Ministry of Environment and Energy
National Environmental Research Institute

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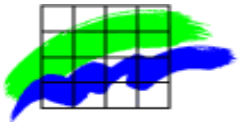
A preliminary assessment of distribution and conservation status in Denmark

NERI Technical Report no 365



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Data sheet

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Summary

Background and purpose

Under the Habitats Directive (The Council of the European Communities: *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*), Denmark has designated a total of 194 habitats to be included in a European network of Special Areas of Conservation (SAC's), *Natura 2000*. The designations are based upon the presence of 60 of the natural habitat types listed in Annex I of the Directive and approx. 44 of the species listed in Annex II which occur within the territory of Denmark and for the conservation of which the Community has a special responsibility.

The member states are obliged to monitor and assess the conservation status of these natural habitat types and species and to report their findings to the Community. To comply with these requirements, the Danish Forest and Nature Agency, the National Environmental Research Institute and the Danish county authorities have initiated a co-operative programme to provide and compile the data necessary to assess the conservation status of the natural habitat types and species concerned.

The purpose of this report is to present the conservation status of the habitats and species in Denmark on the basis of the background data and information available. The report will be integrated as an annex into the first Danish national report in 2001.

The report focuses on a total of 13 priority natural habitat types listed in Annex I and 79 species listed in Annexes II, IV and V of the Habitats Directive. Many of the natural habitat types and species concerned mainly occur in Central Europe, and Denmark frequently represents the northernmost boundary of their distributional range. On the other hand, many characteristic Danish species are not specified in the Directive lists. Hence, the results presented in this report should be considered as a status report in relation to the Habitats Directive and not as an assessment of the status of overall nature conservation interests in Denmark.

Status of natural habitat types

The report presents the very first assessment of the conservation status of Danish natural habitat types covered by the Habitats Directive. The assessment is based on mapping of the natural habitat types in the SAC's put forward by Denmark. The mapping provides information on the occurrence and extent of the natural habitat types and the factors having positive or negative impacts on their typical species.

A total of 61 natural habitat types included in the Habitats Directive are considered to occur at present in Denmark. Thirteen of these are priority natural habitat types and the mapping has primarily focused on these priority types while the remaining types have been only partially surveyed. Consequently the assessment of conservation status covers the 13 priority natural habitat types.

The main conclusions of the assessment of the conservation status of the natural habitat types are:

1. The basic knowledge of the distribution, the typical species, and the structure and function of the natural habitat types is in general not sufficient to make a reliable assessment of their status.
2. The assessment of the conservation status depicts a nature conservation resource that has been, and continues to be seriously threatened by anthropogenic activities. For the 13 priority types, the conservation status is considered to be favourable for 2 habitats, uncertain for 6 habitats, unfavourable for 3 habitats, and unknown for 2 habitats.

The assessment must be considered as prelimi-

nary because precise conservation objectives for the natural habitat types have yet to be developed.

Status of species

In the Habitats Directive, the conservation status of a species is defined in terms of all the influences acting upon the species, which may affect the long-term distribution and abundance of its populations. Such an assessment requires systematically and continuously collected data in order to describe the status and development of the population of the species concerned as well as its natural range and habitat.

Systematic monitoring of particular species listed in the Annexes of the Habitats Directive has only been implemented in a few exceptional cases. Studies of species status and recent distribution have been carried out in a limited number of cases, but for the majority of species this report is based on historical and recent data gathered from scattered information sources. Thus, in general monitoring data relating to individual species are only available at an extensive geographical scale. The background data for the 79 species assessed in this report are therefore only considered to be satisfactory for 30 species whereas the data on the remaining 49 species were insufficient to enable an adequate assessment of their status and abundance.

In these circumstances and based on the data on the total occurrence and distribution of the species in Denmark, the conservation status of species has been assessed based on the following categories:

Favourable conservation status: *14 species* including 11 mammals, 1 amphibian, and 2 fish species.

Uncertain conservation status: *22 species* including the only 2 priority species houting (fish) and hermit (beetle), 4 mammals, 1 reptile, 5 amphibians, 2 dragonflies, and 8 vascular plants.

Unfavourable conservation status: *17 species* including 2 amphibians, 2 fish, 2 butterflies, 1 dragonfly, 2 beetles, 1 bivalve, 5 vascular plants, and 2 mosses.

Unknown conservation status: *13 species* including 4 mammals, 1 reptile, 4 fish, 3 snails, and 1 mussel.

Disappeared: *13 species* including 1 reptile, 2 fish, 3 butterflies, 2 dragonflies, 2 beetles, and 3 mosses.

The assessment is based on the preliminary classification of conservation status into these five categories. It is expected that these will be redefined when conservation objectives for the species listed in the Habitats Directive have been established.

1 Introduction

1.1 Background

In 1992 the Council of the European Communities adopted *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, referred to in common-use English as the Habitats Directive. The main aim of the Directive is to contribute to promoting biodiversity by the conservation of habitats (natural habitat types) and species of wild fauna and flora essential to the community within the European territory of the Member States.

The most important tool for fulfilling the aim of the Directive is the establishment of a European system of Special Areas of Conservation (SACs), known as the *Natura 2000* network. This network includes the special areas of conservation designated under the Habitats Directive and the areas designated under the EEC Bird Protection Directive. Habitat areas for certain natural habitat types and species are to be designated according to Annexes I and II of the Habitats Directive. These areas enjoy a special protection status within the European Community as a whole. The species of community interest listed in Annex IV are in need of strict protection, including the prohibition of certain means of capture/ killing, collection, and commercial exploitation.

Under the Habitats Directive, Denmark has designated a total of 194 habitats for the Natura 2000 network. The designation is based on the occurrence of approx. 60 of the natural habitat types listed in Annex I of the Directive and approx. 44 of the species listed in Annex II represented within the territory of Denmark. These 194 areas include the majority of the 111 bird protection areas designated in 1983 under the Council Directive 79/409/EEC of 2 April 1979 on the protection of wild birds, referred to as the Bird Protection Directive, and the 27 Ramsar-sites designated in 1978 under the Convention on conservation of wetlands of international importance, particularly as habitats for waterfowl, known as the Ramsar Convention. According to international protection directives and conventions, Denmark has thus designated a total of approx. 10,000 km^2, of which 7,020 km^2 represent marine areas.

Under the Habitats Directive, Member States shall every 6 years draw up national reports on " .. *the implementation of the measures taken under this Directive. This report shall include in particular information concerning the conservation measures referred to in Article 6 (1) as well as evaluation of the impact of those measures on the conservation status of the natural habitat types of Annex I and the species in Annex II and the main results of the surveillance referred to in Article 11 ...*" (Article 17 (1). Denmark's first national report will be drawn up in the summer of 2001 and will include an account of the designation of the 194 habitat areas constituting the Danish contribution to Natura 2000 as well as information on the statutory and administrative conservation measures implemented for these areas in Denmark. The report will be drawn up by the Danish Forest and Nature Agency.

The Directive further states that "*For special areas of conservation, Member States shall establish the necessary conservation measures ..*" (Article 6 (1) conservation being defined as "*a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status ..*" (Article 1). Member States shall thus take appropriate measures to ensure a *favourable* conservation status of both natural habitat types and species. The definition of the term 'favourable' as stated in the Habitats Directive is based on a range of biological parameters which collectively form the basis of assessing whether a certain natural habitat type or species are reasonably protected in terms of future conservation.

Member States are obliged to monitor habitats and species: "*Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species*" (Article 11).

To comply with this requirement, the Danish Forest and Nature Agency, the National Environmental Research Institute and the Danish county authorities have initiated a co-operative programme to provide and compile the data necessary to assess the conservation status of the natural habitat types and species concerned.

1.2 Purpose

The purpose of this report is to present the conservation status of species and habitats based on the background data and the information available. The report will be integrated as an annex into the first Danish national report and will include the priority natural habitat types listed in Annex I and the species listed in Annexes II and IV. The non-priority natural habitat types and species listed in Annex V have, except for club mosses, only been considered in summary form or not at all.

The brief for compiling this report was cryptic and, in practise, quite complicated. By way of example, the majority of the natural habitat types specified in the Directive are defined by the occurrence of specific plant communities. However, the individual communities grade naturally into each other and the boundary between communities is often rather arbitrary, not least because the transition communities between individual communities are not necessarily identical in the different European biogeographic zones. Therefore, the results presented in this report should be considered as preliminary and the coming six years will undoubtedly lead to improvements in the verification and standardisation measures within Denmark and throughout the Member States.

Although there exists extensive information relating to the Danish natural environment, there is currently no overall national programme for monitoring the terrestrial natural environment in Denmark. This is relevant in relation to the definitions of 'favourable conservation status' of both natural habitat types and species listed in the Habitats Directive as these definitions are also based on distribution and abundance trends. Geographical range, abundance and distribution should thus be stable or increasing to qualify for the definition of favourable conservation status.

In many cases, the absence of an overall, standardised monitoring programme means that, due to lack of knowledge of the historical distribution and abundance, this status report can only present assessments, which can not be fully based on representative data. For the species specified in the Directive the information base is, however, far more detailed – not least because national *Red Lists* have been prepared over a number of years (latest Stoltze & Pihl 1998a). Knowledge of natural habitat types is less detailed and consistent. This report thus represents an important initial step towards (i) mapping of Danish vegetation types and the natural environment generally and (ii) a future targeted and integrated monitoring programme.

The report focuses on a total of 13 priority natural habitat types and 79 species. Many of the natural habitat types and species concerned mainly occur in Central Europe, and Denmark frequently represents the northernmost boundary of their distribution range. On the other hand, many characteristic Danish species are not specified in the Directive lists. Hence, the results presented in this report should be considered as a status report in relation to the Habitats Directive and not as an assessment of the overall nature conservation interests in Denmark.

2 Material and methods

2.1 Data for assessment of conservation status

The data available on natural habitat types and species included in the Habitats Directive have been provided in a collaborative project between the Danish county authorities, the Danish Forest and Nature Agency, the National Environmental Research Institute, and external consultants with the aim of assessing the conservation status of the natural habitat types and species concerned.

Data on natural habitat types have been provided by the counties and the State Forest Districts in a schematic form and supplemented by relevant reports. For a range of priority natural habitat types the counties have also (to a varying extent) digitised the distribution, extent and occurrence of the priority natural habitat types, primarily based on existing sources of information. The National Environmental Research Institute received 490 data sheets covering the 13 priority natural habitat types and 126 data sheets covering the 46 non-priority natural habitat types.

As for the species concerned, the counties have submitted a small number of data sheets providing information on a relatively limited number of species covered by the Habitats Directive, supplemented by a series of relevant reports. The results of the counties' ongoing monitoring of particularly amphibians and vascular plants have also been incorporated in the material.

On behalf of the Danish Forest and Nature Agency, the National Environmental Research Institute implemented in 1998 and 1999 field projects for collection of data on selected red-listed species and a wide range of species of unknown recent distribution was studied. Six vascular plant species, two butterfly species, and one amphibian species were covered in 1998 (Wind et al. 1999). In 1999, the studies were focused on the two priority species, houting and hermit beetle and five species of mosses, one species of vascular plant, three species of whorl snails, three species of dragonflies (NERI, unpubl. data). The following external expert consultants have contributed to the collection of data on the occurrence and status of species:

Houting: The Counties of Ribe and Southern Jutland
Hermit beetle, stag beetle, and Limoniscus violaceus: Ole Martin, EntoConsult
Bats: Hans Baagøe, Zoological Museum University of Copenhagen (ZMUC)
Harbour porpoise: Finn Larsen, Danish Institute for Fisheries Research and Carl Kinze, Zoological Museum University of Copenhagen (ZMUC)
Dormouse: Helle Wilhelmsen
Northern Birch Mouse: Thomas Secher Jensen, The Natural History Museum, Aarhus
Reptiles, amphibians and snails: Kåre Fog, Amphi Consult
Fish: Søren Berg, Danish Institute for Fisheries Research
Butterflies: Per Stadel Hansen and Preben Nielsen
Dragonflies: Ole Fogh Nielsen, EntoConsult
Water beetles: Mogens Holmen, EntoConsult
Mosses: Karen Thingsgaard, Biomedia

NERI's own subject-specialist departments have been involved in describing and assessing the conservation status of both natural habitat types and species. When external consultants have been involved, the National Environmental Research Institute has made the final assessment of the conservation status.

2.2 Conservation status of natural habitat types

Article 1 (e) of the Habitats Directive states that "*conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as*

the long-term survival of its typical species within the territory referred to in Article 2."

The latter point covers all of the EU.

"*The conservation status of a natural habitat will be taken as 'favourable' when:*

- *its natural range and areas it covers within that range are stable or increasing, and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and*
- *the conservation status of its typical species is favourable as defined in (i)*" *(cf. Chapter 2.3 conservation status of species).*

The conservation status of a natural habitat type can be assessed both at the individual locality level and at the national level. Thus, the conservation status of a natural habitat type may be defined as unfavourable at a particular locality but still, because of its status at other localities, be judged to qualify for a favourable conservation status at the national level. In this report, the conservation status has been classified in four categories: 'favourable', 'uncertain', 'unfavourable', and 'unknown'. The categories 'favourable' and 'unfavourable' have been reserved for localities and natural habitat types unequivocally falling within one of the two categories. The category 'uncertain' is applied to sites and natural habitat types where conditions suggest that the status is or might be 'unfavourable' but where this status can not be definitely verified on the basis of existing data. The category 'unknown' is applied to occurrences and natural habitat types where the data available are insufficient to make an assessment of the conservation status.

Definitions of natural habitat types: To assess the conservation status it is essential that there is a consensus of opinion on the description of the individual types, including their range of variety and boundaries to other naturally occurring habitats. The majority of priority natural habitat types are defined and described based on a Central European phyto-sociological tradition. As this tradition has never been adopted in Denmark, mapping procedures may easily lead to misinterpretations and differences of opinion. It should also be noted that in contrast to phylogenetic species, there are no equivalent clear-cut boundary lines between different natural habitat types, but rather gradual transitions between types. This report gives a brief description of the types and their relationships to other natural habitat types. Whenever possible, it has been considered whether the boundary between habitat types and the mapping of the natural habitat types comply with the definitions of the Commission and represent a common consensus of opinion. However, such an assessment is confounded by the lack of substantial descriptive documentation in the reports received (e.g. a list of species from the classified area). In coming years the basis for the classification of habitat types will be better defined by a more systematic approach to data gathering and improved presentation of the documentation collected.

Range: This status report is based on site reports predominantly relating to designated Special Areas of Conservation (SACs), which should therefore be considered as only a proportion of the total number of localities representing the natural habitat types in Denmark. The representativeness of the SACs for the individual natural habitat types has thus been estimated to the extent possible under the present circumstances. The availability of time series that enable the assessment of long-term changes in the distribution and abundance of the natural habitat types are highly restricted, so the assessment of the conservation status is therefore subject to substantial uncertainty at this time.

S*tructure and functions:* The assessment of the special conditions and the appropriate management necessary for the long-term maintenance of a natural habitat type requires detailed knowledge of the historical background of each individual natural habitat type. Although there is a general consensus of opinion on the consequence of a range of impact factors (drainage, eutrophication, grazing, cutting, soil cultivation, etc.), it is still uncertain which factors are of decisive importance for the long-term maintenance of the natural habitat type and the level at which the critical threshold of these factors has been exceeded.

The assessment is complicated by the dynamics of nature; succession is, for example, an integral

part of the natural dynamics of sand dunes. A long-term conservation of the dune-ecosystem is thus dependent on disturbance that may, at intervals, set succession back to its early stages. Natural succession may also result in one natural habitat type developing into another natural habitat type. As an example, calcareous fens may become overgrown with species from the original reed bed and eventually develop into an ash-alder swamp. It is more complicated to assess whether the effects of succession are positive, negative or neutral. The general opinion is that development from one natural habitat type into another is considered to be negative if it causes a significantly deterioration in the conservation status of the disappearing natural habitat type at the national level, which may particularly happen to already rare and fragmented natural habitat types. These issues need to be discussed in detail when establishing overall conservation objectives.

Generally, it is important to be aware that the continuity of living conditions (e.g. the maintenance of open habitats) is essential for the conservation of biological diversity in a cultivated landscape with small fragmented biotopes and populations of species with a limited capacity for dispersal. Therefore, in each instance, it must be considered whether the successional development is consistent with the conservation of biological diversity and protected natural habitat types at the national level.

In the present synthesis, reports on eutrophication, hydrology and natural disturbances are based on estimates and assessments and must therefore, to a certain extent, be of a subjective character. Factors such as scrub invasion are more easily observable, but information is still based on subjective reports rather than on the results of quantitative time series. The assessment of the conservation status is therefore in some cases subject to great uncertainty.

Typical species: The reports provide relatively little information on the status and abundance of the populations and an assessment of the conservation status of typical species has only been possible in exceptional cases. However, for some species it has been possible to document that a characteristic flora occurred within the biotopes reported.

Conservation status: Each of the 13 priority natural habitat types have been allocated a section in this report discussing the definition, range, structure/function, typical species of the natural habitat type concerned and an assessment of the conservation status. Dot maps illustrate the reported localities of each habitat type. However, due to lack of data, the dot maps representing dune and forest habitat types are only marked for those SACs, within which a certain type has been recorded. The boundary between two of the bio-geographic regions specified in the Habitats Directive, the Continental and the Atlantic region, passes through Denmark and has also been marked on the maps.

2.3 Conservation status of species

Article 1 (i) of the Habitats Directive states that: "*conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2.*" The latter point covers all of the EU.

"*The conservation status will be taken as 'favourable' when:*

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats (1), and*
- *the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future (2), and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis (3).*"

At present, these definitions can not be translated into precise operational interpretations. In the absence of more specific definitions this report has applied the following criteria.

Re 1: In most cases, it is a matter of subjective judgement whether a population or a species (in a national context to be considered as one or more populations) can be expected to maintain

itself on a long-term basis. The phrase 'long-term' does not denote any exact term of years.

The potential of a species to maintain *viable populations* on a long-term basis will, in the absence of any acute threats, depend on the abundance of the population. Everything else considered, small populations are expected to be more vulnerable to both anthropogenic and more natural stochastic and unpredictable effects than large populations. Climatic fluctuations, disease and immigration of competing species fall into the last category.

In practice, it is difficult to make precise estimates of the correlation between population size and vulnerability. Within population genetics the general opinion has been that population sizes should exceed 500 individuals to be considered sufficiently robust to demographic and environmental stochasticity. The limit has been subject to many discussions and it would often seem more reasonable to use 2,000 individuals as the lower limit, also referred to as the *Minimum Viable Population size (MVP)*[1] (Nunney & Campbell 1993).

Small populations will also be more exposed to inbreeding depression and genetic drift than large populations. Within population genetics the concept *effective population number* is used for the number of individuals in a population whose reproduction contributes to the next generation. The effective population number will often be considerably smaller that the actual population. The general theoretical opinion has been that the minimum effective population number should be at least 50 individuals (for a short period of time) to prevent inbreeding. Subsequently, however, a more conservative estimate has defined the minimum to be 500 individuals (Nunney & Campbell 1993).

In most cases, the effective population number can not be estimated on the basis of the data available, but it should be emphasised that in practise the effective population number may be considerably smaller than the number of individuals observed. That means that the latter may give the impression of a larger and more viable population than is actually the case.

In this report the following criteria have formed the basis for assessing the conservation status of a species.

- *Number of localities hosting populations of the species.* As an example, species occurring at less than 10 localities are assessed to be more vulnerable than species occurring at for instance more than 100 localities.
- *Number of individuals in each population.* Assessments are here based on the concept *Minimum Viable Population size* (MVP). Depending on the species concerned and its biology MVP is estimated to be 1,000 - 2,000 individuals.
- *Isolation level of the individual populations.* Isolation for instance will increase the risk of inbreed and genetic drift.
- *Other ecological features of the species* (dispersal capacity, population dynamics, etc.)

Re 2: The meaning of the term 'natural range' is neither precise nor clearly comprehensible. By way of example, several species listed in the Annexes of the Habitats Directive mainly occur in Central Europe and the Danish occurrences are therefore often representing the northernmost boundary of their natural range, where populations can, in certain cases, probably only be maintained by immigration. For pragmatic reasons, this report primarily refers to the actual range as a synonym for the natural range. Depending on the quality of data available, the actual range within the latest 20 - 80 years has been assessed. The concept 'natural range' will be considered later in relation to the establishment of conservation objectives.

Re 3: The extent of available habitat must be considered as relative to the species concerned. In this report 'habitat extent' is assessed on the basis of the population size.

From these definitions it appears that conservation status can not merely be seen as a function of the abundance of a species. Relatively rare species may thus have a favourable conservation status whereas a relatively common species can be judged to be of unfavourable conservation status if its populations are decreasing.

[1] Minimum viable population, i.e. the smallest population size making the species viable / not being extinct for a certain period of time in a certain area (Shaffer 1981).

Systematic monitoring of particular species listed in the Annexes of the Habitats Directive has only been implemented in a few exceptional cases. Studies of historical status and recent distribution have been carried out for a limited number of species but for the majority of species this report is based on anecdotal historical information and scattered information sources. The assessment of the precise conservation status of a species is thus based on variable information and comprehensive adjustments are to be expected when drawing up future reports as such assessments can be based upon improved data from actual monitoring programmes designed for the particular needs of the species and a full assessment of their habitats.

For this purpose, the National Environmental Research Institute has designed a scale serving as a tool for a summary assessment of the conservation status of populations of flora and fauna species at locality level and national level (Table 2.3.1).

Assessment of conservation status: Where the data available are sufficient, the conservation status of a species has been assessed at both locality level and at national level.

The terms localities/habitats are here been generally used for habitats where a species has been recorded and where it is certain or probable that it will reproduce. Occasional occurrences of species showing no sign of reproduction in a particular habitat have not been considered. Particularly in the case of bats and other species ranging over large areas, it has proved difficult to determine the factors relating to a certain locality, which constitutes a suitable habitat for such species. Many species need several types

Table 2.3.1. Scale for a summary assessment of conservation status of populations of flora and fauna species at locality level and national level.

Scale	Definition at locality level	Definition at national level
Favourable	The population of the locality is stable or increasing in number and distribution and the habitat is sufficiently large to ensure a continuous maintenance of the population within the locality.	The national population size of the species is stable or increasing and the habitats are sufficiently large and abundant to maintain the populations of the species on a long-term basis.
Uncertain	The population of the locality can be stable, increasing or decreasing. If the population is stable or increasing, it is so small that it is uncertain whether the habitat is sufficiently large to ensure a continuous maintenance of the population within the locality. Or the development may be subject to uncertainty due to lacking/past data and actual/potential negative influencing factors acting on the species within the locality.	The national population size of the species can be stable, increasing or decreasing. If the population is stable or increasing, it is so small that it is uncertain whether the habitats are sufficiently large and abundant to ensure a continuous maintenance of the population in Denmark. Or the development may be subject to uncertainty due to lacking/past data and actual/potential negative influencing factors acting on the species within essential habitats. Or the species is relatively common but is / appears to be decreasing in parts of its natural range.
Unfavourable	The population of the locality is decreasing in both number and distribution and the habitat is not sufficiently large to ensure a continuous maintenance of the population within the locality.	The population size of the species is decreasing and the habitats are not sufficiently large and abundant to maintain its population on a long-term basis.
Unknown	No, very little and / or very uncertain information is available on the occurrence of the species within the locality and it is unknown whether the habitat is sufficiently large to ensure a continuous maintenance of the population within the locality.	No, very little and / or very uncertain information is available on the national occurrence of the species and it is unknown whether the habitats are sufficiently large and abundant to maintain the Danish population on a long-term basis.
Disappeared	The species is no longer found within the locality despite repeated searches over a long period of years.	The species is no longer found in Denmark despite repeated searches over a long period of years.

of localities. Bats, for instance, need access to appropriate breeding localities, foraging areas, and wintering localities in suitable proximity.

The national status is assessed on the basis of the status at the individual localities. The theoretical background for an assessment of the conservation status is the total occurrence and distribution of the species in Denmark. The biological features, distribution and population size of the species in Denmark, the development of the population and the overall assessment of its conservation status appear from the text, figures and tables in the individual species sections. In the tables, localities are classified in the different conservation categories and as far as possible the percentage of the species' total occurrence at the localities associated with the individual categories is also specified.

The categories 'favourable' and 'unfavourable' are exclusively applied to species where sufficient data are available to substantiate the assessment according to the scale in Table 2.3.1.

The category 'uncertain' has been introduced because the background data available for comparison with the recent status will often be based on fragmentary historical data. Monitoring of most species has generally yet to be implemented and time series for distribution and number of the species are only available to a very limited extent. For these reasons, NERI has, at present, found no basis for replacing this category by sub-divisions of the unfavourable status (unchanged, regenerating or degenerating). Furthermore, species may be classified in this category irrespective of population development when the population is so small that its long-term survival is uncertain. This applies in particular if the supporting data are uncertain / out-of-date or if the species has been subject to negative impact factors. Finally, this category includes several relatively common species that in parts of their natural range are or appear to be decreasing.

The category 'unknown' is used for species where only little or no information on distribution and abundance is available. Species concerned may be those that are difficult to determine or relatively common species where the identification of their conservation status would require the introduction of a specific monitoring programme.

In this context the species particularly difficult to manage are those species which are known for certain or in all probability to have disappeared from a locality or from Denmark. Depending on the biology of the species and the distance to the localities or countries where the species is occurring, the prospects of re-immigration of the species will vary. In practice, this will, in all likelihood not occur without artificial re-introduction. To define a certain species as 'disappeared' implies that despite repeated targeted searches, the species has not been rediscovered in Denmark over a long period of years (*cf.* definition in the 1997 Red List, Stoltze & Pihl 1998a). In practise, it can be extremely difficult to estimate whether a species has indeed completely disappeared. The publication of red lists has in many European countries resulted in rediscoveries of species regarded as disappeared. The results are very likely due to increased search activities for these particular species.

Species which have decreased in Denmark during the last 20 years or species, for which, Denmark has a special responsibility are defined according to the 1997 Amber List (Stoltze & Pihl 1998b).

3 Conservation status of natural habitat types listed in Annex I of the Habitats Directive

Annex I of the Habitats Directive includes those natural habitat types of community interests whose conservation requires the designation of special areas of conservation. In Denmark there is a total of approximately sixty of the natural habitat types listed in Annex I.

Note that on the maps of the natural habitat types the close proximity of sites may result in the overlap of one or several dots.

3.1 Priority natural habitat types

Thirteen of the natural habitat types in Denmark are *priority (*)* natural habitat types for the conservation of which the Community has particular responsibility (Table 3.1).

An assessment of conservation status of priority natural habitat types in Denmark at national level and at locality level is presented in Table 3.2.

Localities are shown as dark dots on the maps of the following natural habitat types. Note that on the maps the close proximity of sites may result in the overlap of one or several dots.

3.1.1 1150* Coastal lagoons

Description

The classical description of a lagoon is a marine area, which has been cut off from the sea by a tongue of land or an isthmus formed by alluvial sand deposits produced by currents and/or wave action. If material is constantly being deposited, the coastal lagoon will eventually be completely separated from the sea and turn into a landlocked lagoon liable to become overgrown with reed and develop into a beach reed swamp. Conversely, the deposits may vary making the lagoon alternately open or closed.

Table 3.1. Priority (*) natural and semi-natural habitat types in Denmark. The code corresponds to the Natura 2000 code.

Code	Habitat types
1150	*Coastal lagoons
2130	*Fixed coastal dunes with herbaceous vegetation (grey dunes)
2140	*Decalcified fixed dunes with *Empetrum nigrum*
2250	*Coastal dunes with *Juniperus* spp.
6120	*Xeric sand calcareous grasslands
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)
7110	*Active raised bogs
7210	*Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
7220	*Petrifying springs with tufa formation *(Cratoneurion)*
9180	**Tilio-Acerion* forests of slopes, screes and ravines
91D0	*Bog woodland
91E0	*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicon albae)*

Table 3.2. Conservation status of priority natural and semi-natural habitat types in Denmark. The code corresponds to the Natura 2000 code.

Habitat code	Area (ha)	No. of localities	Conservation status of localities				National conservation status
			Favourable	Unfavourable	Uncertain	Unknown	
1150	15504	64	12	7	16	29	Unfavourable
2130	6984	82	0	61	21	0	Uncertain
2140	10777	47	6	41	0	0	Uncertain
2250	336	15	14	0	0	1	Favourable
6120	33	21	6	15	0	0	Uncertain
6210	284	22	5	17	0	0	Uncertain
6230	245	35	11	17	7	0	Unfavourable
7110	3375	22	1	0	20	1	Unfavourable
7210	270	32	17	14	1	0	Uncertain
7220	103	36	0	0	26	10	Uncertain
9180	593	20	13	2	0	5	Unknown
91D0	1095	27	16	0	4	7	Favourable
91E0	662	65	36	17	0	12	Unknown

In the Interpretation Manual (Skov- og Naturstyrelsen 1999a) coastal lagoons are defined as areas with stagnant sea water of varying water volume and salinity, wholly or partially separated from the sea by sand banks, shingle, or less frequently, by rocks. Salinity may vary a great deal depending on rainfall, evaporation and the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange. Coastal lagoons may either be without vegetation or with vegetation of *Ruppietea maritima, Potametea, Zosteratea or Charetea* communities. Small lagoons and landlocked lagoons considered to be the Baltic variety of coastal lagoons are small, usually shallow and more or less delimited water bodies still connected to the sea or have been cut off from the sea very recently by land upheaval. This type is characterised by well-developed reedbeds along the banks, luxuriant vegetation of submerged plants and by having several of the morphological and botanical development stages characteristic of the succession process from sea to land.

Coastal lagoons are very dynamic natural habitat types representing many successional stages from newly formed semi-open cut-offs along the coast to overgrown landlocked lagoons eventually developing into coastal saltmarshes / inland salt-basins (Natural habitat type 1310. Vegetation of *Salicornia* and other annuals colonising mud and sand).

Natural range

A total of 111 coastal lagoons have been included in this status report. Some of these are small landlocked lagoons (< 1ha), which are here grouped according to their geographical range. The result is that this status report includes 64 coastal lagoons distributed between 22 Special Areas of Conservation (SACs) assessed to be particularly worthy of conservation under the Habitats Directive (Fig. 3.1.1). In all, the areas cover 15,504 ha.

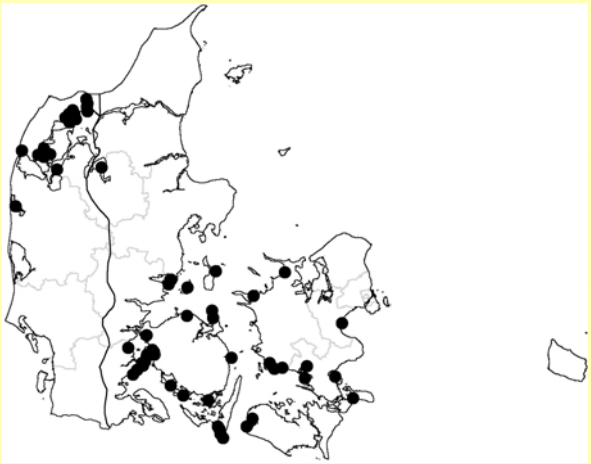

Figure 3.1.1. Coastal lagoons (1150). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

According to the Danish Forest and Nature Agency's descriptions of the designated natural habitats, there is an estimated total area of 45,800 ha of coastal lagoons in Denmark. This corresponds closely with the area of coastal lagoons listed in the European Environment Agency's CORINE (Corine Biotopes Manual 1992) mapping, excluding Limfjorden (45,355 ha) (Anon. 1993). The extent of coastal lagoon area provided by the Danish counties for this status report is not strictly consistent with the CORINE mapping. The latter for instance includes Ringkøbing Fjord, Dybsø and Karrebæksminde Fjord as well as Saltvandssøen (located behind the Wadden Sea dike at Tøndermarsken), all of which could be characterised as lagoon habitats.

Structure and function

This status report is based on the data sheets and questionnaires submitted to the counties and other sources, including NOVA (Danish Aquatic Monitoring and Assessment Programme) reports, local knowledge of a range of coastal lagoons and phone call enquiries to some of the counties. The conservation status of the coastal lagoons has been assessed on the basis of their structure and functions. The structure is described in physical terms: opening to the sea (canal, sluice, ditch, none), water exchange, salinity variations, depth, oxygen, sediments, catchment area and its degree of cultivation in relation to potential nutrient salt depositions and the distribution of structure-forming vegetation (e.g. *Zostera,* eelgrass and *Potamogeton,* pondweed). The ecological condition of the coastal lagoons is described in terms of a wide range of biological conditions such as the occurrence of particularly species of high conservation interest, occurrence and distribution of characteristic species (phanerogams and macroalgae), depth limits for submergent vegetation, and the ratio between primary producers (phanerogams/perennial macroalgae/eutrophic macroalgae/plankton), and benthic fauna communities affected by oxygen depletion.

The eutrophication-related parameters figuring in the description of both structure and function are basic parameters measured as part of the nation-wide marine monitoring programme (Anon. 2000) and are integrated in the annual report on the state of the marine environment (e.g. Markager et al.1999). Many regional surveys and nature monitoring programmes are based on the same concept as the Danish Aquatic Monitoring and Assessment Programme. At present, nature quality criteria for marine areas that can be directly integrated into the assessment of the structure and function of the habitats are not available. However, a system of common standards at regional and national levels has been established based on 11 years experience gained from the marine monitoring programmes Action Plan on the Aquatic Environment, Action Plan on the Aquatic Environment 2, and the present Danish Aquatic Monitoring and Assessment Programme. This standard reference forms the basis for assessing the quality of coastal lagoons.

The natural habitat type Coastal Lagoons embraces many stages of geomorphological and seral succession. To assess the conservation status of the coastal lagoons in terms of their successional status it has been appropriate to classify them into four major types. The classic lagoon types are former marine areas, which have been cut off (wholly or partially) from the sea by an isthmus formed by alluvial deposits from the sea. In addition, we define coves as lagoons (which can be considered as small fjords) enclosed from the sea behind spits of land but which still maintain an open connection to the sea. Landlocked lagoons are former lagoons now completely cut off from the sea and salt-water incursion only occurs through permeation or on particularly high tides. Finally, some areas have been embanked and water exchange is often regulated by a sluice gate, only allowing salt-water incursion through leaks in the sluice and by permeation through the dam. The lagoons included in this review comprise 13 embanked areas, 18 classic lagoons, 9 coves, and 24 landlocked lagoon structures (Tables 3.1.1.1 and 3.1.1.2). The conservation status of these areas has been assessed based on this physical classification and the resulting biological conditions. By way of example, a landlocked lagoon with limited submergent vegetation may be assessed to have a favourable conservation status whereas coastal lagoons having a good water exchange must fulfil much stricter demands to qualify for a favourable conservation status. One of the cri-

Table 3.1.1.1. Distribution of coastal lagoons between counties. I = Reclaimed areas, L = Classical lagoons formed by alluvial sand deposits produced by the sea; N = Cove; S = Landlocked lagoons (groups of coastal lakes).

	No. of localities				
Counties	I	L	N	S	Total
Fyn	3	8	2	9	22
Ringkøbing		1			1
Roskilde		1			1
Storstrøms		3	3	2	8
Sønderjylland		2	2	2	6
Vejle		1		2	3
Vestsjælland	1	1	2		4
Viborg	9	1		7	17
Århus				2	2
Total	13	18	9	24	64

teria is e.g. an extensive depth distribution of sedentary bottom vegetation.

Conservation status

The general conservation status of coastal lagoons is considered overall to be unfavourable (Table 3.2). The range of coastal lagoon habitats in Denmark is not considered to be endangered. The embanked areas have all been designated protected areas or refuges. Agreements to ensure environment-sensitive agriculture have often been established on adjacent cultivated areas, including restrictions on the application of fertilisers. The coves also contribute to the long-term maintenance of the distribution of this natural habitat type. The embanked areas and coves represent 34% of this natural habitat type. The classic coastal lagoons and the landlocked lagoons make up the remaining 66% representing the more dynamic part of this natural habitat type. Almost all of the present landlocked lagoons are protected under Section 3 of the Protection of Nature Act whereas only 4 of the classic lagoons are protected or designated refuges. A few landlocked lagoons are facing a conversion into beach reed swamps thus being transformed into another natural habitat type. At the national level, the distribution of this natural habitat type is not threatened.

Table 3.1.1.2. Distribution of areas of coastal lagoons between counties. I = Reclaimed areas, L = Classical lagoons formed by alluvial sand deposits produced by the sea; N = Cove; S = Landlocked lagoons (groups of coastal lakes).

	Sum of areas (hectares)				
Counties	I	L	N	S	Total
Fyn	49	1386	42	131	1608
Ringkøbing		5933			5933
Roskilde		196			196
Storstrøms		851	610	5	1466
Sønderjylland		82	426	23	531
Vejle		20		6	26
Vestsjælland	1541	65	1553		3159
Viborg	2417	3		161	2581
Århus				4	4
Total	4007	8536	2631	330	15504

Ecological conditions in the coastal lagoons are more variable. Only in approximately 20% of the areas can the conservation status of coastal lagoons be considered favourable. The unfavourable status is primarily due to the scant occurrence of bottom vegetation and the seasonal growth of plankton algae or eutrophication-related macroalgae. In most landlocked lagoons, there is no submergent vegetation and many are at the stage of being overgrown with common reed and transformed into beach reed swamps. In the embanked areas the sluice and the limited water exchange make the areas extremely sensitive to the effects of land-use in the catchment areas. Where no environment-sensitive agricultural agreements exist and the leaching and discharge from individual farms continue, blooms of planktonic algae and eutrophication-related macroalgae persist. Based on site number, the conservation status is considered favourable at 19% of the localities, uncertain or unfavourable at 36% of the localities. In almost half of the localities (45%) it was not possible to assess the status because of insufficient data. In terms of area only 21% of the coastal lagoons have a favourable conservation status, around half of them have an unfavourable conservation status and for 22% of the area it has not been possible to assess the status due to lack of data. The difference between numbers and area is because the lack of data is most pronounced in the small areas.

3.1.2 2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)

Description

Fixed dunes are colonised by a more or less closed vegetation carpet of perennial grasslands, herbs, and luxuriant vegetation of lichens and mosses. This natural habitat type is just part of the dynamic process of coastal ecosystems which exists because of the natural occurrence of sand-dune blowouts, breaches and sand drift. An acidification gradient exists, extending from the green to the grey dunes. The grey dunes represent a typical lichen-dominated habitat requiring a certain level of continuous disturbance to maintain a competitive edge over mosses and vascular plants. The dynamics of the grey and green dunes is more pronounced than in the decalcified fixed dunes of the *Empetrum nigrum* type (2140). The leached and acidified grey dunes are more abundant than the more fertile green dunes.

The nutrient content, the calcium content and sand-grain size are the predominant factors determining the capacity of the sand to retain water, and these features vary considerably between different parts of Denmark. In northwest Jutland, the chain of calcareous cliffs along the coast gives rise to sand of relatively high nutrient and calcareous content, which affects the plant communities of the adjacent dunes. Along coasts of northern Zealand, the sand is generally more coarse-grained than along the west coast of Jutland, and this fact is important for the capacity of the sand to retain water. Precipitation also differs between the west coast of Jutland and northern Zealand. During the 30-year period from 1961 to 1990, the mean annual precipitation was 750-900 mm in western Jutland compared to 550-600 mm in northern Zealand (Frich et al. 1997).

The green dunes of northwest Jutland are unique in Europe, since their vegetation is characterised more by sub-continental species than in more western European dune habitat types (Bruun & Ejrnæs, in press).

Natural range

This habitat type is most abundant in the western part of Denmark, forming an almost unbroken belt along the west coast of Jutland. The occurrence of grey dunes is considerably more restricted to the east coast of Jutland and the Danish islands.

Reports submitted relate to 82 occurrences totalling 6,984 ha (70 km^2) distributed on 30 SACs (Fig. 3.1.2). The largest inter-connected areas representing this natural habitat type in Denmark are all included in the SACs. Outside the SACs, this type is also widely represented in extensive summer recreational areas.

Structure and function

The long-term maintenance of this natural habitat type primarily depends on conservation management measures aimed at maintaining an open natural habitat. Since the beginning of the 16th century, local authorities have tried to curb the extent of sand drift by, for example, imposing restrictions on the general grazing of the dunes. This continued until the 20th century and did not completely cease until after the Second

Figure 3.1.2. Fixed coastal dunes with herbaceous vegetation (2130). Special Areas of Conservation with reported occurrences of the natural habitat type in Denmark. The sites are centred in the Special Areas of Conservation. The boundary between the Atlantic region and the Continental region is shown on the map.

World War. Grazing inhibited the growth of bushes and trees and created local breaches resulting in drifting sand. A wide range of measures such as planting, dune stabilisation, coastal protection and prohibition of grazing has for many years imposed some level of physical stability on the coastal landscapes at the expense of natural dynamic processes typical of this natural habitat type. Tree and scrub growth has been recorded at more than 50% of the localities including moderate to heavy overgrowth at more than 25% of the localities.

Woody plants occupying the green and grey dune zones are the imported mountain and dune pines and the native European aspen, oak, sea buckthorn, and Scotch rose. From many localities, there have been reports on growth of sloe, broom, gorse, and Rugusa rose. At two localities, bracken is cut and removed, and at one locality a campaign to eradicate giant cow parsnip has begun. In the site with bracken, peat cutting is considered to be necessary to maintain local diversity. The reports received do not indicate whether clearing is going on or if there is a need for clearing.

Forty-five percent of all the localities are nowadays being grazed to some extent. Reports received do not specify for how long the areas have been grazed and monitoring activity has only been reported from 17% of the localities. Nevertheless, all grazed localities are supposed to be inspected on a regular basis. At 50% of the reported localities, serious erosion has been reported, at a further 33% of localities, the erosion is estimated to be of minor importance. Of the 50% of reported cases, erosion was considered to have a negative impact, whilst in 20% erosion was considered positive. There is heavy pressure on the habitat in areas bordering centres of tourism. In the white and grey/green dune zones, the number of path networks is increasing, occasionally resulting in entire sections of dunes being blown away, which may have a highly destructive effect on the coastline. Conversely, such sea breaches might, however, also contribute to restoring the patterns of vegetation dynamics in the dunes.

Although ammonium deposition has not been recorded as a direct threat to this natural habitat type, an assessment of the impact of the increased nitrogen load will require long-term monitoring. In the Netherlands, where levels of nitrogen deposition is considerably higher, observations have revealed comprehensive damage to lichens in the dry sand heaths and a tremendous growth of mosses at the expense of lichens. In Denmark, current levels of nitrogen deposition lie close to the critical load for lichens, suggesting that changes might only be noticeable in the long term (Tybirk & Jørgensen 1999).

Observations in Denmark have found damage to species of reindeer mosses, which could possibly be due to the impact of nitrogen deposition (Søchting 1990). In the early 1990s blackening of reindeer mosses was observed in nearshore areas.

In the Netherlands an increase in the dominance of mosses has been observed in dry sand heaths. The invasive moss species, *Campylopus introflexus*, is one of several moss species said to colonise dune systems at the expense of lichens because of the intensified eutrophication. *Campylopus introflexus* is considered to present a greater threat to the green and grey dunes than in the decalcified fixed dunes, type 2140 (U. Söchting, pers. comm.), since mosses generally have an efficient dispersal rate and are highly competitive.

Typical species

Strong gradients typically characterise this habitat type, depending on the salt and calcium content of the soil. The outlying part of the green dunes will frequently be dominated by annuals (*Bromus hordeaceus, Phleum arenarium, Erophila verna,* and *Cerástium semidecandrum)*. Further inland leaching, accumulation of organic matter and acidification will change the plant communities towards more dwarf shrub heathland. The characteristic green dunes are very rich in species and host typical species like *Pulsatilla pratensis, Sedum acre, Galium verum, Lotus corniculatus, Tymus serpyllum, Vicia cracca, Geranium sanguineum, Artemisia campestris, Pimpinella saxifrage, Koeleria glauca,* and *Silene otites.* In northwest Jutland, green dunes support a wide range of dwarf species, although few species dominate individual communities. The most dominant species in the green dunes are *Ammophila arena-*

ria, Poa pratensis, Achillea millefolium, Carex nigra, Armaria maritima, Veronica chamaedrys, Festuca rubra, and *Galium verum*. Frequently woody plants like *Salix repens, Rosa pimpinellifolia,* and *Hippophae rhamnoides* occur.

The grey dunes are poorer in vascular plants and they typically host acid-soil species like, for example, the two dominant monocotyledons, *Carex arenaria* and *Corynephorus canescens*. Green-dune species also occur, but more lichens dominate large areas. The occurrence and distribution of lichens mainly depend on the microclimate, instability of the substrate and competition from the higher plants. The establishment of new areas appropriate for the spread of lichens is dependent on continuous disturbance, including the creation of areas of bare substrate.

Conservation status

The conservation status of the natural habitat type 2130 is considered to be uncertain (Table 3.2). In many areas, coastal protection and dune stabilisation have reduced the level of environmental instability, and this has contributed to seral succession and overgrowing of vegetation due to cessation of grazing (particularly in the green dunes), increases in atmospheric nitrogen deposition and invasive species.

In areas with low rates of nitrogen deposition (< 8 kg N ha^{-1} $year^{-1}$) like Læsø and Anholt and the coast of northern Zealand, the load is not considered to constitute a threat. Repeated surveys of botanical test plots on Læsø showed practically no vegetation changes over a 45-year period (Christensen 1989). However, in these areas the invasion of non-native species like *Pinus montana* and *Rosa rugosa* is still a threat. For the other areas, the present levels of deposition are close to the calculated critical load and the long-term stability of this vegetation type is therefore uncertain. Sporadic studies indicated a growing dominance of mosses at the cost of lichen cover and it can not be ruled out that the expanding distribution and abundance of *Campylopus introflexus* is related to the increase in nitrogen deposition.

A positive contribution to dune management is the Nature Management Strategy of the Danish Forest and Nature Agency (Skov- og Naturstyrelsen 1999b), which provides for new possibilities to support the natural dune vegetation dynamics and ensures that the natural landscape-forming processes will be accepted in the public areas to a far higher extent than has been the case previously.

The overall assessment of the conservation status must be characterised as less than certain, as there is no information relating to the long-term impact of nitrogen deposition on this vegetation type nor to the level of sand drift required to ensure the long-term perpetuation of this natural habitat type. There is no systematic information on the impact of grazing available at present.

3.1.3 2140* Decalcified fixed dunes with *Empetrum nigrum*

Description

In general, coastal heaths are far more varied than inland heathland, a feature attributable to the greater variety of physical factors affecting vegetation processes. The occurrence of decalcified fixed dunes ranges from gravelly, stony beach ridges with more or less superposed shifting sands through wet dune slacks between dunes to dry wind-swept dunes. In the past heather was dominant in the fixed dune heathland but nowadays crowberry is the dominant species. Botanical descriptions of an older date refer to the 'fixed dune heathland' as very open dunes behind the green dunes, mainly dominated by heather.

The traditional use of these landscapes with common dune grazing stopped approximately 50 years ago. In the last 150 years, drifting sand has been efficiently eliminated by reforestation, restricted grazing, mowing and peat cutting, planting of marram grass, anti-erosion features, and coastal protection engineering. Before sheep grazing stopped, the areas included in this natural habitat type were far more dynamic, featuring many areas of bare substrate. At the same time, the forests have advanced and certain coastal areas have been so heavily urbanised that completely undisturbed dune landscapes are

becoming rare. Quite a few of the localities recorded represent mixtures between type 2130 and type 2140 with some mires and fens occurring. In areas with disturbance, wind breaches and dune blowouts are often frequent (type 2120, white dunes).

As this natural habitat type is growing on shifting sands it represents, as is the case for all nearshore areas, a relatively young ecosystem. The soil characteristics of decalcified fixed dune heathland dominated by crowberry have been studied at many localities, and in general the soil in coastal dune areas is less than 300 years old. This fact should be considered when assessing the stability of local conditions. A detailed Danish research project has shown that there is a gradual formation of the sour humus layer, which plays a central role in the nutrient circulation of this natural habitat type, and consequently in patterns of vegetation succession (Nielsen et al. 1999, Nielsen et al. in press). The present vegetation composition is therefore the result of the cessation of extensive grazing management, increased seed dispersal from the dune plantations and (since the early 1970s) the intensification of atmospheric deposition of nitrogen.

Natural range

This natural habitat type occurs mainly in the western part of Denmark, especially in an almost unbroken belt along the west coast of Jutland. Smaller areas occur on the east coast of Jutland and on the Danish islands. The total extent of geomorphological shifting sand area along the coast extends to 1,270 km^2 (Ovesen 1998). Only 4.6% of this area is found on the islands. The extent of actual coastal heathland with no large and dominating built-up areas has been calculated to amount to 327 km^2 (Emsholm 1992).

Altogether 47 reported localities are distributed between 21 SACs (Fig. 3.1.3). The total recorded area representing this natural habitat type is 10,777 ha (~108 km^2). The extent of this habitat type within the SACs represents only a moderate part of the total national resource. The type can also be found in large areas outside the SACs and it is prevalent in the large recreational summer cottage areas at the west coast. There is even an increase in the extent of this habitat as comprehensive sewerage and lowering of groundwater levels (through drainage) have reduced the extent of wetland natural habitat types, many of which have now been converted to dwarf shrub heathland.

Structure and function

The long-term maintenance of this natural habitat type is reliant upon management measures aimed at removing nutrients and preventing overgrowth of trees and bushes. During most of the period in which this natural habitat type has existed in Denmark, it has (according to historical sources) been utilised for grazing. Grazing has only been continuous in Skallingen. For all other areas there is no reported information on the duration and intensity of grazing. Another essential precondition for this type is related to coastal protection and dune stabilisation, as protection at one locality will affect the quantity of sand elsewhere. It is very difficult to comment on the likely natural structure of a Danish coastal landscape today. The picture might very well depend on whether the coastline is receding or whether it is accreting because of the availability of alluvial sand deposits.

Figure 3.1.3. Decalcified fixed dunes with *Empetrum nigrum* (2140). Special Areas of Conservation with reported occurrences of the natural habitat type. The sites are centred in the Special Areas of Conservation. The boundary between the Atlantic region and the Continental region is shown on the map.

In the absence of man, the coastline of the west coast would in some areas be dominated by forest, which would have stabilised the sand and resulted in a quite different formation of the coastal landscape. The question of how close to the contemporary coast the forests might have existed can not be answered nowadays.

In western Jutland, the forests have been cleared for thousands of years. The coastline has been converted into a treeless landscape not capable of affecting wind patterns. The Little Ice Age, which started in the 1500s and culminated during the Dano-Swedish Wars around 1660, caused the recession of sea levels, creating a very wide sand beach exposed to the wind. The overgrazing in the dunes more or less coincided with the Little Ice Age, and probably explains the existence of today's bare, shifting sand areas. In localities with sedimentary sand as e.g. Anholt the type probably exists as a temporary succession stage towards woodland, since in the past, Anholt was covered by pinewood.

The present trend is that the dunes are becoming overgrown with woodland, however, primarily with imported species. Even in the absence of the imported tree species, the dunes have been heavily overgrown since livestock grazing stopped. The grey dune vegetation has, at many localities, been replaced by dense crowberry vegetation and there is no doubt that without the impact of livestock grazing, the majority of the near-shore dunes would eventually turn into woodland or copses.

The natural habitat type 'decalcified fixed dunes with *Empetrum nigrum*' has a calculated critical load of 10-15 kg nitrogen ha^{-1} $year^{-1}$ and the present deposition in the near-shore parts of Denmark is in general 6-15 kg. The lowest levels were measured on Anholt and along the coast of northern Zealand. The present level of airborne ammonium is thus threatening the long-term stability of this type. The interrelation between nitrogen deposition and vegetational change is based on observations made in the Netherlands and England (Bobbink et al. 1998). The Danish county authorities have also reported the first stages of the invasion of bent grass and increasing eutrophication at 4 localities where the natural habitat type borders intensively cultivated farmland.

Historically, the atmospheric deposition of nitrogen in these natural habitat types has contributed between 2 and 5 kg nitrogen per year. Today it is more commonly between 8 and 15 kg nitrogen. In the long run this deposition may shift the balance in these sensitive plant communities towards more nitrogen-loving species such as bent grass and wood reed.

The rising number of tourists particularly in the western part of Jutland may break down the relatively sensitive nature of this natural habitat type. Although recreational erosion is generally considered to be of minor importance, increasing erosion because of growing tourism has been sporadically recorded in recent decades. Erosion is most frequent at the edge of the habitat type and along the paths to the beach.

At 42% of the reported localities there is currently no grazing and in more than 40% of the areas some level of grazing was reported. At one locality the grazing was reported as intense. No scrub encroachment had been recorded at 30% of the localities. Overgrowth by scrub was reported as minor to moderate at 52% and heavy at 7% of the localities. Most of the reports mention the invasion of woody plants, especially mountain pine, but also species like dunal pine, European aspen, gorse, Rugusa rose and broom occur. The reports do not specify whether it is the low, Danish sub-species of broom or a cross-breed with the French sub-species. Apart from European aspen and maybe broom these species are either imported or adventive.

Systematic monitoring of the vegetation only takes place at 3 localities. In the grazing areas there is most likely some sort of regular inspection. This may also be true of areas with pine clearing. Observations here suggest a re-growth of dwarf shrub.

Because of the impact of the increased ammonium deposition, the overall assessment of structure and function must be characterised as 'uncertain'.

Typical species

Uniform crowberry heaths occur in many dune areas strongly affected by the wind. Apparently

crowberry *Empetrum nigrum* is most successful in the western part of Jutland, most likely because of its climatic demands (Tybirk et. al. 2000). *Carex arenaria* is common in sandy and dry areas. Many beach ridges and dry sand bottoms as for example at Sejerø Bay, Rørvig and on Ulvshale on Møn are covered by strong and dense heather, *Calluna vulgaris*, and mosses and lichens.

Woody plants are often represented by self-sown species like *Pinus mugo, Pinus contorta, Populus tremula, Ulex europaeus, Rosa rugosa,* and *Sarothammus scoparius*. The robust moss species *Pleurozium schreberi* and *Hypnum cupessiforme* are often observed in between the dwarf shrub. Lichens as *Cladonia arbuscula* and *C. portentosa* may also be abundant in between the taller plants.

The invasive species Rugusa rose and mountain pine represent by far the greatest management problems. However, a second special problem has become manifest during the latest nearly 30 years: the aggressive moss species, *Campylopus introflexus* is spreading like a carpet in many former low-level dune areas. On Rømø, Anholt and in the army range at Oksbøl, observations have been made of this invasive moss forming carpets over extensive areas. Apart from ousting lichens, this species also prevents seed-dispersing species like heather from settling. In the Netherlands where *Campylopus introflexus* has spread since the 1960s it has occupied very large dune areas. In these areas, attempts to restore the original dune vegetation are being made by peeling off the moss carpet with machines (S.N. Christensen, pers. comm.).

Quite a few of the localities recorded represent mixtures between types 2130 and 2140 with some mires and fens occurring within the stabilised blowing-out areas. These areas may be flooded during the winter and *Erica tetralix* can therefore often be observed in large stands (transitional stage to type 4010). In disturbance areas, wind breaches and thus white dunes (type 2120) may occur.

Conservation status

The conservation status of the natural habitat type 2140 must be characterised as uncertain (Table 3.2). The dwarf-shrub-dominated heathland seems to be stable provided that grazing and the clearing of growth of woody plants are continued. The assessment is uncertain, as the long-term impact of the ammonium deposition on this natural habitat type is unknown. It is also uncertain whether the natural dynamics can be maintained at the present level of coastal protection and dune stabilisation, and the pressure from non-native invasive species seeds.

3.1.4 2250* Coastal dunes with *Juniperus* spp.

The type is defined as *Juniperus communis* (juniper) formations in coastal dunes. At most localities this vegetation type is associated with grey dunes with a dominant vegetation of heather and bent grass, but it also occurs in green dunes. Occurrences in heaths, dry grasslands and inland dunes are classified as type 5130.

The vegetation type is found in areas where grazing is going on or has been practised in the past. The grazing pressure has in the past been intensive and all usable wood has been removed. This community has thus appeared as relatively open scrub far from the nearest woodlands. This situation has changed radically for the majority of the vegetation types recorded where woodlands are now close to the natural habitat type at many localities.

As this community grows on shifting sand, the ecosystem is, as for all near-shore areas, relatively young. The soil characteristics of the fixed coastal dune heathland have been studied in several places and in general the soil is less than 300 years old. This should be taken into consideration when assessing the stability conditions.

Natural range

This natural habitat type is rare and occurs only sporadically in small areas, most frequently in western and northern Jutland, at Sejerø Bay and along Præstø Fjord. A single record on Rømø has been excluded as only one juniper was observed. The type is reported from 15 localities, totalling 336 ha (Fig. 3.1.4). Within the 8 SACs, knowl-

Figure 3.1.4. Coastal dunes with *Juniperus* spp. (2250). Special Areas of Conservation with reported occurrences of the natural habitat type in Denmark. The sites are centred in the Special Areas of Conservation. The boundary between the Atlantic region and the Continental region is shown on the map.

edge of the extent of this type seems to be almost complete. It is also thought that these areas represent the total extent of the Danish resource of this community.

Structure and function

The long-term maintenance of this natural habitat type is considered to be dependent on the grazing intensity, scrub encroachment, recreational erosion, the extent of disturbance/erosion, and on the atmospheric deposition of nitrogen.

Moderate to heavy shrub encroachment was observed at more than 70% of the localities. Apart from one locality where the invasion of sea buckthorn and bushgrass prevents the junipers from regenerating, the invading plants are primarily trees such as oak, pine, spruce, and birch.

At reported localities, 70% are being grazed. Grazing is often combined with removal of trees and in three cases clearing of junipers also occurs. The community type is difficult to maintain in the long term. The natural successional trend will always be towards climax woodlands. Clearing of scrub may therefore be essential to halt succession, and in order to support the regeneration of junipers the maintenance of grazing is also crucial. At 70% of the localities trees have already been or are going to be removed to safeguard the survival of this natural habitat type. Erosion as a result of recreational pressure is considered to be heavy at 20% of the localities.

The National Environmental Research Institute has calculated the critical load for decalcified fixed dunes with *Empetrum nigrum* (natural habitat type 2140) to be between 10 and 15 kg nitrogen ha^{-1} $year^{-1}$ (Tybirk & Jørgensen 1999). As the present annual deposition in type 2250 is likely to be at approximately the same level, there is a risk that the long-term stability of this natural habitat type may be threatened by this source of environmental change. The growing nutrient load is presumed to inhibit the regeneration of junipers, as this species can only sprout in mineral soil and is sensitive to competition from dense vegetation in its early phases of growth. From the reports it appears that eutrophication has not been studied in detail. One reports refers to a general 'homogenisation' of the ground flora and in another report, nearby manure tanks are mentioned as presenting a local risk of eutrophication.

Typical species

The only species stated in the Interpretation Manual to the Habitats Directive is juniper *Juniperus communis*. This species is present at all localities. At four of these, denser juniper stands are considered a management objective, while at another, there is the potential for great spread of the species over the habitat available.

In most localities the type is associated with fixed dune heaths with a dominant vegetation of *Calluna vulgaris, Empetrum nigrum* and *Deschampsia flexuosa* but it has also been located in grey dunes (type 2130) and green dunes. At a few localities species associated with acidic fens and calcareous fens are present.

At one locality specific action has been taken to protect the red-listed species, barred warbler breeding in dry south-facing scrub.

Conservation status

The conservation status of natural habitat type 2250 is assessed to be favourable (Table 3.2), because of the protective action taken. Rather than a decline in this habitat type, the present extent of this community may spread locally (at the cost of bordering woodland) as grazing is planned to be extended to part of the woods in some areas.

The assessment of the national geographical range of the community type is certain, as it is easy to define and map. However, the assessment of the conservation status is uncertain, as it is unknown how the long-term nitrogen deposition will influence the regeneration of junipers. In quite a few cases the management measures have included clearing of juniper shrub to facilitate grazing. The results of this management process are unknown and the knowledge necessary to evaluate the succession processes in relation to the conservation status of the type is not available.

3.1.5 6120* Xeric sand calcareous grasslands

The type is defined as dry, open grasslands on calcareous sand characterised by a high proportion of annuals in the vegetation and a prominent continental flora component. The type is described from southeastern Sweden (Olsson 1974) where it is characterised by extremely dry calcareous sandy soil and many rare species. Cultivated grass fields and fallow land are not included in the Habitats Directive.

In Denmark, this community type is known from both previous and recent studies of grasslands (Bruun & Ejrnæs in press). These studies show that the Danish grassland vegetation is mainly characterised by dry grasslands hosting a vegetation composition primarily determined by a dry microclimate resulting from a south-facing exposure combined with a dry and warm local climate. These dry grasslands can be divided into 3 types, one type occurring on rich calcareous moraine formations, and two types occurring on sandy soils. The sandy-soil types can be considered as type 6120 if the sand is calcareous whereas the moraine type can be considered as type 6210. A definite distinction between the widely defined semi-natural dry grassland and scrubland facies on calcareous substrates (6210) and the narrowly defined Xeric sand calcareous grasslands (6120) requires an in-depth knowledge of the variety of Danish grassland vegetation.

Type 6120 mostly occurs on steep south-facing slopes along existing and former coastlines and in undulating moraine formations. The type is also known from beach ridges and calcareous dunes but is here classed with other natural habitat types occurring on beach ridges and in dunes. The type has a relict character serving as an important habitat for a wide range of rare, native species, e.g. *Potentilla cinerea, Petrohargia prolifera, Medicago minima, Scabiosa canescens, Carex ligerica, Pulsatilla pratensis, Veronica verna,* and *Festuca polesica.* The vegetation type also hosts a series of rare warmth-loving invertebrates.

Natural range

The community type is exclusively known in Denmark east and north of the line defining the extent of ice cover during the last ice age. Its main occurrence is in the Great Belt area but the literature also refers to significant occurrences on Møn, in northern Zealand around Isefjorden, on Bornholm (Hammeren and Boderne) and in Himmerland (Ejrnæs 1998). The biotopes are often small areas of slope characterised by the combination of calcareous sand and south-facing exposure.

Altogether 31 sites of this type have been reported. Twenty-nine examples of this community are distributed between 14 SACs. The remaining 2 examples are recorded from Stege Nor just outside habitat area 179. The remaining habitats are small, typically between 0.5 and 2 ha.

The community type is, in all probability, also present in several localities in SAC 47 in the southern part of Helgenæs (R. Ejrnæs, unpubl. data) and on a south-facing slope at Tissø in SAC 138 (Bruun 1997). The occurrence of type 6210 has been reported from Helgenæs and Tissø and it is likely that both types (6120 and 6210) occur at the localities. The type was previously known

Figure 3.1.5. Xeric sand calcareous grasslands (6120). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

from Hammeren in habitat area 160 and Samsø (Møgelskår and the northern east coast) in SAC 182. The type was possibly also previously occurring on Melby Overdrev (SAC 119), at Dybesø (134), at Korshage (148), at Stejlbanke south of Vester Egesborg (148), and at Lild dune plantation (185). It remains to be checked whether the type occurs on Nekselø and at Sanddobberne (135).

A review of the reported species lists suggests that in 5 out of the 31 occurrences the presence of type 6120 can be substantiated. (Røsnæs, Ristinge Cliff, Høvblege, Møns Cliff and Jydelejet). The type may be represented in 16 sites and a further 10 occurrences should rather be classified as being either 6210 or 6230. The following review of this community type will be based on the 21 (5+16) that are most likely to be representative of this type (Fig. 3.1.5). The digitisation of this community type has been carried out based on various sources of information and should therefore not be considered an appropriate measure of the true extent of the community. However, an estimate suggests that the extent of the community reported, including poorly documented sites is approximately 33 ha.

Structure and function

The combination of an extremely dry microclimate, calcareous, nutrient-poor soils and a strong gradient means that this type is very resistant to scrub encroachment. Stress caused by drought, lack of nutrients, and erosion make it difficult for woody plants to gain a foothold in the vegetation. Nevertheless, the type can become overgrown with woody plants (sloe, hawthorn, roses, and spindle tree) and extensive grazing with browsing of woody plants is considered to be an important factor for the long-term maintenance of this natural habitat type. The relative function of winter grazing versus summer grazing is unknown.

In coastal areas, extensive grazing areas have been converted into coniferous plantations and recreational summer cottage areas during the 20th century, a fact that has added to the threat of scrub encroachment. At many localities invasive species like Rugusa rose, Scots pine, and mountain pine are colonising dry sandy areas and these species must be regarded as a threat to the type, both directly and indirectly, in making the local climate milder and preventing the crucial erosion processes.

In 15 sites, scrub encroachment is stated to be a problem, in 6 occurrences the pressure exercised by the public is indicated to be a potential problem and in 5 occurrences eutrophication is stated to present a potential problem. In one occurrence, sludge was spread in 1999. The impact is not yet known but an estimate suggests that sludge application is irreconcilable with a long-term conservation of the natural habitat type.

Typical species

The Interpretation Manual (Skov- og Naturstyrelsen 1999a) on natural habitat types specifies 16 typical species, among which 9 species are known in Denmark: *Allium schoenoprasum, Cardaminopsis arenosa, Carex ligerica, Dianthus deltoides, Helichrysum arenarium, Herniaria glabra, Koeleria glauca, Petrorhagia prolifera* and *Sedum reflexum.* Apart from *Dianthus deltoides, Helichrysum arenarium,* and *Herniaria glabra* these species are rare. Additionally, more of the species specified are not particularly good indicators of the natural habitat type in Denmark as they are just as abundant or even more abundant in other natural habitat types. This is applicable to *Koeleria glauca,* especially occurring in dunes, *Heli-*

chrysum arenarium, Herniaria glabra and *Dianthus deltoides,* which specifically occur on dry lime-deficient sand soils, and *Allium schenoprasum* which occurs on beach rocks on Bornholm. Many populations of *Allium schenoprasum* and *Sedum reflexum* are thought to have originated from introductions from cultivated areas. Remaining species such as *Petrorhagia prolifera* and *Carex ligerica* are specifically associated with dry, sandy slopes.

To further assist in mapping the true extent of this community, the Danish Forest and Nature Agency has (in collaboration with NERI) and with reference to CORINE (Corine Biotopes Manual 1992) prepared a supplementary list of species characteristic of this type in Denmark. This list includes *Cerastium semidecandrum, Vicia lathyroides, Phleum arenarium, Aira caryophyllea, Trifolium striatum, Erophila verna, Myosotis stricta, Silene conica, S. otites,* and *Festuca polesica.* Several of these species also occur in other ordinary habitats, e.g. sandy fallow lands, although this does not qualify for a classification in this natural habitat type.

From Røsnæs one occurrence where the type is well documented has been recorded. The species specified from this locality are *Silene conica, Trifolium striatum, Aira caryophyllea, Cerastium semidecandrum, Dianthus deltoides, Helichrysum arenarium,* and *Phleum arenarium.* Several reports do include annuals typical of the natural habitat type (e.g. *Cerastium semidecandrum* and *Helichrysum arenarium*). Perennial species characteristic of south-facing slopes (e.g. *Phleum phleoides* and *Artemisia campestris)* have also been identified. Many of these reports also include species such as *Briza media, Plantago media, Poa compressa, Viola hirta, Centaurea scabiosa, Potentilla reptans,* and *Agrimonia eupatoria*. It is, however, assessed that these should rather be classed with the more broadly defined natural habitat type 6210. Quite a few reports include species such as *Rumex acetosa, Calluna vulgaris* and *Agrostis tenuis*, species suggesting the occurrence of the equally broadly defined grassland type 6230 occupying lime-deficient soil.

An assessment of whether occurrences with a well-developed vegetation of the species typical of natural habitat type 6120 are likely to be found within the SACs would require a more detailed survey.

Conservation status

The conservation status of natural habitat type 6120 must be characterised as uncertain (Table 3.2). The community type is particularly common on steep slopes where extensive grazing has stopped. Based on reports received, the vegetation type is considered to be decreasing as a consequence of scrub encroachment and this trend is thought to be generally representative of what is happening to the community type throughout Denmark. On the other hand, scrub encroachment is likely to proceed only slowly because of the microclimate and the nutrient-poor soil that characterises the habitat, and in most sites there is the potential to reverse the trend by reintroducing extensive grazing. Reintroduction of grazing is, however, complicated by the fact that it is difficult to fence the areas, that they provide poor-quality grazing, and that they are often isolated in the neighbourhood of private summer cottage areas.

3.1.6 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia)* (*important orchid sites)

Description

The semi-natural habitat type 6210 is defined as grasslands and scrubland on calcareous to neutral substrates. The vegetation type is considered a priority type if it is an important orchid site, which means habitats hosting many orchid species, at least one red-listed orchid species or an important population of a less common orchid species. Grass fields and fallow lands are not included in the Habitats Directive.

This vegetation type is very broadly defined and includes most of what in Denmark is defined as calcareous grasslands (Bruun & Ejrnæs in press).

The vegetation comprises calcicole plants growing on several different soil types, on flat ground, but also on slopes with varying sun exposure. Exceptions are communities and localities in green dunes that are classified as type 2130 and those localities on very dry calcareous sand that fall within type 6120. In areas where the calcareous content has been wholly or partially washed out (pH 6-7) the community type represents a transitional stage towards type 6230; in such cases, the species composition will determine the appropriate classification. In fresh beach ridge hollows and at the edge of calcareous fens this community type may be in transition towards type 7230. In clearings in woodlands there may be a gradual transition into several different forest types. Areas of dry scrub (e.g. hawthorn, rose, sloe, hazel, spindle tree, apple, elder, dog-berry and other species) are considered to belong to this type if they represent invasion stages of dry grassland vegetation.

The type is prevalent on calcareous moraine slopes along extant and former coastlines, in river valleys, and in lateral moraine formations. The important orchid sites are most abundant in association with the calcareous soils on Møn, central Zealand, and in Himmerland.

Natural range

The type is almost exclusively found north and east of the limit to glacial cover where it occurs in most undulating landscapes. The community is now rare and has declined tremendously because of cultivation, planting, fertilisation and scrubbing over of dry grasslands throughout the last 200 years. This decline is illustrated by the decline in the characteristic species, Dark-winged Orchid, which used to be known from about 50 localities, especially on Zealand, Funen and Bornholm but is now only known to occur at two localities in Jutland (Ejrnæs et al. 1998).

In all, 38 sites of the type have been recorded, all located within or partially within the SACs. Ten localities were originally recorded as type 6120 but these have been revised and are now classified as type 6210. Twenty-two localities are assessed to be priority natural habitat types on the basis that they host important populations of one or more orchid species. These 22 priority

Figure 3.1.6. Semi-natural dry grasslands and scrubland facies on calcareous substrates (6210). Reported occurrences of the semi-natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

habitats are distributed between 9 SACs (Fig. 3.1.6). The extent of these habitats varies from 0.2 ha to approx. 30 ha. However, the extent of the habitat has been digitised on the basis of different information sources and is thus not appropriate for an accurate account of the total area of coverage. However, based on anecdotal accounts and a rough assessment of the material relating to several key species, it is estimated that there is approx. 284 ha of this community type in Denmark. The 16 non-priority sites are considered to represent a small random selection of the community types already well represented in the SACs and so these are not considered further here.

It is thought that the current mapping of 6210* (with orchids) does not fully cover the occurrence of the type within the SACs. The type is known to occur in SAC 20 where two nationally significant orchid species, Dark-winged Orchid and Lady's Slippers Orchid are known to occur.

Structure and function

The habitat type 6210 is a semi-natural type, i.e. the maintenance of the type is dependent on grazing or mowing to halt the succession towards woodland. On very dry or very calcareous slopes, scrub invasion proceeds very slowly and certain species have been suggested as post-

glacial relicts, for example *Polygala amarella, Draba incana, Cineraria integrifolia, Prunella grandiflora, Pulmonaria angustifolia* (Bruun & Ejrnæs 1998). The type is often found on potentially fertile, naturally oligotrophic to mesotrophic soils and has therefore been exposed to fertilisation and cultivation for a long time. Fertilisation and cultivation cause irreversible changes to this community. The habitat type is also considered to be sensitive to dry and wet deposition of airborne nitrogen compounds that may accelerate the scrub development and shift the vegetation towards tall competitive species. Supplementary feeding of livestock on the sites may lead to eutrophication.

The general trend of deterioration in the habitat type is illustrated by recent repeated studies in 1989 of slopes where the vegetation was mapped by Böcher and Fredskild in 1940 and 1951 (Feilberg 1990). This study proved that the vegetation on gentle slopes originally supporting closed herbaceous vegetation had changed significantly. One third of the slopes were completely overgrown with woody plants, many of the other slopes had been invaded by tall meadow oat. Most slopes exhibited an unmistakable decline in species associated with nutrient-poor soils and the invasion of typical farmland species was frequently observed.

Even though the habitat type is dependent upon grazing for its continuation, it is not possible to define the optimum successional stage and hence stocking density in practise. Some species are associated with tall-growing vegetation, others are associated with wood fringes and gaps, e.g. *Cypripedium calceolus, Orchis insectifera, Orchis mascula, Dianthus armeria, Trifolium alpestre, Inula conyza, Melampyrum cristatum, Vincetoxium herundinaria, Satureja vulgare*. This community type has almost disappeared from the landscape following the cessation of grazing in the woods as a result of the Forest Preservation Regulation, after which the borders between wood fringes and the open agricultural landscape became sharply delimited. Other species are more typical of open grassland with both tall and short vegetation, e.g. *Gentianella* spp., *Carex montana, Polygala* spp., *Potentilla* spp., *Inula spp., Petrohargia prolifera, Orchis ustulata*. In small habitat units it can be difficult to strike a balance in grazing intensity that avoid both scrub invasion and overgrazing. It is important to note that scrub also occurs in this type, although such conditions are rarely conducive to the presence of orchid species.

Special conditions apply to the orchids typical of 6210*. The reproductive strategy of the orchids is characterised by their abundant production of small seeds, which provide an enormous capacity for dispersal but carries the cost of very limited competitive ability in the juvenile phase. Hence, the critical factor in the long-term maintenance of a population is not just seed production but relates to their chance of becoming established. Livestock grazing, the behaviour of animals and other sources of disturbance are therefore very important.

Scrub encroachment is the most frequently (16 sites) documented cause of change at the 22 type 6210* sites. Of 16 sites currently being overgrown, 12 localities are presently grazed but it is uncertain whether this management measure is sufficient to counteract further scrub invasion. At 5 sites scrub invasion is considered to be an acute threat, and eutrophication threatens 3 other sites.

Typical species

The community type is characterised by a wide variety of species, which in Denmark are: *Anthyllis vulneraria, Arabis hirsuta, Brachypodium pinnatum, Bromus inermis, Campanula glomerata, Carex caryophyllea, Carlina vulgaris, Centaurea scabiosa, Koeleria pyramidata, Leontodon hispidus, Medicago sativa* spp. *falcata. Orchis insectifera, Orchis mascula, Orchis morio, Orchis purpurea, Orchis ustulata, Primula veris, Sanguisorba minor, Scabiosa columbaria, Bromus erectus,* and *Silene otites.*

There is also a number of more common species that are good indicators of calcareous dry grasslands. The species can be grouped in species reflecting old, unfertilised dry grasslands, e.g. *Linum catharticum, Viola hirta, Cirsium acaule, Briza media, Thymus* spp. and *Filipendula vulgaris* and species that are good indicators of a high soil pH, e.g. *Carex flacca, Dactylis glomerata, Prunella vulgaris, Plantago media* and *Medicago lupulina.* The range of species present reflects the fact that this community type occurs on both

humid north-facing slopes and on dry south-facing slopes.

In the reports received relating to this habitat type, the vegetation present shows a representative selection of the typical species. Amongst these are the following orchid species: *Orchis mascula, Orchis morio, Dactylorhiza fuchsii, Platanthera chlorantha, Orchis purpurea, Cepalanthera damasonium, Listera ovata, Epipaetis atrorubens, Amacamptis pyramidalis, Cephalanthera rubra, Herminium monarchis, Cypripedium calceolus,* and *Orchis ustulata*. However, the species lists reflect that they originate from different plant communities and it is estimated that some of the species rather occur in bordering forest or mire types.

The populations of species such as *Orchis ustulata, Cypripedium calceolus*, and *Amacamptis pyramidalis* are so small and isolated that their conservation status can not be assessed as favourable. The same is true for species considered to be extinct, such as *Coeloglossum viride* and *Spiranthes spiralis*. *Orchis ustulata* previously occurred in many different habitats, and it is considered that this species in particular has the potential to expand given the appropriate management and restoration of conditions within its habitat niche.

Conservation status

The conservation status of 6210* must be assessed as uncertain (Table 3.2). It is essential that many of the important recent orchid sites are subject to some kind of management and monitoring activities and this, to a large extent, is the case within the SACs. Despite these measures, many sites are becoming overgrown and many orchid populations are so small that their long-term survival is uncertain. Airborne nitrogen deposition is a potential threat, but the extent of this problem has not been studied.

The less well-documented community type 6210 sites without orchids are currently undergoing a dramatic decline because of lack of adequate grazing and eutrophication, and as many of these sites are potential orchid sites, the decline contributes to the negative prognosis for 6210*.

3.1.7 6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Description

Type 6230 is defined as semi-natural grasslands on decalcified substrates. A prior condition for this definition is that the vegetation has not been subject to fertilisation or cultivation. The type is highly varied, characterised by species such as *Nardus stricta, Deschampsia flexuosa, Agrostis capillaris/Festuca ovina* and *Carex arenaria*. *Nardus stricta* is thus not a strict prerequisite to qualify for type 6230. *Nardus stricta* is a hydrophyte preferring the precipitation-rich areas of the country and spring fed areas in dry grasslands (e.g. on cool slopes) or areas where the ground-water level is high (e.g. hollows on raised marine deposits). Therefore, only a small fraction of Danish acidic dry grasslands will be characterised by *Nardus stricta*. The title of the type and the typical species specified in the Interpretation Manual suggest a narrow sub-type of very acidic dry grasslands thus creating some difficulty in precisely defining the type. The habitat type includes scrub vegetation but not really dominating dwarf-scrub vegetation. *Calluna vulgaris, Vaccinium myrtillus,* and *V. vitis-idaea* occur sporadically in the herbaceous vegetation. Species-poor sites, e.g. grassland heaths with bent grass *(Deschampsia flexuosa)* and a few companion species are excluded.

The type represents Denmark's most common semi-natural grassland type (Bruun & Ejrnæs 1998). It occurs on many different types of ground and soils both inland and along the coasts. In fixed dunes a vegetation type floristically identical to this type also occurs but here the vegetation is classified as type 2130, fixed dunes with herbaceous vegetation. Like the other semi-natural grassland types, type 6230 is particularly typical of marginal soil types, on slopes not suitable for cultivation or at localities with large stones.

The richest sites are often associated with either

moist areas or dry, warm areas. In such areas leaching, acidification and formation of a crude humus layer are presumably limited by the input of mineral-rich ground water or by the high evaporation. In wet habitats with spring lines (slopes) or a high ground-water level (hallows on marine forelands) rare species occur, e.g. *Arnica montana, Platanthera* spp., *Gentianella campestris, Leucorchis albida, Botrychium, Dactylorhiza sambucina*, but also more common species such as *Lathyrus linifolius, Succisa pratensis, Hypericum pulchrum, Rhinantus minor* and *Ranunculus ocris* occur. In warm, dry habitats species such as *Hypochoeris maculata, Anthericum liliago, Pulsatilla vulgaris, Potentilla* spp., *Dianthus superbus, Festuca ovina, Silene nutans, Dianthus deltoides* and *Taraxacum* spp. occur.

The richest sites are typically characterised by a floral element from calcareous grasslands such as *Leontodon hispidus, Perimula veris, Leucanthemum vulgare, Briza* (wet type), *Avenula pratensis, Thymus pulegioides* and *Filipendula vulgaris* (dry type).

Natural range

The type is widely distributed in Denmark occurring on both sides of the line defining the maximum extent of ice cover. However, the habitat type has become relatively rare and has been declining considerably throughout the last 200 years because of cultivation, planting, fertilisation and overgrowth of dry grasslands. This decline can be illustrated by the declines in distribution and abundance of the orchid species *Leucorchis albida* and *Dactylorhiza sambucina*, species formerly abundant but which are now only known from very few localities (Ejrnæs et al. 1998).

Type 6230 is recorded from 35 sites totalling an area of approx. 245 ha, distributed over 16 SACs. Another 2 sites of approx. 8 ha (Fig. 3.1.7) have been recorded. Based on the species list five localities recorded as type 6210 or 6120 have been classified as 6230. Based on a scientific review of the Danish grassland vegetation (Bruun & Ejrnæs in press) the community type also occurs in the SACs 13, 16, 20, 25, 47, 127, 134, 163, 184, 185. However, the habitat type has not been reported from the counties of Viborg and Northern Jutland where it is supposed to be quite common. Hence, the current status only includes a small to moderate proportion of the total occurrence in the SACs. The present geographical abundance and range of this community type in Denmark is therefore still very incomplete.

Structure and function

Type 6230 is a semi-natural habitat type and its maintenance is conditional on retention of grazing or mowing to halt the succession towards woodland. The majority of this habitat type originates from clearing of wood and subsequent grazing and the long established continuity as an open community is a prior condition for the development of the characteristic vegetation. Many of the species characteristic of this habitat type have a wide ecological amplitude and also occur in light open forest situations. Some species are, however, also closely associated with completely open and light conditions. It is not known to what extent light, open, calcium poor conditions prevailed prior to the Stone Age in the Danish landscape. Most probably such areas may have existed on slopes and marine forelands associated with natural erosion (landslides, water and wind erosion). Grazing livestock or mowing are nowadays factors imperative to ensure the long-term conservation of this type in most areas. The type is associated with

Figure 3.1.7. Species-rich *Nardus* grasslands, on siliceous substrates (6230). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

oligotrophic soils and may be destroyed by eutrophication.

From the reports it appears that scrub invasion is considered to be the most important negative factor for a long-term conservation of this habitat type. Of the reported sites, 17 (representing a total of 150 ha, half of the localities and half of the area) are exposed to encroachment by woody plants. In 10 sites, scrub invasion is characterised as an acute threat. The majority of these sites are, however, managed by grazing or mowing and presumably this management will, in the long term, stabilise the present state. It is, however, estimated that the recorded loss to scrub of 50% is not representative of the status of the type as it is expected that the majority of the registered sites are well-known localities already subject to some level of management and monitoring measures.

Eutrophication is only reported to be a threat at three localities. At two of these, the threat is due to adjacent cormorant colonies. However, it appears that the eutrophication risk is purely based on local opinion and it should be noted that in contrast to scrub invasion, the effects of eutrophication are very difficult to observe by inspection or monitoring.

Typical species

The Interpretation Manual specifies a range of typical species, of which the following occur in Denmark: *Antennaria dioica, Arnica montana, Carex ericetorum, C. pallescens, C. panicea, Festuca ovina, Galium saxatile, Gentiana pneumonanthe, Hypericum maculatum, Hypochoeris maculata, Lathyrus montanus, Leucorchis albida, Nardus stricta, Pedicularis sylvatica, Plathantera bifolia, Polygala vulgaris, Potentilla erecta, Veronica officinalis* and *Viola canina*. A number of the species specified are good indicators of a long continuity of management and unfertilised conditions on Danish grasslands. The narrow species selection specified in the Interpretation Manual is not adequate for the wide variety of species in Denmark and with reference to CORINE (Corine Biotopes Manual 1992) the following common species can also be considered indicative of the habitat type here: *Carex pilulifera, Deschampsia flexuosa, Danthonia decumbens, Anthoxanthum odoratum, Festuca rubra, Agrostis capillaris, Poa angustifolia,* and *Calamagrostis epigejos*.

To the extent verifiable by a species list, the recorded localities for this community type have a first-rate representation of typical species. Nevertheless, there is evidence of a very strong decline in a wide range of typical species during the last 50 – 100 years (e.g. *Hypochoeris maculata, Plathantera bifolia, Leucorchis albida* and *Arnica montana*). For the most rare typical species or red-listed species occurring in this habitat type, the status is considered to be critical if a further population decline (through scrub encroachment or fertilisation) is not avoided. That applies to species such as *Leucorchis albida, Dactylorhiza sambucina, Gentianella campestris, Botrychium simplex* and *Anthericum liliago*. *Orchis spp., Botrychium* spp. and *Gentianella* spp. are poor competitors in their juvenile phase and amongst the *Gentianella* spp., the short-lived seedbank further restricts its ability to persist amongst aggressive competitive species. It is uncertain whether the regeneration abilities of these species are today being adequately considered in the management of their habitats.

Conservation status

The conservation status of 6230 is considered unfavourable (Table 3.2). Extensive scrub encroachment, lack of knowledge of the natural range of the community type and lack of representation in the SACs contribute to the negative assessment. Small isolated populations of typical species are supposed to be exposed to continuous local extinction as a consequence of the decline in the natural habitat type during the latest 200 years. However, on a positive note, it should be emphasised that the decline is being checked as a result of Section 3 of the Protection of Nature Act, which provides general protection against further cultivation and fertilisation. However, how effective these measures have been in achieving a slow-down can not be verified.

3.1.8 7110* Active raised bogs

Description

Type 7110, active raised bogs, is characterised by so much peat formation over a sufficient number of centuries that the bog typically receives only atmospheric water as recharge (ombotrophic water saturation). The raised bog is therefore lime-deficient, acidic and extremely poor in nutrients. The peat is primarily formed by the characteristic raised-bog mosses *Spagnum cuspidatum, S. rubellum* and *S. magellanicum*.

The term 'active raised bog' refers to the fact that an active peat formation of the raised bog must be ongoing. Raised bogs, which for natural reasons might be temporarily not growing, for reasons such as a period of drought, are also included. To support the conservation of this unique ecosystem over its geographic range, areas of a lower 'quality', e.g. partially degraded raised bogs are also included and should, where practicable, be regenerated. (Anon. 1996).

Only a few species of vascular plants and mosses can survive in this extremely nutrient-poor, acidic and wet environment. The natural habitat type is dominated by sphagnum mosses.

The Danish monitoring of raised bogs has focused on the surface relief of the raised bog (Risager & Aaby 1996, Risager & Aaby 1997, Risager 1999) but apart from the raised bog surface it also includes the margin bog zone and the lagg, being a wet zone around the raised bog.

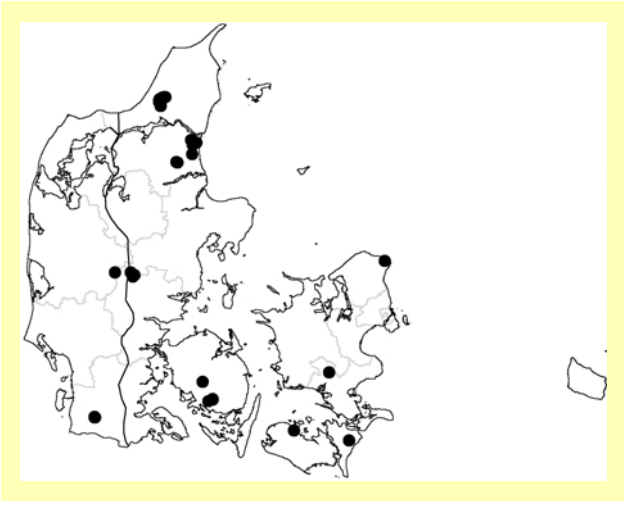

Figure 3.1.8. Active raised bogs (7110). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

In cases where heavy drainage, peat digging, eutrophication and the early stages of immigration of species atypical of raised bogs have modified this community, the habitat type is classified as 7120, degraded raised bogs with the potential for regeneration. Danish experts on active raised bogs are of the opinion that bog woodlands do not naturally occur in Denmark (M. Risager, pers. comm. 2000). Drained, dug-out and eutrophic raised bogs which are now covered by wood should be considered a cultural modification of this habitat type, not comparable with the naturally occurring bog woodlands in, for example, the Baltic countries.

Natural range

This natural habitat type was common in the past, but nowadays it is rare in Denmark and almost everywhere threatened by drainage and eutrophication-related overgrowth (Risager & Aaby 1996, Risager & Aaby 1997).

The southern part of Lille Vildmose, Tofte Mose, is the biggest active raised bog in Denmark and one of the largest in the European lowlands. The area of about 2,000 ha represents approx. 2/3 of the totally reported area.

In two other large active raised bogs Store Vildmose and Homegårds Mose minor parts are still assessed to qualify for the definition active raised bog even if the major part has been disrupted by drainage. Data from 17 bog areas have been reported and the raised bogs in Lille Vildmose, Store Vildmose and Draved Mose have been divided and recorded on several forms. Altogether data from 22 raised bog areas totalling 3,375 ha distributed over 12 SACs have been reported (Fig. 3.1.8). Møllelung Mose and Stenholt Mose have been reported, but they are located outside SACs. Stenholt Mose, which is the third-largest bog area, is considered to be highly worthy of conservation (M. Risager, pers. comm. 2000).

In total, 22 raised bog areas are included in the national programme monitoring Danish raised

bogs (Risager & Aaby 1996, Risager & Aaby 1997). Data from almost half of these areas have not been received. Three of those monitored, but not reported active raised bogs occur in SACs, e.g. Tvilling Mose, Hatten and Langkær Mose (from SACs 41, 41, and 49, respectively). Letmosen is located just outside SAC 41. The remaining four raised bogs covered by the monitoring programme and which still contain remnants of active raised bog (Bølling Mose, Svane Mose, Abkær Mose, and Brandstrup) are located outside the SACs. Four of the reported localities (the raised bogs in Langbjerg Plantation, Nybo Mose, Storelung, and Horreby Lung) no longer qualify for the category 'active raised bog' but should be categorised as type 7120 (M. Risager, pers. comm.). The reported information is thus not representative of this habitat as a whole in Denmark.

The reported data only provides restricted background data for the assessment of whether the natural habitat type has a stable range or is declining. Based on the data reported, primarily including information on structure, it is estimated that the area of mire at one locality is increasing, one is stable, 8 are declining, and the status of 12 localities can not be assessed.

Structure and function

Several of the recorded raised bogs have a very long history dating back several thousands of years. Their history is documented by analyses of several metres of thick peat layers. However, this unique, long-continuity ecosystem has been seriously damaged during the last 200 years owing to drainage, peat digging, and cultivation. In addition, this extremely nutrient-poor habitat type is threatened by nitrogen deposition, which has doubled since the 1950s (Risager 1999). The impact of drainage and nitrogen respectively is difficult to distinguish, as the drainage will also result in eutrophication because of the increased mineralisation of the substrate. Finally, the integrity of this habitat type may also be damaged by intensified agricultural activity, including vehicular access and grazing.

The decline in *Cladonia portentosa* on monitored raised bog areas has, however, been taken as an indication of the negative effects of nitrogen deposition rather than drainage (Risager & Aaby 1996). The fact that eutrophication is heavily influencing the natural habitat type and the vegetation composition has been known for a long time and was described at the beginning of the last century (Petersen 1917). Nitrogen deposition can affect vegetation composition in different ways, for instance by favouring dwarf bushes and trees, which will out-shadow herbs and mosses. Increased nitrogen absorption can probably affect the frost resistance of some species, thus modifying competitive interactions between species. There is, however, no doubt that both eutrophication and drainage have a negative impact on the raised bogs leading to further desiccation and scrub encroachment.

The reports show that the majority (18) of the localities are subject to different monitoring methods. In total, 7 different monitoring methods with 5 different intensity levels have been reported.

Five localities are reported to have become drier, 6 are reported to be affected by eutrophication and 15 are subject to scrub encroachment. In 5 sites, sporting interests (digging of waterholes for ducks, unnaturally large populations of wild boars and red deer, pheasant re-stocking, followed by dumping of gizzard stones) are reported to have a negative impact on the natural habitat type. On this basis, the condition of the 15 localities is considered to be of unfavourable status.

Typical species

The raised bogs are extremely poor in vascular plant species and none of these are exclusive to this natural habitat type. Thus the vegetation of the raised bog can not be exclusively defined based on vascular plants, and it is essential to also include the sphagnum mosses. The typical vascular plants specified in the Interpretation Manual are: *Andromeda polifolia, Drosera rotundifolia, D. anglica, D. intermedia, Eriophorum vaginatum, E. gracile, Oxycoccus palustris, Calluna vulgaris, Empetrum, nigrum, Carex limosa, C. pauciflora, Rhynchospora alba, R. fusca, Scheuchzeria palustris, Utricularia intermedia, U. minor, U. ochroleuca*. Other typical species are *Sphagnum magellanicum, S. angustifolium, S. imbricatum, S. fuscum,*

S. balticum, *S. majus*, *Odontoscisma sphagni*, and *Cladonia* spp.

The vegetation of raised bogs in Denmark has been extensively researched and monitored and a species list more adequately covering the Danish species has been produced (Risager & Aaby 1996, Risager 1999). Basic species mentioned are: *Calluna vulgaris, Erica tetralix, Empetrum nigrum, Andromeda polifolia, Oxycoccus palustris, Eriophorum angustifolium, Eriophorum vaginatum, Trichophorum caespitosum, Rhynchospora alba, Drosera rotundifolia, D. anglica, D. intermedia*, and *Rubus chamaemorus*. Twelve sphagnum mosses have been identified as being typical native species of Danish raised bogs: *Sphagnum magellanicum, S. tenellum, S. compactum, S. cuspidatum, S. rubellum, S. capillifolium, S. fuscum, S. papillosum, S. molle, S. angustifolium, S. imbricatum* spp. *austinii*, and S. *subtines*. It should be noticed that there are essential differences between this species selection and the selection specified in the Interpretation Manual, differences that can not all be explained by the fact that the manual includes the margin and lagg zones.

Based on the existing research and monitoring programme in Denmark it is also possible to list some indicator species known to appear in the raised bog vegetation when the natural habitat is subject to undesirable change. These species are: *Dryopteris carthusiana*, *Carex nigra* (note that the latter species is specifically listed as a typical raised bog species in the Interpretation Manual), *Molinia coerulea, Deschampsia flexuosum, Vaccinium uligonosum Chamaenerion angustifolium, Picea abies, Vaccinium vitis-idaea, Sphagnum fallax, S. palustre* and S. *fimbriatum*.

Raised bog vegetation is the only Danish natural habitat type not hosting any grass species. However, *Molinia coerulea*, has been recorded in half of the habitats suggesting that unnatural conditions prevail on these raised bogs.

The general impression from the species data reported does not enable an assessment of the quantitative and qualitative occurrence of the species over time. The data reported on typical species vary enormously between sites. At five localities, a species list (including *Menha aquatica, Epilobium palustre, Phalaris arundinacea*, and *Mysotis palustris*) proves that the species list was compiled from habitats beyond the boundaries of the true raised bog habitat type. Five reports do not distinguish between the various *Sphagnum* species. It is, however crucial to distinguish between the species to be able to follow the development of the hummock-hollow structure, thus enabling an assessment of the conservation status of the raised bog.

Where monitoring data are available, they have been included in the general assessment, however, with the proviso that the available vegetation data are primarily derived from the active part of the raised bog surface. It is considered that the conservation status of the typical species is unfavourable at 5 locations, that the species are well represented at 10 sites and that the conservation status remains unknown at 7 sites.

An adequate Danish species list can not be compiled for the lagg (floristically very closely related to extremely poor fen) and the margin bog zones.

Conservation status

The national conservation status of natural habitat type 7110 is considered to be unfavourable (Table 3.2). The assessment is considered to be reliable as more than half of the habitats are included in some sort of monitoring. More than 90% of the 22 reported localities are assessed to have an unfavourable conservation status. This assessment is primarily based on the relatively high number of raised bogs facing problems with drainage and eutrophication-related changes in vegetation. Also sport-hunting interests are mentioned as influencing some raised bogs unfavourably.

Monitoring data (Risager & Aaby 1996, Risager & Aaby 1997) support this conservation status assessment. In the period from 1987/1989 to 1995/1996 the hummock vegetation on the raised bogs has generally been increasing. Changes in vegetation composition, including invasion of scrub, is not thought to be exclusively due to desiccation but it is probably also caused by increases in atmospheric nitrogen deposition (Risager & Aaby 1997).

It should be noted that the monitoring has pri-

marily focused on the raised bog surface and that the knowledge of species and processes in the lagg and margin zones is deficient.

3.1.9 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*[1]

Description

Type 7210 is defined as vegetation on wet to flooded soil dominated by or with a considerable component of saw grass, *Cladium mariscus*. It mostly occurs as dense beds along the fringes of lakes and mires but may also occur as a succession stage of fens and wet meadows. The type primarily occurs on calcareous soils and often in association with alkaline fens, but it may exceptionally also develop on lime-deficient soils. Areas supporting other fen and reed-bed vegetation found in combination with *Cladium mariscus* vegetation also fall within this classification. However, if *Cladium mariscus* is not locally dominant, the biotope should not be classified within this type.

Cladium mariscus will occur on oligotrophic soils where it successfully out-competes other species at localities that are too wet for scrub vegetation and too dry for reed beds (Rodwell 1995). Whether the vegetation type can be considered as a 'wandering climax community' shifting in response to natural hydrological changes (including terrestrification and invasion by woody plants) remains uncertain. In eutrophic habitats, other 'reed bed' species, e.g. common reed, oust *Cladium mariscus*.

Natural range

The community type is restricted to south-eastern Denmark, with the most abundant and largest sites on Bornholm, southern Zealand, Møn, and Lolland Falster (Mossberg & Stenberg 1994). Overall, the habitat type is relatively rare in Denmark and occurs predominantly in small and scattered areas.

Figure 3.1.9. Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (7210). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

The type has been recorded at 32 sites, approximately 270 ha in 10 SACs (Fig. 3.1.9). Two localities support more than half of the total area: Søndersø near Maribo (13 habitats of 96 ha) and Ølene on Bornholm (65 ha). Only one small site has been reported in Jutland. Another area of 0.7 ha has been recorded outside the SACs. It is considered that the most extensive Danish *Cladium mariscus* areas are included within the SACs but it is likely that missed examples of this community type also exist at a few other small localities outside the SACs.

Considering the nature of the community type (as is the case for other oligotrophic wetlands), its present range is thought to constitute only a small part of its former range occupied a few hundred years ago, before drainage and cultivation of swamps and mires really accelerated.

Structure and function

A wide range of conditions is considered vital for the long-term maintenance of this vegetation type. The most important features are the hydrological regime, the level of eutrophication and the intensity of grazing and mowing. English studies show that a high, and preferably

[1] The plant community class *Caricion davallianae*

relatively stable, ground-water level, an absence of eutrophication caused by fertilisation, drainage water and nitrogen deposition are important preconditions for the type (Rodwell 1995). No precise studies of the consequences of grazing intensity are available, but experience gained by the counties suggests that the grazing intensity in certain mires may be decisive for the balance between species-rich alkaline fens (type 7230), species-poor *Cladium mariscus* vegetation (type 7210), and woody plant vegetation, and thus for the long-term conservation of the type. In habitats on calcareous soils with a high ground-water level and a low nutrient content, the community type is supposed to be relatively resistant to overgrowth with woody plants.

For the recorded sites, the most frequently quoted threats to the conservation of this type are woody plant encroachment (by such species as common alder, willow and birch species (7 sites) and lowering or raising of the water level (4 sites). At four localities, eutrophication (as a consequence of agricultural activities in the immediate environment) poses a substantial threat to the sites. In total, 17 sites, among them several of the largest, are reported to be subject to scrub invasion at various stages. However, whether the encroachment is occurring in the reed bed or about its periphery is not clear. In the only recorded occurrence in Jutland, Skærbro Kær near Århus, scrub encroachment is so rapid that the community type is disappearing. One of the most extensive localities, Søndersø in SAC 156, is unique in having a very favourable conservation status for the structure and function of the type and has shown considerable benefit from raised water levels, which took place in 1998. Although scrub encroachment was reported as the most critical threat, this may be because this change is easier to verify than more subtle hydrological changes and eutrophication. There are no available data to show the level of effects of eutrophication on sites overall.

Twenty-two sites are subject to some regular inspection. In the majority of these sites one or more plant species are monitored by counts. Only at one locality, Urup Dam on Funen, has effective monitoring been performed since 1984 by repeated analyses of the vegetation in a permanent test plot located in the grazed part of the fen. In the monitored test plot the vegetation type has proved robust to scrub encroachment by woody plants but there is an unmistakable trend that *Cladium mariscus* is being replaced by *Phragmites australis* and *Calamagrostis canescens*.

Recording and monitoring of the type 7210 habitats suggest that grazing is a precondition of conservation of alkaline fens (type 7230) which often occur in close proximity with type 7210 (Vinther 1987). Type 7230 supports many red-listed plant species, including species specified in the Habitats Directive. Even though grazing is estimated to be able to shift the balance between type 7230 and type 7210 in the less wet mires, grazing should not be considered a threat to type 7210, whose most important habitat is the wet reed bed.

Typical species

The only Danish species explicitly specified in the Interpretation Manual is *Cladium mariscus.* This species is, by definition, abundant in all localities. At four sites the species is reported to be increasing, probably as a consequence of the cessation of grazing in the natural habitat type 7230. One site is reported to be completely overgrown with woody plants and in this case the conservation status of *Cladium mariscus* must be characterised as unfavourable. In one occurrence the species is declining in a permanently monitored test plot. Data clarifying the status of the species are not available from the remaining 26 sites.

Apart from *Cladium mariscus* the most abundant species in the recorded sites are *Phragmites australis, Juncus submodulosus, Typha latifolia, Carex lepidocarpa,* and *Molinia coerulea*. Rare reed bed species and aquatic plants are *Samolus valerandi* and the red-listed *Teucrium scordium* and *Potamogeton coloratus* but it is not known whether these species can be considered to be typical of type 7210. Other species mentioned are supposed to be associated with alkaline fens (type 7230) occurring in contact with the type, including *Juncus submodulosus, Carex flacca, Parmassia palustria, Pedicularis palustris, Briza media, Limum catharticum, Pinguicula vulgaris, Dactylorhiza incarnata, D. najalis, Epipactis palustris* and red-listed species such as *Liparis loeselii,*

Gymnademia comopsea, *Salix rosmarinifolia*, and *Gentianella uliginosa*.

Conservation status

The conservation status of natural habitat type 7210 is assessed to be uncertain (Table 3.2). This assessment is based on a documented general decline in oligotrophic mires in Denmark and on the extensive overgrowth and unstable hydrology being reported from the habitats mapped. The monitoring of a test plot further suggests that other processes than scrub encroachment may threaten *Cladium mariscus*. The overall conservation status must be characterised as less certain, since time series are not available to clarify the status of the type in the mapped areas, especially in relation to important factors such as eutrophication, hydrology, mowing and grazing conservation management.

The assessment of the national range and status of the type is equally subject to uncertainty, as the current distribution outside the SACs is not known. In addition, the interpretation of the definition of the type is not consistent and the accuracy of the digitisation of the SACs during the registration process is of variable quality. It is for instance not possible to determine whether, as suggested by the reporting, the type is disappearing from Jutland.

However, it is considered that in general the SACs adequately represent the vegetation type in Denmark.

3.1.10 7220* Petrifying springs with tufa formation *(Cratoneurion)*

Description

Type 7220 is defined as hard water springs where calcium carbonate (travertine) is precipitated as a result of a fall in CO_2 partial pressure, for instance on mosses (calcium incrustation) eventually generating travertine or tufa formations. The type is permanently wet from seeping calcareous and mostly nutrient-poor water. The formations are found in such diverse environments as forests and open countryside. They are generally small point or linear formations dominated by mosses (including the typical species *Cratoneurion commutatum)*. The very wet, often nutrient-poor and calcareous formation with minimum temperature fluctuations means that trees and tall herbs experience difficult growing conditions. This does not mean, however, that the type represents a climax community. British studies prove that the type and its rare flora are favoured by animal grazing and trampling. The type can form complexes with transition mires, fens, heaths, and calcareous grassland. To preserve this natural habitat type, which has a very limited range, it is essential to preserve its surroundings and the whole hydrological system involved (Anon. 1996). As the vegetation type is dependent upon the whole hydrological system around the spring, it is necessary to differentiate the spring area and the diversified adjacent areas. However, none of the reports have made this differentiation, thus making the assessment of the conservation status of this natural habitat type very uncertain.

Natural range

This type is rare in Denmark and occurs in areas with calcareous formations in the subsoil in combination with spring fens or seeping ground water. The type is therefore primarily occurring north and east of the line delimiting the extent of the ice cover during the last ice age. In total, 36 sites distributed between 6 counties in 17 SACs (Fig. 3.1.10) have been recorded. Grejs River Valley in the county of Vejle contains nearly one third of all localities. Other counties have reported several spring areas on one data sheet making it impossible to assess each natural habitat type. The total reported area was approximately 103 ha. A Danish survey illustrating the expanse of this natural habitat type within the SACs has not been made, but there probably remain important areas outside the SAC network.

Structure and function

The combination of calcareous, nutrient-poor and cold water means that the natural habitat type is only slowly affected by tree and scrub growth. Nevertheless, the type may be over-

Figure 3.1.10. Petrifying springs with tufa formation (7220). Reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

grown with woody plants and there is no doubt that this natural habitat type with its typical species, primarily mosses, is negatively influenced by scrub invasion. Grazing and trampling or repeated scrub clearing are essential preconditions for the long-term maintenance of the type. The most serious threat to the natural habitat type is undoubtedly a lowering of the ground-water table. Eutrophication is another threat to the naturally nutrient-poor ecosystem. To obtain a favourable conservation status it is crucial to avoid any drainage or embankment and lime quarrying in the areas surrounding the natural habitat type.

For more than half of the sites (18) scrub invasion is reported to be a problem (4 unknown). Eight sites are reported to have become drier, 7 are reported to face eutrophication problems, and at 4 localities fishponds are reported to constitute a potential threat. Planned golfing greens and other construction works are also indicated as presenting a threat to the natural habitat type. The outcome is that structure and function of this fragile ecosystem are assessed to be unfavourable in 25 sites, 7 could not be assessed and 4 are considered to have a favourable conservation status.

Research on this natural habitat type in Denmark is minimal. Six sites are subject to monitoring (17%). At five of these localities individual species, typically orchids occurring outside the spring area, are being monitored. Monitoring of the entire natural habitat type is only taking place at one locality.

Typical species

The typical Danish species include five mosses *(Cratoneurion commutatum, C. commutatum var. falcatum, C. filicinum, Eucladium verticilliatum* very rare in Denmark, *Catoscopium nigritum* very rare in Denmark, and one vascular plant (*Pinguicula vulgaris)*. Qualitatively and quantitatively the mosses are the most important group of organisms in the central part of the natural habitat type, the water spring area (Rodwell 1991).

To assess whether the whole natural habitat type has a favourable conservation status, it is necessary to assess whether the conservation status of the typical species is favourable. The water spring area is actually the heart of the type and the most important typical species *(Cratoneuron commutatum)* occurs only in this area. Therefore, it is essential to record the mosses in the spring area, or as a minimum the *Cratoneuron*-species. Information on recording of mosses is only available from one habitat. An assessment of the conservation status of the typical species would require a time-series analysis. None of the data reported include a time series.

The occurrence of other species in the vicinity of the springs gives proof of a nature of conservation interest, as it hosts interesting species such as *Paludella squarrosa, Epipactis palustris*, *E. leptochila* and *E. atrorubens, Dactylorhiza incarnata, D. fuchsii*, and *D. najalis, Cephalanthera damasomium,* and *C. rubra, Corallorhiza trifida, Herminium monarchis, Monotropha hypopitys, Cypripedium caleolus, Epipogium aphyllym, Platanthera chlorantha,* and species of community interest *(Liparis loeselii, Saxifraga hirculus)*.

Conservation status

The conservation status of natural habitat type 7220 must be assessed as uncertain (Table 3.2). This assessment is particularly based on the relatively high number of localities, which are being invaded by scrub, and on the indications of

eutrophication reported. The uncertain assessment of the conservation status is due to the fact that first, the mapping is characterised by uncertainty concerning the definition and delimitation of the type, and second, that no time series are available to illustrate the development of the type in the mapped areas in relation to essential structural and functional impact factors such as eutrophication, hydrology, and management of grazing or scrub clearing. The assessment of the national range and development of the type are also subject to uncertainty as the recent distribution outside the SACs is not known, and the definition of the type in the reports is inconsistent. Finally, typical species have only been reported from one habitat.

3.1.11 9180* *Tilio-Acerion* forests of slopes, screes and ravines

Description

Type 9180 includes forest areas on gravelly or stony soils and sloping grounds with mixed deciduous forests with a distinctive component of at least one of the following tree species: ash, elm, lime or sycamore maple. Another defining feature is that no tree species should have a crown formation of more than 50%. The type occurs on slopes where intensive forestry and agriculture are difficult. As for the other priority forest types, the protection only includes forests not being subject to intensive forestry.

Figure 3.1.11. Tilio-Acerion forest of slopes, screes and ravines (9180). Special Areas of Conservation with reported occurrences of the natural habitat type in Denmark. The boundary between the Atlantic region and the Continental region is shown on the map.

The forest type occurs especially on calcareous but also on lime-deficient substrates. This forest type hosts several, very diverse plant communities, e.g. humid north-facing slope forests with species sensitive to withering and dry south-facing slope forests supporting more robust species. A Danish survey of the ecology and variety of the different vegetation types within this natural habitat type has not been made yet.

The successional stages of the type are not sufficiently known and it is therefore uncertain whether the type can be regarded as a 'climax community' on appropriate habitats. Slight changes in the conditions of the substrate or soil humidity can produce a transition towards beech forests or oak forests. In Denmark, the study and description of this community type is very incomplete.

Natural range

The type is relatively rare in Denmark, as it is primarily occurring at localities, hardly accessible for logging and handling machinery because of the undulating ground or administrative protection. The total reported area is 593 ha, representing approximately 1‰ of the total Danish forest area. The forest type is reported from 20 localities distributed between 16 SACs (Fig. 3.1.11). Quite a few of the largest localities have to be re-assessed and probably be excluded from the registration as they do not comply with the criteria of sloping ground and mixed growth. This applies to e.g. Frejlev Skov, Storskov, and Roden Skov on Lolland.

Structure and function

The most important preconditions for a long-term maintenance of the type are related to forestry. Clear felling or conversion to tree species not adapted to the locality are unquestionably the greatest threats to the natural habitat type. Drainage and traffic with heavy machines and intensive cutting are also estimated to present potential threats.

Lateral fertiliser displacement, ammonium deposition and pesticide drift are not considered to be critical threats to the habitat type, as is most often the case, as this community is invariably surrounded by other forest types. Where the vegetation type is not enclosed by a buffer zone, nitrogen fertiliser displacement from adjoining cultivated areas can have a particularly negative impact on the plant communities (both geophytes and epiphytes).

Of the 20 localities, 11 are near-shore forests growing on more or less sloping grounds (slope forests) with different sun exposures, 5 localities are bordering large lakes, and 3 localities are not close to any major wetlands.

The information on the soil characteristics is very inadequate and provides no opportunity for generalisation. Almost no data are available from 4 of the habitats.

It is a well-known fact that deadwood in great quantities is a fundamental structural parameter for the biodiversity in the forest-ecosystem, but there are no reported data on the occurrence of deadwood at the localities. The lack of information on deadwood can be explained by the fact that only 5 habitats have been visited within the last 5 years. Continuity is of vital importance for many species but for only 25% of the sites is there information relating to designation as a natural forest habitat.

Eight localities have been designated as untouched forests, 5 are subject to extensive forestry practising the coppice method or selective felling, 2 are still subject to continuously moderate forestry practises, whereas at 5 localities forestry activities are either unknown or diversified.

More than half (13) of the reported localities are considered to have a favourable conservation status, 5 can not be assessed based on the information available, and 2 localities have an uncertain conservation status owing to forestry activities such as systematic felling of lime and sheep grazing. It is quite doubtful whether lime is able to regenerate under intensive sheep grazing.

Typical species

The Danish species specified in the Interpretation Manual are: *Acer pseudoplatanus, Fraxinus excelsior, Carpinus betulus, Quercus* sp., *Corylus avellana, Taxus baccata, Ulmus glabra, Tilia cordata, Tilia platyphyllos, Actaea spicata*, and *Lunaria rediviva*.

One or more of the typical tree species are reported from 15 localities whereas the vegetation is not known from the last 5 localities. Herbs are only reported from 2 localities, but none of the two herbs (*Actaea spicata* and *Lunaria rediviva)* are recorded. However, the lack of reports received on vascular plants is most probably not due to an unfavourable conservation status, but rather that only 5 localities have been systematically visited within the last 5 years. Three localities are subject to monitoring including amphibians and 2 vascular plant species. So it is not feasible to assess the conservation status of the typical species of this natural habitat type.

Conservation status

The conservation status of habitat type 9180 is considered to be unknown (Table 3.2). The reason is that the majority of the reported localities do not fulfil the criteria specified for this type and that the type is only mapped in the state forest districts.

However, with the reservations stated below, the conservation status of the reported localities is considered to be favourable. This positive assessment is substantiated by the fact that a relatively large proportion of the localities have been designated untouched forest or is being extensively managed. That means that the distribution of the type in these areas must be characterised as stable. The special structures and functions crucial to the type will in the long term be maintained in the untouched forest areas. The assessment of the conservation status of the typical species and their distribution is highly uncertain because of inadequate information. However, it is estimated that the designation of sites as untouched forests will contribute to ensuring a favourable conservation status of the typical tree species.

3.1.12 91D0* Bog Woodland

Description

Type 91D0 is defined as raised bog woodland or peat bog woodland poor in nutrients. The areas are found on humid or wet peaty substrate, with a permanently high level of nutrient-poor water. The natural habitat type frequently occurs in mosaic with other natural habitat types. It is often found in contact with raised bogs (priority natural habitat type 7110), and the type may sometimes be the first slow successional stage towards a complete forest cover. An increased peat formation will eventually result in an oxygen-rich environment in the peat, facilitating the immigration of trees.

For climatic reasons (Risager 1999) natural raised bog woodland is not presumed to occur in Denmark and this type should therefore rather be considered as degraded raised bogs (7120). The occurrence of actual marginal woodland on the raised bog is probably due to improved nutrient supply from, for instance, surface runoff water. Peat bog woodland naturally occurs at oligotrophic lake banks where a peat layer has been formed, and in oligotrophic forest bogs.

The ecology and floristic features of the natural habitat type has been little studied and is only described to a limited extent, reflected by the fact that Warming (1919) dedicates only 2 pages to describe the natural habitat type in his comprehensive study of the Danish vegetation. The vegetation (including specifications of trees) in Maglemose in Gribskov was, however, very well described when the site was protected in 1917 (Petersen 1917).

The most abundant tree species are *Betula pubescens, Frangula alnus, Pinus sylvestris*, and *Picea abies*. The last is not a native species in Denmark. The species found on the woodland floor are species adapted to the humid and oligotrophic ecosystem, primarily *Sphagnum* spp., but also *Vaccinium oxycoccus, Carex* spp., and *Trientalis europaea*.

Natural range

The natural habitat type is rare in Denmark with a few localities distributed throughout most of the country. However, the absence of reports around the Great Belt region was remarkable. Because of drainage, the number of mires has been decreasing during the last 200 years. C. Raunkjær stated in 1911: "When we consider how our country was once filled up with mires and when we are now counting those remaining, untouched by culture, the result will appear to be rather depressing" (Warming 1919). This trend has been allowed to continue and the reduction of wetlands in the period 1857-1988 has been calculated to be 83% in 4 northern Zealand forest areas (Rune 1997) and this trend is most certainly characteristic of the whole country. Conversely, the historical patterns of land use, such as peat digging and mowing/grazing have stopped during recent decades, resulting in other changes in this natural habitat type.

The community type has been reported from 27 sites distributed between 26 SACs (Fig. 3.1.12). One locality lies just outside a SAC. In total, the reported area extends to 1,095 ha. Holmegårds mose is the largest locality amounting to 374 ha, an area that also represents several different natural habitats types. Quite a few of the areas reported comprise several natural habitat types and the total area of reported localities is presumably somewhat less than 1,095 ha. Several of the reported areas should have been classified as type 7120, degraded raised bogs. The re-

Figure 3.1.12. Bog woodland (91D0). Special Areas of Conservation with reported occurrences of the natural habitat type in Denmark. The sites are centred in the Special Areas of Conservation. The boundary between the Atlantic region and the Continental region is shown on the map.

ported habitats are therefore not assessed to adequately represent the range of the natural habitat type at the national level. More private-owned areas belonging to this natural habitat type are supposed to be located within the SACs. It is assumed that there are also localities of this natural habitat type outside the SACs. According to estimates, a moderate proportion of the largest Danish localities are included in the reports, whereas only a small proportion of the small localities are covered.

Structure and function

The greatest threat to the natural habitat type is a lowering of the water table. The major reasons for this phenomenon is drainage, peat digging, extended water catchment, and selection of different tree species (Rune 1997). The conversion to coniferous trees, especially Norway spruce within forestry during the last approximately 200 years has also caused water discharge changes.

Another threat to this oligotrophic ecosystem is the deposition of atmospheric nitrogen. A third threat to the type is the invasion of common spruce, which is a non-native species in this natural habitat type in Denmark. An optimum assessment of the conservation status would require knowledge of the whole surrounding area such as gradients in the ammonium deposition, selection of tree species, farming and water catchment within the drainage area. Such data are not reported for the localities and therefore not included in the final assessment of the conservation status. It should be noted that even if the actual site is administratively designated an untouched forest, it might nevertheless be threatened by external landscape-ecological conditions.

The quantity of information and the quality of reports are differing considerably. Some of the reports (11 localities) are available as compiled reports from larger areas with geographically separated localities reported on one data sheet. In 3 cases more than 30 areas representing this natural habitat type are reported on one single data sheet, which means that the level of information reported varies and is subject to great uncertainty. At 2 localities, monitoring is reported to be ongoing, comprising both counting of orchids and a vegetation survey.

From more than half of the reported (15) localities, data on the hydrological bog type are available. Four habitats are reported to be located in close proximity to former or existing raised bogs, 3 are reported to be associated with a lake area, and 10 are reported to be fens.

More than a third (10) of the localities are designated untouched forests or forests subject to selective-cutting in accordance with the natural forest strategy. The extent of coniferous forests in the surrounding areas is not reported at all. For 2 localities it is reported that far-reaching ammonium point sources and large pigfarms may have a negative impact on the natural habitat type.

The information from 7 localities is so insufficient that it is impossible to assess the conservation status in terms of structure and function. Four habitats are reported to have become drier. From 3 of these 4 habitats it is furthermore reported that there is a risk of both lateral fertiliser displacement and ammonium deposition. Based on the data reported, 16 habitats are assessed to have a favourable conservation status.

Typical species

Typical species are *Agrostis canina*, *Betula pubescens*, *C. canescens*, *C. echinata*, *C. nigra*, and *Carex rostrata*, *Frangula alnus*, *Molinia coerulea*, *Trientalis europaea*, *Picea abies*, *Pinus sylvestris*, *Sphagnum* spp., *Vaccinium oxycoccus*, *Vaccinium uliginsosum*, and *Viola palustris*.

None of the reports specify species data appropriate for a time-series analysis that could reveal inappropriate changes of the natural habitat type. Nobody has collected new species data for this reporting process. From 12 localities no species are reported, from 5 one or two tree species are reported and from 10 localities herbs and/or mosses are reported. Applicable species data are available from 5 of these 10 localities. It appears that from 3 of these localities species not actually belonging to this natural habitat type, such as *Silene alba*, *Carex paniculata*, *Quercus robur*, and *Platanthera bifolia* have been reported.

Such species may indicate that the type is changing, but it is more likely that the type has been too widely defined and that species data originate from a previous survey including a larger area. The reported species data are so sparse that it is not possible to integrate the typical species in the final assessment of the conservation status.

Conservation status

The conservation status of the habitat type 91D0 is favourable (Table 3.2) due to the fact that scrub encroachment of previously open mires has become more common all over Denmark. However, the assessment of the conservation status is for several reasons uncertain. It is estimated that the reports are not representative of the SACs, as only state-owned areas have been mapped. In addition, the type has been interpreted quite differently in different areas, and the accuracy of the digitisation of the natural habitat reports also differs greatly.

With substantial reservations (see below) the conservation status of the reported localities is considered to be favourable. The assessment of the conservation status of the data reported must be characterised as uncertain, as it is in general not based on time series, which could elucidate the development of the type in the mapped areas in relation to essential structural and functional impact factors such as hydrology, eutrophication and commercial forestry activities. Finally, the reported species data are so insufficient that they can not be integrated in the final assessment of the conservation status. Particularly information on the structure and function of the natural habitat type, the few reports on threats to the type and the relatively large number of untouched areas substantiate the assessment of a favourable conservation status of the reported localities. As to the individual localities, 16 are assessed to have a favourable conservation status, 4 are assessed to have an unfavourable conservation status, and 7 can not be assessed due to lack of sufficient information.

3.1.13 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Pandion, Alnion incanae, Salicion albae*)

Description

In Denmark type 91E0 is defined as areas without any stagnant water and dominated by alder and/or ash. The type is therefore typically located in riparian areas or in areas with some water flow, e.g. in the margin zone of springs or spring fens. Even a single row of trees (arborescent galleries) of common alder along watercourses or springs is included. So are also areas located on raised marine sediments where the roots can reach non-stagnant, oxygen-rich ground water. The natural habitat type typically occurs on heavy soils, but it can also be found on light soils periodically inundated by the annual rise of the water level, but which are otherwise well-drained and aerated during low-water. Some of the typical species specified, e.g. *Anemone nemorosa, Carex sylvatia,* and *Urtica dioica* suggest that the definition of the type should be interpreted widely and also include natural successional stages with deposits of so much organic matter that suggest that annual floodings have ceased. If the succession proceeds to further deposit organic matter, trees tolerant of shade such as beech will be able to invade the area. Young or intensively cultivated forests without species of community interest are not included in the Habitats Directive. In terms of vegetation ecology the studies of this type are fairly moderate in Denmark compared to our neighbouring countries (Prieditis 1997).

Natural range

The typical tree species common alder and ash can not succeed on acid and nutrient-poor soils and the natural habitat type is therefore rare in the western part of Jutland (Ødum 1980), whereas it is common in the eastern part of Denmark.

The total area mapped is 662 ha, corresponding to 1.5 ‰ of the total Danish forest area. The type has been reported from 65 localities distributed between 36 SACs (Fig. 3.1.13). It is estimated that the type occupies several localities within the

Figure 3.1.13. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (91E0). Special Areas of Conservation with reported occurrences of the natural habitat type in Denmark. The sites are centred in the Special Areas of Conservation. The boundary between the Atlantic region and the Continental region is shown on the map.

SACs and that it is common outside the SACs. The public-owned areas represent 67% of the reported localities, reflecting a misrepresentation of data as at the national level the public-owned forest areas represent only 31% of the total resource. Many important private-owned areas have not yet been mapped. It is also considered that the reported data represent only a small part of the total area covered by this type.

From 3 localities the natural habitat type is reported to be progressing at the cost of other valuable natural habitat types. From one habitat, the type (91E09) is reported to be expanding at the cost of other and rare natural habitat types (7210* Calcareous fens with *Cladium mariscus* and 7230 Alkaline fens).

Structure and function

The greatest threats to these alluvial forests have undoubtedly been drainage and conversion to meadow or to other tree species, threats that were already identified by Bornebusch (1914) and Vaupel (1863). However, none of the recorded habitats are reported to have become drier and the type is nowadays generally protected against status changes under section 3 of the Protection of Nature Act.

All localities are either unchanged, have become wetter or have unknown conditions. It should, however, be noted that for 40 of the localities this statement is based on undocumented assessments. From 2 habitats felling intensities are reported to have a negative impact on the natural habitat type. The level of detail in the reported data differs considerably. Eleven reports comprise several geographically separated localities on one data sheet making it impossible to assess the individual localities. In 2 cases more than 50 areas representing the natural habitat type have been summarised on one data sheet. The areas around Søndersø near Maribo (9 localities) and Røgbølle Sø (6 localities) have also been reported without any differentiation of the individual areas. Unfavourable impacts from agricultural activities have only been reported from a few of the localities. This is probably due to the fact that the majority of the localities are surrounded by other forest types acting as buffer zones. From one site, there is a reported risk of lateral fertiliser displacement but no pesticide drift is reported. From one area there is a reported risk of ammonium deposition from a pigfarm. Finally, 5 localities are reported to be exposed to the risk of erosion caused by visitors.

Only 22% of the reported functional qualities of the natural habitat type are based on facts or exact knowledge and only 3 localities are included within the provisions of a monitoring programme.

Approximately half (49%) of the reported localities are located in the immediate proximity of a lake, 38% are located in springs, and only 9% are riparian localities. Another 8% are located in ravines or on slopes. Approximately half of the localities have been designated untouched forest (30), forest with selected felling (1), and coppice wood (1) in accordance with the natural forest strategy. Sixteen localities are reported to be subject to forest protection duty.

Deadwood in great quantities is an essential structural parameter for the biodiversity in the forest ecosystem (Aude et al. 2000), and that also applies to type 91E0. Deadwood is reported from 2 localities. Continuity is of vital importance for many species. Twenty percent of the localities are reported to be natural forests.

Typical species

The Interpretation Manual (Skov- og Naturstyrelsen 1999a) specifies 23 typical species: *Anemone nemorosa, Anemone ranunculoides, Ficaria verna, Angelica sylvestris, Cardamine amara* and *C. pratensis*, *Carex acutiformis, C. pendula, C. remota, C. strigosa,* and *C. sylvatia, Cirsium oleraceum, Equisetum telmateria, Equisetum* spp., *Filipendula ulmaria, Geranium sylvaticum, Geum rivale, Lycopus europaeus, Lysimachia nemorum, Rumex sanguineus, Stellaria nemorum,* and *Urtica dioica.* Seven woody plants are also specified: *Alnus glutinosa, A. incanae, Betula pubescens, Fraxinus excelsior, Salix alba, S. fragilis,* and *Ulmus glabra*.

Time series to assess the changes in status of species typical of the natural habitat type are not available. No species data are reported from more than half of the localities (35). From 23 localities only trees and bushes have been reported. Complete species lists are only reported from 7 sites. Only 2% of the potential species in the 65 localities have been reported implying that there is no basis of assessing the conservation status of the typical species.

This natural habitat type is most certainly both qualitatively and quantitatively the principal habitat for mosses in the forest ecosystem (Aude et al. 2000), but no reports on mosses have been presented.

Conservation status

The conservation status of habitat type 91E0 is unknown (Table 3.2). The national conservation status can not be assessed on the basis of the existing mapping. First, the type is only consistently mapped in state-owned areas, and second the interpretation of the definition differs.

More than half of the reported localities (36) are, however, assessed to have a favourable conservation status. Seventeen localities are assessed to have an uncertain conservation status. From 12 localities no data that can elucidate the conservation status have been reported. The assessment is also uncertain due the insufficient documentation on typical species, successional processes, forestry, and hydrology.

3.2 Non-priority natural habitat types

Half of the counties (7) have reported data on 'non-priority natural habitat types'. In total, data from 32 different natural habitat types distributed between 37 SACs have been reported representing a mean number of three reports per type. Two non-priority natural habitat types outside the SACs have been reported. The conclusion is that the data basis is so incomplete that an assessment of the conservation status of the non-priority natural habitat types can not be made.