communities, particularly from hill walking activities. In addition it provides valuable employment and revenue for local communities from sporting activities such as shooting, particularly in the uplands. In the past and as part of a traditionally managed system, heathlands provide fuel, forage and thatch.

<sup>71</sup> Add Annex II species “ 1065 *Euphydryas aurinia* [Sherry]

## 1.8. Conservation status

**Table 57 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see start of chapter 3)**

NZK code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
4010	Northern Atlantic wet heaths with <i>Erica tetralix</i>	range	FV	XX	FV	XX	U1	FV	FV	FV	FV	U1
		area	U2	U2	U2	XX	U2	XX	U1	U1	FV	U2
		structure	U2	U1	U2	XX	U2	U2	U1	U1	U2	U2
		future	U2	U1	U2	XX	U2	U2	U1	XX	U2	U2
		overall	U2	U2	U2	XX	U2	U2	U1	U1	U2	U2

Wet heaths on peaty soils with plants such as cross-leaved heath (*Erica tetralix*) are typical of northwest Europe. Similar vegetation but with Dorset heath (*Erica ciliaris*) is priority habitat type 4020. Particularly typical of the Atlantic region, it is also found in parts of the Boreal and Continental regions together with northern Portugal in the Mediterranean region.

Assessed as 'unfavourable-bad' in the Atlantic, Boreal and Continental regions for all parameters except 'range' and as 'unfavourable-inadequate' for the Mediterranean region. No country assessed this habitat as 'favourable'. Threats and pressures responsible for the conservation status are mostly linked to inappropriate management or to habitat destruction Spain (Summary sheet of the online report on Article 17 of the Habitats Directive). (ETC BD 2012).

## 1.9. Trends

Wet heath is a naturally occurring dwarf shrub habitat, and prevention of succession to woodland is most likely due to the high water table along with the low nutrient status of the soils (Gimingham 1992 in Hampton 2008). Other heathland species would also have been found naturally within open woodland communities, particularly on 'poorer', low nutrient status soils. However, the extent of heathland across Europe is intimately related to human activities, and the large open heathland complex, which includes wet heath, developed around 6000 years ago. Many human induced wet heaths will tend to show a habitat succession if management (in the form of grazing and or mowing) is abandoned. In France, the most common succession is towards light woodland dominated by *Frangula alnus*, *Salix acuminata*, *Salix aurita* and *Betula alba* (Muséum national d'Histoire naturelle [Ed]. 2003-2012).

As early agricultural practices began, woodland areas were cleared for grazing, cutting turf, cutting for fuel and harvesting for fodder, and large open heathland communities began to develop (Gimingham 1992, Webb 1998). For thousands of years people worked the heaths, creating, maintaining and reshaping this unique environment, as a valuable source of livelihood to many communities.

Traditional management has continued to maintain heathland. However, across Europe there is the potential for declines in grazing, burning and cutting which may have a profound impact on the heathland community. During the middle part of the last century, farming methods altered with the development of artificial fertilisers, herbicides and modern forms of machinery for ploughing and drainage. Farmers were encouraged to ‘improve’ heathland areas through ploughing where possible, but also domestic stock numbers rose significantly with the introduction of farm subsidies. Upland heathland [Sherry] areas in the UK in particular suffered from overgrazing, and it is only since the headage-based subsidy was replaced in 2005 that numbers of animals on heaths are no longer encouraged to exceed although grazing levels in some areas remain above those recommended for restoration of wet heath [Sherry]. In the future, there is a risk that some [Sherry] heathlands that have been overgrazed may no longer be agriculturally viable, and will end up ungrazed.

### 1.10 Main pressures and threats

Explanation for the threats and pressures statistics:

Pressures/threats are driven by the habitat type and the species sharing the same pressures/threats are noted in the table as well. This means that a species may have other pressures/threats as well which do not appear in the table. Only those pressures/threats for habitat types are taken into account when they are reported by more than 1/3 of MS where the habitat type/species is present. If a pressure/threat is reported by more than 2/3 of MS this is indicated in light blue colour. If a pressure/threat is reported by all MS where the habitat type or species occurs, it is indicated with darker blue colour.

**Table 58 Main pressures to Northern Atlantic wet heaths with *Erica tetralix* as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Northern Atlantic wet heaths with <i>Erica tetralix</i>	<i>Geomalacus maculosus</i>
Grazing	x	
General Forestry management	x	x
Burning	x	
Pollution	x	
Drainage	x	
Biocenotic evolution	x	

**Table 59 Main threats to Northern Atlantic wet heaths with *Erica tetralix* as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Northern Atlantic wet heaths with <i>Erica tetralix</i>	<i>Geomalacus maculosus</i>
Grazing	x	
Pollution	x	
Drainage	x	
Biocenotic evolution	x	

### Overgrazing

A key threat to the habitat is overgrazing. It can lead to the loss of dwarf shrubs, which are substituted by species that are more resistant to grazing, usually facilitating expansion of grassland habitats that are already present.

Dwarf shrubs such as heather species (*Erica* and *Calluna*) go through specific growth phases, from pioneer through to building, then mature, and finally degenerate. The vigour of heather plants is greatest during the first two phases, while stand productivity is greatest when all the heather plants are in the building phase. At this stage the heather canopy attains maximum coverage and density. Grazing at low densities can impact dwarf shrub growth on heaths by utilising annual growth. It can maintain the plants in the developing or maximum phase of growth and prevent them from passing into the later, degenerate phase. However, too much grazing leads to the loss of dwarf shrub cover (Backshall et al. 2001 in Hampton 2008). Heather cover will generally decline if grazing animals utilise more than 40% of the season's growth (as shown for dry heath), potentially allowing other species such as grasses to dominate the habitat (Thompson et al. 1995 in Hampton 2008).

However, overgrazing may not occur on a well-developed, infertile wet heath (with intact soil and hydrological characteristics) because the vegetation type may be avoided by the animals (unless they are forced to use it, which will be related to stocking rates). Although, a species-rich wet heath, growing on more fertile soil, usually contains a considerable amount of grasses and can be prone to overgrazing, which can cause the expansion of the grasses and herbs. Overgrazing can also impact upland wet heath, growing on a peaty soil that has been (superficially) dried out (De Blust, pers. comm.). Importantly on wet heath, large numbers of animals trampling on the wet, peaty soils may cause erosion leading to the loss of the characteristic wet heath community.

### Grazing abandonment or under stocking

Along with overgrazing, under-grazing can also be a threat to heathland communities through vegetation succession. Although it is thought that undisturbed wet heath could be maintained without management (see below), most wet heath communities will be reliant on some form of disturbance such as grazing, particularly as part of a heathland mosaic. If none occurs, the dwarf shrubs will move from the building phases of growth into the mature and degenerate phases becoming increasingly 'leggy' with gaps forming in the canopy. This may lead to their replacement by other species, eventually leading to woodland (Gimingham 1992 in Hampton 2008)<sup>72</sup>. In south-west Sweden, quite rapid declines in the abundance of *Pedicularis sylvatica* (lousewort) have been related to grazing abandonment.

### Uncontrolled burning

Burning of heathlands has been an element of the traditional land-use, in order to enhance the grazing conditions for livestock. However, uncontrolled fire (in contrast to controlled or prescribed burning) is primarily detrimental for the conservation status of wet heaths. It may be that wet heath is particularly susceptible to damage by burning, especially with regard to the lower plant flora such as bryophytes. *Sphagnum* spp, which are generally slow colonisers and may have taken many years to establish, may be lost due to burning where fires burn into the moss and litter layer (Gimingham

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<sup>72</sup> these developmental stages refer to *Calluna* but not to *Erica*; this sentence is not relevant to 4010. [Bijlsma]

1992 in Hampton 2008). Intense and hot fires can also cause peat erosion, drying of the habitat and loss of dwarf shrubs allowing different plant communities such as grassland to develop. Natural England (previously English Nature) produced a research note on the detrimental effects of burning, which are highlighted below.

However, a study into the effect of uncontrolled fires on heathland communities, including wet heath, suggested that, after the initial impact the wet heath, the habitat showed few responses to the fire and all effects were transitory (Bullock and Webb 1995 in Hampton 2008). However this study only looked at recovery after a single burning incident and there is little research to show the impacts of long-term regular burning. [Sherry] This suggests that more clarity on the use of fire within a heathland system is required.

It is most likely that regular or hot uncontrolled fires within the same wet heath area could destroy the habitat, or trigger damaging peat erosion on a large scale.

### **Artificial drainage**

Drainage of wet heaths will undoubtedly have a detrimental effect on wet heath, as it will change the hydrological regime. Drainage could lead to lowering of the water table and ultimately to the loss of wet heath (Backshall et al. 2001). This will usually be associated with groundwater extraction (for drinking water), agricultural improvement, forestry or development. In Wallonia, drainage was together with afforestation with conifers one of the major reasons for the disappearance of wet heaths as from the 1850ies (DGARNE, 2012). In Wales, UK wet heaths in lowland areas are typically more fragmented than those in more upland areas, for example the mean patch size for wet heath the lowlands is 6.36 ha. (CCW data unpublished). [Sherry]

### **Nitrogen deposition**

The increase of soil nitrogen levels, particularly through increased levels of ammonia in the atmosphere, could threaten wet heath (Dalton and Brand-Hardy 2003, Aerts 1993 in Hampton 2008). To ensure the maintenance of wet heath it is important that soil conditions remain low in nutrients such as nitrogen. Increasing nitrogen levels will favour more competitive grass species such as *Molinia*, leading to a change in plant community (Barker et al. 2004). In addition it is predicted that low intensity grazing may not be sufficient to maintain heathland communities alongside nutrient addition (from the atmosphere) (Hardtle et al. 2006, Terry et al. 2004). The few remaining areas of wet heath in Wallonia suffer from nitrogen deposition leading to the invasion of *Molinia caerulea* (DGARNE, 2012)

### **Afforestation**

Planting of tree crops will lead to the loss of open habitat within the heathland complex, including wet heath. This may potentially have a knock on effect of increased predation for adjacent heath breeding birds (Backshall et al. 2001) and other heathland animals. In Wallonia, afforestation with conifers was together with drainage one of the major reasons for the disappearance of wet heaths as from the 1850ies (DGARNE, 2012)

### **Fragmentation**



In some regions such as Wallonia, many of the subsisting wet heaths occur as small patches in a wider matrix of (production) forest. This poses specific challenges to the management, especially the restoration of good hydrological conditions (D GARNE, 2012).

### **Invasive species**

Species such as *Pteridium aquilinum*<sup>73</sup> (bracken) and *Molinia caerulea* can be damaging to extensive heathland areas by forming dense stands of vegetation and litter at the expense of ericaceous species. *Pteridium aquilinum* tends to be more invasive on the drier heathland areas, being less tolerant of wet conditions. *Molinia* can come to dominate wet heath areas, which can be caused by inappropriate management such as overgrazing or burning, nitrogen deposition or lack of management.

### **Recreation**

Recreational activities can also have a negative effect on heath vegetation, but compared to other issues, may be of little conservation significance. However, activities such as hill walking and mountain biking can be detrimental to fragile ecosystems such as wet heath, leading to erosion and loss of vegetation. Management of visitors and their use of the open moorland is crucial to alleviate any harmful effects (Backshall et al. 2001).

Development such as housing and roads can cause loss and fragmentation of wet heath communities. This has more of an impact in the lowland heaths, particularly in the south of England and previously in Germany, Belgium and the Netherlands.

In **France**, the abandonment of traditional farming and/or management practices is the main threat, followed by the conversion to agricultural land or forestry, often preceded by drainage. This habitat is still declining (Muséum national d'Histoire naturelle [Ed]. 2003-2012).

In **Ireland**, reclamation, afforestation and burning have resulted in extensive loss of wet heath. Overstocking has also degraded large areas of the habitat, especially in uplands of the wettest western regions, through overgrazing and trampling. This has depleted heather and other plant cover and allowed invasion by non-heath species, or exposure of peat to severe erosion. Although various schemes to initiate recovery of damaged habitat through more sustainable stocking rates have been in operation for a number of years, recovery has been slow (NPWS 2008).

In **Portugal** (ALFA 2004) the main threats are those that lead to the destruction of the microtopography, the disturbance of water regime, the change in pH and trophic level, erosion and / or siltation of peat, conditioned on the preservation of peatland vegetation complexes, including grazing, trampling, drainage and the use of fire. The destruction of the vegetation surrounding the bogs also negatively influences their water balance during the summer period, which determines the evolution of complex vegetation.

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<sup>73</sup> **Pteridium is never an invasive species in 4010 in the Netherlands [Bijlsma]**

**Germany, Ackermann pers.comm.:**

1. Entwässerung durch Gräben, aber auch durch Brauch-/Trinkwassergewinnung (Bsp. Lüneburger Heide, z. B. Bewässerung von angrenzenden intensiv bewirtschafteten landwirtschaftlichen Flächen)
2. Nährstoffeinträge (insbes. Stickstoff und Phosphor) durch direkt angrenzende intensive landwirtschaftliche Nutzung, durch Massentierhaltung, aber auch durch Einträge aus der Atmosphäre
3. Fehlende oder inadäquate Pflege und in der Folge Vergrasung oder Verbuschung
4. Übernutzung, insbes. Überweidung mit nachfolgender Degradation der Bestände

Werden erforderliche Bewirtschaftungs- und Pflegemaßnahmen unterlassen oder zu selten angewendet, können Feuchtheiden eine Entwicklung zu Nährstoffsinken erfahren. Infolge der Anreicherung organischer Substanz im Rohhumus und begünstigt durch Nährstoffeinträge aus der Landwirtschaft sowie aus der Luft kommt es zur Sukzession der Pflanzendecke mit Vergrasung (Pfeifengras) oder Verbuschung bis hin zur Waldentwicklung.

**The Netherlands, Bijlsma pers.comm.:**

1. J02 human induced changes in hydraulic conditions
2. H04 acid rain and nitrogen-input mainly from agriculture including (eventually) nitrogen enrichment of local groundwater.
3. J03.03 fragmentation due to former cultivation of heathlands resulting in loss of habitat connectivity especially pressing for small fauna such as butterflies, reptiles and amphibians.

Human-induced drainage is most pressing and results firstly in local extinction of characteristic species such as peatmosses and eventually in species poor dry habitat often dominated by *Molinia*.

**United Kingdom, Coupar pers. Comm.:**

1. Grazing - inappropriate.
2. Burning - inappropriate.
3. Forest Planting – native and non-native.
4. Renewables – wind energy production

Grazing, whether by wild deer or domestic livestock, usually sheep, has a generally neutral, and locally beneficial effect on the habitat when at low intensities. However, heavy grazing adversely affects species structure and composition and the associated trampling can lead to loss of cover, soil disturbance and erosion.

Burning, where it is too intense or too frequent has similar effects and can also result ignition of the soil leading to erosion. It can also be damaging to wildlife, particularly if carried out during the bird breeding season.

Forest Planting results in direct habitat loss and can also contribute to habitat fragmentation if poorly designed. New native woodlands can be more readily integrated than new productive forestry, but design and methods are critical.

The construction of large wind farms in the uplands results in loss and fragmentation of the habitat. This is sometimes a consequence of avoiding areas of blanket bog which is considered even more vulnerable to disturbance. Tracks and pipelines associated with small-scale hydro schemes have similar effects.

**United Kingdom. Sherry:**

1. A04.01.02 Intensive sheep grazing (mainly upland)

2. A04.03. Abandonment of pastoral systems, lack of grazing
3. J01 Fire and fire suppression
4. A04.02 Air pollution, airborne pollutants Nitrogen-input
5. H02.06 Pollution to groundwater diffuse groundwater pollution due to agricultura and forestry activities

## 2 Conservation management

### 2.1. Main conservation requirements

There is still a debate as to whether wet heaths require any form of management. If all things remain equal, undisturbed wet heath communities may be maintained without management because the prevailing ecological conditions (soil nutrients, hydrology, acidity) restrict successional processes (Burgess et al. 1995, Gimingham 1992).

However, as discussed previously, wet heath is usually associated with a wider heathland/mire complex and management becomes essential for maintaining the complex as a whole.

For the maintenance of the favourable conservation status of this habitat any cultivation, soil preparation, application of fertilizers or chemical pesticides, or conversion to water body should be avoided. In addition any change to the hydrological regime (e.g. drainage) should be avoided (Muséum national d'Histoire naturelle [Ed]. 2003-2012)

The most important conditions for optimal conditions for wet heaths are abiotic: sufficiently large areas of open heathland with a natural hydrology, i.e. sites that are not actively drained or suffer from nearby drainage activities. If drainage occurs in or near the site, restoration of favourable conservation status is only possible if the hydrological management is restored to support wet heaths. A second paramount condition for the maintenance or restoration of wet heaths is that input of Nitrogen is kept low, or can be countered (through sod cutting) and that the soil is chemically buffered (Van Uytvanck & De Blust, 2010).

Where restoration of wet heath is considered the topsoil needs to be removed until a depth where the phosphate availability is low (soil test is needed) (Van Uytvanck & De Blust, 2010)

In areas outside the UK where wet heath often occurs in more fragmented, isolated and smaller patches, maintaining or restoring favourable hydrological conditions is essential. Contrary to dry heaths, it is not recommended to plant tree buffers around small wet heath habitats because they negatively influence the local hydrology. Reconnecting isolated patches of wet heath by restoring wet heath habitat and restoring favourable hydrological conditions is an effective landscape level approach to wet heath management (Van Uytvanck & De Blust, 2010). Under active management site based measures are discussed.

Most of the wet heaths and their nature conservation value are related to the impact of low intensity grazing over a very long period. Thus, grazing is the key form of management that management guidelines tend to identify across various countries in Europe (e.g. Gaudillat & Haury

2002, Naturvårdsverket 2005, UKBP 2008e). The main issues for wet heath are the number and type of livestock used and timing of grazing.

For other forms of heathland management, such as burning and mowing, a general view is that they may have a detrimental impact on the community. For example in **England [Coupar]** the general recommendation is that burning and mowing should not be used as management on wet heath, while a less restrictive approach has been adopted for Sweden, Belgium and other parts of Europe.

It is recommended that instructions prohibiting or regulating fertilizing, supplementary feeding of livestock, drainage or introduction of non-native species are included in management plans and protection regulations for wet heath sites (Naturvårdsverket 2005).

For case studies of sites with wet heath, which include site management and relevant issues see references: DEFRA 2007a-c, Forestry Commission 2008, JNCC 2008a.

Germany, Ackermann pers.comm

3. Erhaltung bzw. Wiederherstellung des lebensraumtypischen Wasserhaushalts
4. Vermeidung von Nährstoffeinträgen
5. Durchführung geeigneter Pflege- bzw. Bewirtschaftungsmaßnahmen
6. Extensivierung der landwirtschaftlichen Nutzung

The Netherlands Bijlsma pers. comm.:

1. High water table especially during winter caused by stagnating soils or local groundwater discharge
2. Removal of trees and shrubs to prevent succession to woodland

UK

Coupar SNH

1. Light grazing

This habitat requires requires little if any management in Scotland. In some areas light grazing is required to avoid colonisation by woodland and more generally the habitat is resilient to light grazing, as indeed it is to infrequent low intensity burning.

Sherry:

1. A04.01.02 Extensive grazing with mixed livestock (sheep, cattle, ponies)
2. A04.03 Maintenance or re-establishment of traditional pastoral systems
3. J01 Improved burning management and where appropriate no burning
4. H04.02 Reduced nitrogen-input
5. H02.06 Reduce diffuse pollution impacts Incentive schemes to encourage better management of diffuse pollution and runoff and encourage buffering of habitat areas

## 2.2. Management measures

The following text is primarily based on experiences from the management of wet heaths in UK and Ireland, which host 85% of the surface area of this habitat in the EU. The management prescriptions within the UK tend to be quite strict; particularly with regard to burning (i.e. if in doubt do not use burning as management on wet heath). However, across the rest of Europe controlled burning (along with vegetation cutting and soil removal (sod cutting)) is considered vital for heathland management (including wet heath). **Burning and sod-cutting are traditional forms of management**

(related to particular forms of land use), however nowadays they are not considered as vital for nature management of heathlands in the Netherlands. [Bijlsma]

Given that traditional management includes burning, vegetation cutting and sod removal, it may be that a site-by-site approach is required when developing management prescriptions for wet heath. This should involve site evaluation as to what the community structure is (level of water table, grass to dwarf shrub ratios, general species composition, amount of bare ground etc.), which will determine management tools, such as stocking levels for grazing, use of controlled burning, vegetation cutting and sod removal.

The general text below is based on UK prescriptions for grazing, burning and cutting (mowing), with other European prescriptions such as those used in Sweden and Belgium given as examples presented under separate headings below.

### Grazing

The main reason for grazing, in terms of conservation, is to arrest successional change, ultimately stopping woodland from colonising the heathland areas. This is especially the case when different types of livestock are used in concert, which will generate variations in habitat structure, encourage species diversity and will be more efficient at maintaining the open heathland flora.

As indicated above, it is likely that light grazing has been a natural feature of wet heaths for thousands of years, and is beneficial for maintenance of the habitat (Burgess *et al.* 1995). For successful management of wet heath, low stocking rates are therefore essential. Heavy grazing should be avoided on good quality wet heath as it can lead to a decline in characteristic dwarf shrub cover in favour of grass, sedge and rush species, as well as excessive poaching and erosion of the underlying peat (English Nature 2004).

Appropriate stocking levels for wet heaths should be determined by taking into consideration its conservation status, other management practices, such as burning, and the numbers of wild herbivores present (Backshall *et al.* 2001 in Hampton 2008). A light regime of grazing is essential to maintain or restore the favourable conservation status of this habitat (DGARNE, 2012).

#### **Levels of grazing for wet heath as recommended in Northern Ireland (Millsop 2008)**

- No grazing from 1 November to 28/29 February inclusive.
- Overgrazing and/or poaching is not permitted at any time.
- During the remainder of the year the stocking level must not exceed 0.25 LU/ha (LU = Livestock Unit) at any one time [that is, 1.6 sheep per ha].
- Cattle will not normally be permitted on wet heath but where they are the only livestock on the farm they will be allowed to graze during June, July and August at 0.2 LU/ha with the written permission of Department of Agriculture and Rural Development.

#### **Grazing guidelines for wet heath in Flanders (Van Uytvanck & De Blust, 2010)**

- Frequency: in general each year, especially if the grazing is extensive. For targeted grazing (e.g. to prevent tree and shrub encroachment) the frequency can be lower, e.g. every 3 years. In order to combat dominance of grass species, intensive grazing of the same plot can be repeated up to three times per year.
- Timing: in principle during the growing season (May – October). Else depending on the objective
- Quantity : depends on the productivity of the wet heath, the objectives and the type of grazing.
- Materials: enclosures, animal transport, mineral bloc, drinking containers, winter sheds, stables.

**Levels of grazing in England by Backshall *et al.* (2001), with additions by Stainer (pers. comm.)**

To maintain wet heath (and blanket bog) in favourable condition:

- undisturbed wet heaths and blanket mires require little management and may be left unmanaged (Burgess *et al.* 1995), but few pristine sites now remain in England;
- Light or no grazing in the autumn or winter, with at most very light grazing in the summer is the ideal grazing regime on most wet heaths and blanket mires;
- year round stocking rates should not exceed 0.25-0.5 ewes/ha or 0.037-0.075 LUs/ha;
- winter stocking rates should be reduced by at least 25%, with all cattle and horses removed where there is a risk of poaching;
- Blanket bog or wet heath dominated by *Molinia* will be better grazed with cattle or ponies in the spring and summer months, as this will reduce the dominance of this grass over time and aid restoration.

To bring wet heath and blanket bog into favourable condition:

- a maximum year round stocking rate of around 0.1 sheep/ha or 0.015 LUs/ha has been recommended, with winter levels lower still or stock removed;
- if the habitat is very degraded a period (several years) of no grazing may be appropriate;
- if bare peat is exposed, it is very difficult to stabilise and any stocking could prevent revegetation;
- restoring high water levels may be the most important factor in reversing deterioration of vegetation and peat soils.

Grazing by different animal species should be taken into consideration because different species favour or refuse different sorts of food. For example, goats can be used to tackle areas where *Juncus* spp (rushes) have come to dominate (Gimingham 1992 in Hampton 2008), but this needs to be alongside the use of other animals and should be monitored as to the effects of goats on the habitat as a whole. In some cases, temporary fencing may be an option to enable different management regimes to be implemented (Backshall *et al.* 2001 in Hampton 2008). Also, the use of traditional breeds of cattle is thought to have a greater impact on conservation of heathland compared to those breeds bred for production, through hardiness and choice of vegetation eaten.

Successful maintenance of wet heath through grazing will require careful management. The most vulnerable periods for poaching, particularly by large animals such as cattle, will be in the winter and it is recommended that no, or very extensive grazing be allowed on wet heath through the winter.

Wet heaths are often seasonally dry in the summer, with a water table up to 10 cm below the soil surface (Burgess *et al.* 1995). Allowing light grazing (see stocking rates above) through the summer should not adversely affect the wet heath community. Herbivores, through creating vegetation mosaics, will have a positive effect on the biodiversity of the community and will help control dominant species such as *Molinia caerulea* in certain situations.

Caution needs to be applied in terms of zero or low intensity grazing as it has been suggested that this is not sufficient to maintain heathland communities, and management would also involve regular tree cutting (Bokdam and Gleichman 2000 in Hampton 2008).

In terms of wet heath, it may be that as long as the habitat maintains a suitably high water table, low intensity grazing would be enough. However, open scrub will enhance the wider biodiversity of heaths, and scrub was an integral part of these habitats prior to human management, as shown in the pollen record.

A potential difficulty in terms of grazing for nature conservation, on nature reserves is finding graziers prepared to graze extensively. This has been an issue in the UK and an initiative called the Grazing Animal Project (GAP) was developed to give advice on grazing for conservation and to act as

a point of contact for projects trying to find graziers. The GAP website is also the source of a wealth of information on grazing, particularly for conservation (GAP - <http://www.grazinganimalsproject.org.uk/index.html>).

In France, mowing and cutting are given preference over grazing (Muséum national d'Histoire naturelle [Ed]. 2003-2012)

### **Burning**

Burning has been used for centuries to manage vegetation in some EU countries, such as the United Kingdom, and for stimulating new growth of grasses or heather for agriculture, game rearing and wildlife conservation (Backshall *et al.* 2001). However, inappropriate use of this technique can be dangerous for the survival of wet heaths as it can damage bryophyte and lichen flora and increase erosion through the loss of peat soils. This form of management is not recommended in France, due to its impact on the fauna, the risk of bog fires and the high technical requirements (Muséum national d'Histoire naturelle [Ed]. 2003-2012).

Thus, the general recommendation in **England [Coupar]** is do not burn wet heath communities as regular burning on short cycles will eventually destroy wet heath, favouring grassland species such as *Molinia caerulea* (Backshall 2001). However, this is not considered to be the rule in other countries (see below).

If vegetation is to be managed by burning as part of an overall management structure, then different regimes should be applied to different areas, leaving wet heath for longer periods between burns or left as no-burn zones; this will prevent damage to wet heath and also increase habitat biodiversity by creating a varied structure to the vegetation.

Timing of burns is important to ensure successful management. Burns should be carried out in late winter, early spring with very wet soil conditions, avoiding very windy periods that have a drying effect on vegetation litter and may affect the control of the fire. Only small areas should be burnt at a time, and preventing the outbreak of the fire outside the area by use of firebreaks is also important in controlling the burn.<sup>74</sup>

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<sup>74</sup> **Recommendations concerning burning of blanket mire and wet heath in UK” Only some of these bullets apply in Scotland [Coupar]**

**Recommendations concerning burning of blanket mire and wet heath in England (Blanket Bog burning is not recommended in Wales) [Sherry] (taken from Backshall et al. 2007).**

- As a general rule when managing mires for nature conservation, if in doubt, do not burn.
- Where blanket bog and wet heath is in favourable condition, the ideal option for nature conservation purposes is not to burn at all.
- A 20-year burning regime is the recommended minimum rotation for blanket mires, which may also apply to wet heath, and a burning rotation of 20-30 years may be preferable.
- Where burning is conducted, for conservation purposes it is desirable to convert or maintain sensitive areas (such as wetter, steeper, or higher altitude locations) to no burning areas.
- When conducting any burning on blanket mire or wet heath, follow all the legal requirements, areas to be avoided and other recommendations contained in the previous boxes.
- Large areas of old, tall heather on wet substrates are ideally left un-burnt, because of the risk of very hot fires and little regeneration.
- Areas which contain pools or peat haggings, and close to eroding runnels, should also not be burnt.
- Where accidental fires are likely and extensive areas of old, woody heather exist, burn fire breaks as a precaution or consider cutting fire breaks, but consider the possibly damaging effects of the use of machinery.
- Areas where *Molinia caerulea* is present at more than 20-30% cover are best not burnt, because this may encourage this grass, particularly in the presence of sheep grazing.

**Burning guidelines for wet heath in Flanders (Van Uytvanck & De Blust, 2010)**

- Frequency: Approximately every 15 years
- Timing: Wet periods in winter or early Spring
- Quantity : small patch at a time, in Belgian heaths max. 10 ha..
- Materials: tractor and plough to make the firebreaks, extinguishers, contact with the fire brigade.

**Cutting (by mowing)**

Cutting, like burning, is a drastic event for the vegetation and its associated fauna, particularly on wet heath as heavy machinery can cause compaction and erosion. For these reasons, mowing should, if possible, be avoided on wet heath communities (Backshall *et al.* 2001 in Hampton 2008).

However, cutting may be the only form of management available, and may need to be considered. When it is used for management, it should be adequately planned and monitored. It is possible to use two different techniques: cutting by hand (depending on the area to be cut) and using mechanical means. Where large areas are to be managed, tractor mounted mowers may be the only viable option, but machinery used in cutting can damage fragile ground, such as the peats of wet heath. To avoid excessive damage, cutting should be carried out in drier months of summer, but this should be after the bird nesting season, not before mid-July (to be assessed in the field). However, this may be in conflict with the fact that heather regeneration is usually better after a spring cut (Backshall *et al.* 2001 in Hampton 2008).

If cutting is carried out when the ground is still wet, vehicles will need to have low ground pressure tyres and monitoring will be essential to ensure that recovery of wet heath species has occurred post cutting. Removal of all cuttings may increase the speed of regeneration but it is not essential to maintain the habitat (Stainer, pers. comm. in Hampton 2008).

Cutting is more expensive than burning, but in some particular cases, the sale of cut heather for



commercial purposes can reduce the cost (North York Moors National Park 1991). Also heather foraging may be used for heathland restoration projects, with the cuttings sold to the receptor project. Note that foraging will need to be carried out when there will be mature seed available in autumn/early winter.

Mowing is considered the best management practice for wet heaths in France (Muséum national d'Histoire naturelle [Ed]. 2003-2012). The cutting should however be applied on a rotation basis and the cuttings should be removed from the site (DGARNE, 2012)

**Recommendations concerning heather cutting in England [Shrry] (Backshall et al. 2001)**

- Plan a programme of cutting
- Avoid cutting during the main bird-nesting season
- Regeneration is generally better after spring rather than autumn cutting
- Consider removing cuttings for more rapid regeneration (Stainer, pers. comm.)

**Cutting by mowing guidelines for wet heath in Flanders (Van Uytvanck & De Blust, 2010)**

- Frequency: Approximately every 2 to 3 years (5-8 years in France)
- Timing: in late summer (end August to March in France)
- Quantity : N/A..
- Materials: scythe, brushcutter, tractor and mower.

**Grazing combined with controlled burning and complementary cutting**

For south-west Sweden, a different management approach is used. The main concept is grazing in combination with recurrent burning, and it is recommended that the historical land-use traditions regarding the grazing regime are followed. Complementary cutting of overgrowth and more occasional burning may be considered as additional measures, if needed. This should be decided on a site-by-site basis (Naturvårdsverket 2005, Larsson 2007 in Hampton 2008). A higher grazing pressure during late autumn (as well as in winter if practically possible) and early spring is recommended in order to reduce the re-growth of young trees and bushes and the litter layer. In the summer, a lower grazing pressure is thought to be beneficial in order to allow flowering of important nectar and pollen sources of host plants. This management is thought to reflect the traditional management system where winter grazing was common (Larsson 2007 in Hampton 2008).

The use of fire as a tool to maintain the conservation values associated with both wet and dry heaths is seen as essential in Sweden (Larsson 2007), and in accordance with traditional land-use. This is however not uncontrolled burning but recurring prescribed burning in the spring. Ideally, burning takes place in small sections so that the site contains a mosaic of successional stages from newly burnt areas to areas with old heather.

Done properly, it creates a varied vegetation structure and a diverse flora and fauna, and it is probably a more important disturbance factor than grazing. The cessation of burning, however, tends to result in homogenous vegetation dominated by ericoid species and a reduced diversity of species. For example, many of the species on the national red list and associated with heathlands have responded positively to this management, and the lack of burning is believed to be one of the

most important factors in the decline of threatened species such as *Gentiana pneumonanthe* (marsh gentian) and alcon blue *Maculinea alcon* (Appelqvist & Bengtsson 2007 in Hampton 2008).

Also in Belgium and the Netherlands, burning is considered to be an important management tool for wet heath, when carried out under controlled conditions, and should be used when appropriate (Kvamme *et al.* 2004).

### Scrub removal and Sod cutting

Cutting of trees and shrubs may be required when grazing is not sufficient, to ensure that scrub does not come to dominate the habitat. More important however is sod cutting. This was and is a traditional management technique for heathland, including wet heath. It was used formerly as part of the agricultural use of wet heath for animal bedding and fuel; now it is used as a means to maintain conditions for pioneer vegetation belonging to the wet heath complex. Sod cutting is not only applied as a means to restore degraded wet heath (overgrown by *Molinia*), but also on a small scale, and by hand, to maintain the different successional stages of wet heath.

Determining the right depth of sod cutting is essential. If the cutting is too shallow, too much humus remains. In temporary dry conditions the humus might oxidize and liberate nutrients to the soil that improve conditions for *Molinia*. If the cutting is too deep, too much of the seeds are removed. Moreover, the lowered soil surface leads to possible waterlogged conditions which would prevent heath growth. Liming after sod cutting can be advisable in highly acidic heathlands in order to promote the growth of species sensitive to acid conditions (Van Uytvanck & De Blust, 2010).

#### ***Sod cutting for wet heath in Flanders (Van Uytvanck & De Blust, 2010)***

- Frequency: very low, e.g. every 25 to 40 years
- Timing: late summer (end August, beginning of September)
- Quantity : small patch at a time (few acres) in mosaic to allow species to flee and recolonize the cleared area..
- Materials: either manually: sod cutting spade; mechanically: sodcutting machine.

### Habitat Restoration

Generally, it is of higher nature conservation priority and most cost-effective to concentrate effort on restoration by improving the condition of degraded heaths, rather than trying to re-create it where it has completely disappeared (Thompson *et al.* 1995). Also important will be connectivity to wet heaths in good condition; the closer the restoration project is to favourable wet heath, the more likely species dispersal will occur into the restored area (DGARNE, 2012) An essential step is the restoration of the hydrological regime (Van Uytvanck & De Blust, 2010).

The first step will be the reduction/removal of the cause of habitat degradation. This may involve removal of excessive nutrients or restoring the hydrological regime. Sod removal has been carried out to reduce nutrient levels with varying degrees of success. A study in Belgium succeeded with wet heath restoration when soil (peat) and established vegetation were removed, rather than just mowed, which had little impact on restoration. The authors found that peat removal reduced cover of the dominant *Molinia* and enabled establishment of *Erica tetralix* and other wet heath species (Jacquemart *et al.* 2003). Also in Belgium (Wallonia), removal of forested area between isolated sites has been applied to re-establish connectivity and microclimate (DGARNE, 2012)

Another study in the Netherlands found that restoration of wet heath by sod cutting was hampered by raised levels of ammonium ions originating both from aerial deposition of nitrogen and

from mineralization of organic material (Dorland *et al.* 2003). Also in the Netherlands, experimentation with lime addition on wet heath for restoration purposes are being carried out. The aim is to raise soil pH, which speeds up the conversion of soil ammonium (which at high levels is toxic) into nitrate by microbial nitrification, a process inhibited by soil acidity (Dorland *et al.* 2005). However, this should not be applied 'automatically' and 'everywhere', but only restrictively and on a site-specific basis (e.g. in terms of an impact analysis). Some wet heath types, which have low species richness, have very acid soil conditions naturally. The cation exchange capacity of these soils is very low and will not be increased permanently by a once-only liming. An analysis of the site conditions is necessary before using this technique.

Wet heath is reliant on a high water table and degradation may have been a result of the drying of the habitat, due to drainage. Re-establishing the hydrological regime will be vital for success, such as applying sluice gates or damming ditches, allowing water to stay in the system for longer and re-establishing the natural level of the water table (Van Uytvanck & De Blust, 2010).

Restoration by sod-cutting has the additional disadvantage that, especially in loam-poor soils, the resulting low phosphorous status of the vegetation (N:P>20) becomes limiting for the development of many characteristic insects (Vogels *et al.* 2011). [Bijlsma]

Where soil removal is the best option for restoration, seed application of favourable species may be required, and has been shown to have success in restoration projects (Pywell *et al.* 1995). This will be important where no seed bank remains, which should be examined as part of a restoration project before carrying out any seed addition. Seeds can be obtained from adjacent seed-bearing plants or local wet heath communities. A forage harvester or flail mower and baler can be used where conditions are suitable (e.g. relatively flat, no boulders, not too wet) and this material is normally applied at about 600 g per m<sup>2</sup>. Collecting seed, litter and soil from areas of wet heath, either by hand or an industrial vacuum cleaner can provide an alternative source of seed. This material is usually spread at the lower rate of about 200 g per m<sup>2</sup>. If storage of either type of material is required, it should be dried first. (Backshall *et al.* 2001). The different equipment that can be used for harvesting seed can be found at <http://www.floralocale.org/content.asp?did=24045>.

**Indicators of restoration success on areas of upland wet heath in UK (DEFRA 2005a)**

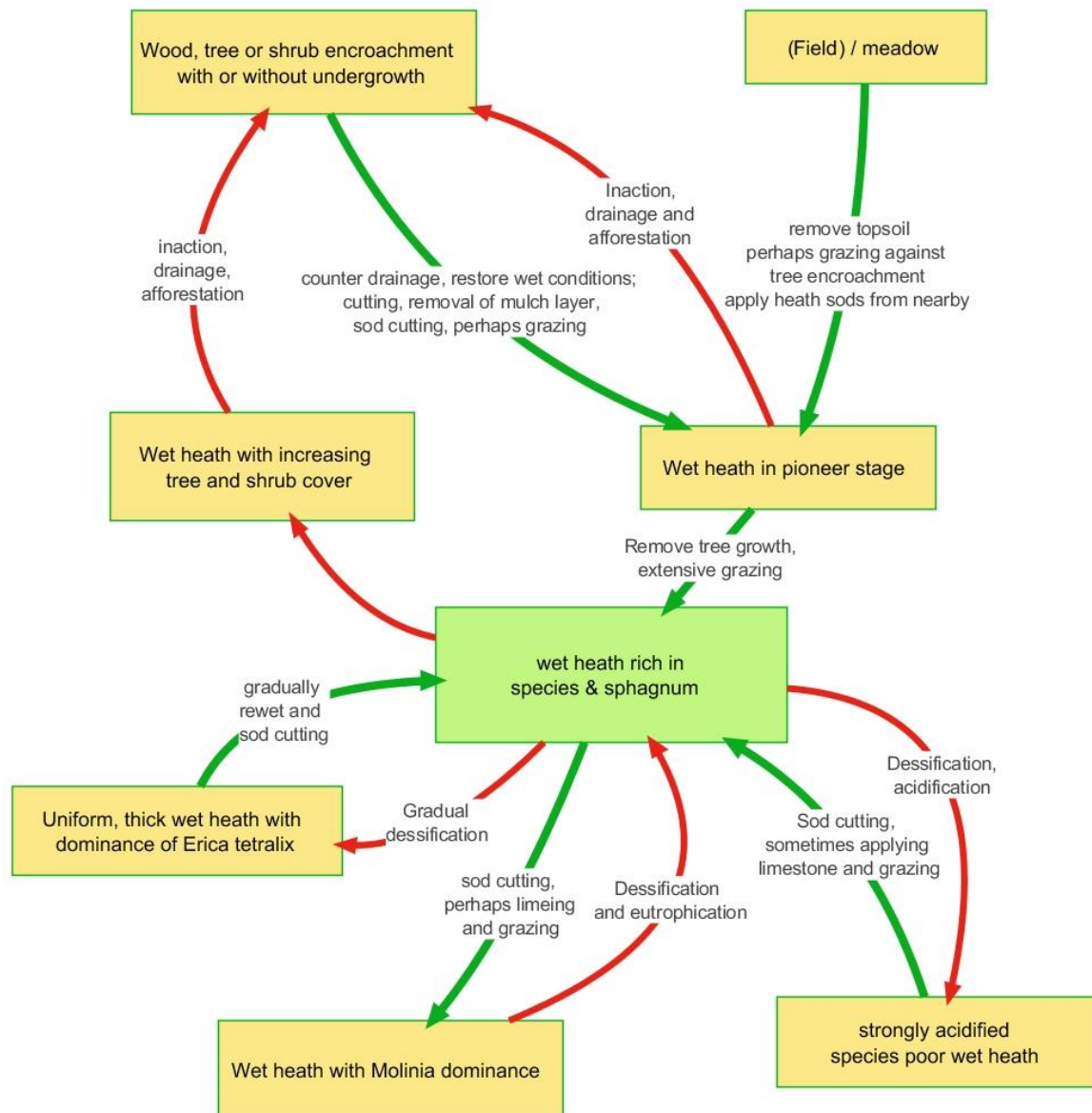
- No burning of the area of recovering dwarf shrub heath. No-burn areas should be incorporated into future management plans (Stainer, pers comm.).
- Between February and April no more than 33% of Heather shoots should show evidence of grazing.

By year 5

- Less than 10% of bog-mosses (*Sphagnum*) should be damaged or dead.
- Flowering Heather plants should be frequent between July and September.
- Dwarf shrubs should be at least frequent.
- The cover of scattered scrub should be less than 20%.
- The cover of Bracken should be less than 10%.
- The cover of invasive weeds such as Rhododendron, Creeping and Spear Thistle, docks, should be less than 1%.
- The area of disturbed bare ground should be less than 10%.

By year 10

- At least 2 dwarf shrub species should be frequent.
- The cover of dwarf shrubs should be up to 75% or have increased by at least 20%. Heather should have a diverse age range, with pioneer stage plants covering between 25% and 50% of the area and mature/degenerate plants covering at least 10%



**Figure 12 Management and development trajectories for Northern Atlantic Wet Heath with *Erica tetralix* (after Van Uytvanck & De Blust, 2010). Red arrows represent pressures, green arrows (management) responses.**

Specific management guidelines in **Portugal** focus on the promotion of the ecological quality of peatlands through (ALFA 2004):

- spatial grazing;
- management of trampling;
- prohibition of drainage;
- ban the use of fire;
- promoting the establishment of management contracts with owners or managers of the commons;

The imposition of immediate measures to wet heathlands with a high biological value and subject to intense exploitation schemes should, in particular go hand in hand with visitor access management and integration in a system of micro-reserves.

**Germany, Ackermann pers. comm.:**

3. Wiederherstellung eines ungestörten Wasserhaushalts durch Schließung von Entwässerungsgräben; Grundwasserentnahmen sollen künftig nur bis zu einem festzulegenden Mindestwasserstand genehmigt werden.
4. Schaffung von landwirtschaftlich nur extensiv genutzten Pufferstreifen, in denen auf Düngung, Kalkung und Pestizideinsatz sowie Entwässerung verzichtet wird.
5. Durchführung geeigneter Pflegemaßnahmen: i) zeitweilig intensives Beweiden mit Heid- oder Moorschnucken im Hütebetrieb und ergänzend/alternativ in mehrjährigen Abständen kleinflächig Plaggen oder auf kleinen Teilflächen eine tiefe Mahd unter Abfuhr des Mähguts; ii) mechanische Entbuschung stark verbuschter Bereiche, wobei der Gehölzschnitt außerhalb der Flächen entsorgt werden soll.
6. Kontinuierliche Anpassung des Weidemanagements auf das Vorkommen wertgebender Arten, u. a. sehr seltene Pflanzenarten, Brutplätze wertgebender Vogelarten und Schlüsselhabitats der Kreuzotter; grundsätzlich sollen die Pflege- und Bewirtschaftungsmaßnahmen eher kleinflächig durchgeführt und großflächige eingriffsintensive Verfahren vermieden werden.

Neuschaffung bzw. Wiederherstellung des LRT durch Rodung von Kiefernforsten und ggf. Ausbringen von Heidemahdgut und Plaggmaterial, Abschieben von Oberboden in früheren Heidemoorgebieten oder Wiedervernässung, Freistellung und Entkusselung

**The Netherlands, Bijlsma:**

1. Extensive grazing (year round if alternative food supplies are available at the landscape level)
2. Sod cutting only as a measure to restore wet heath from *Molinia*-dominance

**United Kingdom, Coupar:**

1. Grazing Management .
2. Burning Management
3. Integrated management of woodland and open habitat
4. Good practice in the location, design and construction of renewables infrastructure

Grazing management of domestic livestock should consider appropriate stocking densities and timing of grazing. Also ensuring that livestock are moved around the area to avoid areas of over- and under-grazing and poaching of the ground. For wild herbivores (deer) the main issue is managing their numbers to avoid over-grazing and trampling damage.

Appropriate burning rotations and intensities, with the avoidance of sensitive areas.

New woodlands should be planned with a view to suitable locations and establishment techniques to ensure biodiversity and other benefits to both the woodland and remaining adjacent wet heath.

Renewables infrastructure should avoid wet heath where possible and use good practice design and construction techniques to minimise impacts where avoidance not possible.

**United Kingdom, Sherry:**

1. A04.01.02. Incentive schemes to encourage extensive mixed grazing, scheme needs to support cattle and/or equines grazing
2. A04.03 Incentive schemes to encourage pastoral system. Niche marketing of products from pastoral systems to improve economic return
3. J01 Implement legislation, guidance codes and cross compliance measures
4. H04.02 Tackle sources of atmospheric nitrogen pollution
5. H02.06 Tackle sources of diffuse pollution. Buffer habitats from impacts of intensively managed agricultural land

### 2.3. Other measures (e.g. monitoring)

**Monitoring**

It is vital that monitoring is carried out on the North Atlantic wet heaths, as it will assess whether management being carried out is maintaining the nature conservation interest found within the wet heath community. More importantly, it will identify when and where degradation is occurring, alerting site managers to assess management needs.

Monitoring on wet heath will need to assess habitat features such as the composition, cover and structure of the vegetation, which in wet heaths can be very variable (JNCC 2006). According to the JNCC common standards monitoring (CSM) guidance, vegetation height is usually 10 - 30 cm, and more rarely 50 cm or more where protected from grazing and burning. Other features highlighted in terms of monitoring include:

- There tends to be a mixture of dwarf-shrubs, graminoids, bryophytes and lichens.
- The presence of *Erica tetralix* at high frequencies is one of the few characteristics which seem to be common to most forms of this feature.
- *Calluna vulgaris*, *Molinia caerulea*, *Trichophorum cespitosum* and *Sphagnum* spp. are often present and sometimes abundant, but relative dominance is influenced by management.

The following table is taken from the Common Standards Monitoring Guidance for Upland habitats in UK – wet heath (JNCC 2006).

**Table 60 Methods of assessments for wet heath in UK (JNCC 2006 in Hampton 2008) <sup>75</sup>**

Mandatory attributes	Targets	Method of assessment / Comments
Feature extent	1) There should be no measurable decline, in the area of the feature.	Field comparison with baseline map of features, or occurrence of feature at sample points on a systematic sample grid.
Vegetation composition — frequency of indicator species	(1) <i>Erica tetralix</i> should be present within a 20 m radius of the centre of the quadrat.	Target (1) assessed against visual estimate up to 20m from centre of the quadrat.

<sup>75</sup> JNCC 2006" should be replaced with the more up to date JNCC 2009 – and it would be better to go to the original source rather than via Hampton 2008 [Coupar]

<p>Vegetation composition — cover.</p>	<p>(1) At least 50% of vegetation cover should consist of species which indicate wet heath (as listed in the guidance) and at least 20% of the vegetation cover should consist of ericoid species*. (2) Less than 20% of vegetation cover should be made up of scattered native trees and scrub. Qualifiers: For target (2) exclude <i>Betula nana</i> and <i>Myrica gale</i>. (3) Less than 10% of vegetation cover should be made up of bracken. (4) Less than 1% of vegetation cover should be made up of non-native species. (5) Less than 1% of vegetation cover should consist of, collectively, <i>Agrostis capillaris</i>, <i>Holcus lanatus</i>, <i>Phragmites australis</i>, <i>Ranunculus repens</i>. (6) Less than 10% of the vegetation cover should consist of <i>Juncus effusus</i>. (7) None of the following should make up more than 75% of vegetation cover: (a) dwarf-shrubs; or (b) graminoids.</p>	<p>Targets (1 and 7) assessed against visual estimate at 4 m2 scale. Targets (2-4) assessed against visual estimate for as much of the feature as is visible while standing at a sample location. Targets (5 and 6) assessed at two scales, and should be met at both scales: (a) Against visual estimate at 4 m2 scale; and (b) Against visual estimate for as much of the feature as is visible while standing at a sample location. * For the purposes of this recording <i>Empetrum</i> should be regarded as 'ericoid'.</p>
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Monitoring protocols such as the JNCC models are set as generic assessments for high quality sites. For monitoring restoration programmes the Defra model could be used (DEFRA 2005a).

For Sweden, it is proposed that the following criteria are investigated for the evaluation of the conservation status of a specific site (e.g. Naturvårdsverket 2005):

- The surface area (in hectares), which should meet the definition of 'Northern Atlantic wet heaths'.
- The percentage of well-managed or well-grazed heath.
- Canopy coverage of trees and scrubs (typical target is ca 1%, but with a wide range between sites, and an upper target of 30%).

A minimum percentage of monitored study plots will have vascular plants characteristic of the habitat (examples of species proposed to be selected for single sites are *Erica tetralix*, *Gentiana pneumonanthe*, *Lycopodiella inundata* and *Pedicularis sylvatica*).

Site specific monitoring protocols rather than generic models could be developed, which take into account what is present on a particular site and what the nature conservation objectives are for that site. These measures of success can be tailored to suit sites, which may differ significantly across the natural range (Hurford and Schneider 2006).

## 2.4. Species specific measures

In general, the correct management of wet heaths such as extensive grazing, some minimal burning and cutting when required will be sufficient to maintain the important species associated with the habitat. However, all species have particular requirements and the specifics for three species are



given below as examples. The key for most rare species will be to get grazing levels right to ensure a varied mosaic of habitat from open ground, dwarf shrub cover to some scattered scrub.

### Tetrao tetrix

Over-frequent moorland burning and overgrazing can affect the habitat, leading to the formation of impoverished acidic grasslands and resulting in the loss of key food plants (Thom & Court 2000, UKBP 2008a), but the main threats to the species linked to management are connected with the regulation of the grazing inside the habitat.

- *Overgrazing*: the management indications of grazing for the benefit of the black grouse are the same as for the heathland habitat itself. Heavy grazing, especially along the lower edge of the moor, not only erodes the heather line, but it produces a short turf without the cover and food of tall grasses and herbs (Black Grouse UK 2008). In addition, the reproduction areas of the black grouse may need to be excluded from grazing to avoid damages to the eggs and to chicks between April and July, although extensive grazing will usually produce suitable breeding conditions. Lack of appropriate management on moorlands such as too little grazing and/or too little patch burning is a significant problem in parts of the UK. It can result in the decline of black grouse populations due to the lack of heather regeneration and insufficient young heather as a food source. [Sherry]

### Coenagrion mercuriale

A lack of appropriate levels of grazing to maintain open habitat, lack of ditch management to ensure water levels are maintained, and deepening of water channels resulting in loss of suitable habitat due are the key issues in terms of site management for southern damselfly (UKBP 2008b, Hampshire Biodiversity Partnership 2000).

- *Undergrazing and overgrazing*: both these management issues can affect the survival of southern damselfly. Sites need a certain level of poaching of flush areas, preferably by cattle (although ponies are also important). Sites thus need to be in active grazing management, particularly in order to control the dominance of purple moor grass and black bog rush, western gorse and willow scrub (Devon Biodiversity Action Plan 2005). A balance in grazing is required, as too much poaching will lead to the loss of food plants.
- *Site hydrology*: a need for shallow, open water streams (runnels) is vital for this species survival (Devon Biodiversity Action Plan 2005). If areas become overgrown and potentially dry up through lack of management (grazing etc.), or dry up due to water extraction, this will lead to the loss of this species.

### Maculinea alcon

The alcon blue butterfly and its host species *Gentiana pneumonanthe* (marsh gentian) are declining in all parts of their European distribution range. In Sweden, both species are associated with wet heath mosaics influenced by grazing and burning that help to maintain suitable "micro-habitats" for the host ant species (Appelqvist & Bengtsson 2007).

- *Undergrazing and overgrazing*: Lack of grazing has led to the scrubbing over of suitable open heathland resulting in a change of ant species communities and unfavourable conditions for both marsh gentian and alcon blue. Active afforestation has had the same effect. Overgrazing in the summer on the other hand, has in some places, led to a severe reduction in the number of stems of marsh gentian. The number of suitable egg laying sites for the alcon blue has thus been reduced.

- *Lack of burning:* The marsh gentian is a perennial plant species able to survive for a long time even under suboptimal conditions. In the long term however, regeneration from seed is necessary. The marsh gentian produces a large amount of very tiny seeds unable to germinate in a closed sward of grasses or dwarf shrubs. Burning seems to be the most important factor for creating patches of bare ground suitable for germination.

**Netherlands, Bijlsma pers.comm.:**

Timing and suitability of measures must always consider the life history and vegetation use of local characteristic fauna such as Alcan blue (*Maculinea alcon*) and European adder (*Vipera berus*). See 4.2.

**United Kingdom, Coupar:**

All species which are associated with this habitat are also associated with other habitats.

**United Kingdom, Sherry:**

A number of vascular plants (*Lycopodiella inundata*, *Mentha pulegium*, *Ranunculus tripartitus*, *Pilularia globulifera*, *Cicendia filiformis*) associated with lowland wet heath require damp bare ground with poaching by livestock e.g. on pond margins, along trackways etc. Management measures can be required to funnel sufficient stock into areas to create the right level of poaching, for example the use of fencing to create pinch points for livestock or encouragement of farmers to shepherd livestock into certain areas.

In Wales RSPB have recently produced an assessment of upland bird habitat requirements for moorlands and heathlands. The conclusion is that specific, targeted, management is required to provide key requirements for the following species on sites:

Hen Harrier, *Circus cyaneus*  
Merlin, *Falco columbarius*  
Black grouse, *Tetrao tetrix*  
Red grouse *Lagopus lagopus*  
Golden Plover, *Pluvialis apricaria*  
Curlew, *Numenius arquata*  
Ring Ouzel, *Turdus torquatus*  
Chough, *Pyrrhocorax pyrrhocorax*

For a second list of species specific habitats or conditions are required, but these are likely to be present without specific targeted management, will be provided through management for a species with a higher priority, or through management to achieve favourable condition for the habitat:

Dunlin, *Calidris alpina*  
Snipe, *Gallinago gallinago*  
Short-eared owl, *Asio flammeus*  
Whinchat, *Saxicola rubetra*  
Wheatear, *Oenanthe oenanthe*  
Stonechat, *Saxicola torquata*

## 2.5. Main constraints / bottlenecks and actual needs

### Germany, Ackermann

1. Landwirte sind nicht zur Extensivierung der Flächen und ihres Umfelds bereit

### The Netherlands, Bijlsma pers.comm.:

1. Lack of knowledge related to local and regional eco-hydrological conditions
2. Lack of knowledge of habitat requirements and life histories of characteristic species related to the timing and effectiveness of measures

### United Kingdom Coupar:

1. Value of habitat not recognised by land managers – or policy makers
2. Limited support to encourage appropriate management

Wet heath 'suffers' from being neither blanket bog, which is increasingly understood as an important habitat, nor dry heath which is more productive. It is also sometimes viewed as degraded woodland (degraded to the point that all the trees have been lost over extensive areas).

### United Kingdom, Sherry, pers.comm.:

1. A04.01.02 Insufficient support and funding to encourage mixed grazing
2. A4.03 Insufficient funding for pastoral systems. Lack of expertise in niche marketing
3. J01 Poor implementation of legislation or cross compliance measures – reluctance to deal with difficult issues
4. H04.02 Lack of Policy Framework to tackle issue across sectors
5. H02.06 Insufficient funding to tackle diffuse pollution or to implement buffer zones

## 2.6. Recommendations

### Germany, Ackermann:

1. Ankauf von Flächen (einschließlich von Pufferstreifen oder geeigneten Entwicklungsflächen)

### United Kingdom, Coupar SNH:

1. Raising awareness that it is a distinct habitat with its own characteristics and management requirements
2. Specific management prescriptions
3. Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.

### United Kingdom, Sherry:

1. A04.01.02 Insufficient support and funding to encourage mixed grazing

2. A4.03 Insufficient funding for pastoral systems. Lack of expertise in niche marketing
3. J01 Poor implementation of legislation or cross compliance measures – reluctance to deal with difficult issues
4. H04.02 Lack of Policy Framework to tackle issue across sectors
5. H02.06 Insufficient funding to tackle diffuse pollution or to implement buffer zones

## Cases / projects

## Sites

## 4030 – European Dry Heaths

### Summary

**Dry heaths are** found on free-draining acid-neutral soils and are dominated by ericoid plant communities. Species such as *Calluna vulgaris* (heather), *Vaccinium vitis-idaea* (cowberry), *Vaccinium myrtillus* (bilberry), *Empetrum nigrum* (crowberry) and *Erica cinerea* (bell heather) are found consistently throughout its range although the proportions of these species varies considerably. Some of the communities within this habitat type, such as coastal dunes with *Erica vagans* (Cornish heath), are particularly rare and listed as priority habitat types under the Directive. Other species such as *Ulex gallii* (Western gorse), *Potentilla erecta* (tormentil), *Festuca ovina* (sheep's fescue), *Athoxanthum oderatum* (sweet vernal grass), *Thymus polytrichus* (wild thyme), *Viola riviniana* (common dog violet) and *Danthonia decumbens* (heath grass) are frequent associates. Dry heaths are a widespread community across northern and western Europe. They also occur in southern Europe but are less common and often restricted to mountainous areas.

**Dry heaths are characterised by** dwarf shrub species. The height and structure of the sub-shrub canopy can vary markedly according to the incidence of burning/grazing as well as the degree of exposure, especially in upland areas. Dry heaths are often found as part of a complex dwarf shrub mosaic, especially when freer draining, more sandy soils are present within a wider peat-dominated soil matrix. Although often part of the same hydrological unit, their ecological processes and land use history are distinct.

This habitat has been characterised and shaped by past human influence. Evidence for widespread clearance of this habitat can be found during the Neolithic; historically these habitats have provided permanent pasture within mixed farming systems where they have not only provided grazing but also fuel, livestock bedding, winter fodder, thatching and even road building material. Their relationship with human communities has since changed and a loss of pastoralism has led to an increasingly fragmented, urbanised, scrubby character, especially in lowland areas.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad'. This is the case for all Regions except the Alpine where it is 'unfavourable-inadequate'. Dry heaths have been assessed as unfavourable by all countries in the Atlantic Region. Reported threats and pressures are mostly linked to inappropriate land management.

**The main reported threats and pressures** to dry heaths in the Atlantic Region are:

- Overgrazing leading to the loss of dwarf shrubs, which are substituted by species more resistant to grazing; usually leading to an expansion of grassland habitats.
- Undergrazing leading to a widespread degenerate phase where gaps form in the canopy allowing invasion by other species and eventual succession to woodland. The accumulation of woody material can also increase the risk of high-intensity, unplanned fires, particularly during summer months.

- Uncontrolled Burning can produce even-aged vegetation, especially on small sites, and lead to the loss of more sensitive lichen species; it can also cause the loss of dwarf shrub species as well as important invertebrate assemblages.
- Nitrogen Deposition will favour more competitive grass species by increasing nitrogen levels leading to fundamental changes in plant community composition and potentially increased pest outbreaks (heather beetle) from higher nitrogen concentration in plant tissues.
- Afforestation results in direct habitat loss and can also contribute to habitat fragmentation if poorly designed. Natural regeneration in and around existing plantations can also reduce the area of open habitat and lead to an increase in the predation rates of ground-nesting birds.
- Cultivation of dry heath for intensive agricultural use leads to direct habitat loss and limits the potential for future restoration through destruction of the seed bank and excessive nutrient enrichment.
- Inappropriate Restoration Methods have resulted in ill-structured and species-poor communities dominated by *Calluna*, *Deschampsia* or *Molinia* in the Netherlands where characteristic species (breeding birds, vascular plants, bryophytes) have now become locally or even regionally extinct.
- Land Abandonment leads to scrub encroachment and the eventual loss of this habitat through succession to woodland.
- Fragmentation increases patch isolation through loss of habitat which leads to the ecological extinction of remaining patches through inbreeding and a loss of recolonisation potential.
- Invasive Species such as *Pteridium aquilinum*, *Ulex gallii*, *Rhododendron ponticum* and *Gaultheria shallon* can become dominant through inappropriate management and can lead to the loss of dry heath communities.
- Pesticide Regulations can lead to the banning of herbicides (e.g. Asulox) that provide effective control measures for invasive species ultimately leading to the loss of dry heaths in some countries through competitive displacement.
- Recreation activities can lead to significant erosion problems and the loss of dry heath vegetation.
- Renewable Power Generation infrastructure can cause significant loss of habitat.
- Artificial Fertilizers used on adjacent land leads to pollution of groundwater and an increase in dominant grass species.
- Urbanisation not only leads to a direct loss of habitat but also creates pressures that can change the viability and composition of dry heath communities through increased fragmentation, disturbance, fire, erosion, etc.

The principal **management measures** for this habitat include:

- Grazing - is used to arrest successional change and stop woodland from colonising open areas.
- Culling of wild herbivore populations (e.g. deer) may be necessary in some areas to control grazing pressure.
- Burning - is used in a similar way to grazing and regular controlled burning is generally recommended for dry heaths provided it is coupled with effective post-burning monitoring.
- Cutting - taken in combination with other measures, this is an essential tool for the management of dry heaths, especially on lowland areas where it mimics traditional practices that previously helped to control invasive species such as *Ulex gallii*. As with burning, cutting should be done over relatively small areas on a rotational basis.
- Scrub Removal - is essential on dry heaths where grazing or regular cutting has failed to prevent the establishment of tree species in open areas. This measure should be used as

part of a phased restoration programme where future management ensures that any recolonisation is controlled through a sustainable grazing management system.

- Invasive Species Control - the active management of habitats to remove invasive plant species is essential.
- Restoration - is undertaken on degraded heaths and requires the removal or reduction of the factor(s) that led to the original degradation. Specific actions are determined by the circumstances of the individual sites.
- Spatial Planning - linked to the planting of new woodlands and forests/location of renewable energy sites/etc should be integrated with the needs of wet heath species and should ensure that areas of existing wet heath, outside Natura sites are not planted all built on, and that barriers to movement are not created at a landscape scale.
- Visitor Management - 'Duckboards' and 'honey pot' areas should be used to control the impact of visitors on sensitive dry heath vegetation and associated ground-nesting birds during the breeding season.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- An assumption that traditional forms of (intensive) land use are suitable for restoring or enhancing characteristic biodiversity;
- A lack of management plans, at the landscape level, that also include woodlands and extensive agriculture;
- Poor understanding of the relationship between conservation measures and biological outcomes at the individual site level;
- Use of overly simplistic compliance monitoring and a lack of clarity over key conservation objectives as well as future 'climate-proofing';
- Lack of appropriate training of advisers/scheme managers and an inability to fully understand the issues;
- Lack of joined up thinking – threats to amphibians and reptiles, ironically, often created by conservation practitioners;
- Opposition to 'open habitats' and their management by pro-woodland conservation organisations and campaigners;
- Lack of knowledge of habitat requirements and life histories of characteristic species to be able to determine the timing and effectiveness of measures;
- Value of habitat is not recognised by land managers or policy makers;
- Limited financial support to encourage appropriate management;
- Poor implementation of legislation and/or cross-compliance measures – reluctance to deal with difficult issues and take action; and
- Lack of suitable policy frameworks to tackle cross-sectoral issues.

**Solutions** to the pressures, threats and bottlenecks may include:

- Clear funding schemes developed with a full understanding of conservation needs supported by the evaluation of biological outcomes rather than just the delivery of management actions;

- Clearer duties placed on public bodies linked to a need to assist with protection and conservation of dry heath sites;
- Conservation goals/outcomes that account for the complexity and needs of whole assemblages rather than individual species;
- Effective monitoring regimes that link habitat management to a range of biological outcomes;
- Education and training to raise awareness of the importance of heathland, as well as the particular measures needed to conserve its full range of biodiversity;
- Development of policies and incentive schemes that encourage traditional pastoral systems including funding for heavy stock, shepherding etc.;
- Education, training and support for marketing products from pastoral systems e.g. Heathland Beef project in Pembrokeshire or Anglesey Wildlife Friendly Produce labelling scheme;
- Influencing policies on atmospheric deposition particularly on the wider environmental impacts, e.g. human health;
- More accessible funding for INNS eradication/control through European structural funds;
- Financial support schemes that encourage extensive, mixed grazing systems as well as the development and marketing of niche products;
- Raising awareness of dry heath as a distinct habitat with its own characteristics and management requirements;
- Develop and implement specific management prescriptions; and
- Develop and implement specific measures within agri-environment schemes and ensure sufficient funding to encourage uptake (and meet demand).

## 1 Description of the habitat

Mesophile or xerophile heaths formed on a range of free-draining soils including rankers, brown earths, brown podzolic soils and podzols, which generally occur over acidic parent rock or on calcareous bedrock mantled by pervious base-poor soils [Sherry] on siliceous, podsolic soils in moist Atlantic and sub-Atlantic climates of plains and low mountains of Western, Central and Northern Europe (EC 2007b).

Heaths on freely draining soils dominated by dwarf shrubs such as heather (*Calluna vulgaris*) and heaths (*Erica* spp) are widespread in northern and Western Europe. They also occur in the south of Europe but are less common and often restricted to mountainous areas. This is a semi-natural habitat resulting from past agricultural management including grazing and burning. Coastal dunes with Cornish heath (*Erica vagans*) are the priority habitat type 4040. (EC 2007a) (ETC BD 2012).

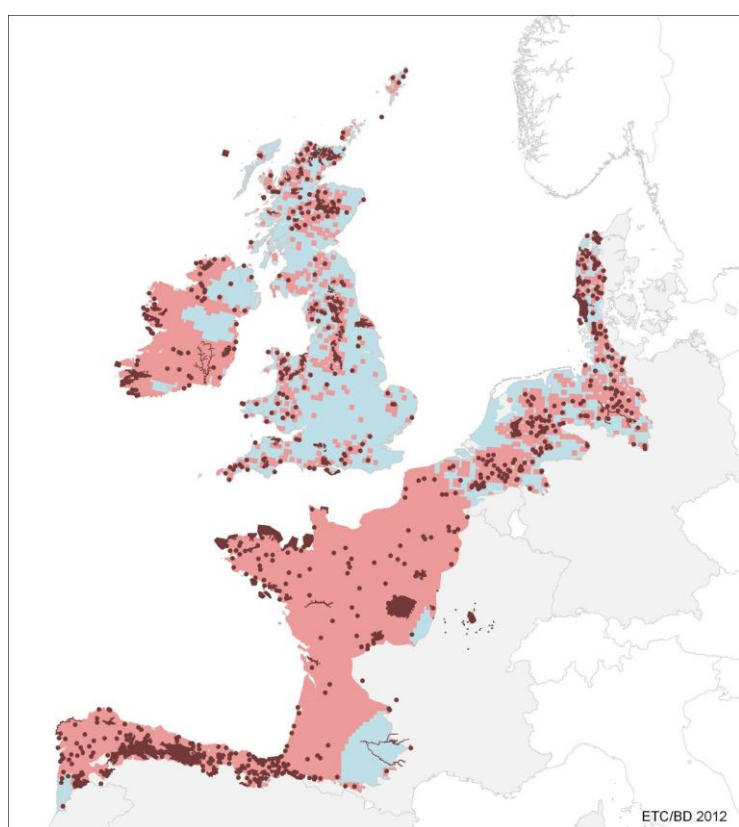
### 1.1. Distribution



**Table 61 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

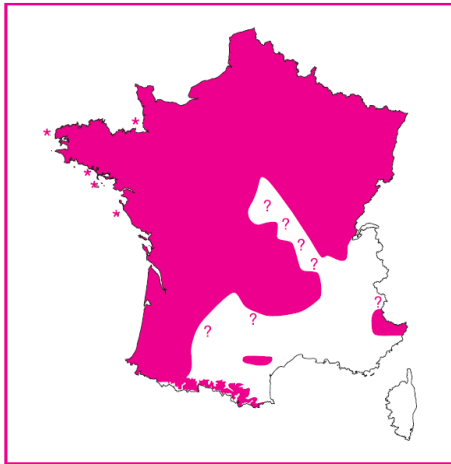
	BE		DE			DK		ES				FR				IE	NL		PT		UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	39	74		104	353	37	55	15	149		153	38	138	116	28	54	22	5		33	166
habitat area (ha)	7913	2077		11654	25705	10299	6921	5898	304923		380404	10481	36004	20824	11393	38745	8444	61031		179262	207642

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 0-50%<sup>76</sup>. This means that actions should be taken also outside the Natura 2000 network to reach the favourable conservation status for this habitat type.



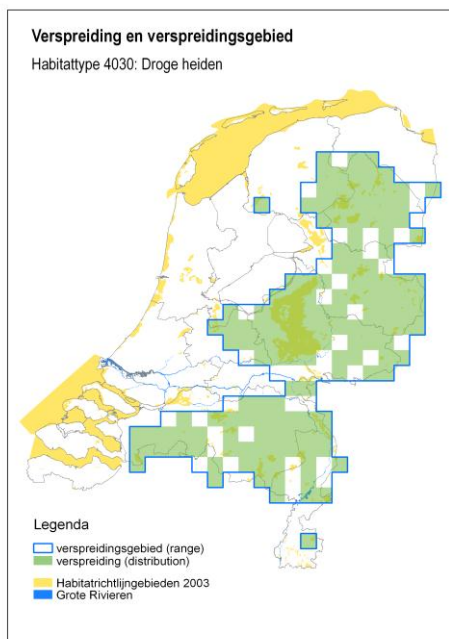
**Figure 13 Map of SCIs proposed for the European dry heaths & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

<sup>76</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



Dry heaths are widely distributed in France, but its development is especially important in the West, the Southwest and the mountains. (Muséum national d'Histoire naturelle [Ed] 2003)

Germany: Dry heaths are spread all over Germany. Particularly well-developed reserves are found in the Northeast and Northwest German lowland and partly also in the low mountain ranges. (Bundesamt für Naturschutz n.d.)

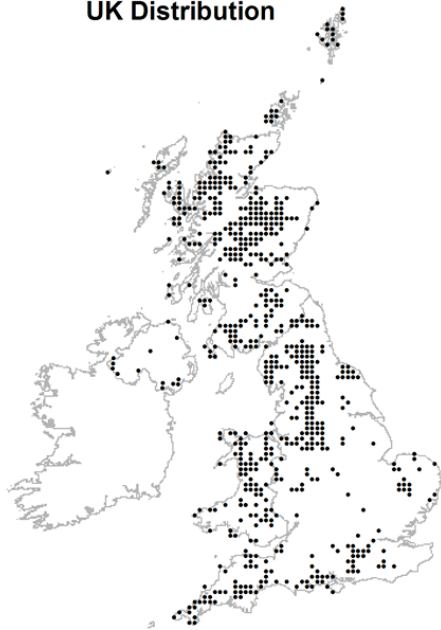


In the Netherlands the habitat type is scattered over the Pleistocene sands. The focus is on the moraines (Utrecht Ridge, Veluwe, Salland Twente) and on the river dunes in the East Meuse Valley. Total area is estimated at 25,200 ha. (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.)

In Wallonia (Belgium), dry heaths were once a widespread landscape in the middle and high Ardennes and in areas with poor soil, sandy (Lorraine, north of the Mons Basin, the Dyle basin) or shale (Fagne-Famenne). Currently, they are largely restricted to military areas and protected areas,

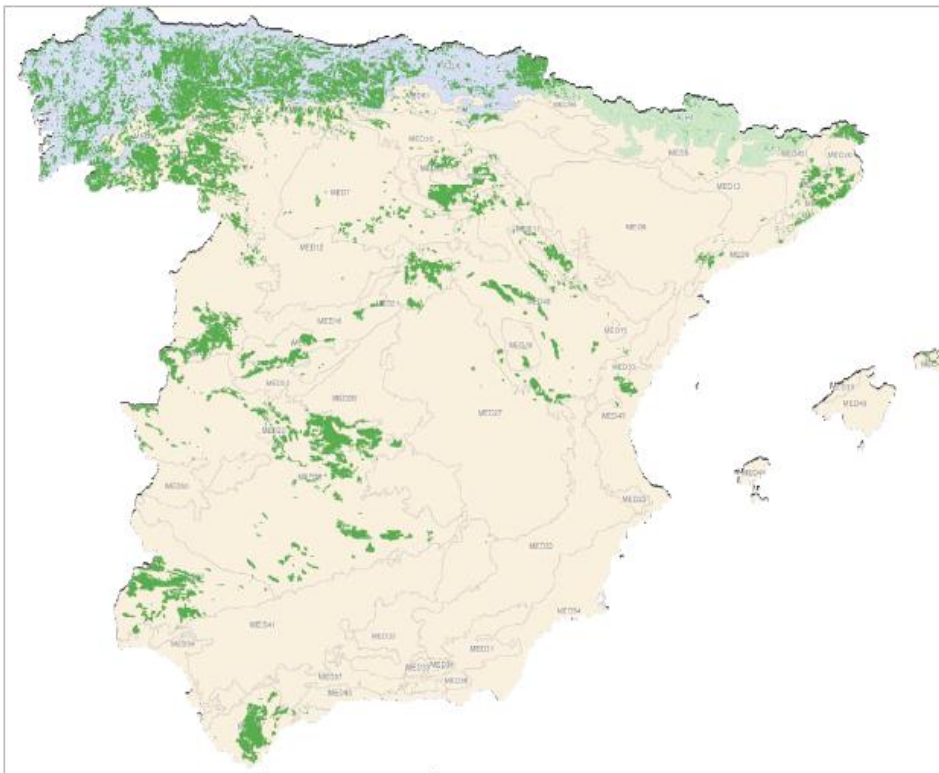
mainly on the high plateaux of the Ardennes. Occasionally species typical of dry heaths reappear after logging of forests. (DGARNE n.d.)

**UK Distribution**



UK Distribution ((Joint Nature Conservation Committee n.d.)

Spain (VV.AA. 2009):



## 1.2. Main features

For the Netherlands, other characteristics of a good structure and function are described as:

- Dominance of dwarf shrubs (> 25%);
- Presence of high, old heather;
- Varied vegetation structure;
- covering of grasses low (<25%) and scrub (<10%);
- Optimal functional scope: from tens of hectares.

Compared to habitat type H2310, in the Netherlands restricted to drift sands the soil is generally richer in minerals. [Bijlsma] This is true on loamy soils, but not on tertiary sands (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.).

Dry heath is a naturally occurring community, having been formed over millions of years, due, in part, to the interactions of abiotic factors such as climate and soil conditions, competition between species, and possibly also as a consequence of grazing from large herbivores (Tubbs 2001, Luxmoore & Fenton 2005 in Hampton 2008). Its present occurrence and variability is however related to human activities and much of the current extent of dry heath, particularly in the lowland, is anthropogenic in origin. [Sherry]

The open heathland complex found across Europe is due to agricultural practices such as domestic grazing, burning and cutting, which began to be developed around 6000 years ago. These practices arrested succession to woodland once the areas were cleared. Without traditional forms of management some areas would no doubt have succeeded to scrub and then back to open woodland. However, the reduction of soil nutrient levels through removal of any former canopy, coupled with leaching of nutrients in areas of high rainfall means that many areas may no longer support significant tree growth. [Sherry]

## 1.3. Ecological requirements

In Spain the heaths that make up this habitat are associated with acid, sandy and oligotrophic substrates, particularly limiting in soluble nitrogen and phosphorus and with high levels of soluble aluminum. They are developed on lithosols or shallow soils in areas exposed to wind, so they are more frequent on ridges and mountaintops. They are not found in areas with an average annual rainfall below 600 mm. They are more abundant in regions and areas with oceanic or softened Mediterranean regimes, so they do not appear in high mountain areas, where they are replaced by alpine heaths (habitat types 4060) or by endemic oro-Mediterranean heaths (habitat type 4090). They tolerate dry summer periods, but not very long nor extreme. Since they require high levels of brightness they are associated with open landscapes without tree cover or with a limited presence of trees. They are associated with the recurring presence of forest fires, particularly heaths of the Atlantic and Mediterranean subtypes (Gill & Groves 1981 and Ojeda 2001 in (VV.AA. 2009)). This association with fire seems to exist before the presence of humans in these ecosystems (Daniau et al. 2007 in VV.AA. 2009) and it results not just in the resistance of the habitat to forest fires, but also in

a dependency of the majority of species on the action of fire to complete their life cycles (VV.AA. 2009).

Belgium (Flanders): Belgium (Flanders): Acid to neutral, nutrient-poor and dry soils, usually with a sandy texture, sometimes more loamy. Usually a clear podzol soil profile is developed, with a dark and heavily humic top layer followed by a light, ash coloured leaching layer which in turn rests on a hard, dark brown sedimentation layer in which often iron accumulation strips are visible (Van Uytvanck et al. 2010)

The Netherlands: not only on typical podzols but on brown podzolic soils and acidic loam as well. Old-growth heathland that escaped intensive management for 50 year or more is now so rare that nature managers and ecologists are not familiar with its specific biodiversity. This value is most prominent on typical podzols where ectorganic humus profiles with amorphic ('peaty') layers and high moisture capacity develop. In this relatively moist 'dry heathland' heather regenerates by layering making the heathland more resilient to drought events. On loamy soils, extensive management results in the colonization of *Vaccinium*-species". The Netherlands: subtypes are not distinguished but 4030 includes *Vaccinium*-*Calluna*-heaths. [Bijlsma]

In the UK European dry heaths typically occur on freely-draining, acidic to circumneutral soils with generally low nutrient content. Ericaceous dwarf-shrubs dominate the vegetation. The most common is heather *Calluna vulgaris*, which often occurs in combination with gorse *Ulex*spp., bilberry *Vaccinium* spp. or bell heather *Erica cinerea*, though other dwarf-shrubs are important locally. Species-rich forms of dry heath (so-called chalk heath and limestone heath) occur where acid surface deposits overlie calcareous materials. Such heaths contain unusual combinations of heath and calcareous grassland species, such as common rock-rose *Helianthemum nummularium* and salad burnet *Sanguisorba minor* ssp. *minor*, and are very rare in the UK. Other unusual forms of species-rich heath occur in Scotland on base-rich glacial drift or on moderately base-rich rocks, such as those on Rum in the Inner Hebrides (JNCC Website). [Sherry]

## 1.4. Main subtypes

Spain (VV.AA. 2009): Atlantic, Continental and Mediterranean subtype.

Belgium (Wallonia) (DGARNE n.d.): Several types of heathland have been described in Wallonia.

- Heaths on poor sandy and acidic soils, mainly characterized by the presence of heather and broom.
- Common blueberry and heather are found together on the acidic and poor soils of the Ardennes plateau, in a cool and damp climate.
- On acid shales of Fagne-Famenne, there may be a variant slightly richer in species.

For the UK, key subtypes identified are based on the UK National Vegetation Classification for Mires and Heaths (Rodwell 1991). Twelve NVC types in Britain meet the definition of this habitat type (JNCC website):

- H1 *Calluna vulgaris* – *Festuca ovina* heath
- H2 *Calluna vulgaris* – *Ulex minor* heath
- H3 *Ulex minor* – *Agrostis curtisii* heath
- H4 *Ulex gallii* – *Agrostis curtisii* heath
- H7 *Calluna vulgaris* – *Scilla verna* heath
- H8 *Calluna vulgaris* – *Ulex gallii* heath

- H9 *Calluna vulgaris* – *Deschampsia flexuosa* heath
- H10 *Calluna vulgaris* – *Erica cinerea* heath
- H12 *Calluna vulgaris* – *Vaccinium myrtillus* heath
- H16 *Calluna vulgaris* – *Arctostaphylos uva-ursi* heath
- H18 *Vaccinium myrtillus* – *Deschampsia flexuosa* heath
- H21 *Calluna vulgaris* – *Vaccinium myrtillus* – *Sphagnum capillifolium* heath [Sherry]

### 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified through expert judgement a number of species under the Habitats and Birds Directive associated with European dry heaths and provided conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 62 Species associated with European dry heaths (for legend, see introduction of chapter 3)<sup>77, 78, 79</sup>**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Lacerta agilis</i> 1261	X							X		
<i>Maculinea arion</i> 1058	X									
<i>Lanius collurio</i> A338	X							X		
<i>Lullula arborea</i> A246	X							X		
<i>Anthus campestris</i> A255	X									
<i>Burhinus oedicnemus</i> A133	X									
<i>Lanius excubitor</i> A340	X									
<i>Saxicola torquata</i> A276	X							X		
<i>Sylvia cantillans</i> A304	X									
<i>Sylvia undata</i> A302	X									
<add possible species reported byMS here>										

**Table 63 Annex II and IV species associated to European dry heaths and their Conservation Status at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K	Species name	Group		ES	FR	UK	REGION
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<sup>77</sup> the reference to “introduction of chapter 3” is not clear; this table should include all typical (characteristic) species used in the evaluation of Structure & Function for Article 17 reporting and SDFs [Bijlsma]

<sup>78</sup> Add for UK (wales) *Asio flammeus*, *Circus cyaneus*, *Falco columbarius*, *Numenius arquata*, *Numenius arquata*, *Pluvialis apricaria*, *Anthus pratensis*, *Tetrao tetrix*, *Lagopus lagopus*, *Caprimulgus europaeus*, *Pyrrhocorax pyrrhocorax*, *Carduelis flavirostris*, *Anthus trivialis*, *Alauda arvensis* subsp. *arvensis/scotica*, *Emberiza citrinella*, *Plejebus argus*, *Viola lactea*, *Chamaemelum nobile* [Sherry]

<sup>79</sup> Additional associates species should be mentioned on the list: *Coronella austriaca*, *Rana arvalis*, *Bufo calamita* [Zollinger]

code							
1058	<i>Maculinea arion</i>	Invertebrates	range	XX	U2	XX	XX
			population	XX	FV	U1	XX
			habitat	XX	U2	U1	XX
			future	XX	U2	U1	XX
			overall	XX	U2	U1	XX

N2K code	Species name	Group		DE	DK	FR	NL	UK	REGION
1261	<i>Lacerta agilis</i>	Reptiles	range	FV	FV	U2	U1	U1	U2
			population	U1	XX	U2	U1	U1	U2
			habitat	U1	XX	U2	U1	U1	U2
			future	U1	XX	U2	FV	FV	U2
			overall	U1	XX	U2	U1	U1	U2

## 1.6. Related habitats

In the Netherlands, open woodland and heathland landscapes with a major contribution of European dry heaths often include Species rich *Nardus* grasslands (H6230) and *Juniperus communis* formations (H5130) on similar dry and relatively mineral rich soils, Inland dunes (H2330), Dry sand heaths (H2310) and Old acidophilous oak woods (H9190) on the most nutrient poor drift sands and Wet heaths (H4010) and Natural dystrophic lakes (H3170) on stagnating soils. [Bijlsma]

## 1.7. Ecological services and benefits

The diverse environmental, social and cultural ecosystem services provided by dry heaths include carbon storage, biodiversity, water provision, flood protection, aesthetic/recreational value, archaeological/historical value and economic value from tourism, sporting enterprises and grazing. [Sherry]

## 1.8. Conservation status

**Table 64 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see start of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
4030	European dry heaths	range	FV	FV	FV	XX	FV	FV	FV	FV	FV	FV
		area	U1	FV	XX	XX	U2	FV	U1	FV	FV	U2
		structure	U2	FV	U2	XX	U1	U1	U2	XX	U2	U2
		future	U1	FV	U2	XX	U1	U1	U1	FV	U2	U2
		overall	U2	FV	U2	XX	U2	U1	U2	FV	U2	U2

Assessed as 'unfavourable-bad' in all regions where present except for the Alpine region where it is assessed as 'unfavourable-inadequate'. The habitat is also assessed as unfavourable by most countries, with a trend to be more favourable in southern Europe where the habitat is rare, as in Italy. Reported threats and pressures are mostly linked to inappropriate land management. (Summary sheet of the online report on Article 17 of the Habitats Directive).

## 1.9. Trends

**Belgium** (Flanders): stable 1994-2006 (De Saeger et al, 2008)

**Netherlands** (Ministerie van Economische Zaken, Landbouw en Innovatie n.d.):

The area of dry heath in the Netherlands is greatly reduced between approximately 1850 and 1950 by land reclamation and planting of coniferous forest. Later the quality greatly reduced by acidification, eutrophication and poor management.

Recent developments: During the period of 1994-2004, an improvement has occurred in the air quality, and in the shape of the recovery control that is applied. Especially to take greater account of the fauna, sod cutting has in many places been reduced or completely stopped. Moreover, during or after sod cutting additional local measures for targeted species have been applied. Since 1950, the distribution pattern is more or less stable. Since 1950 the surface of the dry heath did not substantially reduce by clearing and planting. Since that time, however, the area of species-rich heathland further reduced by overgrowing grasslands and large-scale regeneration of the heath itself. Many areas are (by fragmentation) becoming so small that the characteristic species are not or barely lasting.

UK: Range stable 1994-2006; area stable 1990-1998 ((Joint Nature Conservation Committee n.d.)

In the UK nearly all dry heath is semi-natural, being derived from woodland through a long history of grazing and burning (JNCC website). As early agricultural practices began, woodland areas were cleared for grazing, cutting turf, cutting for fuel and harvesting for fodder, and large open heathland communities began to develop (Gimingham 1992, Webb 1998). For thousands of years people worked the heaths, creating, maintaining and reshaping this unique environment, as a valuable source of livelihood to many communities. [Sherry]

Traditional management has continued to maintain heathland. However, across Europe there is the potential for declines in grazing, burning and cutting which may have a profound impact on the heathland community. During the middle part of the last century, farming methods altered with the development of artificial fertilisers, herbicides and modern forms of machinery for ploughing and drainage. Farmers were encouraged to 'improve' heathland areas through ploughing where possible, but also domestic stock numbers rose significantly with the introduction of farm subsidies. Upland heathland areas in the UK in particular suffered from overgrazing, and it is only since the headage-based subsidy was replaced in 2005 that numbers of animals on heaths are no longer encouraged to excess, although grazing levels in some areas remain above those recommended for management of European dry heath. In the future, there is a risk that some heathlands that have been overgrazed may no longer be agriculturally viable, and will end up ungrazed. [Sherry]

## 1.10 Main pressures and threats



**Table 65: Main pressures to European dry heaths as reported by MS in 2007 and their importance to associated Annex II and IV species (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	European dry heaths	<i>Maculinea arion</i>	<i>Lacerta agilis</i>
Cultivation	x		x
Fertilisation	x		x
Grazing	x	x	x
General Forestry management	x		x
Burning	x		
Urbanised areas, human habitation	x		x
Communication networks	x		x
Pollution	x		
Biocenotic evolution	x		x
Interspecific floral relations	x		

**Table 66 Main threats to European dry heaths as reported by MS in 2007 and their importance to associated Annex II and IV species (for legend, see introduction of chapter 3)**

Threat description (2nd level)	European dry heaths	<i>Maculinea arion</i>	<i>Lacerta agilis</i>
Cultivation	x		x
Fertilisation	x		x
Grazing	x	x	x
General Forestry management	x		x
Urbanised areas, human habitation	x		x
Communication networks	x		x
Pollution	x		x
Biocenotic evolution	x		x
Interspecific floral relations	x		

**Belgium (Flanders) (De Saeger et al, 2008):**

Main pressures:

- 141 - abandonment of pastoral systems
- 161 - forest planting
- 620 - Outdoor sports and leisure activities
- 702 - air pollution
- 730 - Military maneuvers
- 953 - acidification
- 979 - other forms or mixed forms of interspecific floral competition

Main threats:

- 620 - Outdoor sports and leisure activities
- 702 - air pollution

- 953 - acidification
- 979 - other forms or mixed forms of interspecific floral competition

**Belgium** (Wallonia) (D GARNE n.d.):

Dry heaths are, like the ancient rangelands, endangered in Wallonia. Most were destroyed during the twentieth century by urbanization (especially in Brabant and Hainault) or cultivation (mainly in the Ardennes). The others were encroached with pines spontaneously or are afforested. Those that remain are dying and overgrown with bracken (*Pteridium aquilinum*), Wavy hairgrass (*Deschampsia flexuosa*), and Purple moor grass (*Molinia caerulea*) (scrub and grass encroachment). This encroachment is related to land abandonment but also to the general eutrophication of soils affected by air pollution (acid rain, nitrogen deposition). Dry heaths are also often small and isolated in an urban, agriculture or forestry matrix and, in general, in the process of afforestation. Even in protected areas, their maintenance is far from optimal. They really only survive in large military zones of Lagland and Elsenborn where activities are compatible with their maintenance.

In **Germany**, since the habitat type is dependent on an extensive use, any change in land use (conversion, reforestation, etc.) poses a risk to the habitat. Nutrients from the environment as well as intensive recreational use affect the quality of the habitat type. (Bundesamt für Naturschutz n.d.)

Main pressures in the **UK** include (Joint Nature Conservation Committee n.d.):

- 140 - Grazing;
- 141 - Abandonment of pastoral systems;
- 180 - Burning;
- 400 - Urbanised areas, human habitation;
- 401 - continuous urbanisation;
- 402 - discontinuous urbanisation;
- 500 - Communication networks;
- 510 – Energy transport;
- 590 - Other forms of transportation and communication;
- 702 – air pollution;
- 954 - invasion by a species.

Main threats:

- 140 - Grazing;
- 141 - Abandonment of pastoral systems;
- 180 - Burning;
- 402 - discontinuous urbanisation;
- 750 - Other pollution or human impacts/activities;
- 954 - invasion by a species.

In **Ireland**, afforestation, over-burning, over-grazing, under-grazing and bracken invasion pose the main threats to this habitat (NPWS 2008).

Main threats identified in Portugal include (ALFA 2004):

- Physical destruction by building infrastructure and housing;
- Trampling.

The most serious threats to this habitat type in **Denmark** are eutrophication, and too much and/or wrong maintenance, resulting in scrub invasion (scrub invasion is not an anthropogenic impact, but the result of management history) (Søgaard et al. 2007). Large parts of the heaths are being invaded by scrub, especially mountain pine *Pinus montana*, aspen *Populus tremula*, oak *Quercus*, and juniper *Juniperus*. Provided that the heaths are used/maintained, the most serious threat to the West European heaths is the increased fallout of atmospheric nitrogen. The increased eutrophication of the soil, including the raw humus layer, has caused many heaths in the Netherlands and England to develop into grass heaths. Locally, the decrease in heather may further be accelerated by the increased frequency and intensity of attacks by the heather-leaf beetle, apparently due to the increased nutrient content of the heather's.

#### **Netherlands, Bijlsma pers.comm.:**

1. H04 acid rain and nitrogen-input mainly from agriculture including (eventually) nitrogen enrichment of local groundwater
2. A03 former land use and recent (mainly post 1980) intensive nature management including sod cutting and mowing
3. J03.03 destruction (afforestation, urbanisation) and fragmentation resulting in loss of habitat connectivity especially pressing for small fauna such as butterflies and reptiles

In the Netherlands 1.1 and 1.2 have resulted in ill-structured and species-poor vegetations dominated by *Calluna*, *Deschampsia* or *Molinia* on impoverished soils with respect to base cations and phosphorous. Many once quite common characteristic species (breeding birds, vascular plants, bryophytes) became locally or even regionally extinct.

#### **United Kingdom, Coupar pers.comm.:**

1. Grazing - inappropriate.
2. Burning - inappropriate.
3. Forest Planting and regeneration – native and non-native.
4. Renewables including wind energy and other built development.
5. N pollution

Grazing, whether by wild deer or domestic livestock, usually sheep, has a generally beneficial effect on the habitat when at low intensities. However, heavy grazing adversely affects species structure and composition, potentially resulting in the loss of heather *Calluna vulgaris* and the associated trampling can lead to loss of cover, soil disturbance and erosion.

Burning, where it is too intense or too frequent or combined with heavy grazing has similar effects and can also result ignition of the soil leading to erosion. It can also be damaging to wildlife, particularly if carried out during the bird breeding season.

Forest Planting results in direct habitat loss and can also contribute to habitat fragmentation if poorly designed. New native woodlands can be more readily integrated into a heathland context than new productive forestry, but design and methods are critical. Much dry heathland is derived

from former areas of pine woodland and there are pressures to restore areas of this now highly fragmented and reduced in extent. Regeneration of woodland is an issue on some lowland heaths in particular, especially where traditional management practices have been abandoned.

The construction of large wind farms in the uplands results in loss and fragmentation of dry heath. This is sometimes a consequence of avoiding areas of blanket bog and other wet habitats which are more vulnerable to disturbance. Tracks and pipelines associated with small-scale hydro schemes have similar effects as do tracks associated with agriculture and game.

Nitrogen pollution, particularly where associated with heavy grazing, can result in the replacement of dwarf shrubs by graminoids.

#### United Kingdom, Gent pers.comm:

1. I02 problematic native species : KEY ISSUE is loss of 'open habitats' through invasive plant/ scrub species. Active management is required. Controlling the use of some selective biocides may actually be harmful to achieving effective management of heaths – notably ASULOX (a fern specific herbicide) that allows effective management of bracken: ALSO I01 - invasive non-native species (Same issues, different species (Notably *Rhododendron ponticum*, *Gaultheria shallon*;
2. B01 forest planting on open ground: KEY ISSUE is not on-going planting but rather the legacy from previous planting; e.g. self-seeded trees. There is a huge on-going resource requirement to maintain open habitats
3. E01 Urbanised areas, human habitation; URBANISATION creates pressures through fragmentation of habitats and impacts of people through disturbance (birds) fires, etc
4. A04.02 non intensive grazing: GRAZING can be a valuable management tool for open habitats but primarily where this is carried out by people looking at CONSERVATION outcomes – grazing, per se, is not an outcome it is a tool. The basic lack of understanding about impacts of using this tool, the over simplification of heathland management ideas, etc, has clouded the vision of practitioners and results in a poorly thought through campaign of conservation action.
5. J01.01 burning down: FIRES are but one of a series of issues and their significance will depend on geographic location and size of site

The main issue is ensuring a good mosaic of open habitats that support the range of species. Neglect results in loss through succession (or through 'abuse') while management brings with it the risk that this can be too heavy handed or fail to take account of the range of species or habitat features needed.

#### United Kingdom, Sherry, pers.comm.:

1. A04.01.02 Intensive sheep grazing (mainly upland)
2. A04.03. Abandonment of pastoral systems, lack of grazing
3. J01 Fire and fire suppression
4. A04.02 Air pollution, airborne pollutants Nitrogen-input
5. I01 Invasive non-native species (particularly *rhododendron ponticum* but also non-native conifer regeneration)

Impacts differ in upland and lowland areas. In the uplands intensive grazing is still an issue in many areas with ericoid species being suppressed by grazing. Acid grassland has invaded into areas of former heath leading to fragmentation. Where grazing has been reduced on formerly heavily grazed areas vegetation recovery depends on sward composition. For example where ericoids have been suppressed but present in the sward recovery can be relatively quick. However where ericoids are scarce re-colonisation is slow and sites may go through a phase of dominance by rank grass. Burning is an issue with either too regular burning reducing species diversity, particularly of lower plants or abandonment of moorland management on formerly managed areas which has associated species impacts. In some areas burning is not appropriate particularly where there has been a long burn-free period (30 year +) or where sensitive bryophyte-rich heaths are present. In such instances the vegetation may have developed a more "natural" cycle and show structural complexity without burning or mechanical management. Non-native species particularly rhododendron are a particular problem in the acid uplands with vast areas being invaded by the species this can lead locally to habitat loss.

In the lowlands abandonment of pastoral system is the main threat with many heathlands being abandoned or neglected. In Wales the dominance of *Ulex galli* in the canopy is a major threat and seems to be as a result of the cessation of gorse cutting and reduction in grazing. Burning can exacerbate the problem favouring the regeneration of *Ulex*. Many small lowland heaths are not economic to graze with the appropriate stock (mixed grazing). Repeated burning has reduced structural and species diversity in some instances.

Nitrogen impacts poorly understood but are thought to encourage grass invasion. Little data available but critical load for the habitat is exceeded in many areas.

## 2 Conservation management

### 2.1. Main conservation requirements

**Germany:** The dry heath vegetation should be maintained through extensive grazing of sheep and goats for the discharge of nutrients. Section wise turf cutting or alternatively occasional burning stimulate the rejuvenation of the remaining plants. The bushes should be partially removed. Keeping the vegetation open by military use may be sufficient. Buffer zones should be established to minimize the input of nutrients. (Bundesamt für Naturschutz n.d.)

**Netherlands, Bijlsma pers.comm:**

1. Extensive grazing to create or maintain mosaics of dwarf shrubs, grasses, herbs and bare soil with a varied vegetation structure including mature and degenerate heather
2. Removal of trees and shrubs (especially *Prunus serotina*) to prevent succession to woodland
3. Long-term non-intervention management (except for 2.2) to restore gap-phase dynamics in heather and humus profile development, especially on loam-poor soils (podzols)

**United Kingdom, Coupar pers.comm.:**

1. Light grazing
2. Rotational prescribed burning

This habitat requires requires light grazing and rotational burning to ensure diversity of structure and to support a full suite of associated wildlife.

**United Kingdom, Gent pers. comm.:**

1. I02: I01 - active management of habitats to remove invasive plant species that will 'crowd out' the ground vegetation. There are many techniques – with differing outcomes. Many are being carried forward BUT there is insufficient attention being paid to desired end state and ensuring management is not harmful to key interests. Grazing and burning are too frequently being advocated without adequate consideration of their value in specific circumstances. These approaches have their place but they are not a universal panacea! Different species have different needs (see Webb, Drewitt and Measures 2010)
2. Clear conservation objectives/ goals: the complexity of conservation management needs to be addressed via clarity of objectives for habitats features and for characteristic (including, but not only, Habitats Directive priority species). More effort is needed to set management plan frameworks that take account of the range of conservation goals and help guide integration of issues to achieve favourable conservation status for many habitat and species features.
3. Effective monitoring of outcomes: not simply compliance monitoring of activity. Locally developed monitoring plans should be developed to take account of all the conservation objectives and allow flexibility to adapt management to meet species and habitats needs
4. Habitat connectivity: site measures need to be augmented through a landscape level vision –but this should not loose sight of needs of species within the landscape
5. Effective site safeguards & sustainable funding are needed to secure long term prospects

The tendency is to think of heathland as a uniform, treeless block of ericaceous vegetation. The biodiversity characteristic of such heathland requires an equally diverse structure and composition of habitat features. Rarely is this complexity and managed 'dynamism' given the prominence it needs

**United Kingdom, Sherry, pers.comm.:**

1. A04.01.02 Extensive grazing with mixed livestock (sheep, cattle, ponies)
2. A04.03 Maintenance or re-establishment of traditional pastoral systems
3. J01 Improved burning management and where appropriate no burning
4. H04.02 Reduce nitrogen-input and non-native conifers
5. I01 Accurate inventories of INNS, physical/chemical control or eradication, continuing management to prevent re-colonisation

The principles of good heathland management are well understood but it continues to be difficult to apply these across the landscape

## 2.2. Management measures

United Kingdom (JNCC 2009):

- more effective livestock management to address: over-grazing (uplands); under-grazing (lowlands);
- improved burning management practices; [Sherry]
- Habitat restoration/creation at landscape or catchment scale;
- management (including tree/scrub cutting) to reverse abandonment;
- reduction in fragmentation by improving habitat connectivity [sherry].

More detailed measures for the UK include (Joint Nature Conservation Committee n.d.):

- Protection within SACs

Almost 19% of the current resource lies within SACs with management measures specifically aimed at maintaining and enhancing the features for which they are designated, and to address some of the listed pressures and future threats. An unknown but significant proportion of the resource of H4030 also lies within the SSSI/ ASSI series where similar management measures are in place.

- Agri-environment measures

A suite of agri-environment measures are now in place in both the uplands and lowlands which are addressing more appropriate management, particularly grazing levels, for an unknown proportion of the resource of H4030 outside the statutory site series.

- Tomorrow's Heathland Heritage initiative

This initiative was established to restore and recreate lowland heathland across the UK and ran between 1997 and 2010 [Sherry]. There were local projects in many parts of the UK which addressed the restoration and appropriate management of a range of heathland types including an unknown proportion of H4030.

Belgium (Wallonia): Remaining heathland must always be protected and managed adequately. The management can be provided by regular coppicing of shrubs with removal of biomass or by extensive grazing. Ideally, coppicing is practiced in rotation and represents only a fraction of each site each year. As for grazing, it must be very extensive. These techniques are not sufficient for the long-term conservation of the habitat and it is necessary to remove the layer of humus which accumulates under the heather, or by removal of top soil or by controlled burning. Given the sensitivity of the constituent species, these practices shall be conducted in limited areas, in rotation.

Abandoned and encroached heathland can be restored by cutting overgrown bushes and removal of cut biomass. The herbaceous cover and litter must be removed or when access conditions do not permit, grinded. The plots are then maintained according to agreed targets, either by mowing or by very extensive grazing. In urban or suburban areas, close monitoring is necessary to prevent encroachment by invasive exotic species. In particular, the black locust will be eradicated as much as possible. Restoration of dry heaths departing from afforestation is possible, most species have seeds that retain their ability to germinate for many years in the forest floor.

The recreation of heathland should be considered whenever technically possible, especially in the pits and quarries where these settings can sometimes settle spontaneously upon abandonment of operations. (D GARNE n.d.)

**Spain** (VV.AA. 2009):

- Avoid afforestation. One characteristic of this habitat type is the absence of tree cover. Plants of these systems are heliophilous (requiring high brightness), so that the shade by tree coverage means an alteration. Moreover, in many cases, afforestation requires a prior drainage system.
- Prevent eutrophication. Prevent / control the use of fertilizers in agricultural areas nearby (nitrification and eutrophication by leaching). Also, avoiding the close location of emission sources of nitrogen oxides and / or sulfur in thermal or combined cycle industrial plants (nitrification and eutrophication by deposition of nutrients from acid rain).
- Manage livestock density. Avoid or at least control the use of this habitat for extensive livestock farming or for hunting with an overload of wild ungulates (especially deer). The negative effects of livestock on these heaths are determined by the vulnerability of key species to be extremely desirable by herbivores (eg *Teline tribracteolata*, *Genista tridens*), physical damage (trampling) on key plant species (eg *Drosophyllum lusitanicum*) and an excessive intake of excrement to the system (eutrophication).
- Monitoring of biological parameters regularly (once a year) and environmental parameters once every three years.
- Controlled burning every 15 to 20 years for the maintenance of these ecosystems, as recommended for instance in the UK, can only be recommended when making a systematic study on the role of fire in these heaths, as well as the social impact of this type of activity. But what must change is the type of management perspective after an accidental forest fire (natural or intentional): treat the affected area to protect any type of uncontrolled forest activity and / or livestock. Natural feedback monitor must be monitored, in order not to make any type of restorative action beyond the mere protection of natural regeneration. Only in exceptional cases where the fire has happened in a shorter time span than 15 years, or who have suffered episodes of severe or prolonged drought or severe herbivory, other specific strategies for restoration after the fire should be considered.
- Publicize the high diversity of this type of habitat and its ecological value, despite having no trees.

**Belgium** (Flanders) (Van Uytvanck et al. 2010):

Even under optimal environmental and spatial conditions dry heaths need to be actively managed to ensure their survival. Without management, through natural succession heathland evolves into woodland. A well-developed dry heath is characterized by a mosaic of different stages of heather, that together with other dwarf shrubs occupy most of the surface, interspersed with smaller, more herb or grass-rich patches next to bare places and dispersed trees and bushes. Management aims at maintaining this pattern and rich structure. Besides, dry heathland is an ecosystem that is poor in nutrients and, because of the historical use, has become poorer in stored nutrients. Maintaining low nutrient levels is a second objective of management. The effectiveness of management measures will therefore depend on the extent to which they create spatial diversity and variability of the structure of the habitat and of the extent to which minerals can be removed. Under the current circumstances with highly increased input of minerals, the latter is of great importance.



For the restoration of degraded dry heaths and developing new areas the same will be pursued: spatial and structural diversity and low nutrient levels. Any further measures may be necessary for other environmental characteristics such as acidity or to improve the establishment of characteristic species.

### **Location of the measures at the landscape, field or plot level**

At the landscape level it is important that sufficiently large areas remain dry heath and that they are connected in networks. Only then survival of species that naturally require large areas can be guaranteed and undesirable edge effects on the heath can be kept to a minimum. By strategic conservation, planting or development of woody strips around heathlands, some forms of disturbance (visual, sound and partly nitrogen deposition) can be limited. However, this only makes sense if the heathlands are large, e.g. a minimum diameter of about 500 to 1000m. If they are smaller, there is a chance that unwanted edge effects (e.g. continuous tree encroachment) extend over large parts of the site and the area soon has a closed vegetation.

In large heaths, more natural processes can provide the necessary variation in the habitat, and help discharge nutrients. In the first place such natural processes include extensive, free range grazing and wind force for those heathland areas where little vegetation or bare shifting sands occur. Large areas also offer more opportunity for controlled burning and is it easier, using the classical management methods, to obtain a mosaic of habitat patches. Except for extensive dry heathland, it also gives room for additional successional stages. Finally, coincidence can have a much larger role, and, in contrast to small heaths, the boundaries between patches of habitat is less fixed. The dynamic transition between heath and woodland through a "rolling" or "ragged edge of the forest" is an example: places can evolve into woodland while elsewhere heath can be regenerated.

### **Management measures and techniques in the field or plot level**

- Mowing and cutting of the heath;
- Sod cutting;
- Burning;
- Removing storage of trees and shrubs on the heath;
- Grazing.

In **Portugal**, the main management recommendations for this habitat include (ALFA 2004):

- Construction of footbridges;
- Redirection of the visitors interest to other areas;
- Prohibition on subsidized housing and other infrastructure.

### **The Netherlands**

The Netherlands: Recently, the recognition of negative side effects of sod-cutting has led to guidelines that restrict this measure to extensive areas of gras dominance, in particular *Molinia*. Extensive grazing, either by sheep or cattle, appears sufficient to convert *Deschampsia*-dominance into heather-grass mosaics and to enhance the vegetation structure. Gap-phase dynamics of heather and the development of 'peaty' humus profiles (on typical podzols only) or *Vaccinium*-heaths (on

brown podzolic soils) requires a long term strategy based on extensive grazing. The encroachment of heathland by trees (mainly birch and Scots pine) and shrubs (mainly *Prunus serotina*) can not be stopped by extensive grazing and requires additional measures. In dry heaths with a long history of intensive management (mowing, cutting) and high deposition rates, heather often has an N:P-ratio > 20 with low food quality for characteristic insects such as field cricket. Extensive agriculture in or adjacent to heathlands seems necessary to make limiting minerals and phosphorous available again at the landscape level. [Bijlsma]

**The Netherlands**, Bijlsma pers.comm.:

1. Extensive grazing (year round if additional food supplies are available at the landscape level)
2. Very extensive (organic) agriculture as part of the heathland landscape to provide a better food quality (with lower N:P) for insects (and therefore for reptiles and breeding birds)
3. Sod cutting only as a restoration measure to convert extensive *Molinia*-dominated habitat

see form IV (Additions to background document)

**United Kingdom**, Coupar, pers.comm.:

1. Grazing Management .
2. Burning Management
3. Integrated management of woodland and open habitat
4. Good practice in the location, design and construction of renewables infrastructure
5. here to enter text.

Grazing management of domestic livestock should consider appropriate stocking densities and timing of grazing. Also ensuring that livestock are moved around the area to avoid areas of over- and under-grazing, loss of heather and poaching of the ground. For wild herbivores (deer) the main issue is managing their numbers to avoid over-grazing and trampling damage.

Appropriate burning rotations and intensities, with the avoidance of sensitive areas.

New woodlands should be planned with a view to suitable locations and establishment techniques to ensure biodiversity and other benefits to both the woodland and remaining adjacent dry heath.

Renewables infrastructure and other built development should avoid dry heath where possible and use good practice design and construction techniques to minimise impacts where avoidance not possible.

**United Kingdom**, Gent, pers.comm.:

1. I02/I01: variety of active management including cutting of vegetation (by hand/ machine) scraping soils, use of pesticides, grazing, burning, mowing. These should be tailored to specific situations and with clear views on the 'required biological outcome'. These processes should be managed to enhance habitat and characteristic species and should be sensitive to the needs of species that could be adversely affected by their

- execution. This not always the case.
2. Conservation goals are often generic – it is often appropriate that they should be; but they lack sufficient detail, especially looking at key species interests to guide habitat managers/ agencies to take appropriate measures and give due consideration to the range of species implicated. In small habitat fragments especially there needs to be much greater awareness of the needs for integrating species conservation measures.
  3. Monitoring of 'SAC/SSSI condition is taken forward via a statutorily defined process, but we feel this needs to be greatly enhanced. There should be much greater integration of conservation goals for species, matched with an appropriate monitoring scheme, and valuable feedback mechanisms. Assessment of impacts of on the Favourable Conservation Status of Annex IV species, through incidental killing/ injuring, 'habitat management processes' (e.g. burning/ intensive grazing), despite being required by national and European law (Habitats Directive Arts 11 & 12.4) are not undertaken. This should not be an onerous process as such monitoring (and defined target status) should be explicitly part of the conservation plans for an area.
  4. Connectivity could be better guided by more effective habitat inventories – currently there is a general reliance on ad hoc/ opportunistic approaches to find areas for management. Exception to this include Forest management Plans –but there has been some opposition to the development and implementation of the 'Open Habitats Policies' which has impacted on the enthusiasm for uptake of these ideas at a strategic level
  5. The Habitats Directive has remained the key driving force for both site protection measures (designations) and for requiring and securing funding for management. Long term funding needs to be secured through agri- environment schemes and greater clarity needs to be given to allow the maintenance of Single Payment Scheme funds for heathland conservation. This latter scheme has been fraught with red-tape and unclear processes. Individual measures for improving site safety have been pioneered through a LIFE project "Dorset Heaths – combatting urban pressures degrading European Heathlands in Dorset" (LIFE00 NAT/UK/007079 – beneficiary Dorset County Council on behalf of the Urban heaths Partnership) [could cite as a 'best practice' example?] which helped reduce fires, etc, through education and active wardening. More needs to be done to build in sustainable site safeguard measures, such as fire-breaking, especially where small site area means species are especially vulnerable.

Provide a short description / additional information (if necessary): There is a good understanding of habitat management techniques and many are practised. Yet there is less obviously a clear understanding of the complexity of issues that need to be taken into account to ensure the diversity of characteristic species are conserved. Simple message such as 'Lowland habitats are under-grazed' or 'trees are good' may have a small place in PR/ campaigning – but should never be allowed to cloud the vision of habitat managers. There needs to be much better visionary thinking to allow complex (i.e. holistic and integrated) objectives/ goals to be described and set – and their outcomes monitored

#### United Kingdom, Sherry, pers.comm.:

1. A04.01.02. Incentive schemes to encourage extensive mixed grazing, scheme needs to support cattle and/or equines grazing
2. A04.03 Incentive schemes to encourage pastoral system. Niche marketing of products from pastoral systems to improve economic return
3. J01 Implement legislation, guidance codes and cross compliance measures to ensure agricultural management is carried out in a way, which is beneficial to the habitat and associated species. This includes not burning sensitive dry heath habitats such as the

- bryophyte rich H21 heaths or burning areas with sensitive species e.g. juniper
4. H04.02 Tackle sources of atmospheric nitrogen pollution
  5. I01 Eradication/control programmes, in particular for *Rhododendron ponticum* and non-native conifers measures to remove key seed areas.

## 2.3. Other measures (e.g. monitoring)

UK: Develop premium markets for meat and milk from biodiverse systems; work with Fire brigades, local authorities and schools to reduce arson; Promote the Heather and Grass Burning Code / Muirburn Code Best Practice guidelines; Ensure management agreements follow the Heather and Grass Burning Code / Muirburn Code. Increase co-ordination of planning and regulation of development pressures; Reduce Air Pollution, particularly by Nitrogen compounds; Research and monitoring of the impact and management of problematic species (JNCC 2009).

## 2.4. Species specific measures

### United Kingdom, Coupar pers.comm.:

Rotational burning maintains habitat diversity required for range of moorland bird species. Also argued by some that predator control required to maintain populations of ground nesting species.

### United Kingdom, Gent pers.com.:

Heathland has a wide variety of different species – each with their own specific needs. Many invertebrates require close proximity of specific features (e.g. open ground, pollen bearing plant species, invertebrate prey, etc) while some species like short heather, others require long over mature heather – some need birch trees. Herpetologically heathland is associated with all species of reptile and most amphibian species – though specific needs vary. Natterjacks need short, grazed habitats – or habitats with large open areas for hunting plus ephemeral breeding ponds (ideally managed in such a way that it is detrimental to common toads that are competitors and grass snakes that are predators). In the UK sand lizards require open sand patches for egg laying in amongst a generally mature heather mosaic – smooth snakes (being live bearers) do not have such a need and while they do favour the mature open habitat mosaics also benefit from proximity to wetter, boggy/ grassy habitats that can provide an abundance of prey species in hot summers. Grazing may damage such structures (which may benefit natterjack, but not reptiles) or may, if carefully applied with a focus being kept on the resulting habitat structures/ composition, etc, benefit a much wider range of herpetofauna. It is important that when developing management plans that the needs of different species are considered –from a species conservation perspective the saying “one man’s meat is another man’s poison” hold very true. We include references to habitat management handbooks and the 2005 Bern Convention Species Action Plans for sand lizards as EXAMPLES of publications that help guide species specific management needs; to Webb, Drewitt and Measures 2010, that looks at building in mosaics for species into management and a document (Offer, Edwards and Edgar 2003) that proposes a risk assessment approach for managing the impacts of grazing. ARC also has other reports in prep that consider effects of grazing, burning and that look at develop ‘conservation goals’ for herpetofauna species (not referenced)

**United Kingdom, Sherry, pers.comm.:**

In Wales RSPB have recently produced an assessment of upland bird habitat requirements for moorlands and heathlands. The conclusion is that specific, targeted, management is required to provide key requirements for the following species on sites:

Hen Harrier, *Circus cyaneus*

Merlin, *Falco columbarius*

Black grouse, *Tetrao tetrix*

Red grouse *Lagopus lagopus*

Golden Plover, *Pluvialis apricaria*

Curlew, *Numenius arquata*

Ring Ouzel, *Turdus torquatus*

Chough, *Pyrrhocorax pyrrhocorax*

For a second list of species specific habitats or conditions are required, but these are likely to be present without specific targeted management, will be provided through management for a species with a higher priority, or through management to achieve favourable condition for the habitat:

Dunlin, *Calidris alpina*

Snipe, *Gallinago gallinago*

Short-eared owl, *Asio flammeus*

Whinchat, *Saxicola rubetra*

Wheatear, *Oenanthe oenanthe*

Stonechat, *Saxicola torquata*

## 2.5. Main constraints / bottlenecks and actual needs

**Netherlands, Bijlsma pers.comm.:**

1. The implicit assumption that traditional forms of (intensive) land use are suitable as management measures to restore or enhance characteristic biodiversity
2. Intensive mowing and sod-cutting to compensate for nitrogen deposition what resulted in species poor, drought-sensitive and strongly P-limited vegetations
3. The lack of management plans at the landscape level that include woodlands and extensive agriculture (used for shelter, structural diversity, breeding and foraging)

**United Kingdom, Coupar pers.comm.:**

1. Value of habitat not recognised by land managers – or policy makers
2. Limited support to encourage appropriate management

Dry heath is widely viewed as common, robust and of interest to tourists for the 'purple heather' but without any common understanding that much of it has to be managed to be maintained and that although moderately resilient it is also quite easily damaged, or at least reduced in interest.

**United Kingdom, Gent pers.comm.:**

1. Funding will always be an issue – though currently there are effective funding schemes that help take forward conservation (e.g. agri-environment, LIFE (though not often used in UK), Single Payment). We do need clarity of thinking from the funders and an understanding of the relationship between funding needs and biological outcomes – simple compliance monitoring is not helpful! Better training for advisers/ scheme managers to fully understand issues (and not simply look at headline campaign messages) are needed
2. Lack of joined up thinking – threats to amphibians and reptiles, ironically, of often created by conservation habitat managers! We need better information and probably a research project to work out how we can ensure appropriate information and guidance is available at all stages of habitat management (from planning, funding through to delivery)
3. Conservation goals and appropriate monitoring; this would help address issues resulting from overly simplistic approaches to habitat management – people genuinely ‘lose the plot’ and we see a shift in mentality from ‘managing for conservation’ to ‘becoming a cowboy focused on developing grazing for its own ends!’
4. Climate change may well be an issues in future on open habitats. Clear thinking about conservation goals, which in turn are ‘climate proofed’ will allow us to adapt management approaches if and when the effects of climate change are noted. We may see significant changes in the composition of habitats and the behaviour of animal species on them. We should be planning ahead for ‘policy shifts’ (e.g. boundaries on SACs/ funding mechanisms) should this be needed
5. There remains opposition to open habitats management from those driven by the ‘trees are good’ campaigners. Certainly more needs to be done to address public perception – but in turn more may need to be done by those in the conservation sector to be clear about the conservation goals and developing skills at addressing these through more ‘lateral’ approaches. (Elements of this can be illustrated via the Dorset Urban Heaths project where alternative green space is being developed to offset impacts on heathlands)

**United Kingdom, Sherry, pers.comm.:**

1. A04.01.02 Insufficient support and funding to encourage mixed grazing
2. A4.03 Insufficient funding for pastoral systems. Lack of expertise in niche marketing
3. J01 Poor implementation of legislation or cross compliance measures – reluctance to deal with difficult issues
4. H04.02 Lack of Policy Framework to tackle issue across sectors
5. I01 Insufficient funding for very large-scale clearance work required which can run into millions of pounds

Agri-environment schemes are still not sufficiently flexible to deliver what is required on a site-by-site basis. Prescriptions are a blunt tool and the potential of sites to deliver habitat and species outcomes is not fully realised within agri-schemes. Bad and/or illegal practices are not controlled. INNS issues such as rhododendron are too costly to be dealt with under normal mechanisms and other mechanism such as LIFE funding has been impossible to secure.

## 2.6. Recommendations

### The Netherlands, Bijlsma pers.comm.:

1. Education and training focused on relationships between soil fertility and biodiversity at the landscape level

### United Kingdom, Coupar pers.comm.:

1. Raising awareness that it is a distinct habitat with its own characteristics and management requirements
2. **Specific management prescriptions**
3. **Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.**

### United Kingdom, Gent pers.comm.:

1. Clear funding schemes developed with a full understanding of the conservation needs/ outcomes
2. Effective policy and legislation – clearer duties on public bodies linked to a need to assist with protection and conservation of these sites (and especially with regards to public engagement). Public authorities do not always see the need for achieving conservation outcomes and frequently are part of the problem. The habitats Directive remains the single most important driver here
3. Clear conservation goals/ targets that build in the complexity and need of multi-taxa objectives. Documents such as Webb, Drewitt and Measures (2010) helped set a framework to take this thinking forward.
4. Effective monitoring regimes – linking habitat management to a range of biological outcomes. This should effectively engage a wide range of stakeholders, get buy-in from recording schemes and provide a consistent framework for all partners to work to.
5. Education and training is needed across many sectors so that there is a generally raised awareness of the importance of heathland, but also of the particular measures needed to conserve it and its full range of biodiversity.

Provide a short description / additional information (if necessary): It is comparatively simple to conceptualise a hierarchical process where the ambitions for an area are described, articulated, agreed and mapped and measures taken by a broad consortium of people (supported by a consistent funding regime) to take forward the necessary actions. Within such a simplistic vision the monitoring needs are equally obvious and a feed-back mechanism easy to envisage that allows 'tweaking' and rapid responses to areas where this is required. Funding may or may not be available, but resource needs could easily be identified and a strong coherent policy and legislative basis would facilitate positive management while preventing damaging activities, etc. Sadly this scenario is not reflected by current events with possibility of mechanisms via the UK Biodiversity Strategy having been disassembled with the creation of devolved country strategies and the fact that these have yet to provide the visible support needed or coherence across the UK required to meet the UK level obligations. There is scope that this may yet be achieved and our ambition should be to see that this happens.

### United Kingdom, Sherry, pers.comm.:

1. A04.01.02 Development of policies and incentive schemes encourage more extensive grazing regime and support mixed grazing. Including funding for heavy stock, shepherding and other stock management.
2. A4.03 Development of policies and incentive schemes that encourage traditional pastoral systems. Including funding for heavy stock, shepherding and other stock management. Education, training and support for marketing products from pastoral systems e.g. heathland beef project in Pembrokeshire or Anglesey wildlife Friendly Produce label.
3. J01 Enforcement of legislation and cross-compliance measures
4. H04.02 Influencing policies on atmospheric deposition particularly on the wider environmental impacts (mostly concentrated on human health)
5. More accessible funding for INNS eradication/control through structural funds

Incentive schemes need to focus on habitat outcomes not prescriptions; sites need to be assessed on an individual basis. Government needs policies/incentives to link conservation to production.

## Cases / projects

### Sites



## 6210 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (\* important orchid sites)

### Summary

**Semi-natural dry grasslands and scrub** on calcareous substrates occur on thin, well-drained, infertile lime-rich soils that have developed from a variety of limestone bedrocks. The habitat is one of the most species-rich plant communities in Europe and is characterised by a wide variety of grasses and herbs, in which there is at least a moderate representation of calcicolous species. Some species are associated with tall-growing vegetation, others with woodland fringes and gaps; other species are more typical of open grassland with both tall and short vegetation. The habitat has two important sub-types defined by the water supply. One is steppic or subcontinental, the other oceanic or sub-Mediterranean. The latter is semi-natural and is often characterised by a rich orchid flora. Abandonment results in the development of scrub. Variation within the habitat vegetation is also significantly related to human activities.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad' for all parameters except 'range' are 'unfavourable-bad'. Semi-natural dry grasslands were once widespread in Europe, but are now a scarce and threatened habitat which in recent past decades has been pushed back into isolated residual areas. The pressure on grassland habitats is steadily increasing, mainly due to the abandonment of use or changes in use. The remaining areas have become extremely fragmented, mostly confined to calcareous outcrops or steep slopes.

**The main reported threats and pressures** to semi-natural dry grasslands are therefore:

- unregulated grazing: overgrazing, under grazing;
- abandonment;
- invasive species: weeds, alien species;
- eutrophication/fertilization, also airborne nitrogen deposition;
- land-use change;
- human activities: mining, quarrying, roads, housing, landfill, recreation;
- fires;
- the encroachment of scrub and trees;
- climate change;
- damage caused by game (excess population density);
- active afforestation;
- fragmentation.

The principal **management measures** for this habitat include:

- grazing and/or mowing (carefully established types and levels);
- prohibition of: the use of fertilisers, harmful human activities, irrigation, ploughing, afforestation, and the introduction of alien species;
- the regular disturbance of the growing substrate in order to keep the habitat at the pioneer stage through: physical soil disturbance, using controlled fires, controlled cutting or chemical treatment;
- deforestation (including the removal of bushes, scrub, trees);
- restricting public access to less sensitive areas;
- habitat restoration;
- the prevention or limitation of agricultural improvement through legislative and incentive measures;
- national/international policy advocacy to seek to reduce impacts from atmospheric nitrogen deposition and climate change;
- control of deer numbers;
- the clearance of invasive or non-native species by cutting or chemical treatments;
- increasing the connectivity between sites through habitat restoration and creation.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- insufficient funding/incentives;
- insufficient capability and capacity of key nature conservation organisations to provide adequate management and protection;
- ineffective domestic EIA legislation;
- perverse incentives/markets and an unfavourable livestock policy framework;
- lack of public appreciation of the importance/value of species-rich grassland for society;
- a lack of cooperation and/or awareness of owners/land managers.
- appropriate grazing levels may be difficult to achieve in a mosaic of vegetation types;
- lack of effective pollution control regulations, including in relation to airborne depositions;
- a lack of knowledge and guidance for foresters (e.g. In order that they can plan afforestation without damaging high-value grasslands);
- a lack of effective long-term mechanisms for funding habitat restoration and creation (e.g. to reduce habitat fragmentation);
- a lack of effective mechanisms for preventing fertiliser inputs to non-statutory sites;
- a failure to enforce legislation and cross-compliance measures;
- a lack of access to funding for invasive species eradication/control.

**Solutions** to the pressures, threats and bottlenecks may include:

- further statutory designations of sites under domestic legislation;
- strengthening of EIA (agriculture) regulations;
- ensuring an appropriate level of funding *via* ERDP for agri-environment schemes;

- policy advocacy in relation to atmospheric pollution, climate change and livestock;
- awareness raising, education and community engagement;
- the provision of advice and guidance for land managers through appropriate communication media;
- agri-environment funding to support appropriate management;
- prioritising the requirements of the different habitats in rotation over several years;
- the development of effective policies and regulations in relation to deer control.

## 1 Description of the habitat

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 scrub with an intermediate stage of thermophile fringe vegetation (*Trifolio-Geranietea*).

Important orchid sites should be interpreted as sites that are important on the basis of one or more of the following three criteria:

- (a) the site hosts a rich suite of orchid species
- (b) the site hosts an important population of at least one orchid species considered not very common on the national territory
- (c) the site hosts one or several orchid species considered to be rare, very rare or exceptional on the national territory.

Often in association with scrubland and thermophile forests and with dry pioneer *Sedum* meadows (*Sedo-Scleranthea*) (EC 2007b)

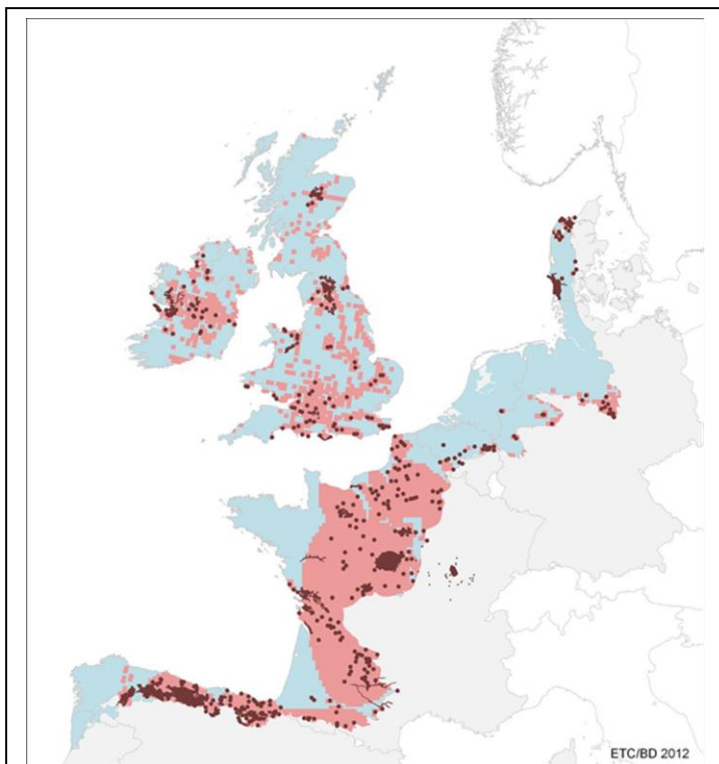
### 1.1. Distribution

**Table 67 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	16	64	22	20	891	16	85	53	86		114	76	161	192	93	36	5			12	82	
habitat area (ha)	128	1052	2313	297	27969	2227	6531	24503	46563		55301	27951	32011	31526	40808	3581	87			10837	33509	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 51-75%<sup>80</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

This habitat includes dry to semi-dry grasslands and scrubland occurring from the lowland to the mountain level and occurring on calcareous to neutral substrates. Calcareous grasslands are present in almost the entire European continent. The dry types are mainly concentrated in South and South East Europe. The Mediterranean biogeographic region has the highest percentage of significant dry grassland habitat areas. (Calaciura & Spinelli 2008).



**Figure 14 Map of SCIs proposed for the Semi-natural dry calcareous grasslands & Article 17 distribution (See for legend (map16) (for legend, see introduction of chapter 3)**

<sup>80</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

### 1.2. Main features

The grasslands of the habitat are among the most species-rich plant communities in Europe in terms of the number of plant species they support per unit area (up to 80 plant species/m<sup>2</sup>). They also contain a large number of rare and endangered species (such as the priority species *Pulsatilla slavica*, the early gentian *Gentianella anglica* as well as various bryophytes and lichens). The invertebrate fauna associated with this habitat, particularly butterflies, is also noteworthy and includes a number of species listed in the Habitats Directive, such as *Maculinea arion*.

The community type is characterised by a wide variety of grasses and herbs, in which there is at least a moderate representation of calcicolous species. Some species are associated with tall-growing vegetation, others with woodland fringes and gaps; other species are more typical of open grassland with both tall and short vegetation (Calaciura & Spinelli 2008).

### 1.3. Ecological requirements

The habitat is found on thin, well-drained, infertile lime-rich soils that have developed from a variety of limestone bedrocks. This habitat type contains several clearly different vegetation types. The most important differentiating factor is the water supply, but the structural and floristic characteristics of the habitat are also strongly influenced by climatic factors, topographic features, soil conditions and management practices, in particular the intensity of grazing.

The close link between the variation within these grasslands and those in climate and soils is shown by the clear geographic sequence across Europe from more mesophytic swards on less drought-prone soils in the Atlantic zone through to steppic grasslands and steppes on very arid soils in the extreme continental climate of the region stretching from SouthEast Europe to the Urals. Moreover, a study carried out on Central European semi-dry grasslands shows that species composition changes considerably along the North West - South East gradient across Central Europe according to the geographic position and the climatic variables (precipitation and temperature). In areas characterized by a Suboceanic climate, these grasslands contain Subatlantic species; by contrast, in the drier areas, semi-dry grasslands contain several species of Continental distribution or Continental steppe species.

Variation within the habitat vegetation is also significantly related to human activities. Where exploitation levels are reduced, calcareous grasslands typically become dominated by coarse grasses and plants of smaller stature become correspondingly scarcer. Shrub species (e.g. *Crataegus* spp., *Rosa* spp., *Prunus spinosa*, *Corylus avellana* and other species) may become established where utilisation is at sufficiently low intensity, and may eventually form patches of scrub.

Transitions to scrub and woody vegetation, developing with the relaxation of management, are also part of the Habitat. Grassland-scrub transitions provide important habitats for a wide range of rare and local species and where scrub is present on calcareous grasslands, a greater range of breeding bird species generally occur. It is important to note that scrub occurrence is rarely related to the presence of orchid species. (Calaciura & Spinelli 2008).

### 1.4. Main subtypes

The European Commission (Calaciura & Spinelli 2008) recognizes three subtypes of the habitat, each with its own flora. See for more information the source.

- Festucetalia valesiaca, includes the most steppic features of the habitat.
- Xerobromion, climatically and/or edaphically limited to dry areas.
- Mesobromion, mainly anthropogenic vegetation types.

### 1.5. Associated species

The European Topic Centre on Biological Diversity has identified through expert judgement a number of species under the Habitats and Birds Directive associated with habitat 6210 and provided their conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 68 Species associated with 6210 Habitat Type (for legend, see introduction of chapter 3)**

Species <sup>81</sup>	ETC/BD	TR08 <sup>1</sup>	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Cricetus cricetus</i> 1339	x										
<i>Euphydryas aurinia</i> 1065	x										
<i>Maculinea arion</i> 1058	x										
<i>Miniopterus schreibersii</i> 1310	x										
<i>Lanius collurio</i> A338 (with bushes)	x										
<i>Anthus pratensis</i> A257	x										
<i>Anthus trivialis</i> A256 (with trees)	x										
<i>Emberiza hortulana</i> A379 (with trees)	x	x									
<i>Jynx torquilla</i> A233 (with trees)	x										
<i>Oenanthe oenanthe</i> A171 (with stones and /or pile of stones)	x										
<i>Gentianella anglica</i>		x									
<i>Pulsatilla slavica</i> *		x									
Orchids typical of 6210*		x									
<i>Falco biarmicus</i>		x									
<i>Sylvia nisoria</i>		x									

<sup>1</sup>TR08 stands for the Technical report on Habitat Management

**Table 3 Annex II and IV species associated to habitat 6210 and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		ES	FR	UK	REGION
1058	<i>Maculinea arion</i>	Invertebrates	range	XX	U2	XX	XX
			population	XX	FV	U1	XX
			habitat	XX	U2	U1	XX
			future	XX	U2	U1	XX

<sup>81</sup> Additional associates species should be mentioned on the list: *Bombina variegata*, *Alytes obstetricans* [Zollinger]

			overall	XX	U2	U1	XX
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N2K code	Species name	Group		DK	ES	FR	IE	PT	UK	REGION
1065	<i>Euphydrias aurinia</i>	Invertebrates	range	U2	XX	U2	FV	FV	U1	U2
			population	U2	XX	U2	U1	XX	U2	U2
			habitat	U1	XX	U2	U1	U1	U2	U2
			future	U2	XX	U2	U1	U1	U1	U2
			overall	U2	XX	U2	U1	U1	U2	U2

N2K code	Species name	Group		ES	FR	PT	REGION
1310	<i>Miniopterus schreibersii</i>	Mammals	range	XX	U1	XX	U1
			population	XX	U2	XX	U2
			habitat	XX	XX	XX	XX
			future	XX	U2	XX	U2
			overall	XX	U2	XX	U2

N2K code	Species name	Group		BE	DE	NL	REGION
1339	<i>Cricetus cricetus</i>	Mammals	range	U1	U1	U2	U1
			population	U2	U2	U2	U2
			habitat	U1	U2	U1	U2
			future	U2	U2	U1	U2
			overall	U2	U2	U2	U2

## 1.6. Related habitats

Transitions between calcareous grasslands and heath, acid grassland, scrub and woodland communities are widespread (Calaciura & Spinelli 2008):

- 2130\* Fixed coastal dunes with herbaceous vegetation (grey dunes)
- 6110 Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi
- 6280 Nordic alvar and Precambrian calcareous flatrocks
- 6120\* Xeric sand calcareous grasslands
- 6230\* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas
- 6240\* Sub-pannonic steppic grasslands
- 6270\* Fennoscandian lowland species-rich dry to mesic grasslands
- 62A0 Eastern sub-mediterranean dry grasslands (*Scorzoneratalia villosae*)
- 6410 *Molinia* meadows on peaty or clayey-silt-laden soils
- 6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)
- 6520 Mountain hay meadows
- 7230 Alkaline fens

Related Habitat types according to hosting Member states:

- Germany: 4060 and 4070 (Bundesamt für Naturschutz);
- Wallonia: 6110, 2330 and 6210 (D GARNE) ;
- France: 9430, 4060, 6110, 8130 (Muséum national d'Histoire naturelle [Ed], 2003).

## 1.7. Ecological services and benefits

In general, calcareous grasslands provide important benefits for society (production, employment), the environment and biodiversity.

- key habitats for many species and pastures
- pastures can sequester 0.3 – 0.6 tonnes of carbon per hectare per year
- has a high recreational value (landscape paintings and appreciation of the countryside)
- steppes are the homes of ancestors to some important crops, garden bulbs, several spices and medicinal plants

(Calaciura & Spinelli 2008)

This habitat type is relevant to agricultural and farming activities and thus, its maintenance has economic and social interest in addition to ecological values.

The maintenance of these herbaceous communities in mountain areas has a high ecological interest: they protect soils from erosion, maintain unstable topographic features such as steep slopes, improve soil structure and fertility, help controlling and managing water resources and maintain a diversity of flora and fauna in general higher than the one that would exist if these areas were abandoned.

The social interest of the use of pastures covered by this habitat type is twofold. On the one hand there is a ‘culture of the territory’, empirical, linked to its exploitation, and which is currently endangered due to abandonment of rural areas. On the other hand, there is an increased social demand for the use of natural areas of interest, both in terms of landscape and for recreation and tourism. As in many other cases, this landscape is valued as a result of continued human action on these plant communities.

Therefore, this habitat type contributes to the achievement of sustainable rural development, since it provides protection, services and resources that enable the improvement of social and economic conditions in the mountain areas where it is located (VV.AA. 2009).

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012)N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	UK	REGION
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates ( <i>Festuco-Brometalia</i> ) (* important orchid sites)	range	FV	FV	FV	XX	FV	FV	FV	FV	XX
		area	FV	U1	XX	XX	U2	U2	U1	U1	U2
		structure	U1	U1	U2	XX	U2	U2	U1	U2	U2
		future	U1	U1	U2	XX	U2	U2	FV	FV	U2
		overall	U1	U1	U2	XX	U2	U2	U1	U2	U2

Assessed as ‘unfavourable-bad’ in the Atlantic, Boreal, Continental and Pannonic regions. In all these regions all parameters except ‘range’ are ‘unfavourable-bad’. Within these regions only Italy (Continental) assessed this habitat as ‘favourable’ although Spain reported ‘unknown’ for its Atlantic region.



Assessed as 'unknown but not favourable' for the Alpine and Mediterranean regions largely as a result of Spain reporting 'unknown' for both regions. Again Italy assessed the habitat as 'favourable' for both regions as did Portugal (Mediterranean). Many threats and pressures are reported but many countries note changes in agriculture, leading to both abandonment and overgrazing. Better information required, especially from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive) (ETC BD 2012).

## 1.9. Trends

Semi-natural dry grasslands, which were once widespread in Europe, are now a scarce and threatened habitat, which has been pushed back into isolated residual areas in the past decades. The total area of grassland in the EU fell by an average of 12% between 1975 and 1998, with increases in only a few areas (Calaciura & Spinelli 2008).

The pressure on grassland habitats is steadily increasing, mainly due to the abandonment of use or changes in use. The grasslands are undergoing a progressive qualitative and quantitative regression and the natural evolution of the vegetation will result in the near-disappearance of the habitat in many sites. The remaining areas have become extremely fragmented, mostly confined to calcareous outcrops or steep slopes, where forest development is retarded (Calaciura & Spinelli 2008).

In Denmark, for instance, the general trend of deterioration in the habitat type is illustrated in the remapping in 1989 of slopes originally mapped in 1940 and 1951. The gentle slopes originally supporting closed herbaceous vegetation had subsequently changed significantly. One third of the slopes were completely overgrown with woody plants; many of the other slopes had been invaded by *Arrhenatherum elatius* (tall meadow oat). Most slopes exhibited an obvious decline in the species associated with nutrient-poor soils and the invasion of typical farmland species was frequently observed. The habitat is now rare in Denmark and has declined tremendously because of the cultivation, planting, fertilisation and scrubbing over of dry grasslands throughout the last 200 years (Calaciura & Spinelli 2008).

This decline is illustrated by the decline in the characteristic species, *Orchis ustulata* (dark-winged Orchid), which used to be known from about 50 localities, but is now only known to occur at two localities in Jutland (DNK). In Austria this type of habitat has suffered a significant reduction in extent as a result of abandonment of use, scrub/vegetation encroachment and fertilisation. In the UK the area of calcareous grassland has suffered a sharp decline over the last 50 years: an assessment of chalk grassland in Dorset found that over 50% had been lost between the mid-1950s and the early 1990s. Calcareous grassland is now primarily restricted to steep slopes on limestone associated with dry valleys or dales and scarp slopes where agricultural improvement has been impractical. In Belgium, urbanisation, abandonment of grazing and fertilisation since World War II have resulted in a dramatic decrease in the grassland area (Calaciura & Spinelli 2008).

## 1.10 Main pressures and threats

According to the Technical report from the EC on the management of habitat type 6210 (Calaciura & Spinelli 2008) the main causes of decline in calcareous grasslands are irrational grazing, afforestation and succession, land-use changes and abandonment.

- Unregulated grazing – grazing is normally the key factor sustaining the habitat, any change in stock grazing will therefore affect it. Overgrazing decreases the total amount of species and structural diversity with a side effect being eutrophication through the excess amount of manure. Thorny species Undergrazing also leads to a decrease in total amount of species.
- Abandonment and succession to woodland – a decline in old-grazing regimes is responsible for the disappearing grasslands. Usually after abandonment scrub encroachment follows. It has to be noted that some extent of scrubland at the margins is regarded as part of the habitat.
- Weeds invasion – undesirable species.
- Agricultural improvement - nutrients input by fertilization and herbicide application decreases the total amount of species.
- Land use change – e.g. change of the particular grassland to ubiquitous grassland to leads to a decline in the specialist flora and fauna found in this habitat.
- Airborne nitrogen deposition – the habitat contains species that require nitrogen-poor soils, nitrogen deposition destabilizes the normal competition between plant species.
- Other local factors affecting the habitat - Human activities (mining and quarrying, road building, house building and landfill) can fragment and isolate sites / Recreational pressure and inappropriate recreational use bring about floristic changes associated with soil compaction and erosion / Alien invasive plants / Fires are a typical threat to this habitat in the Mediterranean regions, resulting in a change of floristic composition and/or in intensive post-fire erosion.

**Table 5: Specific pressures and threats identified by Member States**

Abandonment:	Netherlands, France, UK
Overgrazing:	France, UK
Eutrophication:	Germany, Netherlands, UK
Human Disturbance: climbing:	Germany
Afforestation:	Germany, Wallonia, France, UK
Mining:	Germany, Wallonia, France
Human Disturbance: threading:	Germany
Bush encroachment:	Germany
Urbanization:	Wallonia, France
Invasive species:	Wallonia, UK
Air pollution	UK
Biocenotic evolution	UK

Modification of cultivation practices	UK
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Source: (Bundesamt für Naturschutz, DGARNE, Ministerie van Economische Zaken, Landbouw en Innovatie, Muséum national d’Histoire naturelle [Ed], 2003, Joint Nature Conservation Committee)

In the rocky sites with this habitat in UK, invading alien plants are a threat. Here, bird-sown *Cotoneaster* and *Berberis* species, which can root in crevices have spread extensively over the ground, shading out and smothering the native flora.

**Table 6 Main pressures to habitat 6210 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012)Pressure description (2nd level)	Semi-natural dry grasslands and scrubland facies on calcareous substrates ( <i>Festuco-Brometalia</i> ) (* important orchid sites)	<i>Maculinea arion</i>	<i>Euphydryas aurinia</i>	<i>Miniopterus schreibersii</i>	<i>Cricetus cricetus</i>
Cultivation	x		x	x	x
Fertilisation	x		x		
Grazing	x	x	x	x	
General Forestry management	x		x	x	
Biocenotic evolution	x				

**Table 7 Main threats to habitat 6210 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012)Threat description (2nd level)	Semi-natural dry grasslands and scrubland facies on calcareous substrates ( <i>Festuco-Brometalia</i> ) (* important orchid sites)	<i>Maculinea arion</i>	<i>Euphydryas aurinia</i>	<i>Miniopterus schreibersii</i>	<i>Cricetus cricetus</i>
Fertilisation	x				
Grazing	x	x	x	x	
General Forestry management	x		x	x	
Biocenotic evolution	x				

In **Ireland**, the greatest threats to this habitat are abandonment of traditional agricultural practices on these marginal lands and reclamation. The area of the habitat has decreased over time (NPWS 2008).

The most serious threats to this habitat type in **Denmark** are eutrophication, and too little or wrong management which result in scrub invasion (Søgaard et al. 2007).

**United Kingdom, Jefferson:**

1. Abandonment of pastoral systems, lack of or inadequate grazing
2. Atmospheric Nitrogen deposition
3. Agricultural intensification including ploughing and use of fertilisers
4. Climate change

Complete loss of the habitat to improved grassland/arable (ploughing/intensification). Decline in plant species richness and diversity, (fertilisation, lack of grazing) ecological succession resulting in conversion of species-rich grassland ultimately to scrub/woodland (abandonment, inadequate grazing).

**United Kingdom, Mackintosh:**

1. Non intensive sheep grazing: Over-grazing by sheep destroys structural variety in the sward, prevents flowering and regeneration by seed, and causes erosion and loss of the habitat.
2. Damage caused by game (excess population density): Over-grazing by deer destroys structural variety in the sward, prevents flowering and regeneration by seed, and causes erosion and loss of the habitat.
  - 1.
3. Abandonment of pastoral systems, lack of grazing.: Under-grazing by sheep, or absence of grazing, allows the sward to grow tall, leading to domination by grasses and the loss of small, low-growing broadleaved herbs, and the invasion of scrub and bracken leading to a loss of the habitat.
  - 2.
3. Nitrogen-input.: Nitrogen-input has been shown to cause a decline in some of the characteristic species of calcareous grassland and to affect functions and soil processes
4. Forest planting on open ground (native and non-native trees): Forest planting on open ground (native and non-native trees): Scottish Government targets for woodland expansion may lead to small patches of the habitat being enclosed within new woodland with no access to grazers, therefore at risk of losing small low-growing broadleaved herbs, and being invaded by scrub and bracken leading to a loss of the Habitat.

**United Kingdom, Smith:**

A04.03 abandonment of pastoral systems, lack of grazing.

Agricultural specialisation and intensification has led to grazing abandonment on many sites or parts of sites. This leads to an increase in coarse grasses, especially (in Wales) *Helictotrichon pubescens* and *Arrhenatherum elatius*, and a decline in characteristic herbs of the habitat such as *Thymus praecox*, *Sanguisorba minor* and *Helianthemum nummularium* (Stevens et al 2010). It also typically results in encroachment by scrub (see K02.01 below).

A08 fertilisation.

The habitat is very susceptible to nutrient enrichment from fertilisation (especially from artificial fertilisers, although also farmyard manure). It can lead to a rapid loss of its characteristic plant species, many of which require very low nutrient conditions, and associated invertebrate fauna. There is typically an increase in mesotrophic species such as *Cynosurus cristatus*, *Holcus lanatus*, *Trifolium repens* and coarse weeds such as *Cirsium* and *Sonchus* species. This has been a major issue in the past; although it is now less of an issue and now affects mostly sites outside the statutory sites series, sites are still being affected and, under high levels of fertiliser application, can be permanently lost.

H04.02 Air pollution – nitrogen inputs.

A number of studies have shown an adverse impact of N deposition on unimproved grassland, including specifically on this habitat, e.g. Van Den Berg et al 2010.

#### I01 invasive non-native species

A number of species are impacting this habitat, especially members of the *Cotoneaster* genus. Other problem species include other invasive shrubs such as *Arbutus unedo* and *Berberis wilsonii*, in addition to herbs such as *Sedum album* and *Centranthus ruber*. Expensive and long running control programs are in place on some sites, without which increased invasion is inevitable. Drought-prone examples are particularly at risk, some of which are especially rich in rare and scarce plant species.

#### K02.01 species composition change (succession)

Spread of scrub and to a lesser extent trees is a major issue on many sites. Where appropriate grazing is in place, spread is usually largely kept in check, but under-grazed or neglected sites are particularly prone and sites can and have been lost to extensive scrub invasion. This pressure has been implicated in the loss of important invertebrate populations (e.g. *Plebejus argus*). Some reversal is possible as long as the habitat has not been completely enveloped, and restoration management has been implemented on a number of statutory sites. On some sites scrub margin examples of this habitat are particularly important and may require light grazing levels and therefore regular scrub control management.

#### J03.02 anthropogenic reduction of habitat connectivity

Although there remain some sizable well-connected patches of this habitat in Wales, many examples are small and fragmentary. This is a particular issue for uncommon plant and invertebrate species which, when lost from a site, may not be able to recolonise.

## 2 Conservation management

### 2.1. Main conservation requirements

As the habitat features, conservation values and context (history and development) are very different between the various countries and biogeographical regions, it is important, when planning the management for the habitat, to take into account the following general aspects which will allow sensible management decisions to be taken (Calaciura & Spinelli 2008):

- Site-specific objectives and targets with reference to the conservation status of species;
- Local/regional land use and livestock husbandry traditions, practices and techniques;
- Although it is often neither possible, nor appropriate nor necessary, to mimic historical management, it should if possible be informed by existing knowledge and experience.

It is also recommendable that fertilisers and supplementary fodder are not used on this habitat, because the application of fertiliser decreases species-richness, enhancing the ability of competitive species to thrive and increasing the standing crop (Calaciura & Spinelli 2008).

Insects, need open areas alternating with scrub areas, on a scale of one square meter, while birds or mammals need more extended areas, on the scale of one hectare (Calaciura & Spinelli 2008).

The Boreal Workshop Document (N2K Group 2012) identifies the need to set suitable rules within the existing policies (such as CAP) as well as the creation of a convenient financial framework. Restrictions and regulations of certain human activities are needed. The CAP sets certain

requirements for management that are not always the best for the preservation of the targeted species.

The main recommendations for the conservation of this type of habitat in Spain are (VV.AA. 2009): Establish mechanisms to prevent and control land use changes in areas occupied by these communities.

Manage grazing with the aim of using herbaceous production in an optimal way and maintaining the species composition and pasture quality. The following recommendations can be listed:

- Establishment of loads and seasons of grazing, and appropriate rotation of livestock. This is especially important because the communities that form these grasslands have a high heterogeneity in terms of production and pasture quality. In this sense, management recommendations should be individualized according to the communities and their location.
- Use management practices with appropriate stocking loads that allow the maintenance of these grasslands, preventing the colonization by woodland and shrub species.
- Avoid overexploitation (overgrazing) that can cause degradation of pastures and the appearance of soil erosion.
- Avoid artificial plantation of species, since the established species are able to recolonize any gaps in the vegetation cover.

Promote the maintenance of this type of habitat among farmers in mountain areas. For this purpose it may be beneficial that appropriate agro-environmental measures are developed by regional authorities. Farmers benefiting from these measures should commit for a minimum period of five years, to adopt farming practices that help protect this habitat. In return, they will receive payments in compensation for additional costs and loss of income resulting from changes.

The habitat type relies on the continuous germination of seeds and the successful establishment of new individuals. Therefore, in **Denmark** (Søgaard et al. 2007) it is assessed to be essential that bare spots of mineral soils appear for a number of years in the periods between October and March. Moreover, an assessment of grazing, scrub invasion and indicators of undisturbed nutrient balance should be included in the criteria for favourable conservation status at a local level.

#### **United Kingdom, Jefferson:**

1. Extensive grazing by livestock, normally sheep, cattle or equines with no addition of organic or inorganic fertilisers
2. Cutting can be used to maintain the grassland, but is a poor substitute for grazing as it does not create sward heterogeneity required by invertebrates, in particular.

#### **United Kingdom, MacKintosh:**

1. The habitat must be grazed at levels that maintain a varied sward height, including areas of short sward in which smaller and less vigorous species can persist, but low enough to permit flowering and not lead to soil erosion.
2. As above.
3. As above.
4. A reduction in emissions of oxidised nitrogen gases from transport and power

generation sources, and of ammonia from livestock production.

5. Exclusion of the habitat - small and large patches - from new woodland enclosures.

#### **United Kingdom, Smith:**

1. A04.03 abandonment of pastoral systems, lack of grazing

This habitat requires livestock-grazing management in the great majority of cases, although some particularly drought-prone examples and some scrub edge examples may be maintained successfully with some kind of regular scrub cutting management (especially where rabbit-grazing is significant). Various stock types may be appropriate for the habitat (generally sheep, cattle or horse), although a change in stock type at a site may result in undesirable changes in floristic makeup.

2. A08 fertilisation

This habitat should receive no fertiliser of any sort.

3. H04.02 Air pollution – nitrogen inputs

Critical loads for N are currently exceeded on many sites. There is evidence that species loss may occur/have occurred even below critical load levels (Emmett et al 2010).

4. I01 invasive non-native species

Appropriate grazing levels help to limit spread of invasive non-natives, but additional control measures are required on most sites. Eradication is desirable where practicable, e.g. cutting and/or chemical treatment.

5. K02.01 species composition change (succession)

Stock grazing management alone may be sufficient to maintain scrub at desirable levels, although additional control is required at many sites, such is the intricate association between this habitat and woody vegetation.

6. J03.02 anthropogenic reduction of habitat connectivity

Restoration and creation of sites may be required to reconnect patches of the habitat. Better management of existing sites in the first instance to retain and bolster the current resource.

## **2.2. Management measures**

Semi-natural grasslands require grazing and/or mowing to maintain their communities because it

- Restricts the the growth of shrub and tree species by removing their growing points;
- Prevents coarse grasses and tall herbs from achieving dominance by giving low growing species a chance to compete;
- Removes leaf litter that may further suppress plant growth and increase the soil nutrient status;
- Allows seedlings of short-lived species to become established in the gaps in the grassland produced by grazing animals.

These four points should be the main aims of the management.

Whether grazing or mowing is the most appropriate regular management for high quality calcareous grasslands is a not straightforward question. In an experiment on the effects of several management regimes (grazing, mowing, and non-intervention) on the biodiversity of Dutch chalk grassland, grazing resulted in the highest level of biodiversity, non-intervention in the lowest level. Moreover,

grazing proved to be more efficient than mowing in countering the effects of increased nitrogen levels. Nevertheless, although most studies recommend grazing as the most appropriate management for calcareous grasslands, it was found that in the upper sub-alpine region, calcareous grasslands that have been traditionally mown were favoured by mowing, rather than by grazing. Therefore, when defining appropriate management regimes, history and the nature of the community are very important variables (Calaciura & Spinelli 2008).

A change between grazing and mowing can have particular drastic effects on invertebrates and plant communities. For an effective management of the habitat through grazing and or mowing several aspects should be kept in mind (Calaciura & Spinelli 2008):

- The amount duration and timing of grazing/mowing
- The type of grazing; different types of cattle have different effects

In Germany extensive grazing (sheep or goat) or one-time mowing is used. They advise against using fertilizers and to stop mining and afforestation activities. Harmful recreational activities should be prohibited (Bundesamt für Naturschutz n.d.).

In Wallonia, in order to keep pioneer species soils are being disturbed. Also, deforestation is taking place to induce more light reaching the understory and dry-conditions. Habitats near urban areas are monitored for exotic species and protected against fertilization through biological waste. They propose that public access should be restricted and old mining quarries near existing habitat should be converted into the habitat (D GARNE n.d.).

In the Netherlands they use periodic short-term grazing. The dominance of *Brachypodium pinnatum* because of nitrogen deposition is being countered by mowing at the begin of August (Ministerie van Economische Zaken, Landbouw en Innovatie).

In France, grazing is limited to a maximum of three times a year, by sheep. Rotational grazing is advised. They prohibit irrigation, plowing, the introduction of alien species and afforestation. To induce clearings France is opting the use of mechanical clearing and controlled fire (Muséum national d'Histoire naturelle [Ed] 2003)

#### **United Kingdom, Jefferson:**

1. Ensure appropriate livestock grazing regimes and scrub management
2. Prevent/limit agricultural improvement through legislative and incentive measures
3. National/international policy advocacy to seek to reduce impacts from atmospheric N deposition and climate change

#### **United Kingdom, MacKintosh:**

1. Appropriate grazing levels to be maintained.
2. Control of deer numbers.
3. Appropriate grazing levels to be maintained.
4. Reductions of Nitrogen emissions from all sources.

The habitat must be identified and mapped before new woodland enclosures are planned, and must be excluded from these enclosures

#### **United Kingdom, Smith:**

1. A04.03 abandonment of pastoral systems, lack of grazing



Typically light to moderate grazing levels (typically 0.2 to 0.4 LSU/ha/yr, depending on form of the habitat, local climate, weather, etc) during the growing season. Some drought-prone examples and some scrub edge examples may be maintained successfully with some kind of regular scrub cutting management possibly accompanied by late season (autumn/winter) grazing. Sheep, cattle or horses are appropriate.

2. A08 fertilisation

No fertiliser addition of any sort.

3. H04.02 Air pollution – nitrogen inputs

Monitoring and control of point-source pollution and policy changes to limit national N deposition levels.

4. I01 invasive non-native species

Control or eradicate using cutting and/or chemical treatment as appropriate and practicable.

5. K02.01 species composition change (succession)

Control using cutting and/or chemical treatment as appropriate and practicable.

6. J03.02 anthropogenic reduction of habitat connectivity

Restoration and creation of sites to link and bolster disjunct patches. Manage existing sites appropriately (grazing, cutting etc as above) to maintain and bolster plant and invertebrate populations.

## 2.3. Other measures (e.g. monitoring)

(Calaciura & Spinelli 2008)

- Monitoring of the vegetation allows a reorientation of the habitat management strategy, according to the presence of the Festuco Brometalia characteristic plants
- Stakeholders involvement. There are often situations where local residents are not aware of the presence and/or importance of the habitat. In order to bring about the sustainable preservation and protection of these valuable grassland areas, it is desirable to carry out measures aimed at raising the awareness of local population and tourists on the value of the habitat. This can be done in a number of ways, through educational programs for schools, guided visits, seminars, publication of brochures etc.
- In some cases it might be necessary to route or block vehicles traffic, or to fence the grassland areas in order to prevent access by cars. Where the site is a popular beauty spot, parking on the grassland might be prohibited to prevent damage.
- In some cases it is important to conserve the genetic pool of the most sensitive species and to avoid genetic erosion.

## 2.4. Species specific measures

Plants (Calaciura & Spinelli 2008):

*Gentianella anglica* Grassland sites grazed extensively by sheep and cattle have been found to support the best populations of this species, but sites where thin soils,

summer drought and exposure combine to maintain short grassland are also suitable.

*Pulsatilla slavica*\*

Mowing or grazing once every two or three years is recommended. Grazing seems to be only feasible measure to manage viable population of the species, because it selectively removes competing species.

Orchids typical of 6210\* Grazing is very important for the conservation of orchids, but it is important to avoid grazing during the orchids flowering period (May to July). Leaving scrubland at the margins may favour the presence and spread of orchids. Removal of weed species outside the orchids flowering period is also beneficial.

Birds (Calaciura & Spinelli 2008):

In general: allow for long and short grasses. Cutting outside of breeding and nesting season (April to August). The use of a centre-out mowing method, only an early mowing/cutting could reduce the negative impact on breeding and nesting bird species. Appropriate visitor management to reduce human disturbance.

*Burhinus oedicnemus*: can nest as late as August and so it may be necessary to delay the introduction of livestock to prevent trampling losses, though grazing is vital for this species to provide the necessary habitat structure and dung-dwelling invertebrates.

*Sylvia nisoria*: may suffer from heavy clearing of scrub and it might be necessary to make a sitespecific prioritisation between the habitat requirements of this species and management objectives related to floristic values. But the species may also be negatively affected by over-heavy scrub growth, so a fine-tuning of the site-related management might be necessary.

*Lanius collurio* often respond positively and quickly to removal of overgrown grassland habitats of various types but also suffers from too heavy clearing. 10-15% of a cleared area is recommended to be left with junipers and other scrub (e.g. *Prunus spinosa*, *Rosa* ssp., *Crataegus* ssp.).

**United Kingdom, Jefferson:**

This habitat supports a number of priority species of conservation concern. Many can be maintained or enhanced by simply ensuring that appropriate management to maintain the habitat as a whole is in place. Some however may require non-standard management or ensuring grazing does not take place at key stages in the life cycle.

**United Kingdom, Smith:**

Supported specialist taxa require the habitat conditions enabled by the above measures.

Specialist plant and invertebrate species may require specific management, e.g. some vascular plants insensitive to moderate to high grazing levels and therefore increased scrub control measures are likely to be needed.

**Netherlands:**

Maintenance, restoration or digging of ponds is crucial for *Bombina variegata* and *Alytes obstetricans*. Landhabitat is also important, the grassland and shrubs for foraging and stapled stone walls as shelters and for staying during wintertime. [Zollinger]

For measures see i.e. Action Plan for the conservation of the Common Midwife Toad (*Alytes obstetricans*) in the European Union (European Commission, 2010). [Zollinger]

## 2.5. Main constraints / bottlenecks and actual needs

### United Kingdom, Jefferson pers.comm.:

1. Insufficient funding/incentives, including reduced capability of key nature conservation organisations due to reduction in resources
2. Ineffective domestic EIA legislation for uncultivated/semi-natural habitats
3. Perverse incentives/markets and an unfavourable livestock policy framework
4. Lack of public appreciation of the importance/value of species-rich grassland for society

### United Kingdom, MacKintosh

1. Non-co-operating owners/land managers. However, appropriate grazing levels may be difficult to achieve in a mosaic of vegetation types where some types (such as heathland) need lighter grazing levels than is ideal for the habitat.
2. Non-co-operating owners/land managers.
3. Global economics affect the profitability of upland sheep farming .
4. Lack of effective pollution control regulations.
5. There is a lack of knowledge and guidance needed to help foresters to avoid damaging the habitat..

### United Kingdom, Smith:

1. Fundamental change in the character of lowland farming which makes it economically unattractive to graze what are often small sites with hardy stock. Loss of appropriate hardy stock and experience to manage them.
2. Lack of effective long-term mechanisms for funding habitat restoration and creation to reduce habitat fragmentation.
3. Lack of effective mechanisms for preventing fertiliser inputs to non-statutory sites.
4. Enforcement of legislation and cross-compliance measures.
5. More accessible funding for invasive species eradication/control.
6. Difficulty of securing meaningful reductions in atmospheric N loading.

## 2.6. Solutions and recommendations

### United Kingdom, Jefferson:

1. Further statutory designations of sites under domestic legislation
2. Strengthen EIA (agriculture) regulations
3. Ensure appropriate level of funding via ERDP for agri-environment schemes
4. Policy advocacy in relation to atmospheric pollution, climate change and livestock

5. Increased awareness raising, education and community engagement

#### **United Kingdom, MacKintosh**

1. Communication and guidance for land managers, agri-environment funding to support appropriate management. In the case of a mosaic of vegetation types where some types (such as heathland) need lighter grazing levels than is ideal for the habitat, solutions include prioritising the requirements of the different habitats in rotation over several years.
2. Effective policies and regulations on deer control
3. Agri-environment funding to support appropriate management..
4. Effective pollution control regulations.
5. Guidance to help foresters to avoid damaging the habitat..

#### **United Kingdom, Smith:**

1. Effective long-term and better targeted agri-environment mechanism which provides remuneration that is attractive to farmers. Availability of local grazing animals partnerships to provide expertise and also match appropriate stock to sites. Increased funding support for conservation bodies to enable effective grazing management.
2. Significantly enhanced funding to make de-intensification of farmland linking sites financially attractive.
3. Better regulation.
4. Better enforcement.
5. Better funding mechanisms.
6. Policy changes.

## **Cases / projects**

### **Sites**

## 6230 - Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas in Continental Europe)

### Summary

**Species-rich *Nardus* grasslands** generally occur on oligotrophic siliceous substrates in hill and mountain areas and can be closed, dry and/or mesophile. *Nardus* grasslands can be in contact with a relatively high variety of habitats at different gradients. The vegetation present on sites varies but is characteristically continuous. The habitat occurs in almost all the EU member states and in spite of the fact that some types of *Nardus* grasslands can be considered as climax vegetation which do not require active ongoing management, the long-term existence of the habitat is in general closely associated with pastoral traditions and with extensive agriculture.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as either 'unfavourable-inadequate' or 'unfavourable-bad' across all countries. The pressure on grassland habitats is steadily increasing, mainly due to the abandonment of use or changes in use and the remaining areas have become fragmented.

**The main reported threats and pressures** to species rich *Nardus* grasslands are therefore:

- Fertilization/Eutrophication: Land conversion from historical extensive farming to more productive grasslands during the 20<sup>th</sup> century's intensification of agriculture.
- Input from outside the habitat and lowering of the water table (and the consequent mineralization associated with these changes).
- Abandonment: a substantial area of the sites occur in remote mountainous areas.
- The natural succession of vegetation, and the invasion of scrub and forest species, that often follows after abandonment.
- Active afforestation.
- Inappropriate grazing practices: *Nardus* grasslands are usually highly dependent on regular grazing.
- Tourism pressure: high-altitude mountain areas are highly attractive tourist destinations both in summer and winter.
- Acidification.
- Damage by excess population densities of game.

The principal **management measures** for this habitat include:

- The minimum viable area of habitat should be set at greater than 0.5 ha.
- Avoidance of disturbance.
- The surrounding environment should be monitored and controlled in relation to possible impacting measures; e.g. wastes, use of salt on roads during winter, grazing improvement measures, introduction of selected species, stocking loads.
- Actions that affect the water table, certain fertilizations should be prohibited.

- Cooperation of stakeholders in the management of the grasslands should be actively pursued and encouraged.
- Research into the ecological dynamics of these grasslands should be pursued.
- The public value of these grasslands should be the subject of active promotion campaigns.
- Resumption of traditional farming (e.g. grazing of the grasslands).

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Historical/traditional agricultural management is nowadays too costly.
- Remaining intact habitat is often small and isolated (fragmented).
- There is often a lack of cooperation from owners/land managers.
- Lack of effective pollution control regulations.
- There is a lack of knowledge and guidance needed to help foresters to avoid damaging the habitat.

**Solutions** to the pressures, threats and bottlenecks may include:

- Remove nutrients from the system where necessary (and if possible).
- Communication and guidance for land managers.
- Develop or encourage the use of agri-environmental funding.
- Prioritize the requirement of the different habitats in rotation over several years.
- Effective policies and regulations in relation to deer control.
- Effective pollution control regulations.

## 1 Description of the habitat

Closed, dry or mesophile, perennial *Nardus* grasslands occupying siliceous soils in Atlantic or sub-Atlantic or boreal lowland, hill and montane regions. Vegetation highly varied (the habitat type includes a huge variety of sub-types) but the variation is characterized by continuity. *Nardetalia*: 35.1-Violo-Nardion (*Nardo-Galion saxatilis*, *Violion caninae*); 36.31- *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 (EC 2007b).

Species-rich *Nardus* grasslands are some of the most widespread habitats in the EU, occurring in 24 Member States and 6 different bioregions. It is generally an oligotrophic habitat, typically found mostly on species-poor soils throughout Europe. In spite of the fact that some types of *Nardus* grasslands can be considered as climax vegetation which do not require active ongoing management, the long-term existence of the habitat is in general closely with pastoral traditions and with extensive agriculture. (Galvnek & Jank 2008).

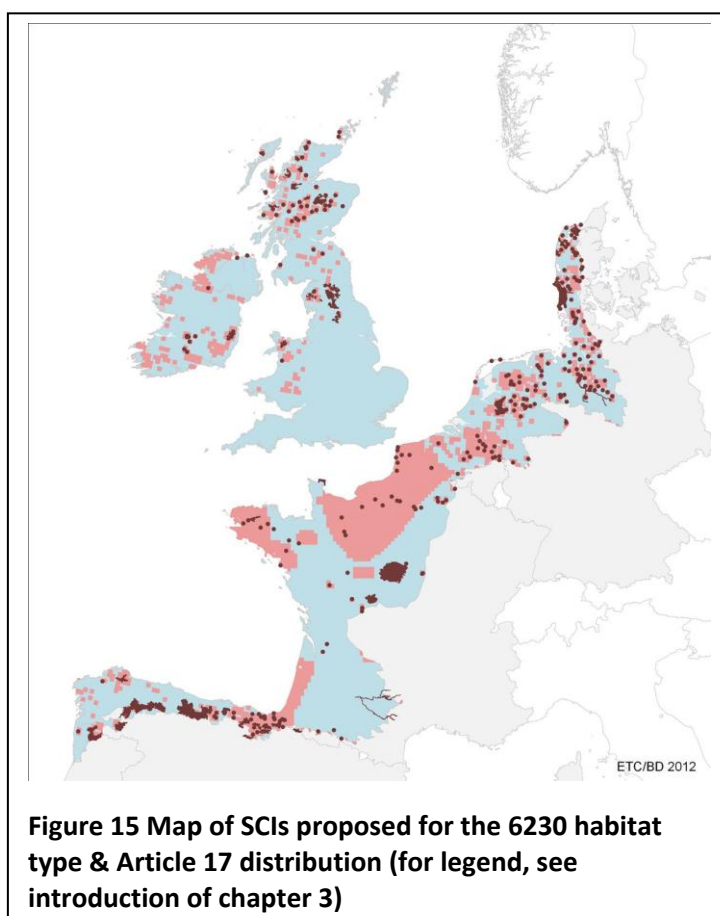
### 1.1. Distribution

**Table 69 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States.**

	BE		DE			DK		ES				FR				IE	NL	PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	13	49	11	66	559	31	102	6	45		33	44	46	69	19	10	24	2		6	49
habitat area (ha)	117	825	122	435	7752	3330	8519	4227	17565		15178	24661	8390	7530	7748	731	1329	978		1175	4651

The habitat occurs in almost all the EU member states, except for Estonia, Malta and Cyprus. However, a major proportion of its area is located within the Alpine bioregion (Alps, Pyrenees and the Carpathian region). It is also relatively frequent in the Mediterranean, Continental and Atlantic bioregions. A small portion of the habitat is distributed in the Pannonian and Boreal bioregions (Galvnek & Jank 2008).

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%. This means that Natura 2000 network provides an important framework for the management of this habitat type. (ETC BD 2012).



### 1.2. Main features

The habitat consists of closed, dry or mesophile perennial *Nardus* grasslands, which can occur from the lowlands to more mountainous areas. It is mostly a mountain habitat in Continental Europe, and it is more frequent in lowland areas in the Atlantic and Boreal parts of Europe (Galvnek & Jank 2008).

### 1.3. Ecological requirements

The habitat is found on nutrient-poor soils on various types of siliceous rocks (mostly crystalline slides, granite, but also volcanic rocks). In some countries (e.g. France or Slovakia) the habitat is also found on calcareous rocks where the calcium content is highly decreased in the upper layers of the soil because of high precipitation. A few countries only include substrates with some content of silica in this habitat type (e.g. the U.K.). The soil can also be acidic (Van Uytvanck, J. et al., 2010). The interpretation manual of EU habitats (European Commission, DG Environment 2007) defines the habitat types as species-rich grassland, so that habitats with a decreased number of species due to overgrazing should not be included. For example in Denmark, the interpretation is even further restricted, stating that the flora must not have suffered any kind of enduring damage from fertilisation or intensive agricultural practices. The fact that a habitat can be present from lowland areas in Atlantic Europe to the alpine areas in European mountains, and that it can be in contact with Festuco-Brometea dry grasslands as well as Caricion fuscae fen grasslands, induces very high variability with respect to altitude and the moisture gradient (Galvnek & Jank 2008).

## 1.4. Main subtypes

France recognizes the following subtypes with sub-subtypes (Musum national d’Histoire naturelle [Ed], 2003.)

- Nardetea Strictae
  - I. Alliance Agrostion curtisii
  - II. Alliance Galio saxatilis-Festucion filiformis B.Foucault 1994
  - III. Alliance Violion caninae Schwick. 1944
  - IV. Alliance Carici arenariae-Festucion filiformis B.Foucault 1994
- Caricetea Curvulae
  - I. Alliance Nardion strictae Braun-Blanq. 1926

The European Commission (Galvnek & Jank 2008) recognizes three subtypes of the habitat, each with its own flora. See the source for more information.

- Acidophilous Nardus grasslands in Atlantic zone (alliances Agrostion curtisii B. Foucault 1986 and Galio saxatilis-Festucion filiformis B. Foucault 1994), within the lowland areas of the Atlantic bioregion
- Acidophilous psamophytic Nardus grasslands (alliance Carici-arenariae-Festucion filiformis B. Foucault 1994), on sand dunes in the Atlantic bioregion.
- Dry or mesophile sub-mountain and mountain Nardus grasslands (alliance Violion caninae Schwickerath 1944), most frequent type of Nardus grasslands in Europe.
- Sub-continental mountain Nardus grasslands (Nardo-Agrostion tenuis Sillinger 1933), mostly in the continental part of Europe.
- High-altitude mountainous Nardus grasslands (Nardion strictae Br.-Bl. 1926, Plantaginion thalackeri Quzel 1953, Campanulo-Nardion Rivaz-Martinez 1963, Potentillo ternatae-Nardion Simon 1958, Trifolion parnassi Quzel 1964, Nardo-Caricion rigidae Nordhagen 1937), typical of the highest mountains in Europe, mostly in the sub-alpine and alpine zones.
- Hygrophytic Nardus grasslands (Violion caninae Swickenrath 1944 p.p., Nardo-Juncion squarrosi (Oberdorfer 1957) Passarge 1964), in moist habitats with poor and highly acidic soils.



## 1.5. Associated species

The European Topic Centre on Biological Diversity has identified through expert judgement a number of species under the Habitats and Birds Directive associated with habitat 6230 and provided their conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 70 Species associated with 6230 Habitat Type (for legend, see introduction of chapter 3)**

Species	ETC/BD	TR08 <sup>1</sup>	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Cricetus cricetus</i> 1339	x										
<i>Euphydryas aurinia</i> 1065	x										
<i>Maculinea arion</i> 1058	x										
<i>Miniopterus schreibersii</i> 1310	x										
<i>Lullula arborea</i> A246	x										
<i>Maculinea alcon</i>		x									
<i>Pholidoptera transilvanica</i>		x									
<i>Gentianella praecox</i> subsp. <i>bohemica</i>		x									

<sup>1</sup>TR08 stands for the Technical report on Habitat Management

**Table 3 Annex II and IV species associated to 6230 Habitat Type and their Conservation Status (CS) at the Atlantic region and MS (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		ES	FR	UK	REGION
1058	<i>Maculinea arion</i>	Invertebrates	range	XX	U2	XX	XX
			population	XX	FV	U1	XX
			habitat	XX	U2	U1	XX
			future	XX	U2	U1	XX
			overall	XX	U2	U1	XX

N2K code	Species name	Group		DK	ES	FR	IE	PT	UK	REGION
1065	<i>Euphydryas aurinia</i>	Invertebrates	range	U2	XX	U2	FV	FV	U1	U2
			population	U2	XX	U2	U1	XX	U2	U2
			habitat	U1	XX	U2	U1	U1	U2	U2
			future	U2	XX	U2	U1	U1	U1	U2
			overall	U2	XX	U2	U1	U1	U2	U2

N2K code	Species name	Group		ES	FR	PT	REGION
1310	<i>Miniopterus schreibersii</i>	Mammals	range	XX	U1	XX	U1
			population	XX	U2	XX	U2
			habitat	XX	XX	XX	XX
			future	XX	U2	XX	U2
			overall	XX	U2	XX	U2

N2K code	Species name	Group		BE	DE	NL	REGION
1339	<i>Cricetus cricetus</i>	Mammals	range	U1	U1	U2	U1
			population	U2	U2	U2	U2
			habitat	U1	U2	U1	U2

			future	U2	U2	U1	U2
			overall	U2	U2	U2	U2

## 1.6. Related habitats

Nardus grasslands can be in contact with a relatively high variety of habitats at different gradients, depending on the area (Galvnek & Jank 2008):

Sand dunes: 2130, 2150, 2190

Sub-types in lowland areas: 6210, 6110, 8230

Wet Nardus grasslands: 7140, 7230, 7110, 7120, 6410

High-altitude mountainous types 6150, 6170

Agricultural areas: 6510, 6520, 4030, 4060, \*4070, 4090, 5120

Iberian Peninsula: 6140, 6160

Nardus grasslands: 9230, 9110, 9120, 9130, 9150, 9160, 9430

Flanders: 6210 (Van Uytvanck, J. et al., 2010)

Netherlands: 2130C, 2130, 6210 (Ministerie van Economische Zaken, Landbouw en Innovatie)

Germany: 6150 (Bundesamt fr Naturschutz)

## 1.7. Ecological services and benefits

Nardus grasslands in mountainous areas are very often located on relatively steep slopes. Their closed canopy may significantly contribute to the prevention of soil erosion, as well as the prevention of avalanches in high altitude mountainous areas. When Nardus grasslands are regularly managed, they can also contribute to flood prevention (quick run-off of rainwater on lodged grass). Nardus grasslands are often managed by traditional pasturing methods, which are a part of the European cultural heritage. They have great pastoral importance, especially in Mediterranean regions (e.g. in Spain), because they do not suffer from summer droughts as much as other pasture habitats. Nardus grasslands host high numbers of endemic and threatened plant taxa. Their conservation and, where necessary, their regular management can contribute very significantly to the protection of the nature value of European mountains (Galvnek & Jank 2008).

This habitat type is highly valued as pasture in Spain because it remains green all year round (Ministerio de Agricultura, Alimentacin y Medio Ambiente n.d.)

Goods and services provided by the habitat type are (VV.AA. 2009):

- Maintenance of biodiversity, especially of species from high mountain pastures, among which there are several endemic species of vascular plants
- Regulation of the water cycle
- Physical retention of soil
- Stock of C and N in the soil
- Production of pasture
- Genetic resources
- Aesthetic and recreational

- Cultural
- Educational
- Scientific

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
6230	Species-rich <i>Nardus</i> grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	range	U1	XX	FV	XX	U1	FV	U1	FV	FV	U1
		area	U2	U1	XX	XX	U2	U2	U2	U1	FV	U2
		structure	U2	U2	U2	XX	U1	U2	U2	U1	U2	U2
		future	U1	U2	U2	XX	U2	U2	U2	XX	U2	U2
		overall	U2	U2	U2	XX	U2	U2	U2	U1	U2	U2

This is a semi-natural grassland widespread across much of the European Union with distinct upland and lowland subtypes. The definition of this habitat has caused problems as several countries have large areas of species poor grassland dominated by matgrass (*Nardus stricta*) as a result of long periods of overgrazing of little interest for nature conservation - the se grasslands should not be included in this habitat.

Assessed as either 'unfavourable-inadequate' or 'unfavourable-bad' across all countries except for Greece and Italy who reported 'favourable' in all regions. As the pressures reported elsewhere as responsible for its unfavourable conservation status (abandonment of grazing or overgrazing) are likely to exist in these countries it is not clear why there should be such a difference (Summary sheet of the online report on Article 17 of the Habitats Directive) (ETC BD 2012).

## 1.9. Trends

There are some types of *Nardus* grasslands which are considered to be climax vegetation, meaning they do not require regular management (e.g. alpine *Nardus* grasslands). However, most *Nardus* grasslands are semi-natural habitats, where regular active management is the ultimate condition of their sustainable existence (Galvenek & Janak 2008).

*Nardus* grasslands are low productivity grasslands, which persist due to extensive farming with low inputs. Most probably, they were in the past widespread on poorer soils in all parts of Europe. However their extent decreased significantly with the intensification of agriculture during the 20th century. The CAP encouraged production in Western Europe and the state subsidised agricultural intensification in Eastern Europe. Both promoted the conversion of low-productive *Nardus* grasslands into grassland types with a higher biomass production (Galvenek & Janak 2008).

On the other hand, there is also the problem of land abandonment. A substantial part of *Nardus* grasslands is located in remote mountainous areas. They are used as seasonal pastures, and

transhumance is also frequent. The marginalisation of rural areas and land abandonment in mountainous areas has led to the deterioration of large areas of mountainous Nardus grasslands, which either transformed into heath or shrub communities, or have become overgrown by forests. Some countries also implemented afforestation programmes, and as a result, Nardus grasslands, with their limited agricultural value, are among the most afforested habitats (Galvnek & Jank 2008).

## 1.10 Main pressures and threats

According to the Technical report from the EC on the management of habitat type 6230 (Galvnek & Jank 2008) the main threats to Nardus grasslands are:

- **Eutrophication:** The habitat occurs on less fertile soils in oligotrophic or lightly mesotrophic conditions. An increased input of nutrients may cause relatively fast deterioration. Nutrient limitation is weakened; plants are taller, and light becomes a limiting factor. Eutrophication can be caused by the addition of mineral or organic fertilisers, but it can also be the result of intense grazing.
- **Inappropriate grazing practices:** Nardus grasslands are usually highly dependent on regular grazing. The organization of grazing in different localities may strongly affect the quality of the habitat. The concentration of animals on small patches of pasture may cause eutrophication, and may destroy the grassland canopy and accelerate invasion by weeds. On the other hand, pasture edges are often undergrazed and may be overgrown with trees and shrubs. Sheep and cattle can usually be shut into fenced areas, such as sheep-folds, during the night to protect them from predators. However, if this is practised inappropriately, it may cause a near total destruction of grass cover where folds are located and may result in strong eutrophication which is later followed by an invasion by nitrophilous species.
- **Land abandonment or low management intensity:** Nardus grasslands are very often situated in remote mountainous areas. This means that they can be threatened by land abandonment and a lower intensity of land use. This can lead to a secondary succession, an invasion by tall herbs and the establishment of trees and shrubs on grassland areas.
- **Afforestation:** Nardus grasslands belong to habitats which are unattractive for agricultural use because of their low biomass production. They were therefore very often targeted by afforestation programmes, especially in some parts of Western Europe.
- **Tourism and skiing activities:** High-altitude mountain areas are highly attractive tourist destinations. The development of tourism infrastructure may lead to a total destruction of the habitat or can strongly influence its structure and species composition (e.g. weed invasion on disturbed patches). The grasslands can also be negatively influenced by artificial snow and by machine-grading.

Specific Pressures and Threats identified by Member States:

Eutrophication	Wallonia, Germany
Inappropriate grazing practices	UK, Germany
Land abandonment or low management intensity	Germany
Afforestation	Germany
Tourism and skiing activities	
Land use change	Wallonia
Fragmentation	Wallonia
Invasive species	UK
Air pollution	UK, Germany

(DGARNE, Joint Nature Conservation Committee, Bundesamt für Naturschutz)

**Table 5 Main pressures to habitat 6230 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	<i>Maculinea arion</i>	<i>Euphydryas aurinia</i>	<i>Miniopterus schreibersii</i>	<i>Cricetus cricetus</i>
Fertilisation	x		x		
Grazing	x	x	x	x	
Biocenotic evolution	x				

**Table 6 Main threats to habitat 6230 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	<i>Maculinea arion</i>	<i>Euphydryas aurinia</i>	<i>Miniopterus schreibersii</i>	<i>Cricetus cricetus</i>
Fertilisation	x				
Grazing	x	x	x	x	
Biocenotic evolution	x				

In **Ireland**, the greatest threats to this habitat are over-grazing and succession over time to dry heath due to the abandonment of traditional agricultural practices. Areas of the habitat have already been lost (NPWS 2008).

In **Portugal** the threats on this habitat include (ALFA 2004)

- Decreasing grazing pressure:
  - the regression of grazing has a dual effect on grasslands
    - invasion by shrubs;
    - reduction process in a positive feedback, the nutritional value and palatability of the grassland (not consumed biomass accumulation and selection of plants);
  - causes the decreasing grazing intensity are complex, eg:
    - it is necessary to overcome great distances, bad roads, to reach the pastures;
    - Nardus has a low quality and low palatability to livestock and therefore incompatible with systems of intensive livestock production;
    - the shepherds are not owners of Nardus grasslands and their profession is socially undervalued;
    - Agriculture is providing large areas of land for grazing or forage production in the lowlands surrounding the mountain ranges;
- Physical destruction of the habitat mainly relevant in the higher temperate regions of the Serra da Estrela, particularly through trampling, installation of structures for tourism and trade, and opening and widening of roads and paths, and on waste disposal and salinization;

- Eutrophication, particularly through the use of nitrogen fertilizers and / or corrective limestones (less relevant).

#### Germany, Ackermann

1. Biocenotic evolution after abandonment
2. Fertilization (Eutrophication)
3. Input of nutrients from surrounding environment (Eutrophication)
4. Lowering of the watertable and consequent mineralization of previous fens
5. Species loss due to acidification

#### United Kingdom, MacKintosh:

1. Non intensive sheep grazing:
  2. Damage caused by game (excess population density)
  3. Abandonment of pastoral systems, lack of grazing
  4. Nitrogen-input
  5. Forest planting on open ground (native and non-native trees)
- Over-grazing by sheep destroys structural variety in the sward, prevents flowering and regeneration by seed, and causes erosion and loss of the habitat.
  - Over-grazing by deer destroys structural variety in the sward, prevents flowering and regeneration by seed, and causes erosion and loss of the habitat.
  - Under-grazing by sheep, or absence of grazing, allows the sward to grow tall, leading to domination by grasses and the loss of small, low-growing broadleaved herbs, and the invasion of scrub and bracken leading to a loss of the habitat.
  - Nitrogen-input has been shown to cause a decline in some of the characteristic species of calcareous grassland and to affect functions and soil processes.
  - Forest planting on open ground (native and non-native trees): Scottish Government targets for woodland expansion may lead to small patches of the habitat being enclosed within new woodland with no access to grazers, therefore at risk of losing small low-growing broadleaved herbs, and being invaded by scrub and bracken leading to a loss of the Habitat.

## 2 Conservation management

### 2.1. Main conservation requirements

The minimum area of the habitat type should be 0.5 ha. If it is smaller external influences become too big and targeted species migration will be too small (Van Uytvanck, J. et al., 2010).

The main recommendations for the conservation of this type of habitat in Spain are (VV.AA. 2009):

- Avoid physical destruction of the habitat. Avoid the creation of tourism infrastructure and facilities that entails the destruction of the habitat (ski resorts and related buildings, roads, wind farms, etc..).
- Control, inspection and elimination of waste derived from tourist activities.
- Control the use of salt in roads during winter.

- Control grazing improvement measures. Prohibition of any action on the physical environment that may promote drainage and / or hinder the supply of water to the system. Prohibition of limestone or fertilizer inputs aimed at increasing soil pH and the expansion of legumes to improve the quality of the pasture, destroying the floristic composition of the habitat type.
- Control the introduction of selected species of productive ecotypes for pasture improvement.
- Control stocking loads. Avoid or at least control the use of high mountain grasslands for extensive livestock grazing. At lower altitudes, apply experiences from livestock management to favor the conservation of these grasslands.
- Periodically monitor both physical-chemical and biological parameters.
- Integrate knowledge of the dynamics (regeneration, mortality) in the management of the habitat type to determine the causes of possible deterioration of the formations.
- Promote and encourage research on these grasslands through the integration of ecological approaches and retrospective studies (paleoecology, dendroecology).
- Preserve protected areas without intervention for their conservation, monitoring and research.
- Provide and encourage cooperation between management, conservation and research agencies, and disseminate as widely as possible the experiences and research activities.
- Disseminate the conservation values of the habitat type.

Include characteristic endemic or rare species in lists of protected species.

#### **Germany, Ackermann**

1. Resume intensive agricultural use (mowing or grazing)
2. Maintain intensive agricultural use (mowing or grazing)
3. Prevent nutrient input from the surrounding environment, prevent atmospheric deposition of nutrients.
4. Preserve the characteristic water table in humid Nardic Grasslands.
5. Change the land use to a favourable one, promote biodiversity

#### **United Kingdom, MacKintosh:**

1. The habitat must be grazed at levels that maintain a varied sward height, including areas of short sward in which smaller and less vigorous species can persist, but low enough to permit flowering and not lead to soil erosion.
2. As above.
3. As above.
4. A reduction in emissions of oxidised nitrogen gases from transport and power generation sources, and of ammonia from livestock production..
5. Exclusion of the habitat - small patches and large - from new woodland enclosures.

## **2.2. Management measures**

The Technical report from the EC on the management of habitat type 6230 (Galvenek & Janak 2008) proposes the following management measures. It also includes some examples.

### **Grazing**

Grazing Intensity is probably the most decisive factor determining the quality of the habitat. The recommended livestock density differs between regions and sub-types. Length of the pasturing season is usually limited by local climatic conditions. As continuous grazing is less suitable, rotation of the area used for grazing is recommended. Mountainous habitats are usually grazed by sheep, but cattle can also be used in some areas; they consume a wider range of grass species. Grazing by horses is also feasible, but it can cause soil erosion in wet conditions. Grazing by sheep only may lead to a dominance of *Nardus stricta* in the canopy, because the sheep avoid it. If cattle or goats graze the pastures, *Nardus stricta* is controlled more effectively. The directing of the sheep by a shepherd in order to avoid selective grazing, should also be considered. The timing of the start of grazing is also very important. Late grazing is not very suitable, because some grass species may lose their nutrient value and will not be consumed by the animals. On the other hand, grazing too early during the spring and summer, e.g. before the flowering and seeding of vascular plants of conservation value, must also be carefully considered. Grazing can also be considered as a potential tool for the restoration of species-rich grasslands.

### **Overnight staying of the animals on the pastures**

A concentration of animals in closed or fenced off areas during the night is a typical practice used in mountainous areas of Europe (e.g. Alps, Carpathians). It was used in the past to increase habitat productivity. It is necessary to ensure a maximum density of animals in an area. To avoid possible damage to places with high animal concentrations, it is better to allocate them to peripheral parts of the pastures to avoid the spreading of nitrophilous species.

### **Mowing**

Mowing is usually employed in regions where there is a lack of more productive habitats. The hay is sometimes not used for feeding, but only for littering. A combination of mowing and pasturing is the traditional method employed on semi-natural grasslands in large parts of Europe. It is highly recommended, because mowing as a non-selective method of biomass removal promotes different species from selective grazing. Mowing itself, with the regular removal of biomass, may lead in some cases to gradual oligotrophisation of *Nardus* grasslands, mostly on very poor soils, and it results in a decreased number of species. Therefore some use of manure, or occasionally leaving the cut and chopped grass on the ground (see below), may be recommended in such cases together with regular mowing. If the habitats are only mown, artificial disturbances to promote space for the recruitment of some less competitive plant species are recommended. Cutting and chopping of biomass with a flail or rotary mower, leaving the cuttings spread on the ground, is widely used for restoration purposes where insufficient domestic animals are available. This practice, when regularly applied, may lead to a change of species composition and the dominance of grasses such as *Avenella flexuosa* and *Holcus mollis*. Therefore, repeating such practice over several years is not recommended. Such management may also lead to the accumulation of biomass on the site, especially when used as a restoration measure on abandoned grasslands.

### **Fertilization**

Eutrophication is one of the biggest threats for a habitat. Therefore, recommendations for habitat management very often do not recommend any kind of additional fertilisation. The type of fertilizer used is also very important, because especially phosphorus is strongly persistent in the soil and may



cause a long-term increase in productivity. An increased calcium level may promote higher species diversity, but it has to be carefully assessed, since liming has long-term effects on species composition.

### **Burning**

Burning is another management measure applied to the habitat. It is a relatively controversial measure, which may lead to changes in species composition, and if applied regularly, it may promote the spreading of invasive species. It requires great areas of land (D GARNE)

### **Control of invasive grass and weed species**

The cessation of grazing practices may lead to the expansion of tall grasses like *Deschampsia cespitosa*, *Calamagrostis sp. div.*, *Molinia caerulea* or species like *Pteridium aquillinum*, *Bistorta major*, *Senecio spp.*. Most of these species are grazing-intolerant, but if they spread over the grassland, restoration is very complicated. Restoration mowing itself may not be sufficient to suppress them, because they can store a high amount of nitrogen within their root systems. Experiments with *Nardus* grasslands overgrown by *Bistorta major* showed that better results can be achieved if the sites are not only mown, but also manured, or mown and grazed. Species-rich grassland can then be restored within 3-5 years.

Management guidelines for *Nardus* grasslands in **Portugal** include (ALFA 2004):

- Promotion of pastoral activity, e.g.:
  - the contracts with those involved;
  - cleaning of the traditional ways;
  - car transport animals up to cervunais;
  - the value of products associated with grazing animals in cervunal;
  - The direct incentives to grazing cervunal.
  
- Active management of the grasslands, e.g.:
  - increasing the pressure by using grazing enclosures;
  - ban on the use of fertilizers and soil;
  - the removal of biomass not consumed by mechanical cutting;
  - the mechanical cutting and removal of understory vegetation (eg scrub of *Calluna vulgaris*).
  
- Specifically for the Serra da Estrela:
  - the reduced use of salt on public roads during the winter;
  - the elimination of threats of physical destruction of habitat;
  - the spatial concentration of tourism;
  - managing the opening and widening of roads and paths;
  - the cleaning of waste resulting from tourism;
  - strengthening the supervision over waste disposal;
  - the reintroduction of indigenous species of herbivores now extinct;
  - the introduction of grazing with cattle.

**Germany**, Ackermann pers.comm.:

1. Durchführung einer extensiven Beweidung (Standweide mit Rindern, Schafen, Ziegen oder robusten Pferderassen) mit geringer Besatzdichte (0,3-1 GV/ha) und einer langen Weideperiode ohne Zufütterung. Alternativ Sommermahd ab Mitte Juli bis Oktober in Teilbereichen, wobei ein von Jahr zu Jahr wechselnder Teil der Wiese ungemäht bleiben sollte. Grundsätzlich soll ein Einsatz von Kalkung, Düngung und Pflanzenschutzmittel unterbleiben.
2. Abschluss von Bewirtschaftungsvereinbarungen/Vertragsnaturschutzprogrammen, die eine unter 1 genannte Bewirtschaftung vorsieht.
3. Schaffung von ungedüngten Pufferstreifen um besonders hochwertige Borstgrasrasen, wenn intensiv bewirtschaftete Acker- oder Wiesenflächen angrenzen.
4. Wiederherstellung des typischen Wasserhaushalts feuchter Borstgrasrasen durch gezielten Verschluss von Entwässerungsgräben
5. Anpassung der Nutzung an die unter 1 genannten Bedingungen, in Einzelfällen kann eine leichte Düngung (ohne Kalk) sinnvoll sein; auf Teilflächen könnte auch die Schaffung von Bodenverletzungen (z. B. durch tiefe Mahd) und der Auftrag von autochthonem Mahdgut aus der Umgebung hilfreich sein.
6. Wiederherstellung bzw. Vergrößerung von Restvorkommen durch Rodung oder starke Auflichtung von Gehölzaufwuchs bzw. jungen Aufforstungen ehemaliger Borstgrasrasen

**United Kingdom**, MacKintosh, pers.comm.:

1. Appropriate grazing levels to be maintained.
2. Control of deer numbers.
3. Appropriate grazing levels to be maintained.
4. Reductions of Nitrogen emissions from all sources.
5. The habitat must be identified and mapped before new woodland enclosures are planned, and must be excluded from these enclosures.

### 2.3. Other measures (e.g. monitoring)

The Technical report from the EC on the management of habitat type 6230 (Galváneek & Janák 2008) proposes the following other management measures. It also includes some examples.

#### **Restoration of the stands overgrown by trees and shrubs**

There are several methods used to restore habitats degraded by secondary succession. If the locality is not heavily overgrown, cutting and chopping of biomass with a flail or rotary mower can be used. If the stage of degradation is higher, that practice is not feasible and a cultivator has to be applied. Manual cutting by brush cutter is also a suitable but costly method. Cutting scrub is always an effective measure, but only if it is followed by regular management. If it is not possible to ensure frequent mowing or grazing after restoration, it is better to skip restoration, because scrub encroachment may be even more vigorous after cutting. It is possible to use herbicide to control scrub encroachment after restoration, but it can be a somewhat risky. To avoid double application of herbicide, the treated areas can be colour-marked. The application of herbicide to freshly cut scrub in the autumn is also effective. Such application kills their root systems, preventing further invasion, and is not harmful to other vegetation or the soil.

#### **Turf stripping**

Turf stripping is a restoration method used mostly in cases where the upper horizons of the soil are suffering from eutrophication. Through the removal of nutrients from the upper soil layer, an oligotrophic habitat, such as *Nardus* grasslands, may be restored. The method was used especially for the restoration of grasslands in areas which used to be coniferous plantations, which are clear-cut, and then sod cutting is applied.

#### **Land acquisition**

The principle that farmers should take care of the habitat is applied in most cases. However, if the area is of no interest to farmers, or the habitat is threatened by different economic activities, land acquisition is relevant means of ensuring its proper management.

#### **Practices connected with grazing management**

Some practices connected with grazing management may be extremely important for habitat conservation. For instance, the use of chemicals for the removal of worms from cattle is not recommended, because it is harmful for coprophag insects which play a very important role in the decomposition of dung. Grazing on *Nardus* grasslands at higher altitudes may be connected with traditional transhumance practices. Maintenance of the infrastructure for transhumance may be an ultimate condition for the maintenance of habitats in remote mountain areas. The purchase of animals or equipment necessary for grazing, such as electric fences, may also be an important part of conservation management.

#### **The restoration of grasslands damaged by ski activities**

The construction of ski infrastructure may in some cases be harmful to *Nardus* grasslands, because of large-scale disturbance and the dispersal of weed species. Several methods can be applied to restore such sites. Dispersal of hay from species-rich grasslands over disturbed places, in combination with the relocation of turves from species-rich grasslands, which are laid on the open land in a chessboard arrangement, appear to be effective. Such a solution promotes seed dispersal and recruitment, and leads to the fast recovery of disturbed habitats. Turf also prevents soil erosion.

#### **Buffer zones**

Germany recommends to creating of buffer zones to decrease eutrophication and (air) pollution (Bundesamt für Naturschutz)

## **2.4. Species specific measures**

### *Maculinea arion* - 1058

In Britain, the species is found on tightly-grazed, warm, sun-exposed pastures. In other parts of Europe *M. arion* inhabits landscapes with a mosaic of differently-mown meadows, extensively-used pastures, hedgerows and small woodlands.

Once the grazing pressure decreases and the vegetation becomes taller and denser, *Myrmica* ant colonies are replaced by other species. Populations of *M. arion* resisted the encroachment of woods on pastures, but the restriction of grazing in nature reserves resulted in their rapid extinction. Only the revival of grazing on a large scale enabled the successful restoration of their population.

The intensification of grassland use and the substitution of sheep grazing by cattle, and the afforestation of abandoned grasslands have destroyed many traditional habitats of the species. Intensified pastures lack the characteristic flora which is the nectar source for adult butterflies. Grazing by cattle creates a very different structure of turf which is not suitable for *Myrmica* ant colonies. Re-introduction of non-intensive grazing by small numbers of sheep or mixed sheep-cattle herds is recommended. A shorter grazing period is to be preferred; a combination of mosaic mowing once per year before the 15th of June or after the 10th of September, with short-term autumn grazing, is also acceptable. Grazing on locations with *M. arion* should be done in a rotational manner, leaving 50% of the area without intervention in year 1, then swapping grazing to the other part in year 2, and back in year 3. Intensive large-scale grazing, and mowing the entire plot twice or even once a year should not be allowed under any circumstances.

Locations left abandoned for longer periods of time, and thus not suitable for the species, can be burnt (with small-scale surface fires set each year on different parts of the site) and then grazed. A suitable season for burning, as well as for the use of heavy machinery, is the winter season, when ants and caterpillars hibernate underground (Galvnek & Jank 2008).

(Galvnek & Jank 2008) also lists: *Maculinea alcon*, *Pholidoptera transilvanica* and *Gentianella praecox subsp. bohemia*

## 2.5. Main constraints / bottlenecks and actual needs

Despite frequent mowing being the practice recommended for *Nardus* grasslands of high nature value, the traditional method is no longer feasible due to high costs. So alternative measures have to be considered (Galvnek & Jank 2008).

### Germany, Ackermann

Remaining intact habitat often small and isolated (fragmented)

### United Kingdom, MacKintosh:

1. Non-co-operating owners/land managers. However, appropriate grazing levels may be difficult to achieve in a mosaic of vegetation types where some types (such as heathland) need lighter grazing levels than is ideal for the habitat.
2. Non-co-operating owners/land managers.
3. Global economics affect the profitability of upland sheep farming .
4. Lack of effective pollution control regulations.
5. There is a lack of knowledge and guidance needed to help foresters to avoid damaging the habitat.

## 2.6. Recommendations

### Germany, Ackermann , pers. Comm.:

1. Develop new *Nardus* grasslands through removal of nutrients in acidic grasslands; possibly by mowing to the ground or removing the top soil and order autonomous grazing to take the environment into account.

**United Kingdom, MacKintosh:**

1. Communication and guidance for land managers, agri-environment funding to support appropriate management. In the case of a mosaic of vegetation types where some types (such as heathland) need lighter grazing levels than is ideal for the habitat, solutions include prioritising the requirements of the different habitats in rotation over several years.
2. Effective policies and regulations on deer control
3. Agri-environment funding to support appropriate management..
4. Effective pollution control regulations.
5. Guidance to help foresters to avoid damaging the habitat.

## Cases / projects

## Sites

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

### Summary

*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils occur on plain to montane levels, on more or less wet oligotrophic and slightly acidic to base-neutral soils. Buffering of the pH is caused by the influence of base-rich ground and or surface water. During winter the water table is at the surface, during the summer it falls to a few centimetres below. These meadows can stem from either extensive, traditional agricultural management, sometimes with a cut late in the year, or they correspond to a deteriorated stage of draining peat bogs. Such grasslands can be found in proximity to (often in direct physical contact with) the *Nardetalia* community or *Cnidion dubii* alliances.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad' in all the countries of the Atlantic biogeographic region with the exception of Portugal where this habitat has been assessed as 'favourable'. The area of the habitat has been found to have suffered a dramatic decreased in the 19<sup>th</sup> century in most countries because agricultural intensification. Whilst some countries have introduced restoration programmes it is only in the U.K. that the range seems to be stable.

**The main reported threats and pressures** to *Molinia* Meadows on calcareous, peaty or clayey silt laden soils are therefore:

- Lowering of the water table: inducing drought during summer.
- Eutrophication/fertilization also atmospheric nutrient deposition
- Land use change toward more productive grasslands (linked to the abandonment of pastoral systems).
- Active afforestation.
- Stock Density: too few or too intense grazing.
- The natural succession of scrub and woodland due to a lack of management or abandonment.
- Water quality: input of nutrient and of pH rich water.
- Invasive species.
- Too frequent burning.
- Fragmentation.
- Acidification.

The principal **management measures** for this habitat include:

- (Late) cutting and removal of the hay; which can be two or three times per year; mowing from the 'inside out'; leaving strips intact; avoidance of using heavy equipment; the possible introduction of grazing where appropriate.

- Prohibition of drainage or other modifications to the water table, with special attention to dry summers.
- Enhancing the quality and extent of agricultural wastewater treatment, urban and industrial.
- Conditioning of grazing.
- Conservation of marshland associated with this habitat.
- Restoration of the original water table: close side-ditches.
- Creation of buffering unfertilised strips when adjacent to intensively managed cropland or pastureland.
- Liming or PK-Fertilization.
- Sod/turf cutting.
- Ensuring the maintenance or restoration of appropriate livestock grazing regimes and scrub management.
- Prevent/limit agricultural improvement through legislative and incentive measures.
- National/international policy advocacy to seek to reduce impacts from atmospheric N deposition, diffuse pollution and climate change.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- The remaining areas are highly fragmented.
- Insufficient funding/incentives, including insufficient capacity/capability of key nature conservation organisations.
- Land ownership.
- External impact of changed water management on large areas outside Natura 2000-site.
- Ineffective domestic EIA legislation for uncultivated/semi-natural habitats.
- Perverse incentives/markets and an unfavourable livestock policy framework.
- Lack of public appreciation of the importance/value of species-rich grassland for society.
- Global economics affect the profitability of rough grazing on low productivity habitat.
- Loss of appropriate hardy stock and experience to manage them.
- Lack of effective long-term mechanisms for funding habitat restoration to reduce habitat fragmentation.
- Changing rain patterns under climate change scenarios.

**Solutions** to the pressures, threats and bottlenecks may include:

- Development/restoration of habitat on areas with remaining Molinion grasses (removing nutrients from the system, raising the water table, deforestation) close or adjacent to existing sites with the habitat type.
- Restoration of fallow stages.
- Ensure appropriate level of funding via ERDP for agri-environment schemes/funding to help make low-intensity stock rearing sustainable.
- Awareness raising, education and community engagement.
- Further statutory designations of sites under domestic legislation.
- Strengthen EIA (Agriculture) Regulations.

- Policy advocacy in relation to atmospheric and diffuse pollution, climate change, livestock and water resource/catchment management (e.g. using the Water Framework Directive – WFD)
- Setting up/making use of local grazing animals partnerships to provide expertise and also to match appropriate stock to sites.
- Increased funding support for conservation bodies to enable effective grazing management.

## 1 Description of the habitat

*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.

Sub-types : 37.311: on neutro-alkaline to calcareous soils with a fluctuating water table, relatively rich in species (*Eu-molinion*). The soil is sometimes peaty and becomes dry in summer. 37.312: on more acid soils of the *Junco-Molinion* (*Juncion acutiflori*) except species-poor meadows or on degraded peaty soils.

In some regions, these grasslands are in close contact with *Nardetalia* communities. For the *Molinia* meadows of river valleys, a transition toward *Cnidion dubii* alliance is observed. (EC 2007a)

### 1.1. Distribution

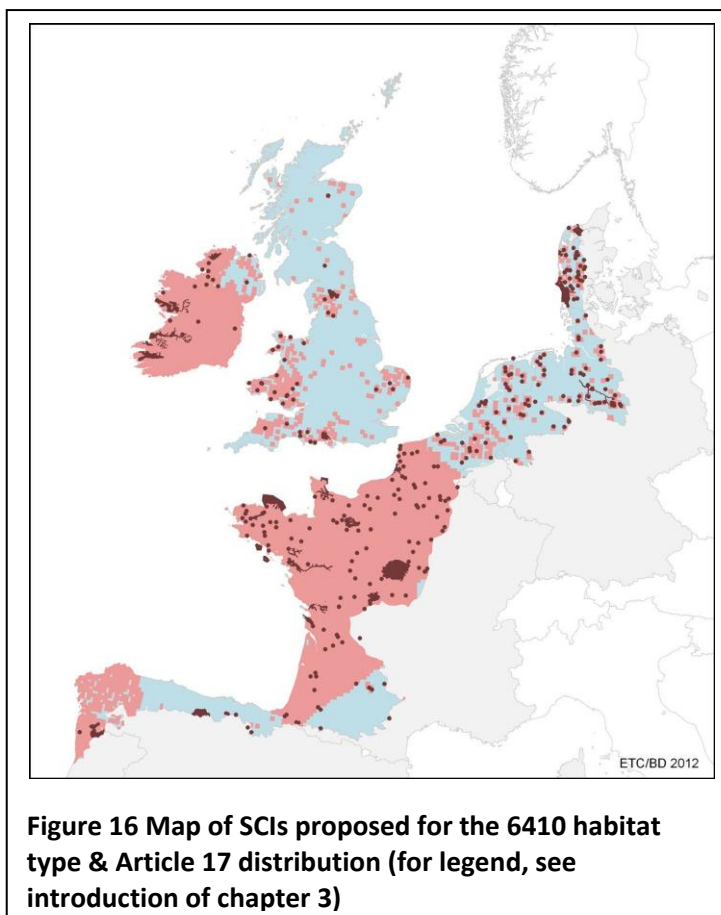
**Table 71 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	12	55	21	50	687	31	68	24	6		49	36	122	143	23	18	21	2		14	43	
habitat area (ha)	133	2212	432	171	7678	3337	6904	1821	304		18538	5055	12446	12304	3049	3074	364	942		2205	2039	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 51-76%<sup>82</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>82</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)





## 1.2. Main features

## 1.3. Ecological requirements

The habitat type occurs mainly on oligotrophic, slightly acidic to base-neutral soils. Buffering of pH is caused by the influent of base-rich ground and or surface water. During winter the water table is at the surface, during the summer it falls to a few centimetres below. How deep exactly the water table falls during summer depends on the type of soil; e.g. Peat vs clay (Ministerie van Economische Zaken, Landbouw en Innovatie).

## 1.4. Main subtypes

See Description.

## 1.5. Associated species

The European Topic Centre on Biological Diversity has identified through expert judgement a number of species under the Habitats and Birds Directive associated with habitat 6410 and provided their conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 72 Species associated with 6210 Habitat Type (for legend, see introduction of chapter 3)**

Species	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Bufo calamita</i> 1202	x									
<i>Aeshna viridis</i> 1048	x									
<i>Apium repens</i> 1614	x									
<i>Bombina variegata</i> 1193	x									
<i>Leucorrhinia albifrons</i> 1038	x									
<i>Leucorrhinia pectoralis</i> 1042	x									
<i>Lycaena dispar</i> 1060	x									
<i>Oxygastra curtisii</i> 1041	x									
<i>Stylurus flavipes</i> 1040	x									
<i>Triturus cristatus</i> 1166	x									
<i>Triturus marmoratus</i> 1174	x									
<i>Acrocephalus schoenobaenus</i> A295	x									
<i>Anas clypeata</i> A056	x									
<i>Anas crecca</i> A052	x									
<i>Anas platyrhynchos</i> A053	x									
<i>Anser anser</i> A043	x									
<i>Asio flammeus</i> A222	x									
<i>Calidris alpina</i> A149	x									
<i>Crex crex</i> A122	x									
<i>Gallinago gallinago</i> A153	x									
<i>Philomachus pugnax</i> A151	x									
<i>Porzana porzana</i> A119	x									
<i>Saxicola rubetra</i> A276	x									
<i>Tringa glareola</i> A161	x									
<i>Tringa nebularia</i> A164	x									
<i>Tringa totanus</i> A162	x									
<i>Vanellus vanellus</i> A142	x									
<i>Anas querquedula</i> A055	x									
<i>Anthus pratensis</i> A257	x									
<i>Emberiza schoeniclus</i> A381	x									
<i>Limosa limosa</i> A156	x									
<i>Locustella naevia</i> A290	x									
<i>Lymnocyptes minimus</i> A152	x									
<i>Motacilla flava</i> A260	x									
<i>Tringa erythropus</i> A166	x									

**Table 3 Annex II and IV species associated to habitat 6410 and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	FR	NL	REGION
1038	<i>Leucorrhinia albifrons</i>	Invertebrates	range	XX	FV	U2	FV
			population	XX	U1	U2	U1
			habitat	XX	U2	U2	U2
			future	XX	U1	U2	U1
			overall	XX	U2	U2	U2

N2K code	Species name	Group		BE	DE	FR	NL	REGION
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1040	<i>Stylurus flavipes</i>	Invertebrates	range	FV	FV	FV	FV	FV
			population	U1	FV	FV	XX	XX
			habitat	U1	FV	FV	FV	FV
			future	FV	FV	FV	FV	FV
			overall	U1	FV	FV	FV	FV

N2K code	Species name	Group		ES	FR	PT	REGION
1041	<i>Oxygastra curtisii</i>	Invertebrates	range	XX	U1	XX	U1
			population	XX	U1	XX	U1
			habitat	XX	U1	XX	U1
			future	XX	U1	XX	U1
			overall	XX	U1	XX	U1

N2K code	Species name	Group		BE	DE	FR	NL	REGION
1042	<i>Leucorrhinia pectoralis</i>	Invertebrates	range	U2	U2	U2	U2	U2
			population	U2	U2	U2	U2	U2
			habitat	XX	U2	U2	U1	U2
			future	U1	U1	U2	U1	U1
			overall	U2	U2	U2	U2	U2

N2K code	Species name	Group		DE	DK	NL	REGION
1048	<i>Aeshna viridis</i>	Invertebrates	range	U2	U1	U2	U2
			population	U2	U1	U2	U2
			habitat	U1	XX	U1	U1
			future	XX	FV	U1	XX
			overall	U2	U1	U2	U2

N2K code	Species name	Group		DE	FR	NL	REGION
1060	<i>Lycaena dispar</i>	Invertebrates	range	XX	U1	U2	U1
			population	XX	XX	U2	XX
			habitat	U2	U1	U2	U1
			future	U2	U1	U1	U1
			overall	U2	U1	U2	U1

N2K code	Species name	Group		BE	DE	DK	FR	NL	UK	REGION
1166	<i>Triturus cristatus</i>	Amphibians	range	U2	U1	FV	U1	U1	FV	U1
			population	U2	U1	XX	U1	U1	U1	U1
			habitat	XX	U1	XX	XX	U1	XX	XX
			future	U2	FV	XX	U1	U1	FV	U1
			overall	U2	U1	XX	U1	U1	U1	U1

N2K code	Species name	Group		ES	FR	PT	REGION
1174	<i>Triturus marmoratus</i>	Amphibians	range	XX	U2	FV	U2
			population	XX	U1	FV	U1
			habitat	XX	XX	FV	XX
			future	XX	U1	FV	U1
			overall	XX	U2	FV	U2

N2K code	Species name	Group		DE	FR	NL	REGION
1193	<i>Bombina</i>	Amphibians	range	U2	U2	U2	U2

	<i>variegata</i>		population	U2	U2	U2	U2
			habitat	U1	FV	U2	FV
			future	U2	U2	U2	U2
			overall	U2	U2	U2	U2

N2K code	Species name	Group		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
1202	<i>Bufo calamita</i>	Amphibians	range	FV	FV	FV	XX	U2	U2	FV	FV	U1	U2
			population	FV	U1	U2	XX	U2	U2	U2	XX	U2	U2
			habitat	XX	U1	U2	XX	U2	U1	U1	U1	U1	U2
			future	FV	U1	U1	XX	U2	U1	U1	FV	FV	U2
			overall	FV	U1	U2	XX	U2	U2	U2	U1	U2	U2

N2K code	Species name	Group		BE	DE	ES	FR	NL	UK	REGION
1614	<i>Apium repens</i>	Vascular plants	range	U1	U2	XX	U2	U2	U2	U2
			population	U1	U2	XX	U2	U2	U2	U2
			habitat	U1	U1	XX	U2	U1	U1	U2
			future	U1	U1	XX	U2	U1	U1	U2
			overall	U1	U2	XX	U2	U2	U2	U2

In Spain *Carterocephalus palaemon*, which is a butterfly distributed mainly in Northern and central Europe, is very rare and its larvae feed exclusively on *Molinia caerulea* (Ministerio de Agricultura, Alimentación y Medio Ambiente n.d.).

## 1.6. Related habitats

Netherlands: 6410, 7230 (Ministerie van Economische Zaken, Landbouw en Innovatie)

Wallonia: 6430 (DGARNE)

France: 6420 (Muséum national d'Histoire naturelle [Ed], 2003.)

Germany: 7230 (Bundesamt für Naturschutz)

## 1.7. Ecological services and benefits

According to the Spanish Ministry of Environment (VV.AA. 2009) this type of habitat has a very important function regulating the water cycle, acting as buffer against floods and as natural reservoir that releases water after rainfall.

The pastoral value of this habitat type is low because of the high presence of *Molinia caerulea* and rushes with low nutritional value for livestock, but it is interesting for the general cycle management as it provides pasture out of the high offer period and gives shelter through soil moisture during the hottest periods.

*Molinia caerulea* meadows contribute to the stability of the ecotone in aquatic and terrestrial ecosystems with enormous environmental value. This type of habitat helps to regulate the water cycle and improves water quality.

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012)N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils ( <i>Molinia caerulea</i> )	range	U2	XX	FV	XX	FV	FV	U1	FV	FV	FV
		area	U2	U2	FV	XX	U2	U2	U2	FV	U2	U2
		structure	U2	U2	U2	XX	XX	U2	U2	XX	U2	U2
		future	U2	U2	U1	XX	U2	U2	U1	FV	U1	U2
		overall	U2	U2	U2	XX	U2	U2	U2	FV	U2	U2

Meadows with purple moorgrass (*Molinia caerulea*) on wet, unfertile soils resulting from long periods of traditional management such as mowing. Species-poor meadows dominated by purple moorgrass, often a result of draining peat bogs, are not included in this habitat. This habitat is wide spread across central, northern and western Europe, it also occurs more rarely in the Mediterranean region (ETC BD 2012).

Assessed as 'unfavourable-bad' in all regions in which it occurs except for the Mediterranean region where it is 'unknown' as a result of Spain reporting all parameters as 'unknown'. Only in Estonia (Boreal) and Portugal (Atlantic and Mediterranean) has this habitat been assessed as 'favourable'. Most countries include changes in agricultural management amongst threats and pressures, many also note drainage. Better information required, particularly from Spain and Luxembourg (Summary sheet of the online report on Article 17 of the Habitats Directive) (ETC BD 2012).

## 1.9. Trends

In the Netherlands the total area of the habitat has decreased from 100.000 ha in the 19th century to about 1 ha now. This decrease has been mainly caused by the intensification of agriculture (i.e. lowering of the water table and eutrophication) on these sites. With the loss of the habitat came a decrease and localized loss of associated species.

Recently during the period 1994-2004 actions were taken to increase and restore area of the habitat type. Still, in most of the habitat area the outlook is not favourable because required hydrologic conditions are lacking. (Ministerie van Economische Zaken, Landbouw en Innovatie)

The same decrease holds for Wallonia, France and the UK with a dramatic decline in the 20<sup>th</sup> century (DGDARNE) (Muséum national d'Histoire naturelle [Ed], 2003.) (Joint Nature Conservation Committee).

Most area in Wallonia has been converted to grassland by lowering of the water table or has been afforested (DGDARNE).

The range of the habitat in the UK seems to be stable since 1994 because of conservation programmes (Joint Nature Conservation Committee).

## 1.10 Main pressures and threats

**Table 5 Main pressures to habitat 6410 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012) Pressure description (2nd level)	Molinia meadows on calcareous, peaty or clayey-silt-laden soils ( <i>Molinia caeruleae</i> )	<i>Leucorrhinia albifrons</i>	<i>Stylurus flavipes</i>	<i>Oxygastra curtisii</i>	<i>Leucorrhinia pectoralis</i>	<i>Aeshna viridis</i>
Cultivation	x			x		
Fertilisation	x			x	x	x
Grazing	x					
General Forestry management	x					
Drainage	x	x			x	x
Modification of hydrographic functioning, general	x	x	x	x	x	x
Biocenotic evolution	x	x	x		x	

Pressure description (2nd level)	<i>Lycaena dispar</i>	<i>Triturus cristatus</i>	<i>Triturus marmoratus</i>	<i>Bombina variegata</i>	<i>Bufo calamita</i>	<i>Apium repens</i>
Cultivation	x	x	x		x	
Fertilisation		x				
Grazing					x	x
General Forestry management		x		x		
Drainage		x	x	x	x	x
Modification of hydrographic functioning, general		x		x	x	
Biocenotic evolution		x	x	x	x	x

**Table 6 Main threats to habitat 6410 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

(ETC BD 2012) Threat description (2nd level)	Molinia meadows on calcareous, peaty or clayey-silt-laden soils ( <i>Molinia caeruleae</i> )	<i>Leucorrhinia albifrons</i>	<i>Stylurus flavipes</i>	<i>Oxygastra curtisii</i>	<i>Leucorrhinia pectoralis</i>	<i>Aeshna viridis</i>
Cultivation	x			x		
Fertilisation	x			x	x	x
Grazing	x					
General Forestry management	x					
Drainage	x	x			x	x
Modification of hydrographic	x	x	x	x	x	x

functioning, general						
Biocenotic evolution	x	x	x		x	

Threat description (2nd level)	<i>Lycaena dispar</i>	<i>Triturus cristatus</i>	<i>Triturus marmoratus</i>	<i>Bombina variegata</i>	<i>Bufo calamita</i>	<i>Apium repens</i>
Cultivation	x	x	x		x	
Fertilisation		x				
Grazing						x
General Forestry management				x		
Drainage			x	x	x	x
Modification of hydrographic functioning, general		x			x	x
Biocenotic evolution			x	x	x	x

The UK gives an elaborate description of the pressures on their habitat area:

- Under-grazing

Eu-Molinion wet grasslands in the UK have been traditionally managed as rough grazing, particularly by cattle, and to a much lesser extent by cutting to maintain favourable structure and function. A major current problem is agricultural neglect leading to litter build-up and scrub invasion. Underlying causes of under-grazing are still thought to be largely due to current agricultural economics and policies, exacerbated by e.g. BSE and Foot and Mouth disease, leading to a reluctance to keep stock (large stock in particular) on pasture perceived to have little nutritional value.

- Lack of remedial management

It is natural for open fens to change spontaneously into wooded fens, and management, such as scrub clearance and grazing, is required to prevent this.

- Over-grazing

Less prevalent than under-grazing, overgrazing by sheep is still sometimes reported, along with occasional poaching and trampling by livestock during wet periods.

- Water management and quality

The management of surface and groundwater is clearly crucial to providing the surface: groundwater requirements of each type of fen, as are its constituents, for example basic ions such as calcium, its pH, and quantity of the plant nutrients nitrogen and phosphorus.

- Agricultural improvement

This includes drainage, cultivation and fertiliser applications.

Also reported, but probably less widespread, are:

- invasive species
- too frequent burning

- agricultural abandonment, leading to rankness and scrub encroachment through lack of grazing
- fragmentation and disturbance for developments such as housing and road constructions
- afforestation, especially in Northern Ireland and Scotland

Based on an assessment of the exceedence of relevant critical loads, air pollution is considered to be a potentially significant pressure to the structure and function of this habitat (Joint Nature Conservation Committee).

In **Ireland**, agricultural intensification over the past century, drainage and more recently, abandonment of pastoral systems, which contributes to rank vegetation and scrub encroachment, all lead to the loss of some typical flora and to a reduction in the area of the habitat (NPWS 2008).

In **Portugal**, the main threats to these grasslands include (ALFA 2004):

- Drainage;
- Eutrophication of water upstream;
- Excessive grazing.

The most serious threats to this habitat type in **Denmark** are changed hydrological conditions due to drainage or water catchments, eutrophication and overgrowth. These factors should therefore be considered when assessing the conservation status of the occurrences (Søgaard et al. 2007).

**Germany**, Ackermann (translated from German):

1. Lowering of the water table
2. Too intensive use of the grassland with fertilizers
3. biocenotic evolution after abandonment or afforestation
4. Nutrient input from the surrounding environment
5. Species loss by acidification

**Netherlands**, Janssen:

1. Drainage
2. Eutrophication (intensification of land use)
3. Abandonment of management (extensification)

lead to increase of tall grasses (*Molinia*) and shrubs, resulting in decrease of species richness

**United Kingdom**, Jefferson:

1. Abandonment of pastoral systems, lack of or inadequate grazing
1. Agricultural intensification including drainage, ploughing and use of fertilisers
2. Climate change
3. Atmospheric nitrogen deposition and nutrient enrichment via surface/groundwater

Complete loss of the habitat to improved grassland/arable (drainage/ploughing/intensification). Decline in plant species richness and diversity, (fertilisation, lack of grazing, N deposition) ecological succession resulting in conversion of species-rich grassland ultimately to scrub/woodland



(abandonment, inadequate grazing). Change in the species composition due to changes in rainfall amount/pattern and temperature changes (Climate change)

**United Kingdom, MacKintosh:**

1. Abandonment of pastoral systems, lack of grazing.
2. Fertilisation.
3. Nitrogen-input
4. Droughts and less precipitations

Provide a short description how the threat(s) affect the habitat:

1. Under-grazing or absence of grazing allows the sward to grow tall, leading to the loss of small, low-growing broadleaved herbs; also to the invasion of scrub and bracken, leading to a loss of the habitat.
2. Fertilisation with inorganic fertilisers is not permitted on designated habitat but may be permitted on adjacent ground, and therefore contribute to nutrient enrichment of the habitat. May. Fertilisation is a threat to non-designated habitat..
3. Nitrogen-input has been shown to affect the species composition of other types of semi-natural habitat and is likely to affect this habitat.
4. The soils of this habitat are rarely water-logged and can dry out in summer but the characteristic species would be unlikely to survive prolonged or repeated droughts.

**United Kingdom, Smith CCW**

1. A04.03 abandonment of pastoral systems, lack of grazing
2. A08 fertilisation
3. J02 Human induced changes in hydraulic conditions
4. K02.01 species composition change (succession)
5. J03.02 anthropogenic reduction of habitat connectivity

Provide a short description how the threat(s) affect the habitat:

A04.03 abandonment of pastoral systems, lack of grazing.

Agricultural specialisation and intensification has led to grazing abandonment on many sites or parts of sites. This leads to an increase in *Molinia caerulea* and bulky rushes at the expense of lower-growing herbs such as *Succisa pratensis* and short-growing *Carex* species (Stevens et al 2010), ultimately leading to loss of the habitat to more species-poor communities. It also typically results in encroachment by scrub (see K02.01 below).

A08 fertilisation.

The habitat is susceptible to nutrient enrichment from fertilisation (especially from artificial fertilisers, although also farmyard manure). It can lead to a rapid loss of characteristic plant species, which require low nutrient conditions, and associated invertebrate fauna. There is typically an initial increase in one or both of *Juncus effusus* and *Deschampsia cespitosa*, and the grass *Holcus lanatus*. Under even moderate levels of fertiliser application, sites can be permanently lost.

J02 Human induced changes in hydraulic conditions.

Many Welsh sites for this habitat are affected by a degree of land drainage and there has almost certainly been considerable loss of this habitat in Wales through drainage in the past (Blackstock et al 1998). Drainage typically results in sward impoverishment and an increase in bulky rushes.

K02.01 species composition change (succession)

Spread of scrub and to a lesser extent trees is a major issue on many sites. Where appropriate

grazing is in place, spread is usually largely kept in check, but under-grazed or neglected sites are particularly prone and sites can and have been lost to extensive scrub invasion. Areas less accessible to livestock are particularly at risk.

#### J03.02 anthropogenic reduction of habitat connectivity

Fragmentation of the habitat is an increasing problem, although some sizable well-connected patches of this habitat remain in parts of south and west Wales. It is a particular issue for uncommon plant and invertebrate species associated with the habitat which, when lost from a site, may not be able to recolonise.

## 2 Conservation management

### 2.1. Main conservation requirements

The Netherlands recognises the following characteristics of a 'good' habitat condition:

- The yearly removal of hay
- The influent of base-rich water (either by floods of surface water or influent ground water)
- Presence of bush and trees <5%
- Minimum area of habitat several hectares
- if necessary the removal of the organic material, to counter acidification

(Ministerie van Economische Zaken, Landbouw en Innovatie)

The main recommendations for the conservation of this type of habitat in Spain are (VV.AA. 2009):

#### **Distribution**

Existing information on the area occupied by the habitat type within its distribution range is very poor, so for the proper conservation of the habitat type the development of a good cartographic database is recommended. On the other hand, the range of habitat type is very similar to the area occupied, although there is currently no sufficient data to make objective assessments.

#### **Structure and function**

This type of habitat is sensitive to variations in the level of soil moisture, therefore it is essential to pay particular attention to the conservation of these conditions and respect the ecological factors that cause them: rivers, streams, valleys, springs and other. Therefore, water catchments, drains and cuts of water flow, either surface or groundwater, for infrastructure or other alterations should be avoided.

Livestock pressure can be a threat to the conservation of the structure of this habitat type, although in the current socio-economic context it seems much less likely than other anthropogenic pressures. A moderate presence of cattle favors the permanence of the sites and can help maintain biodiversity by reducing the number of dense species and allowing the installation of other small pioneer plants. In contrast, high and excessive pressure of livestock disturbs the soil structure and vegetation and can have destructive effects.

Harvesting *Molina caerulea* fields can help maintain its floristic diversity but will also promote floristic changes of different level. In any case, it seems reasonable to delay the harvest in relation to

the possible nesting birds that may frequent the habitat type and the late sprout of the plants that make up the habitat type.

### Future prospects

For the preservation of *Molinia caerulea* pastures it is very important to consider soil moisture levels and water quality. For the proper conservation of this habitat, drains and other disturbances of the water cycle in soil and pollution by dumping of any kind, including those originating from farms and agricultural wastes should be avoided. Actions of this type currently proliferate in areas within the habitat distribution range, since they have been considered unproductive mudflats or even harmful to human health.

The future of this habitat type depends to a large extent on the abandonment of traditional uses in remote areas and, on the contrary, on the increasing human pressure in communities located at lower altitudes and valleys. The special interest for this type of habitat, and wetlands in general, along with its high vulnerability and the expected deterioration caused by natural and anthropogenic impacts, should be especially considered in the preparation of environmental impact assessments for project developments.

Finally, awareness raising campaigns on the ecological and landscape interest of the habitat should be conducted, especially in the rural areas where local population have a negative perception of the habitat type.

In **Denmark** it is observed that one of the most important factors for the presence of this habitat type is a temporarily high water level, typically during the winter. Changes in the water level, which prevent winter flooding, are thus unfavorable to the habitat type (Søgaard et al. 2007).

### Germany, Ackermann Pan (translated from German):

1. Preservation or restoration of the original water table
2. Extensive agricultural use without drainage, fertilizer, use of pesticides, breaks and grading
3. Resumption of an extensive agricultural use by mowing if necessary, removal of trees
4. Prevention of nutrient input from the surrounding environment and reduction of atmospheric nutrient deposition
5. Change of use / care for the promotion of biodiversity

### Netherlands, Janssen

1. Water regime which results in buffering of top soil (by flooding or influent of ground water)
2. No influx from nutrients from surroundings or the air

Hay making in late summer, considering fauna (eventually combined with grazing)

### United Kingdom, Jefferson:

1. Extensive grazing by livestock, normally cattle but occasionally sheep or equines with no addition of organic or inorganic fertilisers
2. Cutting for a hay crop and aftermath grazing by livestock– not many sites are managed in this way
3. Maintenance of existing surface drains (where present) to ensure sites do not get too wet resulting in vegetation change

#### United Kingdom, MacKintosh:

1. The habitat must be grazed at levels that maintain a varied sward height, preventing domination by tall species and allowing smaller and less vigorous species to survive.
2. Absence of fertilisation is required to maintain a low productivity sward in which smaller and less vigorous species can survive.
3. A reduction in emissions of oxidised nitrogen gases from transport and power generation sources, and of ammonia from livestock production.
4. It may be necessary to maintain the water levels of sites with this habitat artificially.

#### United Kingdom, Smith

1. A04.03 abandonment of pastoral systems, lack of grazing

This habitat generally requires livestock-grazing management by either cattle or horses. Hay meadow management, with livestock grazing of the aftermath growth, can be appropriate, but is now rarely practised in Wales.

2. A08 fertilisation

This habitat should receive no fertiliser of any sort and liming should be generally avoided.

3. J02 Human induced changes in hydraulic conditions

The habitat occurs on fairly well-drained peaty soils in areas of intermediate wetness, avoiding situations which are either dry for extensive periods or are permanently waterlogged. The mechanisms of water supply for the habitat are poorly understood, but recharge from minor underground aquifers is probably important in many cases (Stevens et al 2010).

4. K02.01 species composition change (succession)

Stock grazing management alone may be sufficient to maintain scrub at desirable levels, although additional control is required at many sites, especially bearing in mind variable levels of stock grazing across large sites.

5. J03.02 anthropogenic reduction of habitat connectivity

Restoration of derelict sites, where rank grasses/rushes have become over-dominant and/or scrub has invaded, is required to reconnect patches of the habitat and favour associated invertebrate fauna.

## 2.2. Management measures

Wallonia, France and Germany propose a late cutting and removal of the hay, or were that is impossible to allow grazing by cattle during an extensive period. Drainage must be prohibited, with special attention to dry summers (DGDARNE) (Muséum national d'Histoire naturelle [Ed], 2003.) (Bundesamt für Naturschutz).

Management guidelines for **Portugal** include (ALFA 2004)

- Prohibition to drainage;
- Control of discharge of untreated effluents;
- Enhancing the quality and extent of agricultural wastewater treatment, urban and industrial;
- Conditioning of grazing;
- Conservation of marshland associated with this habitat (see Guidelines for management, habitat 91E0).

**Germany, Ackermann:**

1. Resotration of the original water table by closing side-ditches
2. Yearly Mowing with the removal of the hay according to the speciescomposition during September and Oktober; In high eutrophic conditions or unfavourable species composition mowing twice per year (first cut in June before the main flowering of the characteristic species, second depending on the species composition in September or October after the main characteristics of the flower species). Mowing of the plots if possible from inside out or side to side with leaving small margins intact. Avoid the use of heavy equipment because it damages the habitat.
3. In certain areas with small-sized species (eg *Carex pulicaris*) temporary grazing would be beneficial. In these cases examine whether grazing can be controlled so that the typical structure and species composition remains a Molinia meadow. Otherwise, mow to the vegetation more to the ground and possibly earlier. Most of the remaining moor grass meadows are too small to be suitable for regular grazing.
4. Creation of buffering unfertilised strips when adjacent to intensively managed cropland or pastureland.
5. On base-poor soils, the mowing-related nutrient deprivation that causes an impoverishment of species can be compensated with liming or PK-Fertilization. The right balance should be determined before extensive application

**Netherlands, Janssen**

1. Water management focussed on high tables in winter, lower table in summer
2. Sod cutting
3. Hay making, sometimes (combined with) grazing

**United Kingdom, Jefferson Natural England:**

1. Ensure appropriate livestock grazing regimes and scrub management
2. Prevent/limit agricultural improvement through legislative and incentive measures
3. National/international policy advocacy to seek to reduce impacts from atmospheric N deposition, diffuse pollution and climate change

**United Kingdom, MacKintosh:**

1. Appropriate grazing levels to be maintained
2. Extensive management without inorganic fertilisation to be maintained..
3. Reductions of Nitrogen emmissions from all sources.
4. Water levels to be maintained artificially in droughts

**United Kingdom, Smith:**

1. A04.03 abandonment of pastoral systems, lack of grazing

Typically light to moderate grazing by cattle or horse (typically 0.2 to 0.4 LSU/ha/yr, depending on local climate, weather, etc) during the growing season.

2. A08 fertilisation

No fertiliser addition of any sort.

3. J02 Human induced changes in hydraulic conditions

Avoid major modifications to the existing drainage systems. Some minor modifications may be desirable where sites are drying up or wetting up.

4. K02.01 species composition change (succession)

Control using cutting and/or chemical treatment as appropriate and practicable.

5. J03.02 anthropogenic reduction of habitat connectivity

Restore derelict sites as appropriate, e.g. through cutting of rank Molinia/rushes followed by grazing. Control scrub. Controlled burning for site restoration should be employed with caution.

## 2.3. Other measures (e.g. monitoring)

## 2.4. Species specific measures

### **Netherlands, Janssen:**

For typical butterflies like *Maculinea* species and other insects, but I don't know exactly the details

### **United Kingdom, Jefferson:**

This habitat supports a number of priority species of conservation concern. Many can be maintained or enhanced by simply ensuring that appropriate management to maintain the habitat as a whole is in place. Some e.g. *Euphydryas aurinia* however may require non-standard management or ensuring grazing does not take place at key stages in the life cycle.

### **United Kingdom, MacKintosh:**

On a very few sites in Scotland, management specific to the Marsh Fritillary is needed.

### **United Kingdom, Smith:**

Supported specialist taxa require the habitat conditions enabled by the above measures.

Specialist plant and animal species may require specific management, e.g. bird species such as lapwing, snipe and curlew.

## 2.5. Main constraints / bottlenecks and actual needs

### **Germany, Ackermann**

1. Remainder areas are often too small and isolated to allow a long-term survival of the typical flora and fauna (Fragmentation).

### **Netherlands, Janssen:**

1. Finances
2. Land ownership
3. Isolation, related to low dispersal capacity of several typical plant species
4. External impact of changed water management on large areas outside Natura 2000-site

### **United Kingdom, Jefferson:**

1. Insufficient funding/incentives, including reduced capability of key nature conservation organisations due to reduction in resources
2. Ineffective domestic EIA legislation for uncultivated/semi-natural habitats
3. Need for sustainable water resource management and pollution control
4. Perverse incentives/markets and an unfavourable livestock policy framework
5. Lack of public appreciation of the importance/value of species-rich grassland for society

**United Kingdom, MacKintosh:**

1. Global economics affect the profitability of rough grazing on low productivity habitat.
2. As above.
3. Lack of effective pollution control regulations.
4. Lack of money.

**United Kingdom, Smith:**

1. Fundamental change in the character of lowland farming which makes it economically unattractive to graze what are often small sites with hardy stock.
2. Loss of appropriate hardy stock and experience to manage them.
3. Lack of funding to restore derelict grazing infrastructure (fences etc.).
4. Lack of effective long-term mechanisms for funding habitat restoration to reduce habitat fragmentation.
5. Lack of effective mechanisms for preventing fertiliser inputs to sites.
6. Enforcement of legislation and cross-compliance measures.
7. Changing rain patterns under climate change scenarios.

## 2.6. Solutions and Recommendations

**Germany, Ackermann**

1. Development of new habitat on areas with remaining Molinion grasses through removing nutrients from the system and if needed, raising the water table. For this purpose, for the first year a more intensive mowing (possibly three cuts between late May and September) may be required.
2. Restoration of fallow stages in areas with remaining Molinion grasses through regular mowing and possibly deforestation. This is especially true for reported occurrences in FFH areas that are affected by bioscenotic evolution or abandonment. In individual cases, removal of certain vegetation.

**Netherlands, Jansen:**

1. Restoration (close to existing sites with the habitat type)
2. Fund raising (relation to agro-environmental schemes)
3. Awareness raising

**United Kingdom, Jefferson Natural England:**

1. Further statutory designations of sites under domestic legislation
2. Strengthen EIA (Agriculture) Regulations
3. Ensure appropriate level of funding via ERDP for agri-environment schemes
4. Policy advocacy in relation to atmospheric and diffuse pollution, Climate change, livestock and water resource/catchment management (WFD)
5. Awareness raising, education and community engagement

**United Kingdom, MacKintosh:**

1. Communication and awareness raising of the Habitat management requirements, coupled with agri-environment funding to help make low-intensity stock rearing sustainable. Development of local markets to help make low-intensity stock rearing

sustainable.

2. As above
3. Effective pollution control regulations.
4. Agri-environment funding

**United Kingdom, Smith:**

1. Effective long-term and better targeted agri-environment mechanism which provides remuneration that is attractive to farmers. Availability of local grazing animals partnerships to provide expertise and also match appropriate stock to sites. Increased funding support for conservation bodies to enable effective grazing management.
2. As above.
3. As above.
4. As above
5. Better enforcement.
6. Better enforcement.
7. Policy changes.

## Cases / projects

### Sites



## 6510 - Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)

### Summary

**Lowland hay meadows** are usually species-rich hay meadows on lightly to moderately fertilised soils on the plain to submontane levels, belonging to the *Arrhenatherion* and the *Brachypodio-Centaureion nemoralis* alliances. These extensive grasslands are rich in flowers and they are usually cut once or twice a per year. Wet to dry sub-types occur. If the management practices become intensive with heavy applications of fertiliser, the species diversity rapidly declines.

**Lowland hay meadows are characterised by** the dominance of the tall grasses, usually on eutrophic, clayey soils. The habitat occurs in different site conditions (therefore it is quite variable), mainly on river forelands and floodplains. Lower areas are known to be more or less regularly flooded. Lowland hay meadows are very rich in flowering plants and thus support a wide range of other species, including species of conservation concern. This habitat is wide spread in central and northern Europe, also occurring, but more rarely, in the Mediterranean region. According to the Netherlands the following sub-types of 6510 occur:

- A: Alliance *Arrhenatherion elatioris*, on the higher parts (of river forelands, etc.)
- B: Alliance *Alopecurion pratensis*, on the lower parts, exposed to flooding.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable -bad' due to structural issues, missing information about range and area in some countries, and "unfavourable – inadequate" future prospects. Only the range was assessed by some countries as "favourable".

**The main reported threats and pressures** to lowland Hay Meadows in the Atlantic region are:

- Land-use or regime changes that have to do mainly with modification of cultivation practices.
- Abandonment or insufficient management of meadows and pastoral systems (and resulting succession)
- Afforestation/general forestry management.
- Recreation and construction/urbanized area.
- Unsuitable ways of management - not proper cultivation, drainage, intensification, ploughing and mulching, fertilization, pesticides use, manuring, eutrophication.
- Invasive species.

The principal **management measures** for this habitat consist of:

- Mowing.
- Grazing and mixed grazing-mowing, in an appropriate way and level of intensity (pasturing in the second crop in late summer-autumn).
- Simulating traditional ways of management.
- Promotion of habitat heterogeneities.
- Variable mowing cycles in over different parts of the habitat.
- Implementation of varied regimes.
- Accompanied by restoration of abandoned grasslands through removal of trees and shrub.

The 6510 habitat type requires mowing, grazing (mowing in midsummer and possible grazing in late summer) and mainly, with respect to the current state of the habitat, intensive restoration management of mowing, grazing and clearing scrub. The main recommendations for the conservation of hay meadows of the alliance *Arrhenatherion* are:

- Prevent land use changes, ensuring, as far as possible, the maintenance of such communities.
- Maintenance of the extensive form of the habitat use: keep balanced management practices on these communities. In this sense, the following management recommendations can be made:
  - Conduct a minimum of one and a maximum of two harvests of grass per year. In many cases, obtaining a second harvest is conditioned by the summer irrigation of the meadow. Hay making in late summer, considering fauna, namely the grassland nesting birds.
  - Hay cutting is a basic management type. A combination of mowing and grazing is possible; grazing should be a complementary measure. The grasslands could be used for a maximum of two annual grazing periods: mostly in autumn and if available, the spring one is shorter. Avoidance of drainage, keeping the natural water regime with incidental flooding in winter and low(er) tables in summer.
  - In productive sites no or almost no use of fertilizers. If fertilizing necessary, fertilize the lawn with the solid organic manure that has traditionally been used in such fields. The cattle slurry used on some fields has immediate effects on production, but favors grasses compared to other plant species in the community. Prevention of eutrophication is necessary.
  - Avoid the reseeding with market forage species. The gaps of vegetation that may arise from some disturbance such as excessive trampling by livestock, the activities of wild boar or voles (*Microtus* sp.) will eventually be colonized by geophytes and seeds of established vegetation.
  - Increase awareness of farmers in mountain areas about the importance of maintaining this habitat. For this purpose it may be beneficial that appropriate agro-environmental measures are developed by regional authorities. Farmers benefiting from these measures should commit for a minimum period of five years, to adopt farming practices that help protect this habitat.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Grassland with a good management of 6510 habitats produces a smaller output of grass / hay than grassland with intensive mowing or grazing. Therefore the subsidies are needed to encourage land users to carry out this management.
- In some countries, the 6510 habitats are nowadays quite isolated, there is a low dispersal capacity of several typical plant species.
- The water level depends on larger areas rather than on one single meadow. All stakeholders have to agree to keep a sufficient high water level or to raise it.
- The lack of public appreciation of the importance/value of species-rich grassland for society.

**Solutions** to the pressures, threats and bottlenecks may include:

- Strengthen EIA (Agriculture) Regulations.
- Ensure appropriate level of funding via ERDP for agri-environment schemes.
- Policy advocacy in relation to atmospheric pollution, Climate change, livestock and water resource/catchment management (linked to the Water Framework Directive – WFD).

- Awareness raising, education and community engagement.
- Further statutory designation of sites under domestic legislation.
- Restoration (close to existing sites with the habitat type). Note that the restoration schemes for 6510 habitats should include a transfer of hay and seeds from existing sites.

## 1 Description of the habitat

Species-rich hay meadows on lightly 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 cut before the grasses flower and then only one or two times per year.

Wet to dry sub-types occur. If management practices become intensive with heavy applications of fertiliser, the species diversity rapidly declines. (EC 2007a)

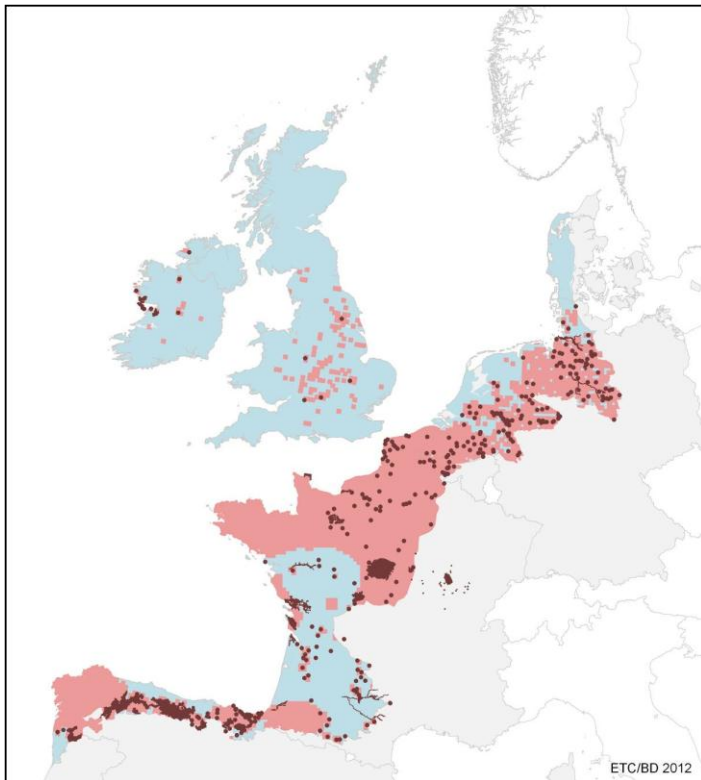
### 1.1. Distribution

**Table 73 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	36	95	11	111	1586			47	69		80	14	123	163	40	10	11	3		10	5	
habitat area (ha)	1726	6383	240	4619	78257			8941	19561		29957	1857	40895	35183	21635	940	606	2336		5655	672	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>83</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>83</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 17 Map of SCIs proposed for the habitat 6510 & Article 17 distribution (for legend, see introduction of chapter 3)**

## 1.2. Main features

Areas of habitat type 6510 are species and flowering plant rich meadows that have eutrophic, clayey soils. The habitat occurs mainly on river forelands and on the areas nearby a river that lay lower than it. Lower areas are known to be flooded from time to time (Ministerie van Economische Zaken, Landbouw en Innovatie).

## 1.3. Ecological requirements

The habitat type needs a somewhat eutrophic soil soil with a combination of light clay, sand and peat in the under layers (Ministerie van Economische Zaken, Landbouw en Innovatie).

## 1.4. Main subtypes

According to the Netherlands the following sub-types of 6510 occur:

- A: Alliance *Arrhenatherion elatioris*, on the higher parts (of river forelands, etc.)
- B: Alliance *Alopecurion pratensis*, on the lower parts, exposed to flooding. The Netherlands holds one of the largest population of *Fritillario-Alopecuretum pratensis*.

(Ministerie van Economische Zaken, Landbouw en Innovatie)

## 1.5. Associated species

The European Topic Centre on Biological Diversity has identified through expert judgement a number of species under the Habitats and Birds Directive associated with habitat 6510 and provided their conservation status for Annex II and IV species in the Atlantic Member States (see tables below).

**Table 74 Species associated with 6210 Habitat Type (for legend, see introduction of chapter 3)**

Species	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Maculinea arion</i> 1058	x									
<i>Maculinea nausithous</i> 1061	x									
<i>Lanius collurio</i> A338 (with bushes)	x									
<i>Anthus pratensis</i> A257	x									
<i>Anthus trivialis</i> A256 (with trees)	x									
<i>Emberiza hortulana</i> A379 (with trees)	x									
<i>Jynx torquilla</i> A233 (with trees)	x									
<i>Oenanthe oenanthe</i> A171 (with stones and /or pile of stones)	x									

**Table 3 Annex II and IV species associated to habitat 6510 and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		ES	FR	UK	REGION
1058	<i>Maculinea arion</i>	Invertebrates	range	XX	U2	XX	XX
			population	XX	FV	U1	XX
			habitat	XX	U2	U1	XX
			future	XX	U2	U1	XX
			overall	XX	U2	U1	XX

N2K code	Species name	Group		DE	ES	NL	REGION
1061	<i>Maculinea nausithous</i>	Invertebrates	range	U2	XX	U2	U2
			population	U2	XX	U2	U2
			habitat	U2	XX	U2	U2
			future	U1	XX	U2	XX
			overall	U2	XX	U2	U2

## 1.6. Related habitats

Wallonia: 6520 (DGDARNE)

France: 6520 (Muséum national d’Histoire naturelle [Ed], 2003.)

Germany: 6520 (Bundesamt für Naturschutz)

## 1.7. Ecological services and benefits

Lowlands hay meadows are very rich in flowering plants and thus support a wide range of other species (DGDARNE).

It could be affirmed that mountain meadows have a strategic agricultural use: the grass produced, stored as hay or silage, is used to feed livestock during the winter and thereby allows the maintenance of semi-extensive farms that are based on grazing in mountain pastures in summer. Nowadays, in valleys used for livestock breeding there is a combined management of pasture and

mountain meadows which is complemented with the resources obtained from the grasslands throughout the year for feeding the livestock, providing a more balanced diet than the one obtained from forage monocultures.

Maintaining these herbaceous communities in mountain areas has a high ecological interest: they protect the soil from erosion, maintain unstable slopes, improve soil structure and fertility, help control and conservation of water resource and maintain a diversity of flora and fauna, sometimes higher than the one it would exist if these areas were abandoned. Therefore, the farmer with his management creates a landscape composed of diversified plots of communities with different degrees of maturity, resulting in a spatial diversity that seems the most suitable for conservation.

The social interest of the use of pastures covered by this habitat type is twofold. On the one hand there is a 'culture of the territory', empirical, linked to its exploitation, and which is currently endangered due to abandonment of rural areas. On the other hand, there is an increased social demand for the use of natural areas of interest, both in terms of landscape and for recreation and tourism. As in many other cases, this landscape is valued as a result of continued human action on these plant communities.

Therefore, this habitat type contributes to the achievement of sustainable rural development, since it provides protection, services and resources that enable the improvement of social and economic conditions in the mountain areas where it is located, which are in general less favoured areas(VV.AA. 2009).

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	ES	FR	IE	NL	PT	UK	REGION
6510	Lowland hay meadows ( <i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i> )	range	FV	XX	XX	U1	U2	U1	FV	FV	XX
		area	U1	U2	XX	XX	U2	U2	U1	U1	XX
		structure	U2	U2	XX	U2	U2	U2	U1	U2	U2
		future	U1	U2	XX	U1	U2	U1	U1	U2	U1
		overall	U2	U2	XX	U2	U2	U2	U1	U2	U2

Haymeadows at low altitudes which are mown after most of the plants have flowered, they maybe lightly fertilised but frequent or heavy fertilisation quickly reduces the species diversity. These meadows are important for a wide range of invertebrates as well as plants. This habitat is wide spread in central and northern Europe, also occurring, but more rarely, in the Mediterranean region.

Unfavourable-inadequate' in the Alpine and Continental regions where the habitat is most abundant with only 'range' assessed as 'favourable'. Only Slovakia (Alpine) has assessed this habitat as 'favourable' for these two regions although Spain reported all parameters as 'unknown' for the Alpine region.

Assessed as 'unfavourable-bad' in the Atlantic and Pannonian regions with no country reporting 'favourable' although Spain reported all parameters as 'unknown'. The United Kingdom reported

‘unfavourable-bad but improving’. Assessed as ‘unknown but not favourable’ for the Mediterranean region as Spain reported all parameters as ‘unknown’.

Excluding Spain from the regional assessment would lead to ‘unfavourable-bad’ due to the French assessment although reported as ‘favourable’ by Italy. The threats and pressures reported by the countries are varied but most note changes to agricultural practice. Better information required, especially from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive).

### 1.9. Trends

In the Netherlands during the 20<sup>th</sup> century area with habitat type 6510 was lost and degenerated because intensification of agriculture and changes in the water table. In particular area of sub-type B was lost because *Fritillario-Alopecuretum pratensis* disappeared. Because of eutrophication, inadequate management and the removal of higher areas in river forelands species rich “vlakdekkende” plant covering has become rare (Ministerie van Economische Zaken, Landbouw en Innovatie).

Since 1994 no significant change in area of habitat type 6510 has occurred in the Netherlands and the UK (Ministerie van Economische Zaken, Landbouw en Innovatie) (Joint Nature Conservation Committee).

Germany recognizes the same causes for decline, alongside too early cutting/grazing. However a new situation is developing in Germany as eutrophication is lessening due to less use of fertilizers. This leads to species impoverishment (Bundesamt für Naturschutz).

### 1.10 Main pressures and threats

**Table 5 Main pressures to habitat 6510 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Lowland hay meadows ( <i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i> )	<i>Maculinea arion</i>	<i>Maculinea nausithous</i>
Cultivation	x		x
Use of pesticides	x		
Fertilisation	x		
Grazing	x	x	
Restructuring agricultural land holding	x		
General Forestry management	x		
Urbanised areas, human habitation	x		
Communication networks	x		
Pollution	x		
Landfill, land reclamation and drying out, general	x		
Drainage	x		
Modification of hydrographic functioning, general	x		
Biocenotic evolution	x		

**Table 6 Main threats to habitat 6510 as reported by MS in 2007 and their importance to associated Annex II and IV species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Lowland hay meadows ( <i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i> )	<i>Maculinea arion</i>	<i>Maculinea nausithous</i>
Cultivation	x		x
Use of pesticides	x		
Fertilisation	x		
Grazing	x	x	
General Forestry management	x		
Urbanised areas, human habitation	x		
Drainage	x		
Modification of hydrographic functioning, general	x		

This habitat type is also being addressed in the Boral Seminar. The main pressure recognized by the Boreal Seminar is abandonment, connected with overgrowing with shrub and trees. Change in land use has to do mainly with afforestation/general forestry management, recreation and construction/urbanized area. Another group of pressures are unsuitable ways of management – cultivation, ploughing and mulching, fertilization, eutrophication, or insufficient management – weak grazing or inadequate clearing of bushes and trees. Individual Member State pressures were fragmentation, the negative role of (conflicting) national rules of CAP, atmospheric nitrogen deposition and climate change (Dušek et al., 2012).

Wallonia (**Belgium**) also recognized land-use change or regime change (e.g. shifting from mowing to grazing or vice versa) as threat to the habitat type (DGDARNE).

The **UK** also lists regime change as possible threat as well as invasive species, discharges, abandonment of pastoral systems and modification of cultivation practices (Joint Nature Conservation Committee).

In **Ireland**, agricultural intensification over the past century, drainage and more recently, abandonment of pastoral systems, which contributes to rank vegetation and scrub encroachment, all lead to the loss of some typical flora and to a reduction in the area of the habitat (NPWS 2008).

In **Portugal**, the most relevant threats, in order of importance, to the conservation of the structure and functions of the hay meadows are as follows (ALFA 2004):

- withdrawal (end of haymaking);
- careless husbandry;
- replacing hay making by silage;
- planting of trees;
- use of fertilizers;
- substitution of other crops;
- extending the period of spring grazing.

**Germany**, Ackermann, pers. comm.

4. Pflegeumbruch, Neuansaat, Umwandlung in Acker, Aufforstung, Bebauung
5. Starke Düngung, Umwandlung in Intensivgrünland, intensive Beweidung



6. Natürliche Sukzession nach Nutzungsaufgabe
7. Entwässerung auf mäßig feuchten Standorten

**Germany, Letz, pers.comm.**

1. A 08 Fertilisation: The use of fertilizers could lead to a change of the characteristic vegetation.
2. A 11 Drainage: Drainage could lead to a change of the characteristic vegetation.
3. A 03.01 intensive mowing or intensification: Intensification usually goes along with no. 1 + 2. In addition, it could depress characteristic herbs by preventing seed production.
4. A 03.03 abandonment / lack of mowing: Occurs on badly managed grasslands (sometimes in SCIs). Leads to vegetation types dominated by weeds.
5. A 04.01.03 intensive horse grazing: Horse grazing leads to long-term extinction of characteristic plants, esp. *Fritillaria meleagris*.

**Netherlands, Janssen, pers. comm.**

- Abandonment of management (extensification)
- Intensification of land use (Eutrophication, manuring, ...)
- Changes in natural water regimes

**United Kingdom, Jefferson, pers. comm.**

1. Agricultural intensification/improvement especially improvement by application of fertilisers
2. Abandonment of pastoral systems especially cessation of mowing and/or aftermath grazing
3. Adverse changes in site/catchment hydrology including flooding regimes and cessation of drain maintenance
4. Nutrient enrichment from atmospheric and diffuse (e.g. floodwater) sources
5. Development especially gravel extraction

## 2 Conservation management

### 2.2. Main conservation requirements

According to the Boreal Workshop Document the active management consists of ways of mowing, grazing and mixed grazing-mowing, in a sufficient way and intensity (pasturing in the second crop in late summer-autumn), simulating traditional ways of management– promotion of habitat heterogeneities, variable mowing cycles in over different parts of the habitat, implementation of varied regimes, accompanied by restoration of abandoned grasslands through removal of trees and shrub (Dušek et al., 2012).

According to the Boreal Workshop Document the passive measures are restrictive: preventing afforestation and other alterations of grasslands, preventing unregulated development, improving effectiveness of existing financial tools and developing new ones (Dušek et al., 2012).

Flanders recognizes the following steps needed for optimal management/reconstruction:

- Open terrain
- Allowing winter flooding
- Mowing-time restrictions or grazing with large herbivores/sheep herds
- Minimum area is 0.5 hectare

(Van Uytvanck, J. et al., 2010. Vademecum)

The main recommendations for the conservation of hay meadows of the alliance *Arrhenatherion* in mountain areas in Spain are (VV.AA. 2009):

- Prevent land use changes, ensuring, as far as possible, the maintenance of such communities in the valleys of mountain areas of the northern half of the Iberian Peninsula.
- Keep on these communities balanced management practices between the abandonment of farming practices and excessive intensification. In this sense, the following management recommendations can be made:
  - Conduct a minimum of one and a maximum of two harvests of grass. In many cases, obtaining a second harvest is conditioned by the summer irrigation of the meadow.
  - Use the meadows for a maximum of two annual grazing periods. The most important one is in autumn and if available, the spring one is smaller. Grazing is complementary to the main exploitation of the pasture by harvesting. If we promote the use of grazing of the habitat instead of harvesting the habitat is transformed into 6510 habitat type.
  - Fertilize the lawn every year with the organic manure that has traditionally been used in such fields. The cattle slurry used on some fields has immediate effects on production, but favors grasses compared to other plant species in the community. Fertilization based on inorganic products, if performed, should be done every two or three years, and using fertilizers that mainly correct extractions of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O.
  - Avoid the reseeding with market forage species. The gaps of vegetation that may arise from some disturbance such as excessive trampling by livestock, wild boar or voles actions (*Microtus* sp.) will eventually be colonized by geophytes and seeds of established vegetation.

Increase awareness of farmers and ranchers in mountain areas about the importance of maintaining this habitat. For this purpose it may be beneficial that appropriate agro-environmental measures are developed by regional authorities. Farmers benefiting from these measures should commit for a minimum period of five years, to adopt farming practices that help protect this habitat. In return, they will receive payments in compensation for additional costs and loss of income resulting from changes.

**Germany, Ackermann, pers. comm.**

1. Verhinderung einer Nutzungsänderung mit einhergehender Vernichtung des LRT
2. Beibehaltung der extensiven Nutzungsformen
3. Beibehaltung der extensiven Nutzungsformen
4. Erhaltung des Wasserhaushalts auf mäßig feuchten Standorten

**Germany, Letz pers. comm.**

1. A 08 Fertilisation: No, or almost no use of fertilizers (incl. organic fertilizers).

2. A 11 Drainage: No change in the natural water balance.
3. A 03.01 intensive mowing or intensification: Securing an adequate land use.
4. A 03.03 abandonment / lack of mowing: Securing an adequate land use.
5. A 04.01.03 intensive horse grazing: No horse grazing on 6510 habitats.

**Netherlands, Janssen, pers. comm.**

Hay making in late summer, considering fauna

No manuring, prevention of eutrophication

Natural water regime with incidental flooding in winter and low(er) tables in summer

**United Kingdom, Jefferson, pers. comm.**

1. Hay cutting
2. Aftermath grazing in late summer/autumn
3. Maintenance of surface drainage systems

Replenishment of nutrient status via nutrients supplied in flood water or sustainable application of organic manures for sites that do not regularly flood

## 2.2. Management measures

According to the Boreal Workshop Document the 6510 habitat type requires mowing, grazing (mowing in midsummer and possible grazing in late summer) and mainly, with respect to the current state of the habitat, intensive restoration management of mowing, grazing and clearing shrub (Dušek et al., 2012).

Flanders (**Belgium**) recognizes several programmes to recover degenerated habitats to favourable conservation status. It covers degenerated habitats such as bush/forest covered area, shrub covered area, dominance of certain eutrophic species, species poor meadows and species poor grasslands, see Van Uytvanck, J. et al., 2010. Vademecum.

Van Uytvanck, J. et al., 2010. Vademecum also covers some pointers for optimal mowing, grazing and removal of trees/bush.

Management guidelines in **Portugal** (ALFA 2004) have very different effects on the services provided by this habitat and there are complex trade-offs between different effects at different time scales. For example, many of the measures to increase productivity can have a perverse effect on diversity and populations of rare species. From an organizational point of view the creation of a specific program to meet the management objectives is promoted, with a strong contract extension and implementation and monitoring of active management directly.

The following table (ALFA 2004) summarizes the short to medium term effects of some management practices on:

- **productivity** - productivity (hay + pasture);
- **diversity** - species diversity in vascular plant species (the scale of the marsh);
- **rare species** - persistence of rare species of vascular plants;
- **functions** - conservation of the structure and functions (see concept in Natura 2000 - standard data form).

	productivity	diversity	rare species	functions
Haymaking (versus non haymaking)	+++	+++	+++	+++
Late haymaking (versus early haymaking or silage)	+	+/**	**/**	-/0/+
Traditional grazing (versus no grazing)	+/**	+/**	--/	+
Late closure to grazing (versus early closure to grazing, ie traditional)	-	0/-	---/--	---/--
Fertilization	**/**	--/	---	--/0
Maintenance of hedgerows and woodlands in the vicinity	-	**/**	**/**	0/+/**
Elimination of species of low palatability (by herbicides or manually)	**/**	-	-/0/+	+/**
Cleaning of irrigation system, the margin of water lines and walls	**	-/0/+	-/0/+	+/**
Leveling of blind mice and moles' heaps	+	-	0	0/+

#### Germany, Ackermann, pers. comm.

1. Mahd i. d. R. zweimal pro Jahr zwischen Juni und Oktober, wobei die zweite Nutzung frühestens 40 Tage nach der ersten erfolgen darf. Bei sehr mageren Varianten kann auch ein Schnitt als Pflegemahd ausreichen. Wenn eine Aushagerung relativ nährstoffreicher Bestände erwünscht ist, sollte dreimal jährlich gemäht werden. Die Mahd der Parzellen sollte von innen nach außen oder von einer zur anderen Seite erfolgen. Das Mähgut ist grundsätzlich abzuräumen. Positiv ist die Einrichtung von Randstreifen, die wechselnd in mehrjährigem Abstand gemäht werden, oder auch eine zeitlich gestaffelte Mahd, so dass im Gebiet ein kontinuierliches Blütenangebot besteht. Teilflächen besonders magerer, artenreicher Ausprägungen sollten jedes zweite Jahr nur einmal im Spätsommer (September) gemäht werden, was sich unter anderem förderlich auf die Insektenfauna auswirkt.
2. Allenfalls moderate Düngung, insbesondere auf armen Standorten. (Der Stickstoffbedarf wird in der Regel aus der Luft und durch erhöhten Leguminosenanteil gedeckt. Eine mittlere bis gute Versorgung mit Phosphor, Kalium und ggf. Kalzium wirkt sich positiv auf den Artenreichtum aus. Leguminosen und zweikeimblättrige Kräuter werden bei guter Kali- und Phosphorversorgung und mäßigen Stickstoffgehalten des Bodens gefördert, Gräser sind dann weniger dominant.) Die Bemessung sollte im besten Falle auf Grundlage von Bodenanalysen und Entzugsbilanzen erfolgen. Am günstigsten ist die Ausbringung von Festmist, da dieser eine ausgewogene Nährstoffzusammensetzung aufweist. Keine Gülledüngung, da sie einseitig Gräser und Doldenblütler fördert.

3. Eine Kombination von Mahd und Beweidung ist bei Bedarf möglich; dabei ist eine kurzzeitige, möglichst intensive Beweidung zu bevorzugen (Umtriebsweide, 1-2 Weidegänge pro Jahr). Auch eine Winter- oder Frühjahrsbeweidung mit Schafen ist bis Ende April möglich.
4. Verbrachte und verbuschte ehemalige Wiesen können durch Entbuschung und Wiederaufnahme der Nutzung wieder zu Flachland-Mähwiesen entwickelt werden; Neuentwicklung ist durch Umwandlung von Intensivgrünland oder Ackerland nach Ausmagerung der Standorte durch Biomasseentzug über zwei- bis dreimalige Mahd pro Jahr zwischen Ende Mai und Oktober und Abtransport des Mähguts möglich.

**Germany, Letz, pers. Comm.**

1. A 08 Fertilisation: The use of fertilizers should only be allowed, if it is needed for the characteristic vegetation. Solid dung mixed with straw should be preferred.
2. A 11 Drainage: Existing drainage systems may be maintained, if necessary for further mowing.
3. A 03.01 intensive mowing or intensification: Habitats should be in public ownership or specific contracts should be offered to private owners.
4. A 03.03 abandonment / lack of mowing: Habitats should be in public ownership or specific contracts should be offered to private owners.
5. A 04.01.03 intensive horse grazing: No horse grazing on 6510 habitats.

**Netherlands, Janssen, pers. Comm.**

Hay making, sometimes (combined with) grazing

**United Kingdom, Jefferson, pers. Comm.**

1. Ensure appropriate extensive cutting and grazing regimes
2. Prevent/limit agricultural improvement and inappropriate developments through legislative, planning and incentive measures
3. Ensure maintenance of drainage systems
4. Seek to influence river catchment management to limit/prevent detrimental impact of diffuse pollution and inappropriate flooding regimes
5. National/international policy advocacy to seek to reduce impacts from atmospheric N deposition and diffuse pollution

## 2.3. Other measures (e.g. monitoring)

## 2.4. Species specific measures

**Germany, Ackermann, pers. Comm.**

Berücksichtigung von Wiesenbrütern wie Wiesenpieper, Braunkehlchen, Uferschnepfe, Großer Brachvogel, Kiebitz oder Wachtelkönig bei der ersten Mahd; dort am besten nur Anlage von Frühmahdstreifen in Bereichen, an denen keine Brutplätze bekannt sind, und ab Juli Durchführung der restlichen Mahd.

**Netherlands**, Janssen, pers. Comm.

For typical butterflies like *Maculinea* species and other insects, but I don't know exactly the details

**United Kingdom**, Jefferson, pers. Com.

This habitat supports a number of priority species of conservation concern. Many can be maintained or enhanced by simply ensuring that the appropriate management to maintain the habitat as a whole is in place. Some however may require non-standard management or ensuring grazing/cutting does not take place at key stages in the life cycle.

## 2.5. Main constraints / bottlenecks and actual needs

**Germany**, Ackermann, pers. Comm.

Andere landwirtschaftliche Nutzungen (Intensivgrünland, Umbruch und Maisanbau etc.) sind finanziell attraktiver

**Germany**, Letz, pers. Comm.

1. Grassland with a good management of 6510 habitats produces a smaller output of grass / hay than grassland with intensive mowing or grazing. Subsidies are needed to encourage land users to carry out this management.
2. The water level depends on larger areas rather than on one single meadow. All stakeholders have to agree to keep a sufficient high water level or to rise it.
3. 6510 habitats are nowadays quite isolated. If 6510 habitats are to be restored, the distance to the next existing 6510 habitat could be too far to allow a successful immigration of the typical plants.

**Netherlands**, Janssen, pers. Comm.

1. Finances
2. Land ownership
3. Isolation, related to low dispersal capacity of several typical plant species

External impact of changed water management on large areas outside Natura 2000-site

**United Kingdom**, Jefferson, pers. Comm.

1. Insufficient funding/incentives, including reduced capability of key nature conservation organisations due to reduction in resources
2. Ineffective domestic EIA legislation for uncultivated/semi-natural habitats
3. Perverse incentives/markets and an unfavourable livestock policy framework
4. Lack of public appreciation of the importance/value of species-rich grassland for society

Need for sustainable river catchment management and pollution control

## 2.6. Solutions and Recommendations

### Germany, Ackermann, pers. Comm.

Anpassung der Förderinstrumente, um die extensive Bewirtschaftung des LRT auch finanziell für den Landwirt attraktiv zu machen.

1. **Germany**, Letz, pers. Comm.
2. Subsidies should be provided under the CAP.
3. The best solution is public ownership.
4. Restorations schemes for 6510 habitats should include a transfer of hay and seeds from existing sites.

### Netherlands, Janssen, pers. Comm.

1. Restoration (close to existing sites with the habitat type)
2. Fund raising (relation to agro-environmental schemes)
3. Awareness raising

### United Kingdom, Jefferson, pers. Comm.

Further statutory designation of sites under domestic legislation  
Strengthen EIA (Agriculture) Regulations  
Ensure appropriate level of funding via ERDP for agri-environment schemes  
Policy advocacy in relation to atmospheric pollution, Climate change, livestock and water resource/catchment management (WFD)  
Awareness raising, education and community engagement

## Cases / projects

### Sites

## 7110 – Active Raised Bogs

### Summary

**Active raised bogs** are 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 *Sphagnum* hummocks allowing for the growth of the bog (*Erico-Sphagnetalia magellanici*, *Scheuchzerietalia palustris* p., *Utricularietalia intermedio-minoris* p., *Caricetalia fuscae* p.). Active raised bogs are those which are peat forming, disturbed bogs which are no longer active are the non-priority habitat type '7120 Degraded raised bogs capable of natural regeneration'.

There are three key conditions which have to be maintained if lowland raised bogs are to retain their characteristic features. Firstly, they are waterlogged systems so alterations to the rate of water loss will destabilise them. Secondly, water inputs are from precipitation alone and are therefore low in solutes, so significant increases in the base or nutrient status of the system will alter the vegetation cover in favour of non-bog species. However, a lateral water flow providing local CO<sub>2</sub>-enriched groundwater will further stabilise the water table and stimulate the growth of both hollow and hummock forming peat mosses. Thirdly, the living layer of vegetation acts as a 'natural' regulator for water loss; so destruction or alteration of the vegetation will have significant implications for the long-term stability of the ecosystem as a whole.

The **conservation status of this habitat type** in the Atlantic region has been assessed as 'unfavourable-bad', except for Spain who reported the Alpine region as 'unknown' and the United Kingdom reports the habitat as 'improving'.

**The main reported threats and pressures** to active raised bogs in the Atlantic region are:

- Peat extraction.
- Water abstraction: loss of area by drainage and conversion to intensive agriculture.
- Destruction (cultivation), isolation and fragmentation resulting in loss of habitat connectivity within 7110 and between related habitats.
- Burning.
- Acid rain and nitrogen-input mainly from agriculture including (eventually) nitrogen enrichment of local groundwater.
- Absence of or inappropriate management: Lack of or inappropriate management of existing bogs leads to drying out, scrub encroachment and succession to woodland.

The principal **management measures** for this habitat include:

- Restoration of the water regime. Removal of drains, blocking of existing drainage channels and tree removal to lower evapotranspiration. Establishment of natural or near natural hydrological regimes. [Note that often the hydrological requirements can only be achieved by measures at the landscape level, well beyond the site boundaries.]
- Pollution and nutrient reduction. An integrated approach to controlling the full range of pollution sources is needed. The establishment of buffer zones is a powerful measure, especially to avoid nutrient inputs from the immediate area; similarly installation of silt traps, creation of constructed wetlands/surfacing of field drains that avoid direct flow of water to



wetland. Control of small and non-point sources is more challenging and requires a strategic catchment-based approach, it requires a range of agricultural and silvicultural management measures to control diffuse pollution loads, including the conversion of highest risk land and land on critical hydrological pathways to semi-natural vegetation.

- Measures to prevent organic matter accumulation (natural acidification) and encroachment by shrubs and trees. These can include mowing in autumn or winter (mowing by hand or with extremely light machinery), grazing (light seasonal grazing by lightweight traditional breeds of domestic animals) and controlled light burning.
- Traditional methods for peat/removal of intensive peat extraction.
- Restoration of degraded habitats.

Note that in the Netherlands several active raised bogs were restored by means of the following **management measures**:

- Compartmentalisation within sites to store rain water and local groundwater and zone bog development (only in subtype A).
- Regeneration of bog development by sod-cutting and excavation (only subtype A).

In all sites, restoration was successful for this kind of initial peat forming process dominated by *Sphagnum cuspidatum* and *S. fallax*. Another effect of restoration is that further degradation of active remnants has been stopped. An important aspect of restoration was the acquisition of land with (former) agricultural function around the sites which function as hydrological buffer zones.

In the UK there are specific conservation programmes for the raised bogs resource. As well as this a suite of agri-environment measures are now in place in the lowlands which are addressing more appropriate management, particularly grazing levels. Furthermore the Water Framework Directive (WFD) adds considerable impetus for widespread action on issues affecting the resource of H7110 such as abstraction licences and pollution.

The **main constraint** in the conservation and/or restoration of active raised bogs is the fact that sustainable bog development requires large-scale restoration and regional hydrological measures. This is not only very expensive, but has the potential to raise conflicts with agricultural interests as well as the peat extraction industry. The most frequently encountered additional **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Significantly more of the resource in unfavourable condition is declining than improving.
- Lack of knowledge on hydrological system functioning.
- Lack of regulatory and/or financial incentive to landowners to make necessary beneficial land use.
- Restoration of habitat integrity is not likely to be achieved while background levels of Nitrogen and Ammonia loads remain high and further licenses to emit are still being granted.
- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.
- Difficulty of securing meaningful reductions in atmospheric Nitrogen loading.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Widespread introduction of restoration measures (and associated stakeholder engagement, policy change and implementation, etc).

- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Maintenance of appropriate hydrological conditions.
- Effective control of air quality.
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand. Effective long-term agri-environment mechanism support which provides both flexibility in relation to stocking rates and remuneration that is actually attractive to farmers.

## Description of the habitat

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 intermedio-minoris* p., *Caricetalia fuscae* p.). 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 (EC 2007b).

In order to support the conservation of this ecosystem over its geographic range and its genetic diversity, marginal areas of lower quality as a result of damage or degradation which abut active raised bogs may need to be included, protected and, where practicable, regenerated. There are very few intact or near-intact raised bogs in Europe, except in Finland and Sweden where active raised bogs are the predominant mire complex type in hemiboreal and southern boreal regions (EC 2007b)

Active raised bogs are peat-forming ecosystems that have developed during thousands of years of peat accumulation, to such an extent that the depth of peat isolates them from the influence of groundwater. Active bog vegetation is characteristic of intact (primary) bog surfaces, but peat-forming communities also occur frequently on bogs which have previously been cut for peat (secondary surfaces) but have since become revegetated (Joint Nature Conservation Committee n.d.).

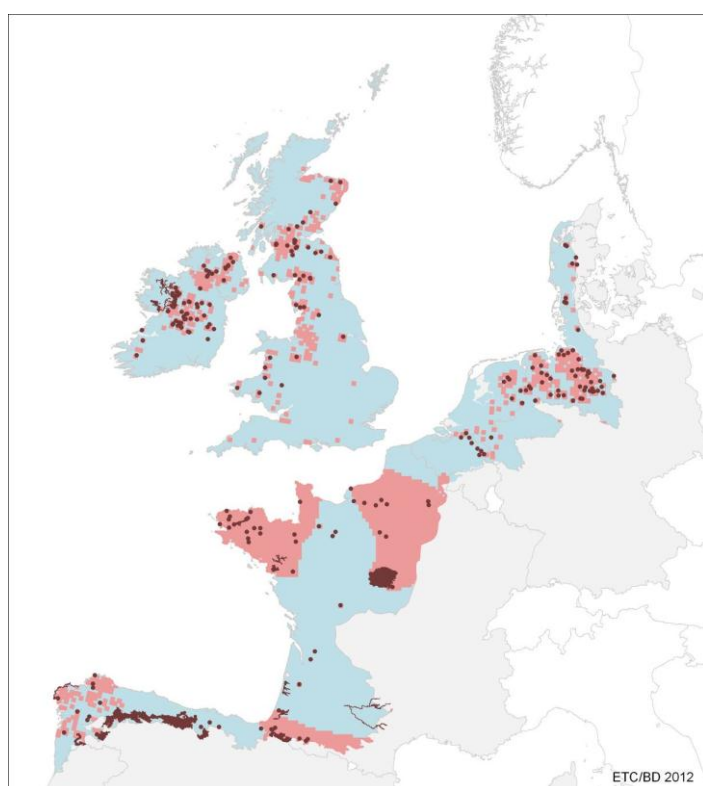
Classical descriptions of the ecosystem show raised bogs as having a discrete lens-shaped dome of peat with flat or imperceptibly sloping topography with a halo of fen vegetation in the zone where water draining the bog meets that from adjoining mineral soils. This is known as the lagg. A characteristic of the lagg zone is that normally it has more available plant nutrients, is more alkaline and hence shows greater species diversity, with a preponderance of sedge *Carex* spp. As a result of peat-digging and other activities, no example of raised bog that conforms exactly to this model is now known in Europe. (Joint Nature Conservation Committee n.d.)

### 1.1. Distribution

**Table 75 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT		UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	8	20	15	47	82	8	19	7	31		24	53	54	104	11	53	4		5		56
habitat area (ha)	3	248	421	713	4597	178	2739	396	6743		9259	3928	6738	5673	929	2435	104		779		7870

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>84</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).



**Figure 18 Map of SCIs proposed for Active raised bogs & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

There are three key conditions which have to be maintained if lowland raised bogs are to retain their characteristic features. Firstly, they are waterlogged systems so alterations to the rate of water loss will destabilise them. Secondly, water inputs are from precipitation alone and are therefore low in solutes, so significant increases in the base or nutrient status of the system will alter the vegetation

<sup>84</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

cover in favour of non-bog species. However, a lateral water flow providing local CO<sub>2</sub>-enriched groundwater will further stabilise the water table and stimulate the growth of both hollow and hummock forming peatmosses (Smolders et al. 2001; Tomassen et al. 2011)<sup>85</sup>. Thirdly, the living layer of vegetation acts as a 'natural' regulator for water loss, so destruction or alteration of the vegetation will have significant implications for the long-term stability of the ecosystem as a whole. (Joint Nature Conservation Committee n.d.).

### 1.3. Ecological requirements

### 1.4. Main subtypes

#### The Netherlands

Bijlsma, pers.comm.:

In the Netherlands subtype A represents active raised bogs in (former) peat areas and subtype B small active bogs in heathland landscapes often associated with pools. Despite the small areas of subtype B, this kind of raised bogs is rich in characteristic species and appears very resilient.

### 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Active raised bogs and provided their conservation status in the Atlantic Member States (see tables below).

**Table 76 Species associated with Active raised bogs (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Gallinago gallinago A153	X									
Pluvialis apricaria A140	X									
Tringa glareola A161	X									
Anthus pratensis A257	X									
Tetrao tetrix A409	x									
Andromeda polifolia										x

<sup>85</sup> Bijlsma, pers. comm., references:

Smolders, A.J.P., H.B.M. Tomassen, H.W. Pijnappel, L.P.M. Lamers, & J.G.M. Roelofs (2001) Substrate-derived CO<sub>2</sub> is important in the development of Sphagnum spp. *New Phytologist* 152: 325-332.  
 Tomassen, H.B.M., A.J.P. Smolders, J. Limpens, S. van der Schaaf, G.A. van Duinen, G. van Wirdum, H. Esselink & J.G.M. Roelofs. 2011. Research in aid of the restoration and management of Dutch raised bogs. Final report [in Dutch]. OBN151-NZ, Den Haag (edepot.wur.nl/181521).

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Betula nana										x
Vaccinium microcarpum										x

## 1.6. Related habitats

Within the raised bog ecosystem the bog surface typically displays a distinctive microtopography, with patterns of hummocks and hollows rich in *Sphagnum* and other peat-forming species. Around bog pools there may sometimes be patches of H7150 (Depressions on peat substrates of the *Rhynchosporion*). (Joint Nature Conservation Committee n.d.)

## 1.7. Ecological services and benefits

- Many characteristic species
- Many host plants species for 2 butterfly species (*Boloria aquilonaris* and *Coenonympha tullia*)
- In flooded basins of the bog: place for dragonflies to breed
- Habitat for *Tetrao tetrix* (threatened species)

(DGARNE n.d.)

## 1.8. Conservation status

**Table 77 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	UK	REGION
7110	Active raised bogs	range	U2	U1	FV	XX	XX	U2	U1	FV	XX
		area	U2	U2	U2	XX	U2	U2	U2	U2	U2
		structure	U2	U2	U2	XX	U2	U2	U2	U2	U2
		future	U1	U1	U2	XX	U2	U2	U2	U1	U2
		overall	U2	U2	U2	XX	U2	U2	U2	U2	U2

Raised bogs are formed by bog mosses (*Sphagnum* species) and are dependent on rainfall for their nutrients. They often form a dome with an internal watertable higher than the surrounding watertable. The habitat is widely distributed across northern Europe, particularly in the Atlantic, Boreal and Continental regions. Active raised bogs are those which are peat forming, disturbed bogs which are no longer active are the non-priority habitat type '7120 Degraded raised bogs capable of natural regeneration'.

Assessed as 'unfavourable -bad' in the Alpine, Atlantic, Continental, Macaronesian and Mediterranean regions. Within these regions only Germany and Italy (both for the Alpine region) have reported this habitat as 'favourable' although Spain reported Alpine, Atlantic and Mediterranean regions as 'unknown'. The United Kingdom (Atlantic) reports the habitat as 'improving' while Sweden (Continental) notes 'deteriorating'. 'Unfavourable-inadequate' for the Boreal and Pannonic regions with Estonia noting that the conservation status is deteriorating. (ETC BD 2012).

## 1.9. Trends

### The Netherlands

Bijlsma, pers. comm.:

As a result of extensive restoration projects in most sites with active raised bogs in the Netherlands, several characteristic species increased, such as *Sphagnum papillosum*, *S. magellanicum*, *Vaccinium oxycoccos*, *Andromeda* en *Rhynchospora alba*. The strong increase of *Sphagnum magellanicum* in several sites came as a pleasant surprise. Effects on fauna are more ambiguous. Some critical species show a positive trend, e.g. the butterfly *Coenonympha tullia* in the Fochteloërveen, others appear negatively affected by the strongly raised water tables, at least in the short term (Natuurmonumenten et al. 2011)<sup>86</sup>.

An unexpected recent trend in the Netherlands is the successful establishment and expansion of typical peatmosses of raised bogs on mineral soil in several nature development sites with strong (local) groundwater discharge, in particular *Sphagnum papillosum*, to a lesser extent *S. magellanicum* and *S. rubellum* as well, often accompanied by peatmosses of wet heaths such as *S. molle* and *S. tenellum* (Bijlsma et al. 2011)<sup>87</sup>.

## 1.10 Main pressures and threats

A variety of threats and pressures have been reported but many countries mention drainage, peat extraction and pollution/eutrophication. Better information required, particularly from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive)..

**Table 78 Main pressures to Active raised bogs and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Active raised bogs
General Forestry management	x
Peat extraction	x

<sup>86</sup> Natuurmonumenten, Staatsbosbeheer, Landschap Overijssel & Ministerie van Defensie. 2011. Evaluation of raised-bog sites in the Netherlands [in Dutch]. 's-Graveland.

<sup>87</sup> Bijlsma, R.J., A.J.M. Jansen, J. Limpens, M.F. Wallis de Vries & J.P.M. Witte. 2011. Raised bogs and climate change in the Netherlands [in Dutch]. Alterra-report 2225, Wageningen (www.alterra.wur.nl).

Landfill, land reclamation and drying out, general	x
Drainage	x
Modification of hydrographic functioning, general	x
Biocenotic evolution	x

**Table 79 Main threats to Active raised bogs and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Active raised bogs
General Forestry management	x
Peat extraction	x
Drainage	x
Modification of hydrographic functioning, general	x
Biocenotic evolution	x

Threats to **Walloon** active raised bogs are (D GARNE n.d.):

- Climate change
- Pollution
- Exploitation resulting in:
  - Drainage
  - Coniferous plantations
  - Higher risks for fire

Factors which currently either disrupt the balance of these conditions, or which lead more immediately to the destruction of raised bog habitats and their remnants, include (Joint Nature Conservation Committee n.d.):

- Water abstraction: loss of area by drainage and conversion to intensive agriculture has adversely affected the UK resource of H7110. Lowland raised bogs frequently occur in drained agricultural landscapes. Perimeter drainage and water abstraction from underlying aquifers may limit the rewetting potential of certain sites.
- Grazing: A lack of grazing coupled with drier conditions has favoured the expansion of scrub and tall heather to the detriment of bog species<sup>88</sup>. However, over-grazing can lead to trampling and compaction as well as contamination.
- Peat extraction: The extraction of peat and/or underlying mineral deposits both in existing and proposed new areas.
- Burning: on lowland raised bogs is not encouraged with the consequential losses in bog vegetation.
- Built development: Linear developments and other land reclamation for built development (including waste disposal) affect many areas. Such developments have long-term repercussions on the stability of the ecosystem. In addition, raised bogs and the scope for their expansion onto archaic peat are vulnerable to windfarm developments.
- Fragmentation: On a local scale lowland raised bog was more extensive and continuous in the past, but since the 19th Century this habitat has become more fragmented. It is not

<sup>88</sup> Remark on this point by Jansen (The Netherlands): "This can only be the case in desiccated bogs. Raised bogs are habitats with almost no trees in undisturbed, undrained conditions."

realistic that these bogs will once again become reconnected, but it is important that they do not become isolated islands within intensively drained landscapes. To this end water margins, and other wetlands play an important role in connectivity.

- Absence of or inappropriate management: Lack of or inappropriate management of existing bogs leads to drying out, scrub encroachment and succession to woodland.
- Forestry operations: In addition to the direct impacts of existing plantations on deep peat, successive rotations dry out neighbouring areas and act as an invasive seed source.
- Air pollution
- Climate change is considered a major threat to the future condition of this habitat especially in the long term. However, there is a high degree of uncertainty in defining future climate threats on habitats and species due to uncertainty in: future greenhouse gas emissions; the consequential changes in climatic features (for instance temperature, precipitation CO2 concentrations)

In **Ireland**, intact active raised bog is extremely rare, having decreased in area by over 35% in the last 10 years. Ongoing deterioration of the hydrological conditions of raised bogs at current rates caused by peat cutting, drainage, forestry and burning severely threatens the viability of the habitat at most locations (NPWS 2008).

The most serious threat to this habitat type in **Denmark** today is changed hydrological conditions caused by drainage and water catchment in the hydrological basin of the bog (Søgaard et al. 2007). However, drainage is not the only forest management measure that distresses raised bogs situated close to large forest areas. The massive occurrences of *Picea abies* and other coniferous trees have had an unfavourable hydrological influence on the habitat type. Moreover, this habitat type, which is extremely lacking in nutrients, is seriously threatened by eutrophication, which has doubled since the 1950s (Risager 1999). The reduction of the area, range, and quality of this habitat type means that many raised bogs today are too small to be able to maintain viable populations of the characteristic species. Finally, it is important to avoid grazing domestic animals and unnatural dense (feeded) game at the very bog.

In Germany, the exploitation of peat (particularly in the past) has resulted in the destruction of raised bogs. Drainage and the subsequent conversion of peatland to grassland and afforestation are, together with the inflow from nutrients from surrounding areas, the major constraints for raised bogs (Bundesamt für Naturschutz n.d.).

Ackermann, pers. comm.:

- Entwässerung/Grundwasserabsenkung
- Nährstoffeintrag aus der Luft
- Verbuschung/Bewaldung
- Torfabbau (indirekte Einflüsse)

## The Netherlands

Bijlsma, pers. comm.:

- J03.03 destruction (cultivation), isolation and fragmentation resulting in loss of habitat connectivity within 7110 and between related habitats (isolated habitats: loss of risk spreading)



- J02 human induced changes in hydraulic conditions
- H04 acid rain and nitrogen-input mainly from agriculture including (eventually) nitrogen enrichment of local groundwater

The remaining fragments in the Netherlands require a high management input to secure small populations of characteristic bog species and reinstate local active bog development. High nitrogen deposition stimulates the colonization of birch and shrubs especially following drought periods.

## 2 Conservation management

### 2.2. Main conservation requirements

The main conservation requirement for active raised bogs in Wallonia (**Belgium**) is the restoration of the hydrology and vegetation areas that are still considered active (D GARNE n.d.)

In order to obtain favourable conservation status in **Denmark** it is necessary to secure a buffer zone around the bog where there is no drainage or water catchment (Søgaard et al. 2007).

In Germany, conservation of active raised bogs consists in the maintenance of the typical water and nutrient dynamics and the chemical composition of the water. In the surrounding areas, the presence of buffer zones should minimize the inflow of nutrients in the system. Normally, no management is required (Bundesamt für Naturschutz n.d.).

Ackermann, pers.comm.

- Wiederherstellung des lebensraumtypischen Wasserhaushalts
- Vermeidung von Nährstoffeinträgen, insbes. aus der direkten Umgebung
- Bei Bedarf Durchführung von Entbuschungsmaßnahmen
- Einstellung des Torfabbaus im Umfeld

#### The Netherlands

Bijlsma, pers. comm.:

- Hydrological measures to warrant high and rather stable water tables, at least to prevent long periods of desiccation. Local groundwater can contribute to the required hydrological stability and provide CO<sub>2</sub>-enriched water that stimulates the growth of typical bog peat mosses.
- Removal of trees and shrubs (especially birch) to prevent succession to woodland

### 2.2. Management measures

Following management practices are applied in the UK to protect / restore raised bogs:

- Specific conservation programmes for raised bogs resource:

- The English Nature (EN) Lowland Peatland Programme, launched in 1992, focused particular attention on the conservation of lowland raised bogs in England. Outcomes of this programme have included acquisition and after-use agreement on land worked by a major peat cutting company, declaration of three large raised bog National Nature Reserves (NNRs), resource assessment of English lowland raised bogs and prioritisation of sites for conservation and rehabilitation, production of rehabilitation management plans for priority sites, a review of monitoring and development of a computer database for data storage and interrogation.
- The Scottish Wildlife Trust (SWT), with EU *Life* funding for a three-year project, accrued survey data for many of Scotland's lowland raised bogs. Under the same project the SWT also held an international Peatland Convention in 1995 the proceedings of which (*Conserving Peatlands*) were published in 1997. The project also published *Conserving Bogs: The Management Handbook*, a best-practice guide on management and rehabilitation of lowland raised bogs.
- A suite of agri-environment measures are now in place in the lowlands which are addressing more appropriate management, particularly grazing levels, for an unknown proportion of the resource of H7110 outside the statutory site series.
- Water Framework Directive (WFD): adds considerable impetus for widespread action on issues affecting the resource of H7110 such as abstraction licences and pollution. Furthermore water level management plans are in place for much of the lowland raised bog resource to address water management in the immediate catchment of the bog.
- UK Biodiversity Action Plan (BAP): The habitat is covered by the lowland raised bogs action plan under the UK Biodiversity Action plan (see [\\_Hhttp://www.ukbap.org.uk](http://www.ukbap.org.uk)), as well as under country and local biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource. More specifically, the UK habitat action plan includes targets to rehabilitate 110km<sup>2</sup> (11,000 ha) of degraded bog habitat and restore 15km<sup>2</sup>(1,500 ha) to ensure a sustainable hydrological regime.

## Germany

Ackermann, pers.comm.

- Wiederherstellung eines ungestörten Wasserhaushalts durch Schließung von Entwässerungsgräben (nach Aufnahme der hydrologischen Verhältnisse); dabei sind ggf. geregelte Abflüsse vorzusehen; bei Bedarf randliche Polderung, um ein oberflächiges Abfließen des Regenwassers zu verhindern.
- Schaffung von Pufferzonen zu intensiv land- oder forstwirtschaftlich genutzten Flächen, Verkehrswegen, Stallanlagen und Siedlungen; deren Größe (100 bis 500 m Mindestbreite) muss von den möglichen Beeinträchtigungen abhängig gemacht werden; in den Pufferstreifen/-zonen muss auf Düngung, Kalkung und Pestizideinsatz sowie Entwässerung verzichtet werden.
- Insbesondere an den Moorrändern in mehrjährigen Abständen Rücknahme des Gehölzaufwuchses durch Entkusseln (sofern es sich nicht um naturnahe Moorwälder

handelt); bei gestörtem Wasserhaushalt, wegen Stickstoffeinträgen aus der Luft und/oder starken Sameneintrag aus angrenzenden Wäldern sollten Moorflächen ggf. regelmäßig entkusselt werden.

- Einstellung des Torfabbaus vorrangig in den Gebieten, in denen sich auch noch intakte Hochmoore oder renaturierungsfähige degradierte Hochmoore befinden, damit der Wasserhaushalt in den intakten Flächen nicht beeinträchtigt wird bzw. eine Wiedervernässung renaturierungsfähiger Flächen durchgeführt werden kann.

### The Netherlands

Bijlsma, pers. comm.:

- Compartmentation within sites to store rain water and local groundwater and zone bog development (only in subtype A)
- Regeneration of bog development by sod-cutting and excavation (only subtype A)

In the Netherlands, 13 raised bog remnants survived in nature reserves, all within the Natura 2000 network. In most of these sites extensive restoration projects have been completed or are in progress, especially focused on hydrological measures including compartmentation. Total costs per site exceeded often 1 M€. The 'first generation' compartments appeared mostly too large resulting in large water bodies with a very slow succession to floating mats of hollow-forming peat mosses and without colonisations by hummock-forming species. In all sites, restoration was successful for this kind of initial peat forming process dominated by *Sphagnum cuspidatum* and *S. fallax*. Another effect of restoration is that further degradation of active remnants has been stopped. An important aspect of restoration was the acquisition of land with (former) agricultural function around the sites which function as hydrological buffer zones (Natuurmonumenten et al. 2011)<sup>89</sup>.

## 2.3. Other measures (e.g. monitoring)

## 2.4. Species specific measures

### The Netherlands

Zollinger, pers.comm.:

Maintenance, restoration of ponds or digging of new ponds is crucial for *Bombina variegata* (Annex 2) and *Alytes obstetricans* (Annex 4). Landhabitat is also important, the grassland and shrubs for foraging and stapled stone walls as shelters and for staying during wintertime.

For measures see i.e. Action Plan for the conservation of the Common Midwife Toad (*Alytes obstetricans*) in the European Union (European Commission, 2010).

Bijlsma, pers.comm.:

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<sup>89</sup> Natuurmonumenten, Staatsbosbeheer, Landschap Overijssel & Ministerie van Defensie. 2011. Evaluation of raised-bog sites in the Netherlands [in Dutch]. 's-Graveland.

Several characteristic butterfly species (such as *Boloria aquilonaris*, *Coenonympha tullia*) are strongly endangered in the Netherlands and require specific attention and careful planning of hydrological measures.

## 2.5. Main constraints / bottlenecks and actual needs

### The Netherlands

Bijlsma, pers. comm.:

- Sustainable bog development requires large-scale restoration and regional hydrological measures. This is not only very expensive, but will raise conflicts with agricultural interests as well.
- Climate change is not considered a threat in sites with optimal hydrological conditions

### Germany

Ackermann, pers.comm.:

Es gibt nach wie vor großflächige Vorranggebiete für Torfabbau.

## 2.6. Solutions and recommendations

### 2.6.1 Solutions

#### Germany

Ackermann, pers.comm.:

Einführung eines kontinuierlichen EU-weiten Torf-Verbots (Verbot der Einfuhr und Verwendung von Torf)

### 2.6.2 Recommendations

## Cases / projects

### Sites

## 7140 - Transition mires and quaking bogs

### Summary

**Transition mires** are peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous/topogenous 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. The habitat includes minerotrophic fens not being part of a larger mire complex, open swamps and small fens in the transition zone between water and mineral soil. These mires and bogs belong to the *Scheuchzerietalia palustris* order (e.g. oligotrophic floating carpets) and to the *Caricetalia fuscae* order (quaking communities). Oligotrophic water-land interfaces with *Carex rostrata* are included.

**Transition mires are characterised by** the vegetation that in floristic composition and general ecological characteristics is transitional between acid bog and alkaline fens, in which the surface conditions range from markedly acidic to slightly base-rich. The vegetation has intimate mixtures of species considered to be acidophile and others thought of as calciphile or basophile. In some cases the mire occupies a physically transitional location between bog and fen vegetation, but they can occur in a variety of situations: flood plain mires, valley bogs, basin mires, lagg zone of raised bogs, and as regeneration surfaces within mires that have been cut-over for peat or areas of mineral soil influence within blanket bogs. Many of these systems are very unstable underfoot and can therefore also be described as 'quaking bogs'. Transition mires and quaking bogs represent a suitable habitat for many species, amongst which are found rare dragonflies of oligotrophic or dystrophic waters.

Overall the **conservation status of this habitat type** in the Atlantic Region has been assessed as 'unfavourable-bad'; (in particular due to the 'structure' and 'future prospect' which was classified by majority of countries as 'unfavourable-bad').

**The main reported threats and pressures** to the Transition mires in the Atlantic Region are:

- Surface Drainage and Abstraction. Both hydrological changes in the fen itself and in the surroundings lead to degradation of the habitat. Many sites have internal ditches, culverted outflows and overflows. The off-site drainage may reduce the quantity of water reaching the site. Excessive water abstraction from aquifers has dried up or reduced spring line flows, and generally lowered water tables, resulting in drying out of sites.
- Aquatic and air pollution. Eutrophication, diffuse pollution to surface waters due to agricultural and forestry activities in surrounding land (input especially of ammonium), also pollution caused by agricultural run-off within the catchments. Nitrogen and sulphate deposition may contribute to eutrophication and represent potentially significant pressure to the habitat structure and function.
- Climate change. It is likely that changes in the hydrological regime will affect peat accumulation rates, recycling of nutrients and plant community composition.
- Lack of management leading to natural succession, including encroachment of shrub and trees, resulting in development of coarse vegetation and secondary woodland. The accumulation of organic matter can result in natural acidification. Removal of grazing has

meant that this habitat has often become rank and less diverse, both in species and structural terms.

- Grazing. Degradation due to overstocking: livestock contributes to the acceleration of erosion at the edges of the mire, to increased compaction and exposed peat surfaces.
- Agriculture and forestry use. This includes direct conversion to utilized areas: poplar plantations, fish ponds, agricultural fields. Whilst direct loss of the habitat to more intensive agriculture is not a major threat now, land-use immediately around sites supporting H7140, and in the wider water catchment, has a significant effect on the habitat.
- Peat extraction.
- Fragmentation and isolation. Sites of 7140 now fall largely outside of conventional agriculture as they are incompatible with the modern farming systems, therefore many sites are now isolated in intensively managed agricultural landscapes. This, in combination with a small total area of habitat and critically small population sizes of several key species dependent on the habitat 7140, provides the major threats to the long-term integrity and even survival of the habitat.

The principal **management measures** for this habitat include:

- Restoration of the water regime. Removal of drains, blocking of existing drainage channels and tree removal to lower evapotranspiration. Establishment of natural or near natural hydrological regimes. [Note that often the hydrological requirements can only be achieved by measures at the landscape level, well beyond the site boundaries.]
- Pollution and nutrient reduction. An integrated approach to controlling the full range of pollution sources is needed. The establishment of buffer zones is a powerful measure, especially to avoid nutrient inputs from the immediate area; similarly installation of silt traps, creation of constructed wetlands/surfacing of field drains that avoid direct flow of water to wetland. Control of small and non-point sources is more challenging and requires a strategic catchment-based approach, it requires a range of agricultural and silvicultural management measures to control diffuse pollution loads, including the conversion of highest risk land and land on critical hydrological pathways to semi-natural vegetation.
- Mowing in late summer to prevent organic matter accumulation (natural acidification) and encroachment by shrubs and trees. Bog-moss dominated reed vegetation: mowing in autumn or winter. Mowing by hand or with extremely light machinery.
- Grazing reintroduction. Light seasonal grazing by lightweight traditional breeds of domestic animals.
- Adjustment of peat extraction in the area.
- Restoration of degraded habitats. Various measures could be applied: deforestation, creating new pools, submergence. These methods allow vegetation pioneers who settle spontaneously or when seeds or spores remain in the peat to develop and encourage species that may still be present.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Significantly more of the resource in unfavourable condition is declining than improving.
- Lack of knowledge on hydrological system functioning.
- Lack of regulatory and/or financial incentive to landowners to make necessary beneficial land use.
- Restoration of habitat integrity is not likely to be achieved while background levels of Nitrogen and Ammonia loads remain high and further licenses to emit are still being granted.

- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.
- Difficulty of securing meaningful reductions in atmospheric Nitrogen loading.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Maintenance of oligotrophic conditions. Reducing or eliminating nutrient inputs from local terrestrial and aquatic sources is a critical part of an overall approach to reduce or mitigate nutrient impacts.
- Effective control of air quality
- Strategic planning of management measures at a site level, changing policy at the landscape level.
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand. Effective long-term agri-environment mechanism support which provides both flexibility in relation to stocking rates and remuneration that is actually attractive to farmers.

## 1 Description of the habitat

Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, 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. (EC 2007a) (ETC BD 2012)

The term 'transition mire' relates to vegetation that in floristic composition and general ecological characteristics is transitional between acid bog and alkaline fens, in which the surface conditions range from markedly acidic to slightly base-rich. The vegetation normally has intimate mixtures of species considered to be acidophile and others thought of as calciphile or basophile. In some cases the mire occupies a physically transitional location between bog and fen vegetation, as for example on the marginal lagg of raised bog or associated with certain valley and basin mires. In other cases these intermediate properties may reflect the actual process of succession, as peat accumulates in groundwater-fed fen or open water to produce rainwater-fed bog isolated from groundwater influence. Many of these systems are very unstable underfoot and can therefore also be described as 'quaking bogs'. Transition mires and quaking bogs can occur in a variety of situations, related to different geomorphological processes: in flood plain mires, valley bogs, basin mires and the lagg

zone of raised bogs, and as regeneration surfaces within mires that have been cut-over for peat or areas of mineral soil influence within blanket bogs (e.g. ladder fens). (Joint Nature Conservation Committee 2007)

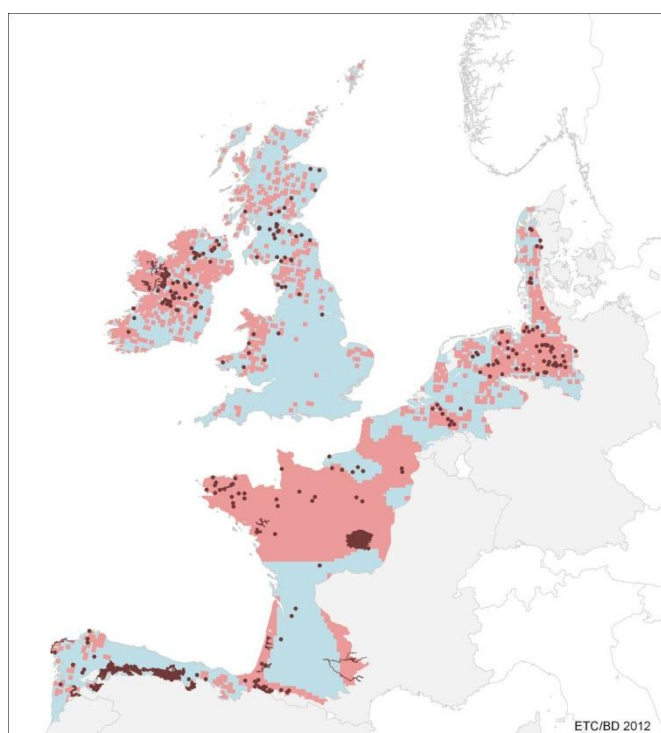


## 1.1. Distribution

**Table 80 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States**

	BE		DE			DK		ES				FR				IE	NL		PT		UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL
number of sites	9	15	17	182	652	31	57	2	39		44	36	44	86	6	17	16	3		7	93
habitat area (ha)	182	114	249	3313	6707	791	1855	90	9161		16336	3505	5575	2687	423	1305	1664	1032		1782	3551

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>90</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).



**Figure 19 Map of SCIs proposed for the Transition mires and quaking bogs & Article 17 distribution (for legend, see introduction of chapter 3)**

Transition mires and quaking bogs are a widespread but local habitat type in the UK that is ecologically variable and occurs in a wide range of geomorphological contexts. Transition mires and quaking bogs have a wide European distribution but appear to be relatively scarce in the Mediterranean region. (Joint Nature Conservation Committee 2007)

<sup>90</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)

This habitat type is distributed throughout almost whole Germany, where the beginning of the Alps are best endowed. Especially in the low mountain ranges near water sources like lakes and ponds as well as raised bogs this habitat type occurs. (Bundesamt für Naturschutz 2012)

## 1.2. Main features

Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, 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. (Joint Nature Conservation Committee 2007)

## 1.3. Ecological requirements

This habitat type consists of peat growth under relatively poor to moderately nutrient-rich conditions. It is preceded by vegetations growing on open waters, like habitat type 3150, and under certain circumstances in successor state are followed by habitat type 4010. Quaking bogs is a species-rich and fragile vegetation consisting of a floating plant community on water.

(Ministerie van Economische Zaken, Landbouw en Innovatie 2008)

## 1.4. Main subtypes

### Sub-types

- H1310\_A Salt pioneer vegetations (*Samphire*)
- H1310\_B Salt pioneer vegetations (*Sea aster*)

(Ministerie van Economische Zaken, Landbouw en Innovatie 2008)

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with transition mires and quaking bogs, and provided their conservation status in the Atlantic Member States (see table below).

**Table 81 Species associated to Transition mires and quaking bogs (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Lycaena dispar 1060	X									
Asio flammeus A222	X									
Gallinago gallinago A153	X									
Philomachus pugnax A 151	X									
Anthus pratensis A257	X									

**Table 82 Species associated to Transition mires and quaking bogs and their Conservation Status (CS) at the Atlantic region and MS level (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		DE	FR	NL	REGION
1060	<i>Lycaena dispar</i>	Invertebrates	range	XX	U1	U2	U1
			population	XX	XX	U2	XX
			habitat	U2	U1	U2	U1
			future	U2	U1	U1	U1
			overall	U2	U1	U2	U1

The Habitats Manual lists the following Annex II/IV plant: *Liparis loeselii*.

## 1.6. Related habitats

Associated with amphibious communities (22.3), fens (54.2 et 54.4), bogs (51.1-2) or humid grasslands (37.2-3).

## 1.7. Ecological services and benefits

Transition mires and quaking bogs represent a suitable habitat for many species, amongst which rare dragonflies of oligotrophic or dystrophic waters. It is also the habitat of the rare Pearl of the cranberry, a butterfly whose larvae develop on the cranberry. (DGARNE n.d.)

## 1.8. Conservation status

**Table 83 Conservation status (CS) assessed at the Atlantic region and MS level (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
7140	Transition mires and quaking bogs	range	U1	XX	FV	XX	U1	FV	U1	FV	FV	U1
		area	U1	U1	XX	XX	U2	FV	U1	U1	XX	U2

		structure	U2	U2	U2	XX	U2	U2	U2	U2	U2	U2
		future	U2	U1	U2	XX	U2	U2	U1	U2	U2	U2
		overall	U2	U2	U2	XX	U2	U2	U2	U2	U2	U2

Peat forming plant communities with a wide range of variation depending on local conditions and often associated with aquatic, open water habitats. Widely distributed across the European Union although more local to the south, the distribution in Spain is much greater than shown on the map.

Assessed as 'unfavourable-bad' in the Alpine, Atlantic, Continental, Mediterranean and Pannonian regions with no parameters assessed as 'favourable'. Several countries assessed the Alpine region as 'favourable' and the regional assessment is largely a result of the French report and it is possible that the French proportion of this habitat has been overestimated. Elsewhere the habitat has been assessed as 'favourable for Italy (Continental) and Czech Republic (Pannonic). Assessed as 'unfavourable-inade quate' in the Boreal and Macaronesian regions. In the Boreal region 'range' is the parameter consider red 'favourable' although the habitat was assessed as 'favourable' in Latvia. A variety of threats and pressures have been reported but many countries mention changes to the water regime, peat extraction and pollution/eutrophication. Better information required, especially from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive).

## 1.9. Trends

Habitat prospects over next 12-15 years considered to be bad in the UK, with severe impact from threats expected and long term viability not assured (Joint Nature Conservation Committee 2007).

In the course of the twentieth century this habitat type strongly detoriated through acidification, water depletion and eutrophication in the Netherlands (Ministerie van Economische Zaken, Landbouw en Innovatie 2009).

## 1.10 Main pressures and threats

The most obvious major future threats to Transition mires and quaking bogs are listed below:

- Overabstraction (water);
- grazing;
- fragmentation
- lack of or inappropriate management;
- aquatic and air pollution;
- climate change;
- peat decline;
- agriculture and forestry use;
- recreational use.

Extrapolating beyond the statutory site series this suggest that more than 25% of the overall UK resource will be in unfavourable condition in the immediate future.

(Joint Nature Conservation Committee 2007) (Bundesamt für Naturschutz 2012)

In Spain, the main processes of degradation and threats that affect this type of habitat are (VV.AA. 2009):

- Drainage: opening of trenches in order to eliminate waterlogging.
- Degradation due to overstocking: livestock contributes to the acceleration of erosion at the edges of the mire, to increased compaction and exposed peat surfaces. In areas with high stocking density it is possible that modifications are produced due to the effect of the droppings (e.g. in studies undertaken in peat plots significant changes were detected in the proportion of coprophilous fungi, for example, which are believed to respond to changes in stocking rates and the associated changes in nutrient loading).
- Modification of vegetation: reforestation and transformation to prairies.
- Change in oligotrophic conditions: eutrophication through the use of fertilizers to maintain plant communities that do not appear in mire habitats; also as a side effect due to surface water runoff combined with the fertilization of soils in the watershed.
- Fire: to promote the regrowth of tender vegetation for cattle.
- Increased solids loading: by changes in the basin (soil erosion) and dragging of inorganic materials.
- Construction of infrastructure: although, in general, the direct occupation of mires by infrastructure is rare, the indirect effects are more frequent (dragging of solids by erosion or destabilization of slopes, opening of roads that facilitate access to and conversion of peatland). To the impact of access it should also be added a greater frequency of visits and even an increase in the collection of typical peatland plants.
- Air pollution: N and S deposition may contribute to eutrophication.
- Climate change: the effects are to be determined, but it is likely that changes in the hydrological regime will affect peat accumulation rates, recycling of nutrients and plant community composition.

In Ireland, the main threats are drainage, infilling, reclamation and pollution (NPWS 2008).

**Table 84 Main pressures to Transition mires and quaking bogs, and their importance to associated species (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Transition mires and quaking bogs	<i>Lycaena dispar</i>
Grazing	x	
General Forestry management	x	
Pollution	x	
Trampling, overuse	x	
Drainage	x	
Modification of hydrographic functioning, general	x	
Biocenotic evolution	x	

**Table 85 Main threats to Transition mires and quaking bogs, and their importance to associated species (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Transition mires and quaking bogs	<i>Lycaena dispar</i>
General Forestry management	x	
Pollution	x	
Other pollution or human impacts/activities	x	
Drainage	x	
Modification of hydrographic functioning, general	x	
Other human induced changes in hydraulic conditions	x	x
Biocenotic evolution	x	

### Other information

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100% (see Appendix 1). This means that Natura 2000 network provides an important framework for the management of this habitat type.

Reported threats to this habitat in **Portugal** (ALFA 2004) are mainly associated to the physical destruction of habitat, particularly through grazing, trampling, the use of fire, drainage.

## 2 Conservation management

### 2.1. Main conservation requirements

- The landscape-typical water and nutrient variability should be maintained and be restored, for example by the removal of drains and the congestion of agricultural ditches. "Grassed areas", such as those with an increased occurrence of large sedges, can become more nutrient poor with help of grazing. (Bundesamt für Naturschutz 2012)
- The transition mires and quaking bogs should be undisturbed to be able to continue without intervention. However, most have been the subject of former drainage attempts and the effects continue to be seen. It may therefore be necessary to fight against water loss by getting a hold on this drainage. (DGARNE n.d.)

### 2.2. Management measures

- In degraded areas, various works of restoration (deforestation, creating new pools, submergence) are needed. They allow the development of vegetation pioneers who settle spontaneously when seeds or spores remain in the peat or when species are still present. (DGARNE n.d.)
- Protection within SACs – A significant proportion of the current resource lies within SACs with management measures specifically aimed at maintaining and enhancing the features for which they are designated, and to address some of the pressures listed within Section 4.1 and the future threats listed in Section 5.1.2. An unknown but significant proportion of the resource of H7140 also lies within the SSSI/ ASSI series where similar management measures are in place.

- Agri-environment measures – A suite of agri-environment measures are now in place in both the uplands and lowlands which are addressing more appropriate management, particularly grazing levels, for an unknown proportion of the resource of H7140 outside the statutory site series.
- Water Framework Directive (WFD) – In addition to the drive for improvement generated by the SAC and SSSI network, the WFD is adding considerable impetus for widespread action issues such as abstraction licences, and pollution.
- UK Biodiversity Action Plan (BAP) – The habitat is covered by both the blanket bog and fens action plans under the UK BAP (see <http://www.ukbap.org.uk>), as well as under country and local biodiversity action plans and strategies, with targets to maintain, improve, restore and expand the resource corresponding to H7140.

(Joint Nature Conservation Committee 2007)

Management guidelines for **Portugal** include (ALFA 2004):

- For the improvement of the state of conservation of the current area:
  - manage grazing;
  - the interdiction of trampling;
  - ban the use of fire;
  - the ban on draining bogs;
  - define the zones of protection for the habitat.
- For the increase the habitats area:
  - survey and mapping degraded peatlands that could be restored;
  - restore habitat conditions favorable to the accumulation of peat (eg closing of drainage ditches).

### 2.3. Other measures (e.g. monitoring)

### 2.4. Species specific measures

### 2.5. Main constraints / bottlenecks and actual needs

- More than 25% of the habitat area is considered to be unfavourable as regards its specific structures and functions (including typical species). Significantly more of the resource in unfavourable condition is declining than improving.
- Habitat prospects (as regards range, area covered and specific structures and functions) over next 12-15 years considered to be bad, with severe impact from threats expected and long term viability not assured.
- Although there is no evidence to suggest a future decline in either the range or area of H7140 in the UK by more than 1% p.a., the evidence from future favourability from CSM suggest that a substantial but unknown proportion of the total resource of H7140 is likely to remain in poor condition.

(Joint Nature Conservation Committee 2007)

## 2.6. Recommendations

Cases / projects

Sites



## 7230 – Alkaline Fens

### Summary

**Alkaline fens** are wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils that are permanently waterlogged, with a soligenous or topogenous base rich, often calcareous water supply. This habitat type has a high water table with minimal water level fluctuations. The vegetation in the best-preserved mires has a mosaic-like structure of calciphilous plant communities, pools, springs, pioneer communities and peat-forming moss-sedge communities.

Calciphile small sedges and other *Cyperaceae* usually dominate these mire communities, which belong to the *Caricion davallianae* community. This is a community of open low-growing small sedge vegetation. **It is characterised by** an usually prominent "brown moss" carpet formed by *Campyllum stellatum*, *Drepanocladus cossonii*, *Cratoneuron commutatum*, *Caliergonella cuspidata*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others; a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Trichophorum alpinum*, *Eleocharis quinqueflora*; and a very rich herbaceous flora including *Tofieldia calyculata* (in northern Europe *Tofieldia pusilla*), *Dactylorhiza incarnata*, *D. traunsteinerioides*, *D. russowii*, *D. majalis* ssp. *brevifolia*, *D. cruenta*, \**Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis sceptrum-carolinum*, *Primula farinose* and *Swertia perennis*.

Vegetation units in alkaline fens have similar physiognomy. Because there is a wide distribution range of alkaline fens, their species composition changes depending on the geographical region, altitude and water chemistry. Mire development is determined by water: the amount of water available and its chemical composition affects the morphology and surface pattern of a mire as well as its floristic composition, the productivity of its vegetation, the distribution of microtopes and the accumulation of peat. Two fundamental processes are prerequisites in the formation of mires: a positive water balance and the accumulation of peat. Both groundwater regime and quality play a crucial role in determining whether fens are formed. Fens can be subdivided on the basis of hydrology into topogenous and soligenous. Soligeneous fens are groundwater-fed systems on a possibly non-calcareous substrate where the chalk comes from the water. Topogeneuous fens are surface water-fed systems on a calcareous substrate where the water just causes wetness and the chalk comes from the substrate. Both types are very sensitive to hydrological changes.

Overall, **the conservation status of this habitat type** is assessed as 'unfavourable-bad' for the Atlantic Region due to changes in hydrological conditions and pollution/eutrophication (incl. atmospheric deposition).

**The main reported threats and pressures** to alkaline fens in the Atlantic Region are:

- Hydrological changes in the fen itself or in the surroundings, causing desiccation which stimulates decomposition and mineralization.
- Eutrophication of surface-water and/or groundwater caused by nutrients filtering in from agricultural soils and waste water.
- Atmospheric deposition of nitrogen.

- Direct conversion into alternative land uses (e.g. Poplar plantations, fish ponds, agricultural fields, etc)
- Abandonment of traditional management practices.
- Peat mining (especially in the past).

The most important **management practices** to address these threats and pressures are:

- Management of the hydrological conditions in order to ensure a stable water regime and the correct nutrient balance. (Note that if the hydrological conditions and the nutrient balance are good, alkaline fens require no special management; however, like many other wetland habitats, because of the variable external conditions and impacts referred to above, ongoing management may be required as listed below).
- Restoration of the water regime/restoring of qualitative and quantitative hydrological conditions.
- Pollution and nutrient reduction. An integrated approach to controlling the full range of pollution sources is needed. The establishment of buffer zones is a powerful measure, especially to avoid nutrient inputs from the immediate area; similarly installation of silt traps, creation of constructed wetlands/surfacing of field drains that avoid direct flow of water to wetland. Control of small and non-point sources is more challenging and requires a strategic catchment-based approach, it requires a range of agricultural and silvicultural management measures to control diffuse pollution loads, including the conversion of highest risk land and land on critical hydrological pathways to semi-natural vegetation.
- Measures to prevent organic matter accumulation (natural acidification) and encroachment by shrubs and trees. These can include mowing in autumn or winter (mowing by hand or with extremely light machinery), grazing (by sheep), cutting of invasive tree and shrub species and controlled light burning or a combination of these measures.
- Restoration of degraded habitats; removal of the top soil layer is only recommended in case of a highly degraded top layer where the habitat type has disappeared and where hydrological restoration measures alone are not sufficient for restoration.

The most frequently encountered additional **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Conflict of interest with other stakeholders in case of managing landscape hydrology.
- Lack of funding at site level.
- Significantly more of the resource in unfavourable condition is declining than improving.
- Lack of knowledge about hydrological system functioning.
- Isolation: often small isolated sites combined with the low dispersal capacity of several typical plant species, small areas are also very sensitive to external pressures.
- External impact of changed water management on large areas outside Natura 2000-site.
- Lack of regulatory and/or financial incentive to landowners to make necessary beneficial Land use.
- Restoration of habitat integrity is not likely to be achieved while background levels of Nitrogen and Ammonia loads remain high and further licenses to emit are still being granted.
- Lack of any mechanism for enabling definition and management of a groundwater protection zone for nature conservation purposes.

**Solutions** to the pressures, threats and bottlenecks are to be sought in in the development of:

- Widespread introduction of restoration measures (and associated stakeholder engagement, policy change and implementation, etc).

- Strategic planning of management measures at a site level, changing policy at the landscape level.
- At the site level: fund raising.
- Awareness raising.
- Restoration (close to existing sites with the habitat type).
- Maintenance of appropriate hydrological conditions.
- Effective control of air quality.
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand. Effective long-term agri-environment mechanism support which provides both flexibility in relation to stocking rates and remuneration that is actually attractive to farmers.

## 1 Description of the habitat

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 baserich, 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 intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others, a grasslike sward of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich herbaceous flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *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 caerulea*, e.g. *Juncetum subnodulosi* & *Cirsietum rivularis*, 37), tall sedge beds (*Magnocaricion*, 53.2), reed formations (*Phragmition*, 53.1), fen sedge beds (*Cladietum mariscae*, 53.3), may form part of the fen system, with communities related to transition mires (54.5, 54.6) and amphibious or aquatic vegetation (22.3, 22.4) or spring communities (54.1) developing in depressions. The subunits 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 (16.3), in transition mires (54.5), in wet grasslands (37), on tufa cones (54.121) and in a few other situations. The codes below can be used, in conjunction with the relevant principal code, to signal their presence. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. (EC 2007a) (ETC BD 2012).

Remark on this point by van Diggelen and Aggenbach (**The Netherlands**), pers.comm.:

1. The subdivision and delineation of this habitat type is not treated clearly. The interpretation manual of the Habitat Directive and several other overview documents are very clear with respect what belongs to this habitat type but the present text is NOT. Instead the type is treated in a very broad sense and includes many transitions to other vegetation types or even types that do not belong at all to this habitat but instead to fen meadows. A consequence is that estimates based upon such a broad definition are far too optimistic. Of course this is done by the member states but the authors should have been much more critical in their treating these figures. For example, the figures for the surface of 7230 in NL and BE are likely to be 3-4 times overestimated whereas figures for Atlantic Germany seem much more realistic.
2. Existing overviews that cover the same topics (e.g. Anon., 2011. *Herstelstrategieën stikstofgevoelige habitats. Rapport Ministerie van Economische zaken, Landbouw en Innovatie. 8 Delen*) are not obviously used.
3. The descriptions show no clear distinction between well-developed and degraded stands. This leads to unclear assessments of abiotic constraints and sometimes even to erroneous recommendations such as grazing with cattle of (extremely sensitive) peat soils.

## 1.1. Distribution

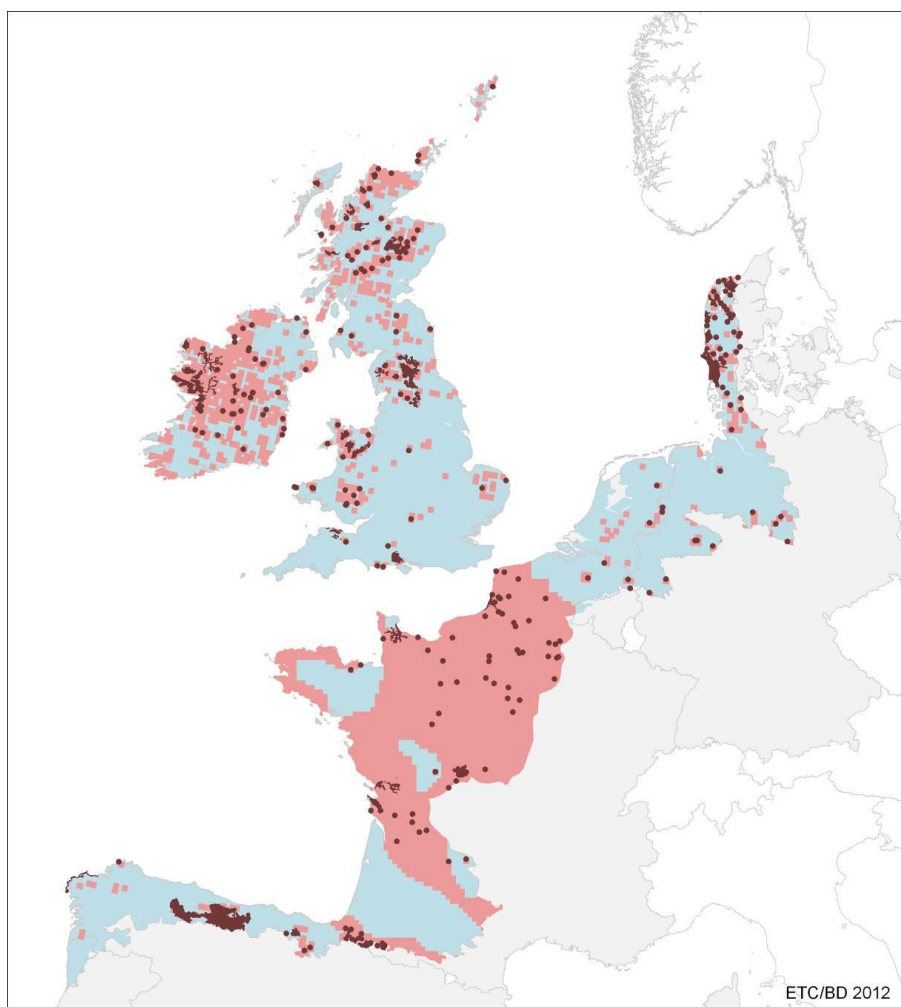
Alkaline fens occur in most bio-geographical regions and in 23 EU countries. The largest designated surface area (more than 60%) is in the Boreal and in the Continental biogeographical region, with 30% of the total in Poland and Estonia. Although the final list of sites have not been agreed for either country, alkaline fens can also be found in Romania and Bulgaria (ŠeffEROVÁ StanOVÁ et al. 2008).

**Table 86 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	IL	PT			UK	
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	2	5	36	15	434	35	112	23	20		24	72	72	69	16	39	7					87
habitat area (ha)	99	123	1206	37	6180	3077	7734	1936	5177		7994	7477	8667	2922	1761	2968	55					1823

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 76-100%<sup>91</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>91</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 20 Map of SCIs proposed for Alkaline fens & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

Alkaline fens are mires of peat or tufa-producing small sedge and brown moss communities, which have a high water table, a calcareous water supply and minimal water level fluctuation. In many cases, the dividing line between rich fen (peat-forming) and fen meadow is fuzzy, and the two often occur alongside each other. Generally, they are species-rich both in terms of moss and flowering plant species.

The vegetation in the best-preserved mires has a mosaic-like structure of calciphilous plant communities, pools, springs, pioneer communities and peat-forming moss-sedge communities belonging to the *Caricion davallianae* alliance (Wolejko et al. 2005).

Caricion davallianae is a community of open low-growing small sedge vegetation. It is characterised by:

- an usually prominent "brown moss" carpet formed by *Campylium stellatum*, *Drepanocladus cossonii*, *Cratoneuron commutatum*, *Caliergonella cuspidata*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others,
- a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Trichophorum caespitosum alpinum*<sup>92</sup>, *Eleocharis quinqueflora*, and
- a very rich herbaceous flora including *Tofieldia calyculata* (in northern Europe *Tofieldia pusilla*), *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* (EC 2007).

Vegetation units in alkaline fens have similar physiognomy. Because there is a wide distribution range of alkaline fens, their species composition changes depending on the geographical region, altitude and water chemistry. The floristic and faunistic differences between biogeographical regions may be significant. (ŠeffEROVÁ StanOVÁ et al. 2008)

**Remark on this chapter by Janssen (The Netherlands), pers.comm.:**

This section has a lot of overlap with 1.1. It would be good to focus in this section on aspects of good 'structure & function'. For instance the second paragraph is good, but the 3rd is more or less similar with section 1.

### 1.3. Ecological requirements

Mire development is determined by water: the amount of water available and its chemical composition affects the morphology and surface pattern of a mire as well as its floristic composition, the productivity of its vegetation, the distribution of microtopes and the accumulation of peat (Damman 1995). Two fundamental processes are prerequisites in the formation of mires: a positive water balance and the accumulation of peat (Mitsch & Gosselink 2000). Both groundwater regime and quality play a crucial role in determining whether fens are formed. Fens can be subdivided on the basis of hydrology into topogenous and soligenous. In topogenous fens the ground water level is high due to the local relief – water movement is often slow. They include basin fens and floodplain fens. Soligenous fens are largely the result of flowing surface ground<sup>93</sup> water. They include mires associated with springs, mountain flushes, valley mires, and water tracks and ladder fens in blanket and raised bogs.

Rich fens receive a significant groundwater component that is rich in base cations (principally calcium, but also magnesium and potassium), but poor in nutrients (nitrogen and phosphorus). The base cations enter the water as it travels over or through calcareous bedrocks such as limestone. These fens are therefore restricted to areas with significant calcareous geological deposits. The pH is

<sup>92</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Character species *Trichophorum caespitosum* is a species of wet heathlands and bogs. The authors probably mean the related species *Trichophorum alpinum*".

<sup>93</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.

also high, ranging from 6 to 8.5 across most of the continent, but in northern Europe occasionally as low as 5.5 (Airaksinen & Karttunen 1999).

Groundwater levels in undisturbed basiphilous fens are usually high and oscillate close to the mire surface, sometimes seeping out and filling small depressions and ponds (Wolejko *et al.* 2005). (ŠeffEROVÁ StanOVÁ *et al.* 2008)

Remark on this point by van Diggelen and Aggenbach (**The Netherlands**), pers.comm.:

1. Although the report clearly recognizes hydrology as THE master factor in this type of systems a hydrological analysis of the functioning is totally lacking. Essentially there are two types: groundwater-fed systems on a possibly non-calcareous substrate where the chalk comes from the water (or if you like "Soligeneous fens") and surface water-fed systems ("Topogeneous fens") on a calcareous substrate where the water just causes wetness and the chalk comes from the substrate. Both types are very sensitive to local hydrological changes (drainage IN the system) but the previous one is also very sensitive to hydrological changes outside the system. Threats and management options are therefore completely different for both types!!! Soligeneous fens are fed by groundwater.
2. This neglectance of how the system functions leads to unclear prioritization of threats and management actions to counteract these. E.g., effects of lack of management and of eutrophication occur only or are at least highly magnified under a changed hydrology (drainage, etc.). A review on status and threats of fens in the temperate zone (Van Diggelen, R., Middleton, B.A., Bakker, J.P., Grootjans, A.P. & Wassen, M.J., 2006. Fens and floodplains of the temperate zone: present status, threats, conservation and restoration. Applied Vegetation Science 9: 157-162 and references therein) lists two groups of threats: 1. Direct conversion such as woodland plantations, fish pond creation, other agricultural uses, 2. Hydrological changes both within the system and in the surroundings. These authors consider other threats as derived from the above ones.

## 1.4. Main subtypes

The French Natura 2000 handbook (Gaudillat & Haury 2002) mentions also *Hydrocotilo vulgaris-Schoenion nigricantis*, which occurs in France in regions with Atlantic trends. Species composition is typical for occidental regions, with strong Atlantic influence. In northern Europe, a variety of subtypes have been identified, with reference to the proportions between *Carex* spp. and various herb varieties, and the amount of shadow created by birch, pine and spruce trees (Pahlsson 1998, Airaksinen & Karttunen 1999). (ŠeffEROVÁ StanOVÁ *et al.* 2008)

Remark on this point by van Diggelen and Aggenbach (**The Netherlands**), pers.comm.:

Subtypes unclear. This is however, highly relevant (see remark above).

Remark on this point by Janssen (**The Netherlands**), pers.comm.:

The EU-manual doesn't clearly distinct subtypes. Therefore I doubt whether the information given in 1.4 is relevant. The example from France shows mainly that the definition may vary between different countries, which has influence on for instance area of the habitat type, but probably less than for many other habitat types.

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Alkaline fens and provided their conservation status in the Atlantic Member States (see tables below).

**Table 87 Species associated with Alkaline fens (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
Euphydryas aurinia 1065										
Hamatocaulis vernicosus 1393										
Liparis loeselii 1903										
Saxifraga hirculus 1528										
Vertigo angustior 1014										
Vertigo moulinsiana 1016										
Gallinago gallinago A153										
Anthus pratensis A257										

**Table 3 Species associated to Alkaline fens and their Conservation Status (CS) at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Species name	Group		BE	DE	FR	IE	NL	UK	REGION
1014	<i>Vertigo angustior</i>	Molluscs	range	U1	U2	U2	FV	XX	FV	U2
			population	U2	U2	U2	U1	XX	FV	U2
			habitat	U1	XX	U2	U1	U1	FV	U1
			future	U1	U2	XX	U1	U1	U1	U1
			overall	U2	U2	U2	U1	U1	U1	U2

N2K code	Species name	Group		BE	DE	FR	IE	NL	UK	REGION
1016	<i>Vertigo moulinsiana</i>	Molluscs	range	U1	U2	U2	U2	U1	FV	U2
			population	U1	U2	U2	U2	XX	XX	U2
			habitat	U1	U1	U2	U1	U1	XX	XX
			future	U1	U2	XX	U2	U1	FV	U2
			overall	U1	U2	U2	U2	U1	XX	U2

N2K code	Species name	Group		DK	ES	FR	IE	PT	UK	REGION
1065	<i>Euphydryas aurinia</i>	Invertebrates	range	U2	XX	U2	FV	FV	U1	U2
			population	U2	XX	U2	U1	XX	U2	U2
			habitat	U1	XX	U2	U1	U1	U2	U2
			future	U2	XX	U2	U1	U1	U1	U2
			overall	U2	XX	U2	U1	U1	U2	U2

N2K code	Species name	Group		BE	DK	IE	NL	UK	REGION
1393	<i>Drepanocladus vernicosus</i>	Non-vascular plants	range	U2	U1	FV	U2	FV	FV
			population	U2	XX	FV	U2	FV	FV
			habitat	U2	U2	FV	U1	FV	FV



			future	U2	U2	FV	U1	FV	FV
			overall	U2	U2	FV	U2	FV	FV

N2K code	Species name	Group		DK	IE	UK	REGION
1528	<i>Saxifraga hirculus</i>	Vascular plants	range	XX	FV	U1	U1
			population	XX	FV	U2	U2
			habitat	XX	FV	U1	U1
			future	XX	FV	FV	FV
			overall	XX	FV	U2	U2

N2K code	Species name	Group		BE	DE	FR	NL	UK	REGION
1903	<i>Liparis loeselii</i>	Vascular plants	range	U2	U2	U2	U2	U2	U2
			population	U2	U2	U2	U1	U2	U2
			habitat	U2	U2	U2	U1	U2	U2
			future	U2	U1	U1	U1	U2	U1
			overall	U2	U2	U2	U2	U2	U2

## 1.6. Related habitats

A fen is often a mosaic of different habitats ranging from open-water, through small sedge vegetation, wet and mesotrophic grasslands, reed-beds and tall sedges, to semi-terrestrial birch and alder woodland. The complex of habitats that can occur within a fen contributes to the rich diversity of plants and animals. The following communities may form part of the fen system:

- \*Calcareous fens with *Cladium mariscus* and *Caricion davallianae* (7210).
- *Molinia* meadows on calcareous, peaty or clayey silt-laden soils (*Molinion caeruleae*) (6410)
- ~~Large herbs dominated *Calthion* meadows, while grasses and sedges are of secondary importance in many of its communities.~~<sup>94</sup>
- Fennoscandian mineral-rich springs and spring fens (7160).
- In the extreme north of Europe, smaller areas of alkaline fen may be embedded in larger areas of aapa mire (\*7310), or in blanket bogs (\*7130) in the British Isles.
- ~~Tall sedges (*Magnocaricion*) and reed beds (*Phragmition*) may form a part of the fen system.~~<sup>95</sup>
- \*Alpine pioneer formations of *Caricion bicoloris-atrofuscae* (7240)
- \* Transition mires and quaking bogs (7140)<sup>96</sup>

Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.:

Fens do by definition not contain grasslands, these are fen meadows and an indication of slight drainage and/or eutrophication

<sup>94</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Remove. This community is typical of drainage."

<sup>95</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Remove. This communities are typical of eutrophication and/pr slight drainage."

<sup>96</sup> Added by Janssen, pers.comm. (The Netherlands)

## 1.7. Ecological services and benefits

Fens act in a number of different ways to regulate the environment. These functions include water purification, flood prevention, and carbon storage, which have become increasingly important since the recognition of global warming. Peatlands are one of the major global carbon stores and play a key role in controlling the levels of carbon dioxide in the atmosphere and thereby mitigating climate change.

Like bogs, the peat in fens contains a very informative record of the past. Much of this is organic material that has not been preserved elsewhere. This information can be used as a reliable record of past environmental conditions, and may also contain valuable information about our ancestors' way of life (ŠefferoVá Stanová et al. 2008).

## 1.8. Conservation status

**Table 4 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	UK	REGION
7230	Alkaline fens	range	U2	U2	FV	XX	FV	FV	U2	FV	FV
		area	U1	U2	U2	XX	U2	FV	U2	XX	U2
		structure	U1	U2	U2	XX	U2	U2	U2	U2	U2
		future	U1	U2	U2	XX	U2	U2	U1	U2	U2
		overall	U2	U2	U2	XX	U2	U2	U2	U2	U2

This habitat includes a wide variety of fens with alkaline groundwater, they occur where the groundwater is suitable throughout Europe but rare in the south. The vegetation is usually dominated by small sedges (*Carex* species), is often species rich and sometimes with Annex II and IV species such as the fen orchid (*Liparis loeselii*).<sup>97</sup>

Assessed as 'unfavourable-inadequate' for the Alpine and Boreal regions. However in the Alpine region there is much variation between countries and the habitat is 'favourable' in the Fennoscandian subregion. Assessed as 'unfavourable-bad' for the Atlantic, Continental, Mediterranean and Pannonic regions. Within these regions only Greece (Mediterranean) and Italy (Continental and Mediterranean) assessed this habitat as 'favourable'. A variety of threats and pressures have been reported but many countries mention changes to the water regime, changes in

<sup>97</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Remove. Redundant with intro."

agricultural practices and pollution/eutrophication. Better information required particularly from Spain (Summary sheet of the online report on Article 17 of the Habitats Directive). (ETC BD 2012)<sup>98</sup>.

## 1.9. Trends

Alkaline fens are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most.

The plant communities characteristic of the habitat can be either undisturbed or influenced by human activities. These ecosystems are very sensitive to changes in hydrology and hydrochemistry in the wider area. For example, in the United Kingdom, it is estimated that 95-98 % of species-rich fens existing in 1940 have been lost. Similar losses have been reported in France and the Netherlands (Middleton *et al.* 2006).

The following root causes of biodiversity loss were identified.

Drainage for intensive agriculture and forestry. Peatlands have been subject to artificial drainage for centuries. This drainage has been in response to demands for agricultural land, forestry, peat for horticulture and energy, and flood prevention (Holdena *et al.* 2004). Past drainage of surrounding areas has lowered water tables and led to the drying out of even the remaining fen habitats. Large-scale or local drainage schemes were particularly successful in the lowlands, where the majority of fens have been drained and transformed into arable land with limited potential for restoration. Due to the fact that the drainage infrastructure is in some cases relatively recent, the majority of drainage schemes are still in operation. Afforestation has also contributed to the drying out of fens.

Human induced change in hydrological conditions in the recharge area (water level drop, change in the direction and volume of groundwater flow). Drainage activities change the routes water takes within the hydrological system and result in the mixing of different water sources. This usually means that the influence of groundwater decreases while that of rainwater increases. This in turn affects the fen's vegetation composition. Another problem is the knock-on effect on protected sites of damage to hydrological systems in neighbouring areas, caused by a lack of hydrological understanding in land use planning. The effects on the vegetation of soligenous mires can be severe: the encroachment of woody species; reduction in the rate of peat formation, and, in extreme most<sup>99</sup> cases, peat mineralisation and the invasion of nitrophilous species (Wolejko *et al.* 2005).

Abandonment of traditional management practices. Traditional fen management practices consisted, in most countries, of mowing and light grazing. Hand mowing was used successfully to manage fens for generations. From the 1950s onwards, machines replaced hand mowing and habitats which are of marginal importance for agriculture were abandoned.

In some Central European countries, the lack of management was caused by nature conservation policy, which was influenced by a paradigm that promoted the exclusion of human activities from strictly protected areas. This happened from the 1960's to the 1990's. This policy ignored the

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<sup>98</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Checked in the expert group IMCG : knowledge on status is at present TOTALLY INADEQUATE. This should be much more emphasized."

<sup>99</sup> Adjustment on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.

importance of farmers and their traditional low-intensity practices in maintaining habitats. The subsequent lack of management caused a rapid succession of grass or tussock-forming sedge communities, followed by scrub and tree encroachment, resulting in the loss of biodiversity.

**Nutrient enrichment.** The main source of pollution tends to be fertilisers and herbicides applied by farmers, leading to the eutrophication of fen waters and changes in plant communities. Fens are very sensitive to eutrophication and many sites are affected by it.<sup>100</sup>

**Water abstraction.** Excessive water abstraction from aquifers dries up or reduces spring flows, lowers water tables and affects water quality. Abstraction also affects the natural balance between ground water and surface water, with their different hydrochemistries (ŠeffEROVÁ StanOVÁ et al. 2008).

## 1.10 Main pressures and threats<sup>101</sup>

(ŠeffEROVÁ StanOVÁ et al. 2008)

**Drying out:** The lowering of the water table leads to the ground drying out slowly, and to drastic changes in its physical and chemical properties (Dupieux 1998).

Chemical processes:

- **Desiccation** can also stimulate decomposition and mineralization<sup>102</sup>
- **Eutrophication** of surface-water and/or groundwater by nutrients filtering in from agricultural soils and waste water (= external mobilization of nutrients)
- **Alkalinisation** increases the decomposition of organic material (mineralisation), which leads to an increase in the available nutrients. (=internal mobilization of nutrients). In Dutch fens this phenomenon — a result of the influx of alkali surface water into fens during the summer months — has been recorded.<sup>103</sup>

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<sup>100</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: “Untrue! Mainly from internal sources, especially related to hydrological changes! Second source is atmospheric deposition, however much less important in this system.”

<sup>101</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: “This section contains quite some double information and may be structured better, providing first general information on pressures and threats, and later examples from countries.”

<sup>102</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: “This is by far the most important process.” (We’ve changed the order)

<sup>103</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: “‘Alkalinisation’ does not refer to habitat 7230, but rather to 7140: no influx of alkaline surface water into fens of type 7230 takes place, but into fens of type 7140. So, leave out that paragraph.”

**Vegetation changes:** decrease/disappearance of species with weak competitive capability and low ecological amplitude, invasion by, or increase of, ubiquitous and nitrophilous species, an increase of meadow species in drained fens<sup>104</sup>

**Table 5 Main pressures to Alkaline fens and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Alkaline fens	<i>Vertigo angustior</i>	<i>Vertigo moulinsiana</i>	<i>Euphydryas aurinia</i>
Cultivation	x	x	x	x
Fertilisation	x	x	x	x
Grazing	x	x	x	x
Pollution	x	x	x	
Landfill, land reclamation and drying out, general	x		x	
Drainage	x	x	x	x
Other human induced changes in hydraulic conditions	x			
Biocenotic evolution	x	x	x	
Other natural processes	x			

Pressure description (2nd level)	<i>Drepanocladus vernicosus</i>	<i>Saxifraga hirculus</i>	<i>Liparis loeselii</i> <sup>105</sup>
Cultivation			x
Fertilisation	x		x
Grazing	x	x	
Pollution	x		
Landfill, land reclamation and drying out, general			x
Drainage	x	x	x
Other human induced changes in hydraulic conditions			
Biocenotic evolution	x		x
Other natural processes			

**Table 6 Main threats to Alkaline fens and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)<sup>106</sup>**

Threat description (2nd level)	Alkaline fens	<i>Vertigo angustior</i>	<i>Vertigo moulinsiana</i>	<i>Euphydryas aurinia</i>
Cultivation	x	x	x	x
Fertilisation	x	x	x	
Grazing	x	x	x	x
Landfill, land reclamation and drying out, general	x		x	
Drainage	x	x	x	
Other human induced changes in hydraulic conditions	x			

<sup>104</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: “The text under vegetation changes may be left out. This is no pressure or threat, but a result of changes in the type because of pressures and threat.”

<sup>105</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: “The situation for *Liparis* is worse than indicated here. It is also affected severely by the other threats mentioned.”

<sup>106</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: “Difference with table 5 unclear”

Biocenotic evolution	x	x	x	
Other natural processes	x			

Threat description (2nd level)	<i>Drepanocladus vernicosus</i>	<i>Saxifraga hirculus</i>	<i>Liparis loeselii</i>
Cultivation			x
Fertilisation	x		
Grazing	x	x	
Landfill, land reclamation and drying out, general			x
Drainage	x		x
Other human induced changes in hydraulic conditions			
Biocenotic evolution	x		x
Other natural processes			

Main pressures to Walloons alkaline fens are (DGARNE n.d.):

- drainage
  - Causes mineralization which gives growth of tall herbs and trees
- plantations
- the excavation of ponds
- embankments
- changes in the quality of the water supply (quantity and quality).
- Eutrophication due to pollution

In **Ireland**, like most peatland types in Ireland, fens have experienced a decline in quality, mostly as a result of activities such as peat mining, draining for cropland, infilling, and fertiliser pollution and eutrophication. Only limited measures have been introduced to address these damaging activities, which are likely to have increased in severity since the 1990's (NPWS 2008).

The most serious threats to this habitat type in **Denmark** are overgrowth, eutrophication, and changed hydrological conditions due to drainage and water catchment (Søgaard et al. 2007). Most occurrences are likely to be small areas, which is why the impact from neighbouring areas will generally be of great importance.

### The Netherlands

van Diggelen and Aggenbach, pers. comm.:

Neglectance of how the system functions in the previous chapters leads to unclear prioritization of threats and management actions to counteract these. E.g., effects of lack of management and of eutrophication occur only or are at least highly magnified under a changed hydrology (drainage, etc.). A review on status and threats of fens in the temperate zone (Van Diggelen, R., Middleton, B.A., Bakker, J.P., Grootjans, A.P. & Wassen, M.J., 2006. Fens and floodplains of the temperate zone: present status, threats, conservation and restoration. Applied Vegetation Science 9: 157-162 and references therein) list two groups of threats: 1. Direct conversion such as woodland plantations, fish pond creation, other agricultural uses, 2. Hydrological changes both within the system and in the surroundings. These authors consider other threats as derived from the above ones.

1. Direct conversion (poplar plantations, fish ponds, agricultural fields)
2. Hydrological changes in the fen itself
3. Hydrological changes in the surroundings

Janssen, pers.comm.:

1. Drainage
2. Eutrophication (intensification of land use)
3. Abandonment of management (extensification)

## Germany

Ackermann, pers.comm.:

1. Nutzungsaufgabe, Sukzession
2. Entwässerung, Grundwasserabsenkung
3. Düngung, Nährstoffeinträge
4. Zu intensive oder nicht angepasste Nutzung

## 2 Conservation management

### 2.1. Main conservation requirements<sup>107</sup>

The main conservation requirements alkaline fens in Wallonia (**Belgium**) are (D GARNE n.d.):

- Stop water loss and drainage
- Restore characteristic species by:
  - Mowing (preferred method)
  - Grazing

According to **Danish** guidance (Søgaard et al. 2007), one of the most important conditions for habitat type 7230 is soil that is constantly water-saturated. Particular threats to this type thus include dehydration caused by drainage, water catchment (or other regulations) and increased evaporation from hydrologically connected neighbouring areas, where trees and bushes dominate on adjacent areas.

## Germany

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<sup>107</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: “Also here: provide first general information on conservation requirements, and later specific examples from countries.”

Ackermann, pers.comm.:

1. Fortführung einer sehr extensiven landwirtschaftlichen Nutzung/Pflege
2. Vermeidung von Grundwasserabsenkungen (Entwässerung, Drainagen etc.) bzw. Wiederherstellung des lebensraumtypischen Wasserhaushalts
3. Unterlassung jeglicher Düngung und Vermeidung von Nährstoffeinträgen aus dem Umfeld

## The Netherlands

Janssen, pers.comm.:

1. Water regime which results in buffering of top soil (by flooding or influent of ground water)
2. No influx from nutrients from surroundings or the air
3. Hay making in late summer, considering fauna (eventually combined with grazing)

## 2.2. Management measures

(ŠeffEROVÁ StanOVÁ et al. 2008).

**Restoring of qualitative and quantitative hydrological conditions:** <sup>108</sup>

### Mowing:

Mowing is an important management tool, and it has proven successful in maintaining species richness, particularly in fens that have been mowed annually for centuries. At present, mowing is carried out with light, usually small, machinery adapted to the sensitive fen environment, such as pedestrian-driven mowers. Cut biomass is then gathered and removed from the site. This method, particularly the collecting and disposing of material, is very labour intensive. The use of fertilizers and grazing is not recommended for calcareous fens. The optimal time for mowing is late summer, when the sites are not as wet as in spring or early summer.

A prototype harvester, specially designed for wetland conditions was developed in the United Kingdom as part of the LIFE-funded New Wetland Harvest project (LIFE97ENV/UK/000511). This project, which started in 1997, involved the development of a low ground pressure machine that

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<sup>108</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "This is by far the most essential restoration measure and should be placed on top."



was able to cut, collect and remove material from the fens<sup>109</sup>. (<http://www.broads-authority.gov.uk/managing/land/fen/management/fenharvester.html>)<sup>110</sup>.

### Grazing:

Moderate grazing on fens can be recommended as an alternative conservation strategy to mowing or abandonment, but a reduction in species variety and changes in species composition and species traits may occur. Optimal grazing conditions have to be developed to minimize the unwanted effects of foraging and trampling.<sup>111</sup>

In France, extensive grazing is often considered to be the most natural management method, which permits the softest and the most beneficial ecological impact, since herbivores are a part of the managed ecosystem, in some respects re-creating past conditions, when these ecosystems were managed by large wild herbivores<sup>112</sup>.

In Scotland, fens should be accessible to stock during the driest months of the summer. They should be grazed for at least two weeks each year.

If grazing is used as a management technique, it should aim to create a diverse structure of short vegetation and taller tussock areas where grasses and herbs can flower and set seed - the flowers will provide nectar and pollen for insects. In this respect, cattle are preferable to sheep.<sup>113</sup>

### Removal of the top soil layer:<sup>114</sup>

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<sup>109</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Several MS use a modified "Piston Bully" for this purpose. Probably adverse effects of these kinds of machines on microtopography and biodiversity are unknown."

<sup>110</sup> Adjustment on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Website no longer existing".

<sup>111</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "I see no evidence for this! On the contrary, in a scientific review on this topic (Middleton et al 2006) it was concluded "Therefore, we only advocate using grazing as a management tool in the case of abandoned nutrient-rich fens (not nutrient-poor fens)."

<sup>112</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "This is not the situation in the case of alkaline fens. The -chemically limited- productivity is so low that there is no grazing there."

<sup>113</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Cattle are far too heavy to graze such wet ecosystems: they completely destroy the organic soil."

<sup>114</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: "I doubt whether this is a good management practice for this habitat type, which is so vulnerable to trampling. This action may destroy small topographical differences, peat layer, populations of invertebrates, and a seed bank. Maybe it may help for restoring the habitat type in areas where it has been disappeared. But not for still functioning localities of habitat type 7230."

An alternative to raising the water table is the removal of the top layer of soil.<sup>115</sup> This technique is appropriate in small, isolated areas that have been influenced by excess transport of nutrients and changes in the water regime (Brulisauer & Klotzli 1998)<sup>116</sup>.

### Scrub and woodland removal:

Restoring fens that have been invaded by scrub and woodland is something of a technical challenge. Fens are wet and often treacherous places where large machinery can quickly become stuck and cause significant damage to this fragile environment.

### Restoration management:

Management at the start of the season is, in this case, highly effective (Huhta *et al.* 2001). It should reduce the grasses' ability to compete. Mowing of *Phragmites communis* (common reed) or *Molinia* spp. is most effective at the start of flowering.<sup>117</sup> However, all types of this kind of management have little effect as long as the cause of eutrophication etc. has not been removed and early mowing and grazing restricts plants to reproduce by seeds.<sup>118</sup>

### The Netherlands

van Diggelen and Aggenbach, pers. comm.:

1. If hydrology is OK: hardly any requirements
2. In the case of insufficient hydrology: removal of nutrients (by mowing)

Janssen, pers.comm.:

1. Water management focussed on high tables in winter, lower table in summer
2. Sod cutting
3. Hay making, sometimes (combined with) grazing

### Germany

Ackermann, pers.comm.:

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<sup>115</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "This is not an alternative for hydrological restoration but a possibility (necessity?) when a highly degraded top layer frustrates the effects of hydrological restoration measures."

<sup>116</sup> Remark on this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.: "Example e.g. Drentse Aa (NL): Staatsbosbeheer."

<sup>117</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: "This text doubles with previous paragraphs, and is about mowing, not about restoration. So, leave it out."

<sup>118</sup> Adjustment to this point by van Diggelen and Aggenbach (The Netherlands), pers.comm.

1. Einmalige Mahd zwischen Mitte Juli und Februar in Abständen von 1 bis 3 Jahren unter Abtransport des Mähguts, wechselnde Teilflächen sollten ungemäht belassen bleiben; bei fortgeschrittener Sukzession sind u. U. frühere und häufigere Schnitte erforderlich; innerhalb größerer Weideparzellen kann alternativ einmal jährlich extensiv mit Rindern zwischen Mitte Juli und Mitte September für maximal drei Wochen lang beweidet werden; bei Sümpfen mit Kalktuffbildung ist darauf zu achten, dass diese empfindlichen Strukturen nicht durch Tritt oder Befahren zerstört werden.
4. Entfernung von Drainagen bzw. Verschluss von Entwässerungsgräben; es darf jedoch kein nährstoffreiches Oberflächenwasser zugeleitet werden.
5. Schaffung von Pufferstreifen (Mindestbreite 30 - 150 m) zu angrenzenden intensiv landwirtschaftlich genutzten Flächen, Verkehrswegen und Siedlungen; im Pufferstreifen muss Düngung, Kalkung, Pestizideinsatz und Entwässerung unterbleiben
6. Bei längerfristig brachliegenden Flächen kann die Wiederherstellung der typischen Vegetation dieses Lebensraumtyps durch eine mehrschnittige Nutzung über ein bis zwei Jahre eingeleitet werden (ggf. nach vorheriger Rodung von Gehölzaufwuchs).

### 2.3. Other measures (e.g. monitoring)

(ŠeffEROVá StanOVá et al. 2008).

#### **Turf pond creation:**

Shallow peat diggings, or turf ponds, were dug in the Broads during Victorian times. Some were dug to provide fuel, while others may have been cut as a way of clearing the fen to improve the quality of the reed and sedge harvest.<sup>119</sup>

#### **The Netherlands**

van Diggelen and Aggenbach, pers. comm.:

The same technique was used also in other member states. Especially large surfaces of this type occur in the Netherlands. Re-opening of now filled up turf ponds has been carried out in this country in an attempt to increase the surface of habitat type 7140, sod cutting was most effective for habitat type 7230. Despite several attempts this approach has not resulted in much gain, most likely because the abiotic (especially hydrological) conditions in the surrounding landscape are highly unfavourable.

Janssen, pers.comm.:

Maybe it could be added under 2.3 that it may be appropriate to pay attention to invertebrate communities in this type of fens. They may contain some rather rare species.

<sup>119</sup> Remark on this point by Janssen (The Netherlands), pers.comm.: "Turf pond creation: This should be under 2.2, but I would say it is not a restoration measure but a way to destroy the habitat type! So, leave it out."

## Reducing the impact of external land use

### 2.4. Species specific measures

(ŠeffEROVÁ StanOVÁ et al. 2008)

butterfly *Coenonympha oedippus* :

suppressing the succession of trees and shrubs, and on protecting, and where necessary restoring, the fen's water regime to prevent it drying out. Invasion of reeds and other competitive plants should be prevented.

Populations of rare dragonflies such as the *Leucorrhinia pectoralis*

The preservation of the fen's natural water regime, and, where necessary, its restoration with the aim of stabilising the water level. Any active management, such as mowing, reed cutting or shrub removal, should be done regularly but spread over several years. Overgrown water pools, where the species used to be found, should be deepened, creating at least 5-10 m<sup>2</sup> of open water, which should also be exposed to the sun. The removal of adjacent scrubs should also be considered

Whorl snails require an undisturbed water regime, with the groundwater table located near the surface, and short vegetation with non-intensive grazing or mowing (Šteffek & Vavrova 2005).

*Dolomedes plantarius* (fen raft spider): Preventing the fen surface from drying out ensures a continuity of the habitat. Besides this, the source and the quality of water would need to be monitored.

*Acrocephalus paludicola* (aquatic warbler): Favourable management techniques include non-intensive grazing (less than 1 fully grown cattle/ha), combined with mowing, which also helps to suppress reed and shrub growth. Grazing by horses, goats or sheep is also employed.

*Liparis loeslii* (fen orchid), management involves a balance between the definite need for mowing or grazing, and the fact that the species might also suffer from too intensive management or trampling by cattle (Sundberg 2006).

### 2.5. Main constraints / bottlenecks and actual needs

[text to be completed as a result of the consultation process]

#### **The Netherlands**

van Diggelen and Aggenbach, pers. comm.:

1. In case of managing landscape hydrology: Conflict of interest with other stakeholders
2. At the site level: lack of funding

Janssen, pers.comm.:

1. Finances
2. Land ownership
3. Isolation, related to low dispersal capacity of several typical plant species
4. External impact of changed water management on large areas outside Natura 2000-site

### Germany

Ackermann, pers.comm.:

Trotz Flächenankauf und extensiver Nutzung oder Pflegemaßnahmen werden LRT-Flächen oft durch angrenzende Nutzung nachhaltig beeinträchtigt.

## 2.6. Solutions and recommendations

[text to be completed as a result of the consultation process]

### 2.6.1 Solutions

#### The Netherlands

van Diggelen and Aggenbach, pers. comm.:

1. At the landscape level: changing policy
2. At the site level: fund raising

Janssen, pers.comm.:

1. Restoration (close to existing sites with the habitat type)
2. Fund raising (relation to agro-environmental schemes)
3. Awareness raising

#### Germany

Ackermann, pers.comm.:

Auch auf angrenzenden Flächen sollen bei Bedarf vertragliche Regelungen vereinbart werden, z. B. wenn diese eine Bewirtschaftungseinheit mit den Niedermoorbereichen bilden oder um schädliche Einwirkungen zu verhindern.

### 2.6.2 Recommendations

## Cases / projects

## Sites

## 91E0 - Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)

### Summary

**Alluvial forests include** riparian ash (*Fraxinus excelsior*) and alder (*Alnus glutinosa*) forests and willow (*Salix alba*, *S. fragilis*) and black poplar (*Populus nigra*) galleries along lowland and hilly watercourses, together with grey alder (*Alnus incana*) riparian forests of sub-montane to sub-alpine rivers. All types occur on alluvial deposits (generally rich in clay), mostly inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated during periods of low-water. The herb layer is composed of tall herb species preferring humid and nutrients rich soils. Most of these forests are in contact with humid meadows or ravine forests (*Tilio-Acerion*). A succession towards *Carpinion* (*Primulo-Carpinetum*) can be observed.

**Alluvial forests need** a high base saturation (especially calcium), a pH (KCl) of more than 5.5, a high moisture demand, and high to medium demand for nutrients. Inundations, a high clay content, or lithotrophic groundwater influence can help to meet these demands. Seed banks are also influenced by actual fluvial processes or a fluvial past. In addition some Alderwoods of the brook valleys may tolerate somewhat lower pH and peaty soils. Spring fed alluvial forests are favoured by base rich groundwater with a low content of phosphorus and tolerate small fluctuations between highest and lowest groundwater level.

This habitat type is relatively widespread, but occurs as fragmentary stands where the hydrologic regime is favourable.

The **conservation status of this habitat type** is mostly 'unfavourable bad' in the Atlantic region due to management of water levels and regulation of water courses.

**The main reported threats and pressures** to alluvial forests in the Atlantic Region are:

- Inappropriate grazing regimes and poaching of the soil by livestock
- General forestry management (cessation of traditional management, clear cut heavy equipment).
- Poor water quality arising from eutrophication (mainly by fertilizers from the agricultural surroundings), industrial effluents or rubbish dumping.
- Atmospheric pollution from ammonia and oxides of nitrogen.
- Water management: (i) lowering of water tables through drainage or water abstraction; (ii) flood prevention measures, river control and canalization.
- Modification of hydrological functioning.
- Biocenotic evolution – the encroachment of trees and scrub.
- Invasive non-native species (*Acer pseudoplatanus*, *Fagus sylvatica*, *Rhododendron ponticum*, *Prunus laurocerasus*, *Cornus sericea*, *Impatiens glandulifera* and *Heracleum mantegazzianum*, Himalayan balsam, *Fallopia japonica*)
- Fragmentation: small wooded areas are more vulnerable to external impacts, genetic isolation, climate change, the border effects are relatively great, etc.
- Clearance and conversion for other land uses

The principal **management measures** for this habitat include:

- Re-afforestation (of the appropriate species) in order to improve connectivity and extend the area of existing sites.
- Active control and the prevention of colonisation by non-native, invasive species.
- Development / restoration of a species-rich herb layer, a rich forest structure with a characteristic tree composition and sufficient quantities of dead wood.
- Transformation of popular plantations through the (re)planting of appropriate species.
- Rewetting by blocking drains.
- Improving the water quality and the local groundwater influences.

The most frequently encountered **bottlenecks** in the conservation or restoration of favourable conservation status for this habitat are:

- Insufficient funds and personnel.
- Lack of understanding and knowledge by landowners/stakeholders.
- Weak policies/lack of regulatory and/or financial incentive to landowners to make necessary beneficial land use.
- Conflicts with other interests (eg. the 'roughness' [their perceived propensity to impede the flow of floodwater off the inundated surface] of the alluvial forests is seen as a risk in times of excessive flooding leading to the removal of forests and bushes to lower the roughness of the inundated surface).
- Conflicting interests with agriculture, forestry.
- No solution presently available for the Elm and Ash disease.

**Solutions** to the pressures, threats and bottlenecks are to be sought in the development of:

- Awareness raising.
- Education, training and communication
- Balanced policy on conflicting items; (e.g. strategic planning of management measures at a site level, changing policy at the landscape level).
- Creation of buffer zones with low levels of fertilization around this habitat type.
- Reducing or eliminating nutrient inputs from local terrestrial and aquatic sources.
- Harmonising approaches to Habitats Directive and Water Framework Directive implementation.
- Specific measures in agri-environment schemes and sufficient funding to encourage uptake and meet demand.

## 1 Description of the habitat

Riparian forests of *Fraxinus excelsior* and *Alnus glutinosa*, of temperate and Boreal Europe lowland and hill watercourses (44.3: *Alno-Padion*); riparian woods of *Alnus incanae* of montane and sub-montane rivers of the Alps and the northern Apennines (44.2: *Alnion incanae*); arborescent galleries of tall *Salix alba*, *S. fragilis* and *Populus nigra*, along medio-European lowland, hill or sub-montane rivers (44.13: *Salicion albae*). All types occur on alluvial deposits (generally rich in clay), mostly<sup>120</sup> inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated

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<sup>120</sup> ALTERRA Wageningen UR, de Waal, pers. comm



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*, *A. ranunculoides*, *Corydalis solida* (EC 2007b).

Most of these forests are in contact with humid meadows or ravine forests (*Tilio-Acerion*). A succession towards Carpinion (*Primulo-Carpinetum*) can be observed. (ETC BD 2012).

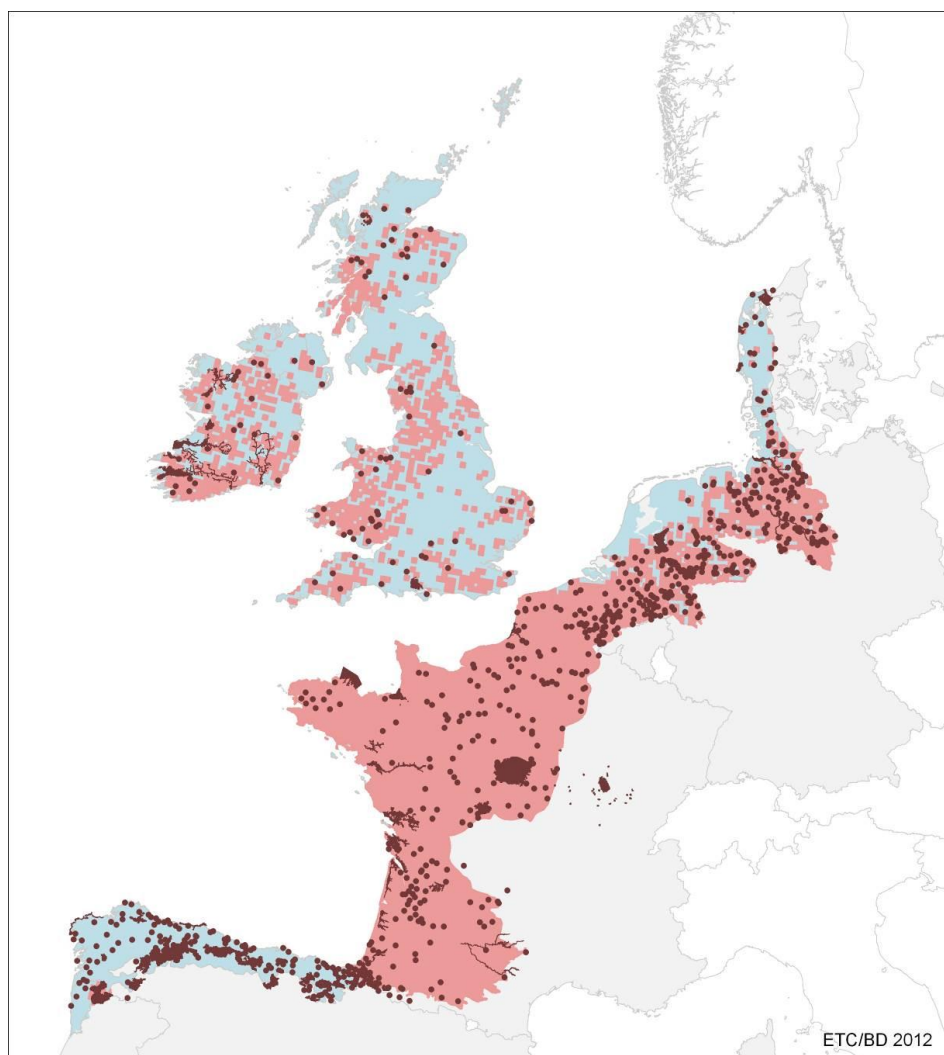
### 1.1. Distribution

**Table 88 Number of Sites of Community Interest (SCIs) and habitat area (ha) within SCIs per Member State in the different biogeographical regions of the Atlantic Member States (ETC BD 2012)**

	BE		DE			DK		ES				FR				IE	NL		PT			UK
	ATL	CON	ALP	ATL	CON	ATL	CON	ALP	ATL	MAC	MED	ALP	ATL	CON	MED	ATL	ATL	ATL	MAC	MED	ATL	
number of sites	79	155	21	213	1715	18	108	22	154		150	39	224	232	48	29	35	6		25	74	
habitat area (ha)	6804	5455	867	5002	42168	1003	7304	944	16477		37472	17216	62424	23591	7385	3490	3321	3230		14666	3340	

According to the ETC/BD estimation the percentage of the habitat area in the network falls into the class 51-76%<sup>121</sup>. This means that Natura 2000 network provides an important framework for the management of this habitat type (ETC BD 2012).

<sup>121</sup> See the problems with data quality on page 16 of the Pre-scoping document dated 27.3.2012 (ETC BD 2012)



**Figure 21 Map of SCIs proposed for Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) & Article 17 distribution (ETC BD 2012) (for legend, see introduction of chapter 3)**

## 1.2. Main features

Many H91E0 forests are dynamic, being part of a successional series of habitats. Their structure and function are best maintained within a larger unit that includes the open communities, mainly fen and swamp, of earlier successional stages. In other situations the alder woods occur as a stable component within transitions to surrounding dry-ground forest, sometimes including other Annex I woodland types (JNCC n.d.)

## 1.3. Ecological requirements

The forests of the this habitat need an high base saturation (especially calcium), a pH (KCl) of more then 5.5, a high moisture demand, and high to medium demand for nutrients. Inundations, a high clay content, or lithotrophic groundwater influence can help to meet this demands. Seed banks are also influenced by actual fluvial processes or a fluvial past. (ALTERRA Wageningen UR, de Waal, pers. comm)

In addition some Alderwoods of the brook valleys may tolerate somewhat lower pH and a peaty soils. Spring fed alluvial forests are favoured by baserich groundwater with a low content of phosphorus and tolerate small fluctuations between highest and lowest groundwater level. (ALTERRA Wageningen UR, de Waal, pers. comm)

## 1.4. Main subtypes

This habitat includes three main types:

- i. riparian forests of *Fraxinus excelsior* and *Alnus glutinosa* of temperate and Boreal Europe lowland and hill watercourses (*Alno-Padion*);
- ii. riparian woods of *Alnus incanae* of montane and sub-montane rivers of the Alps and the northern Apennines (*Alnion incanae*); and
- iii. arborescent galleries of tall *Salix alba*, *S. fragilis* and *Populus nigra* along medio-European lowland, hill or sub-montane rivers (*Salicion albae*).

In addition, several sub-types are identified: (a) ash-alder woods of springs and their rivers (*Carici remotae-Fraxinetum*); alder-woods of lowland brooks (*Carici elongatae-Alnetum*)<sup>122</sup>; ash-alder woods of fast-flowing rivers (*Stellario-Alnetum glutinosae*); ash-alder woods of slowflowing rivers (*Pruno-Fraxinetum*, *Ulmo-Fraxinetum*); montane grey alder galleries (*Calamagrosti variae-Alnetum incanae* Moor 58); sub-montane grey alder galleries (*Equiseto hyemalis-Alnetum incanae* Moor 58); white willow gallery forests (44.13 - *Salicion albae*). The Spanish types belong to the Cantabric atlantic and southeast Iberia peninsula alliance (*Osmundo-Alnion*) (JNCC n.d.)

In Ireland *Alnus glutinosa* woodlands occur on lake shores and around springs and seepage areas within *Quercus petraea* and *Fraxinus excelsior/Corylus avellana* woods. In the very humid climate in these situations the soils often remain permanently water-logged or dry out only on the surface in the summer. (Cross, pers. comm)

## 1.5. Associated species

The European Topic Centre on Biological Diversity (ETC BD 2012) has identified a number of species associated with Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion*

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<sup>122</sup> ALTERRA Wageningen UR, de Waal, pers. comm (The Netherlands)

incanae, Salicion albae) and provided their conservation status in the Atlantic Member States (see tables below).

**Table 89 Species associated with Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) (for legend, see introduction of chapter 3)**

SPECIES	ETC/BD	BE	DE	DK	ES	FR	IE	NL	PT	UK
<i>Anas crecca</i> A052										
<i>Luscinia svecica</i> A272										
<i>Cuculus canorus</i> A212										
<i>Dendrocopos minor</i> A240										
<i>Luscinia megarhynchos</i> A271										
<i>Phylloscopus collybita</i> A315										
<i>Scolopax rusticola</i> A155										
<i>Sylvia borin</i> A310										
<i>Tringa ochropus</i> A165										
<i>Carex pendula</i>		x						x		x
<i>Ribes rubrum</i>								x		x
<i>Carex elongata</i>								x		x
<i>Petasites hybridus</i>										x
<i>Cardamine amara</i>		x						x		x
<i>Carex remota</i>		x						x		x
<i>Lysimachia nemorum</i>										x
<i>Scirpus sylvaticus</i>								x		x
<i>Veronica montana</i>								x		x
<i>Chrysosplenium oppositifolium</i>		x						x		
<i>Equisetum telmateia</i>		x						x		
<i>Impatiens noli-tangere</i>		x						x		
<i>Chrysosplenium alternifolium</i>		x						x		
<i>Festuca gigantean</i>		x						x		
<i>Aconitum lycoctonum</i>		x								
<i>Stellaria nemorum</i>		x						x		

Wallonia (D GARNE n.d.):

Characteristic species near a streaming well are:

- *Cardamine amara*
- *Chrysosplenium oppositifolium*
- *Equisetum telmateia*
- Various Sedge species: e.g. *Carex pendula*, *Carex remota*, ...

Characteristic species near fast streaming rivers are:

- *Impatiens noli-tangere*
- *Chrysosplenium alternifolium*
- *Festuca gigantean*

- *Aconitum lycoctonum*
- *Stellaria nemorum*

## 1.6. Related habitats

In Ireland related habitats include Phragmites stands, tall herb communities (e.g. *Lythrum salicaria*, *Lysimachia vulgaris*, *Filipendula ulmaria*, etc.) and stony shore-line habitats. (Cross, pers. comm)

## 1.7. Ecological services and benefits

Ecological benefits associated to this habitat in Wallonia (**Belgium**) include:

- Rich biodiversity due to interaction between terrestrial and aquatic habitats
- Remote and abandoned areas have over time developed rich habitats
- Historical value
- Ecological corridor
- Regulatory services: filtration and purification of water, limitation of flooding in other areas due to water capture in the forest.

(DGARNE n.d.)

In **Portugal** (ALFA 2004), this habitat is considered to provide the following ecosystem services:

- Carbon sequestration
- Soil retention
- Prevention of catastrophic phenomena
- Wood production
- Nutrient cycle regulation
- Aesthetic information (landscape)
- Education and science

## 1.8. Conservation status

**Table 90 Conservation status (CS) assessed at the Atlantic region and MS level (ETC BD 2012) (for legend, see introduction of chapter 3)**

N2K code	Habitat name		BE	DE	DK	ES	FR	IE	NL	PT	UK	REGION
91E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> ( <i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i> )	range	FV	FV	FV	XX	FV	FV	FV	FV	FV	FV
		area	FV	U1	FV	XX	U2	U2	U1	FV	U1	U2
		structure	U2	U1	FV	XX	U2	U2	U1	XX	U2	U2
		future	FV	U1	XX	XX	U2	U2	U1	FV	U1	U2
		overall	U2	U1	FV	XX	U2	U2	U1	FV	U2	U2

This varied habitat type includes riparian ash (*Fraxinus excelsior*) and alder (*Alnus glutinosa*) forests and willow (*Salix alba*, *S. fragilis*) and black poplar (*Populus nigra*) galleries along lowland and hill watercourses together with grey alder (*Alnus incana*) riparian forests of sub-montane to sub-alpine rivers. The habitat occurs on heavy and periodically inundated soils. **The habitat includes also forests of Ash in no longer inundated reclaimed floodplains<sup>123</sup>**. The herb layer is composed of tall herb species preferring humid and nutrients rich soils. (Summary sheet of the online report on Article 17 of the Habitats Directive).

This habitat type is relatively widespread, but occurs as fragmentary stands where the hydrologic regime is favourable. It is, especially in lowland areas, seriously threatened due to management of water levels and regulation of water courses. The conservation status is ‘unfavourable bad’ in all regions. Member State assessments for the Atlantic, Continental and Pannonian regions are mostly ‘unfavourable-bad’. In the Alpine and Mediterranean regions only France assessed this habitat as ‘unfavourable-bad’ while in the Boreal only Finland assessed this habitat as ‘unfavourable-bad’. In these regions, at the country level, the status of the habitat was mostly ‘unfavourable-inadequate’ (Summary sheet of the online report on Article 17 of the Habitats Directive).

In Wallonia (**Belgium**), the alluvial forests are quite rare and often limited to flood terraces bordering the river (DGARNE n.d.)

## 1.9. Trends

### 1.10 Main pressures and threats

**Table 91 Main pressures to Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Pressure description (2nd level)	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> ( <i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i> )
Grazing	x
General Forestry management	x
Pollution	x
Drainage	x
Canalisation	x
Modification of hydrographic functioning, general	x
Biocenotic evolution	x

<sup>123</sup> ALTERRA Wageningen UR, de Waal, pers. comm (The Netherlands)

**Table 92 Main threats to Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) and their importance to associated species (ETC BD 2012) (for legend, see introduction of chapter 3)**

Threat description (2nd level)	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> ( <i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i> )
General Forestry management	x
Drainage	x
Modification of hydrographic functioning, general	x
Biocenotic evolution	x

Threats to Walloon (**Belgium**) alluvial forests are (DGARNE n.d.):

- Grazing by livestock
- Creation of wetlands, which excludes recolonization of alluvial forests
- Inefficient forest exploitation results in drainage or soil compaction
- Tourist activities: passageways and trampling
- The rectification, reshaping riverbanks or the deposit of dredged land on a habitat
- Exotic plants species

The main pressures and threats likely to be affecting H91E0 in the **United Kingdom** are listed below (Joint Nature Conservation Committee n.d.):

- Water management and pollution: important pressure that takes several forms: (i) lowering of water-tables through drainage or water abstraction, which results in a transition to drier woodland types; (ii) flood prevention measures, river control and canalisation, which leads to a loss of dynamic disturbance-succession systems and invertebrate communities, and possible reductions in the extent of individual sites; and (iii) poor water quality arising from eutrophication, industrial effluents or rubbish dumping, which changes the composition of the ground flora and invertebrate communities.
- Cessation of traditional management (e.g. coppice management): leads to a reduction of their wildlife value and may encourage succession to drier types of woodland.
- Inappropriate grazing regimes and poaching of the soil by sheep, cattle and deer: leads to changes in the woodland structure, impoverished the ground flora, damaged the soil structure, and created difficulties for regeneration.
- Invasion by non-native species (including Himalayan balsam, *Impatiens glandulifera*; giant hogweed *Heracleum mantegazzianum*, and Japanese knotweed *Fallopia japonica*). Non-native hybrid poplars have also been introduced in places for forestry purposes: these can be difficult to irradiate and spread via suckers.
- Clearance and conversion for other landuses.
- Constraints on expansion imposed from agriculture, industrial or residential development on the spread of woodland onto adjacent ground. This reduces opportunities to diversify the forest age structure.
- Disease: A *Phytophthora* root disease has badly affected some alluvial forest stands. This affects alder trees and can, in some cases, kill trees outright.
- Air pollution: Atmospheric pollution from ammonia and oxides of nitrogen are considered to have potentially damaging impacts on the bryophyte and lichen communities of wet woodland habitats.

In **Ireland**, the area of alluvial forests has declined and this, together with their fragmented nature, abundance of alien invasive species and sub-optimal grazing regimes and drainage (NPWS 2008) **has resulted in an unfavourable bad assessment.**(Cross, pers. comm)

#### **Ireland:**

**Cross, pers.comm**

1. IO1. Invasive non-native species. The trees *Acer pseudoplatanus* and *Fagus sylvatica* and the shrubs *Rhododendron ponticum*, *Prunus laurocerasus* and *Cornus sericea* shade out the native flora and prevent regeneration of native trees. The herbs *Impatiens glandulifera* and *Heracleum mantegazzianum* compete with native species and can encourage bank erosion.
2. J02.03. Canalisation and water deviation.
3. J02.04.02 Lack of flooding. With 2. above this results in drying out of the alluvial woodlands and loss of associated species.
4. A02.01 Agricultural intensification. Often combined with 2 and 3. above leads to drying out and loss of area as margins of the woodland are cut-back or reclaimed. This has happened over large areas over many years resulting in the very small area of alluvial woodlands.
5. J02.01.Landfill, land reclamation and drying out. Infilling of flood plains leads to direct loss of habitat or increased flow and erosion.

#### **The Netherlands:**

**Aggenbach and Vegter (OBN), pers. comm:**

1. drainage in and outside SAC's
2. high nitrogen deposition
3. high sulphur deposition in the past
4. eutrophication by high nutrient load in rivers and brooks
5. eutrophication of seepage depended habitat by fertilising in the catchment area isolation
6. sites become to small for related species
7. partly improper forest management (clear cut, heavy equipment)



de Waal, pers. comm:

1. Lowering of the groundwater level by drainage and lack of inundation of the floodplains because of the the dikes;
2. pollution (mainly by fertilizers from the agricultural surroundings)
3. Elm and Ash diseases (*Chalara fraxinea*).
4. Lack of management. Especially the composition of tree species and structure is not favourable.
5. Fragmentation. Wooded areas are very small and vulnerable for unwanted influences. The border effects are relatively great (catch of N-deposition). Although rivers forms a natural ecological corridor, the woods in the smaller river and brook systems and the floodplain area within the dikes mostly are small and isolated;
6. Safety measures in relation to high riverlevels (lowering resistance inundating water);
7. Straightening river channels;
8. Invasion by non-native species.

## 2 Conservation management

### 2.1. Main conservation requirements

The main conservation requirements for logging practices in alluvial forest of Wallonia (**Belgium**) are (DGARNE n.d.):

- Selective logging instead of traditional logging
- Collecting seeds of minority native species
- Avoiding disturbance by logging with a cable next to the habitat and not to drive vehicles in the river bed.
- No draining of the soil
- Preserving micro-habitats
- No exploitation during the nesting period of birds (April 1 to June 30)
- Ensure natural regeneration of the forest
- Ensure the equilibrium between wild animals and the forest, feeding of wild animals is prohibited
- Extend the alluvial forests to create ecological corridors
- Extract invasive species
- Avoid recalibrating river streams; such as dams or channels
- Not using pharmaceutical products: herbicides, insecticides, fungicides,...

In order to maintain and restore riparian communities in **Spain** it is necessary to regulate agricultural activities (VV.AA. 2009). It should be sufficient to applying the water law and to respect the public water to preserve a large number of sites that currently house riparian forests or their remnants. It

should then not even be necessary to designate SCIs for this type of riparian habitat. Therefore, it is urgent to establish a true national water plan that not only contemplates the water demands of various human activities but also the ecological requirements of riparian communities. It is also necessary to consider water catchment management, because excessive regulation prevents the development of communities that require a constant flow.

#### **Ireland:**

Cross, pers.comm

1. Control of invasive alien species.
2. Re-watering of the systems
3. Re-creation of alluvial woodland by planting flood plains.
4. Prohibition of land reclamation and changes in planning laws.
5. Reducing fragmentation.

#### **The Netherlands:**

De Waal, pers. comm

1. Hydrological improvement both in water quantity and water quality (in river and in groundwatersystem). Though, too long periods of water saturation has to be prevented.
2. Lowering levels of fertilization in nearby agricultural areas. Creation of gradual borders of the woods to lower the absorption of N-deposition.
3. Improvement in management. Replacement of tree species with bad litter quality (beech, oak, conifers) in favour of species with a well decomposable litter (Ash, Elm, Hazel); eventually combined with removing of the litter. Replacement of poplar stands (except those with a specie-rich herb layer).
4. Improvement of a mixed structure of woods.
5. Stimulating the shrub layer to improve the microclimate.
6. Avoiding disturbance by logging.
7. Improvement of recolonization of rare and characteristic species.
8. Creation of ecological corridors and enlarging flooded plots.
9. Development of gradual structure of borders to lower the impact of N-deposition
10. Avoiding recalibration of riversystems;

## 2.2. Management measures

With regard to the management of habitat 91E0, two important aspects can be distinguished:

- maintaining or developing a typical and species-rich herb layer
- maintaining or developing a rich forest structure with a varied species characteristic tree composition and sufficiently thick trees and dead wood (Van Uytvanck et al. 2010)

In the Natura 2000 Vademecum of Flanders (**Belgium**) a distinction is made between regular maintenance and restoration measures (Van Uytvanck et al. 2010):

Regular management:

1. Multifunctional sustainable forest management: the management of a forest in which economic and ecological goals are interwoven
  - a. scaling down: reduce the scale of management interventions as much as possible to create a forest with a mosaic structure
  - b. creation of mixed forest and shrub layer
  - c. protection of ecologically valuable trees
  - d. maintain sufficient dead wood
  - e. identify, preserve and manage areas with 'nature' as main function
  - f. appropriate, ecological sustainable forest exploitation
2. Regular management with restoration of historic forms of management (coppice wood)<sup>124</sup>
3. Regular management without production function: zero management

Restoration measures:

- Afforestation
- control of exotic invasive species
- development / restoration of herbaceous vegetation
- transformation of poplar plantations

In the **UK** considerable work has gone into improving the condition and expanding the area of H91E0 alluvial forest. Alluvial forest woodland is subject to a number of legal instruments, national policy measures and grantaid schemes. These prevent clear-felling for conversion to other land uses, and aim to maintain and restore their ecological interest and expand remnant and new native woods. All woodland is expected to be managed according to the UK Forestry Standard, with ancient and semi-natural woodland receiving special provision. Felling of trees and grant aid are controlled by the Forestry Authority and are conditional upon management achieving these aims in accordance with

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<sup>124</sup> Remark on this point by Aggenbach and Vegter (OBN, The Netherlands): *There is no evidence available related to the ecological benefits of the historic forms of management (coppice wood). The fact that management is historical does not mean this management was beneficial. Many coppice woods in Belgium and the Netherlands were developed on meadows and developed to structureless forests. Coppice wood practice disturbs the stability in alder cares.*

published guidance. The Woodland Grant Scheme provides finance for regenerating, planting and other management activities. Various other measures and initiatives have been put in place to help conserve such woodland, including published guides on their management and creation. Amongst various initiatives that have undertaken is The New Forest Life Project, part of output being the restoration of 261 ha of alluvial forest (see <http://www.newforestlife.org.uk/>). (Joint Nature Conservation Committee n.d.)

A very important restoration measure for habitat 91E0 is rewetting by filling in drainage at and in the surroundings of sites. (Aggenbach and Vegter, pers. comm)

#### **Ireland:**

Cross, pers.comm

1. Removal of invasive species.
2. Blocking drains/cessation of drainage and clearance of streams/rivers.
3. Encouraging planting of trees on flood plains and changing the mind-set of foresters/landowners
4. Planting to improve connectivity and extend the length and area

#### **The Netherlands:**

De Waal, pers. comm

1. Last decades general measures have been taken on a European scale to improve the water quality of the main rivers. This resulted in an improvement of the conservation status of the habitat. On management scale local groundwater influences are improved by filling up ditches. Filtering the water of rivers and brooks are locally practiced for further improvement of the water quality. These measures are mostly not focussed on the alluvial forest. Generally measures and practices are seldom taken especially for alluvial forests. Especially the alluvial forest of the small rivers and brooks are neglected.
2. Measures are been taken on general level to create ecological corridors and to extend the flooding areas of the rivers. Most of the measures are not executed and hampered by other interests such as navigation of the main rivers and security against excessive flooding.

## **2.3. Other measures (e.g. monitoring)**

## 2.4. Species specific measures

In the Netherlands there are unwanted species in both the tree layer (species with unfavourable litter quality) and the herb layer (exotic species). In a lot of alluvial forests some typical species are lacking (de Waal, pers. comm).

## 2.5. Main constraints / bottlenecks and actual needs

### Ireland:

Cross, pers.comm

1. Insufficient funds and personnel
2. Lack of understanding and knowledge of landowners/stakeholders
3. Weak policies.
4. Competing landuse, e.g. agricultural production v. forestry

### The Netherlands:

de Waal, pers. comm.

1. Conflicts with other interests. For example the roughness of the alluvial forests is seen as a risk in times of excessive floodings. Measures in favour of safety in case of severe floods. Removing of forests and bushes to lower the roughness of the inundated surface and straightening of the river channel for inland navigation;
2. Conflicting interests with agriculture
3. No solution available for the Elm and Ash disease
4. Lack of funds
5. There are also conflicts of interest between alluvial forest and habitats of the short alluvial vegetation types.
6. Recent policymaking on national level. Especially concerning creation of ecological corridors

## 2.6. Solutions and Recommendations

### **Ireland:**

Cross, pers.comm

1. Awareness raising.
2. Education, training and communication
3. Influencing policies

### **The Netherlands:**

de Waal, pers. comm

1. Balanced policy on conflicting items. On places where alluvial forests sustains other objectives there will be no problem. Awareness of especially the historic and the value as part of the alluvial landscape is important.
2. Creation of buffer zones with low levels of fertilization around this habitat type. Those buffer zones could be beneficial for other habitats too.

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## Sites

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## **Annex 1 – Atlantic Biogeographic Region – Case Studies**

The role of the case study review is twofold: it allows threats, pressures and issues that relate to specific habitats to be linked to specific sites and it also supports the contractor in the selection of specific sites for closer scrutiny where these threats, pressures and issues will be explored in greater depth. The main aim of this work is to ‘ground’ thinking in practical situations rather than focus entirely upon more abstract, strategic perspectives. This will help to highlight where particular management actions have led to success and also help to identify potential alternatives through model-based insight. The inclusion of case studies within the annex is intended to provide an overview of projects relevant to the selected habitats across the whole region. Although still incomplete, it is hoped that at least five different, completed projects per country will be captured to illustrate a range of issues and potential solutions. Information has been captured in a standardised format to allow comparison between projects and to support further investigation. Its main use, at this stage, is to simply provide Member State experts with a summary and direct link to projects that are relevant to the habitats that have been selected. Once more detailed information has been captured on specific sites this will then be used to illustrate specific issues, using case study text boxes, in the background document, inform the modelling process and potentially form the basis for knowledge exchange trips that ‘showcase’ best practice on the ground. Any nomination of further case studies and the capture of associated information in a standardised format by individual Member States would be most welcome. Co-operation in the capture of site-based information would also be extremely helpful. Neither of these are essential if there are no staff resources to support this process but it will ultimately lead to a more complete overview. In summary, the role of the case studies is an evolving one that will change as we move through the process.

**The case studies are presented in a separate document.**

## **Annex 2 - Atlantic Biogeographic Region – Peer-reviewed Literature Bibliography**

A systematic review of English language, peer-reviewed literature has been undertaken to provide a rigorous overview of the current state of knowledge relating to the habitats that have been chosen as the focus for the Atlantic process. More specifically the review provides background information on the ecology of these habitats as well as the threats and pressures that have been identified through independent research as opposed to the Article 17 reporting. The bibliography should be interpreted as a quantitative result of a structured, repeatable literature review rather than as a list to which further references should be appended. This is why the precise search terms, as well as a quantification of the results, have been included in the annex. This was not only done for the sake of transparency but also to enable replication of the same review in the different languages of the Atlantic region if Member States wish to generate comparative data. This represents the first potential use of this review. The second potential use is to provide a starting point for a synthesis of the scientific literature either by Member States or the European Commission. The third and final potential use of this bibliography is to help support decision-making through the identification of gaps in knowledge. These could either be gaps in basic research, that the figures may illustrate, or it

could address gaps in individual expert knowledge. In combining groups of habitats with threats and pressures, the searches have been designed to highlight papers that address cross-cutting issues that may not have been previously considered. This resource is supported by an excel database that allows filtering by subject area as well as an online bibliographic database that also contains the abstracts so that individual papers can be evaluated in greater detail. These will be made available through an internet-based communications platform in due course. The only element of the annex that requires input from Member State experts at this stage are the core information sections for each habitat. The information sources are multilingual and have been captured from a variety of different sources. They are intended to show a small number of key information sources for each country that either describe the habitats, their location and status or provide nationally/internationally agreed management guidelines. These are intended for use by a wider audience beyond the biogeographic process when the background document enters the public domain. If they are deemed to be useful they can be retained but they will require additional input from Member State experts as some notable gaps still exist. Feedback on whether the EUNIS-based habitat descriptions should be included in the annex would also be helpful. They were only included for the sake of completeness so that the annex could be viewed as an independent document. This output will provide background information to support Member State experts and ultimately lead to a more informed conclusion to this biogeographic process.

**The literature review is presented as Annex in a separate document.**