



Workshop on Harmoni- sation of Nordic Habitat Classifications in an EU Perspective

Ed. Helle Skånes

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ANP 2005:742

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Printed in Denmark

Nordic Council of Ministers

Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council

Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

www.norden.org

Nordic Environmental Co-operation

The Nordic Environmental Action Plan 2005-2008 forms the framework for the Nordic countries' environmental co-operation both within the Nordic region and in relation to the adjacent areas, the Arctic, the EU and other international forums. The programme aims for results that will consolidate the position of the Nordic region as the leader in the environmental field. One of the overall goals is to create a healthier living environment for the Nordic people.

Nordic Co-operation

Nordic co-operation, one of the oldest and most wide-ranging regional partnerships in the world, involves Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland. Co-operation reinforces the sense of Nordic community while respecting national differences and similarities, makes it possible to uphold Nordic interests in the world at large and promotes positive relations between neighbouring peoples.

Co-operation was formalised in 1952 when *the Nordic Council* was set up as a forum for parliamentarians and governments. The Helsinki Treaty of 1962 has formed the framework for Nordic partnership ever since. The *Nordic Council of Ministers* was set up in 1971 as the formal forum for co-operation between the governments of the Nordic countries and the political leadership of the autonomous areas, i.e. the Faroe Islands, Greenland and Åland.

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Preface

The aim of the workshop in Stockholm (February 19-21, 2004) was to initiate a Nordic platform for harmonising habitat classifications across Europe and to strengthen the Nordic position within the ongoing EU FP5 concerted action project BioHab (contract no: EVK2-CT-2002-20018). The main purpose of this document was to provide the BioHab project with a report that facilitates the project's further development and strengthens its Nordic representation.

The main missions of the workshop were to initiate the work of:

- Identifying the links between the preliminary BioHab General Habitat Categories and Nordic expertise and propose concrete improvements and solutions regarding the relationship of Nordic habitats to this list. This work will include filling out habitat keys (descriptions) to be fed back into the BioHab database. It should be emphasised that the BioHab General Habitat Categories are the lowest common denominator across the whole of Europe and must be elaborated at a local level.
- Harmonising the respective countries national systems for habitat classification and monitoring of nature and biodiversity. Further achieving a common basis for explicit cross-walks between EUNIS, NATURA2000 and Nordic and national classification systems, such as *Vegetation Types in the Nordic Region* compiled by the Nordic Council of Ministers.
- Analysing a proposition of a 'General Habitats Monitoring Framework' to support stratification within the EEA:s existing bio-geographical zones. This stratification framework has been developed by Alterra Green World Research, The Netherlands, as tool for stratified descriptions of habitat status and change (Metzger *et al.* submitted).

1. Notes of Presentations and Discussions

1.1 Presentations

Below, short summaries follow of each presentation given at the workshop. The summaries have been written based on the respective Power-Point presentation.

1.1.1 Welcome and Workshop Presentation (Helle Skånes)

The workshop was opened and introduced with a warm welcome and a short background. This background is the same as the summary of this final report. The BioHab project is currently in a highly dynamic state of development and we are aware of the difficulties for external experts to contribute to the BioHab discussion with this short time for preparations. However, we need as much input to the project as possible and we hope that this workshop will strengthen the Nordic perspective and find support for the BioHab views on pan-European habitat classification.

1.1.2 Background and Current Status of the BioHab Project (Bob Bunce)

To provide the participants with a common view and good starting point for the workshop discussions, Bob gave a short presentation of the background and current status of the BioHab project. He introduced the programme, the field recording procedure and the field handbook (see executive summary in appendix 2). He also gave examples of rule based categorisation of forests, grasslands and mixtures of habitats illustrated by matrices of wetness gradients versus Ellenberg values of nutrient status. Finally Bob presented the focus points for the Stockholm meeting. These were:

- Assessment of forest matrices and relationship with Nordic classes (>5 m height)
- Outline of matrices for scrub (low = 0.05-0.6 m, mid = 0.6-2 m, and high = 2.6-5 m height vegetation)
- Outline of matrices for grasslands (this has not been done so far within BioHab)
- Comments also especially on bogs, high mountain, and northern habitats
- Possible field testing in northern Scandinavia, August 2004

One problem is the rapidly increasing number of BioHab categories developing so far within the project. These categories are entirely determined according to the rules.

- Initial ECOLAND Forum 90 cat
- First BioHab categories list without rules 150 cat
- Second BioHab list with initial rules 250 cat
- Number of habitat categories prior to Stockholm workshop $\approx$ 500 cat

1.1.3 Short National State-of-the-Art Habitat Classification Presentations

1.1.3.1 Norway (Jogeir Stokland): National Habitat Classification Systems State-of-the-Art Presentation from Norway.

The Norwegian presentation gave an overview of existing classification systems as well as planned classification systems in Norway. Three major classifications were described: vegetation types, valuable nature types, and structural forest elements. The first, on vegetation types (in total 137 classes) is a comprehensive list of all vegetation types in Norway. The methodological basis rests on i) indicator species, where Ellenberg scores can be indirectly derived, and ii) ecological gradients regarding hydrology, soil types and pH, cultural influence, climate, topography, salinity etc. The valuable nature types (in total 56 classes) mainly compose aggregations of the vegetation type classification. The structural forest elements are used in the National forest inventory that consists of 10,000 plots in a 3x3 km sample grid. Habitat parameters described within these plots are: vegetation type, tree species, canopy height, stand age, amount and types of dead wood, and key biotopes. A worked matrix example was presented to show how the Norwegian forest types would fit into the BioHab system according to the forest matrix template distributed prior to the workshop. In general it is easy to relate the Norwegian vegetation types to the BioHab categories. In some important cases there are some problems where forest types would not follow the BioHab intervals for moisture and pH levels.

The presentation also gave an overview of the Q3 system (cultural landscapes) and the Nordic system of mires. At the end some BioHab challenges were pointed out. These were a) the harmonization of regional sets of indicator species based on Ellenberg values, b) distinction between various types of wet habitats that are not clearly separated in the current BioHab categories, and c) the development of system of qualifiers for habitat conditions.

1.1.3.2 Sweden (Anders Glimskär and Ola Inghe): Landscape Monitoring in Sweden

The Swedish presentation gave an outline of the recently launched National Inventory of Landscapes in Sweden (NILS). NILS is the first

Swedish monitoring programme that includes all terrestrial environments. It will monitor landscape composition, biodiversity, aspects of cultural heritage, and Natura 2000 biotopes. This monitoring project is carried out by the Swedish Agricultural University in collaboration with several institutes and authorities in Sweden. Funding is provided by the Swedish Environmental Protection Agency. The inventories are performed using both digital stereographic aerial photo interpretation and field-based methods. Within the programme, 630 permanent 5x5 km landscape units have been sampled. The centre 1x1 km square of 1/5 of these will be studied every year in a five year interval. The following variables are used in NILS: land use and exploitation, vegetation cover, lists of characteristic plant species, structures and substrates, linear landscape features, spatial relations and patterns. Vegetation cover % is studied in depth in 10 m radius plots. The layers studied are tree and shrub species, field layer, litter, bottom layer, and exposed substrates. More detailed vegetation inventories are carried out in sampling plots of 0.25 m². The year 2003 was the first operational NILS season.

The habitat classifications used for area estimates will be made *a posteriori*, based on a combination of quantitative (e.g., vegetation cover) and categorical (e.g., land use) variables. By this approach, the data can be used in a more flexible way, as a basis for several different classification systems. It also increases the possibilities to use the data for analysing trends. Area estimates will be based on two-phase sampling, through a combination of field data and aerial photo interpretation.

1.1.3.3 Finland (Tytti Kontula): Finnish Habitat Classifications, Habitat Monitoring and Evaluation of Threatened Habitat Types

The Finnish presentation focused on two major classification systems in Finland; vegetation and habitat classification, and general biotope classification. The first was based on vegetation mapping in the field, and the second based on aerial photographic interpretation. The presentation gave several examples of possible confusions between the Finnish classification systems and the BioHab categories. Several of these problems might be an effect of terminological confusion that needs to be cleared.

There is no national large-scale or systematic monitoring of biodiversity for habitat types in Finland. A number of national forest inventories have been carried out since the 1920's. This inventory program concentrates on forest resources but it has produced also some data for biodiversity research. Other ongoing, larger inventories are carried out on state-owned land (on protected areas and wilderness reserves), and also on private or forest company land related to the Forest Act and Nature Conservation Act key biotopes. At the end, Tytti presented a new Finnish project, evaluation of threatened habitat types in Finland. The method and criteria for the red-listing of habitat types is based on the method earlier used in Germany and Austria. Finally, Tytti also gave an outline of the

Finnish mire type system to point out the inconsistencies within the BioHab list.

1.1.3.4 Estonia (Anneli Palo): State-of-the-Art of Habitat Classification in Estonia.

This presentation gave a colourful overview of Estonian habitat classes with in the field illustrations. The Estonian major classification consists of 8 major classes with many subclasses. This system builds on field based inventories. There are a number of national environmental monitoring programme where the sub-programme no 6 is the monitoring of biological diversity and landscapes. The landscape monitoring programme is based on satellite imagery. Anneli also gave an overview to the problems of cross-walks between the Estonian classification and EUNIS, problems that would be similar in comparison with the BioHab list. The major problems seem to be that units are not mutually exclusive. Some Estonian units can be comparable to several EUNIS types. It was also pointed out that many habitats are complex since they are mosaic and under successional transition. This instability might cause problems in the BioHab perspective.

1.1.3.5 Denmark (Rasmus Ejrnæs): Supervised Classification of Habitats

The Danish contribution focused on supervised classification of habitats. Three main questions were posed; i) why classify habitats, ii) why involve statistics and data, and iii) why choose supervised methods. The answer to the first question is basically the need by authorities to follow up status and change in habitats that are in the legislation. The reason to involve statistical data is that Danish experience shows that subjective judgements are not rigorous enough. As conservation commitments are getting increasingly serious, the need for rigorous arguments that will hold up in court increases. The main argument for using supervised classification versus unsupervised is that supervised classification predicts known classes from a number of indicative variables whereas the unsupervised classification assumes no prior knowledge about class membership. In the case of the Habitats Directive, it would be pointless inventing a new classification. Rasmus briefly described the major steps of the method: a) reduction of dimensions and noise, b) finding training data, c) choosing the method, d) prediction on new data, e) assessing the uncertainty, and f) assessing the conservation value. An important concluding remark was that although BioHab appears to produce a much more operative system –we have to apply CORINE Biotopes 1991. However, BioHab could be useful for stratified sampling and the planning of monitoring.

1.1.3.6 Iceland (Sigurdur H Magnusson): Classification and Mapping of Habitat Types in Iceland

This presentation gave an overview to an ongoing habitat project with the aim to develop methods to define and describe Icelandic highland habitat types, to determine their size and distribution, and to fulfil Icelandic obligations for nature conservation. Since the natural conditions of Iceland differ greatly from most areas in Europe, the country cannot use existing European classification systems without refinement and development. This project tested and revised the classification of Icelandic habitats with methods built on CORINE habitat classification, ANNEX 1, and Palaearctic Habitat classification. The test included both vegetation transects and bird transects. The vegetation transects were analysed using TWINSPLANS and the results were used as a base for habitat type classification. The analysis revealed 20 habitat types with great variation in both vegetation cover and other characteristics.

The method has several advantages but was found complex and time consuming and further improvements of the method is therefore needed.

1.2 Group Sessions – Foci and Guidelines

There are optional ways to divide the landscape into group sessions to cover major aspects of habitats. The division into three natural groups that all shared the cultural component was deliberate (Figure 1). By not treating the cultural landscape as a group of its own, all the groups were forced to discuss both the natural aspects of habitats and the cultural impact and successions induced by human influence. This was explained at the beginning of the workshop and the participants found the division interesting and challenging.

The three groups forest-cultural / wet-coast-cultural / mountain-cultural looked at the general habitats list from their respective points of view.

We discussed around the following topics:

1) Harmonisation of definitions and structural issues

- 1.a Status of consistent definitions of habitat types and concepts (i.e. grassland, forest)
- 1.b Status of consistent descriptions of existing habitats (incl. references)
- 1.c Discussion of matrix classification of soil moisture and nutrients
- 1.d Agreement between the existing summary of matrices for forests and Nordic conception
- 1.d Outline of corresponding summary of grasslands matrices (not done in BioHab)

2) Improvements of General habitats list

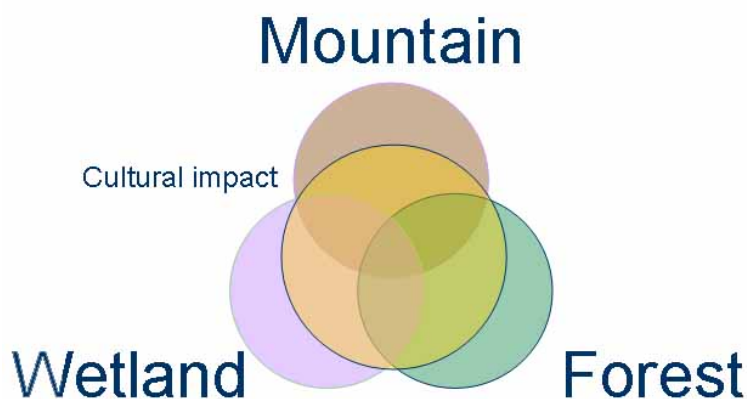
- 2.a Do habitats need to be added (missing habitats)
- 2.b Does the list include impossible combinations that should be excluded or modified?
- 2.c Discussion of key species to habitat list

The participants attended the groups as follows:

Forest – cultural Helle Skånes (C/R) Jogeir Stokland (R) Bob Bunce Anders Glimskär Kimmo Syrjänen Seppo Tuominen	Wetlands/coastal – cultural Geoff Groom (C) Eva Johansson (R) Rasmus Ejrnæs Urban Ekstam Tytti Kontula Anneli Palo Lars Pålsson	Mountain – cultural Margareta Ihse (C) Ann Norderhaug (R) Ola Inghe Akse Østebrøt Borgthor Magnusson Sigurdur Magnuson Odd Stabbetorp
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C = convener, R = taking notes and summarising

Figure 1. The proposed division of landscape in our group discussions where the three major habitat groups forest, wetland and mountain were superimposed with the cultural impact as a part of each group along the gradient natural – semi-natural – cultural.



1.3 Group Sessions – Summary and Main Points

The three groups had rewarding discussions that sometimes left the foci of BioHab. All the groups worked on the matrices but due to group dynamics as well as variations in habitat configuration, the groups did not work on the same levels of detail. Still, the outcome of the discussions was interesting and useful for the BioHab project.

1) Harmonisation of definitions and structural issues

We discussed along most of the points set for the workshop, however it was not easy to arrive at any conclusions due to lack of time. These

aspects we could have spent a couple of days to discuss. Now the main focus was placed on the matrix classification of soil moisture and nutrients and the outline of corresponding summary of matrices for grasslands that was completely missing within BioHab.

2) Improvements of General habitats list

We discussed both the need to add missing habitats and how to exclude impossible combinations. However, some combinations and pure classes not included in the original list were suggested to be added.

1.3.1 Summary of Discussions from the Forest – Cultural Group

This group started the work by making a worked example of the grazed forest case (Table 1). We tried to fill in the details for each field in the current BioHab field code, and then made a tentative entry in the matrix of this forest type (Table 2).

We also had a long discussion regarding the stability of scrub vegetation in the Nordic region and the turnover of successions in forest, both natural and human induced (as in clear cut or abandonment). We established a gradient in height and time for the transition of habitats from grassland through scrub to forest. All forest phanerophytes (FPH) may pass through the stages LPH, MPH and TPH, all depending on the time interval of survey (Figure 2). Different types of succession are plausible (Figure 3): the pathways are similar, but with different qualities depending on how they evolved. This information must be recorded, perhaps as primary qualifiers.

Table 1. Suggested BioHab code for a mesic basic grazed forest habitat

BioHab primary code	Life form and species	Below the upper canopy (dominating features >10%)	EUNIS / Annex 1 / Veg. associations / Other habitat classific.	Qualifiers	Indicators (should be species)
Broad-leaved winter deciduous forest mesic and basic (many other forest types possible)	Trees >5 m 40% <i>Fraxinus excelsior</i> 50% + species >10% <i>Populus tremula</i> 50% + species >10% Mixed grass-land 60% <i>Trifolium medium</i> <i>Agrostis capillaris</i>	Mixed grass-land 60% Deciduous scrub 30%	Deciduous forest Fennosc. wooded pasture NO: hagmarksskog SE: hagmark FI: metsälaidun (forest pasture)	Grazing by domestic animals hollow trees traces of pollarding	Key/rare species <i>Gymnadenia conopsea</i> <i>Cephalanthera longifolia</i>

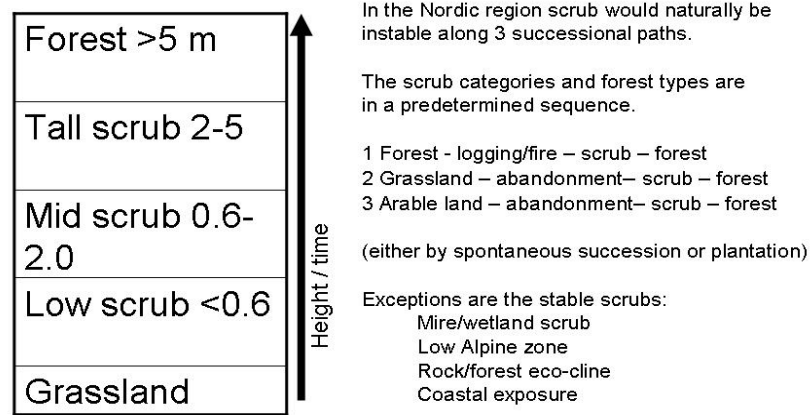
Table 2. Matrix position of our worked example of a mesic basic grazed forest.

Deciduous	WET (Ellenberg >7.0)	SEASONALLY WET (Ellenberg variable)	MESIC (Ellenberg >4.1- 7.0)	DRY (Ellenberg 2.5-4.0)
	Ellenberg species value >8		Ellenberg species value 5-8	Ellenberg species value 2-4
Eutrophic (Ellenberg fertility >7)				
Acid (pH <5) (Ellenberg fertility 1-3)				
Neutral (pH 5.1-7.0) (Ellenberg fertility >7)				
Basic (pH >7.1) (Ellenberg fertility 7-9)			<i>Our example grazed forest</i>	

The forest group was concerned with land-use history of habitats and how that could be expressed in the categories. The unstable vegetation type *scrubs* can emerge from arable fields, grasslands and felled forests. These scrub types will have different biodiversity status in terms of quality and should be separated by some kind of qualifier. We also pointed out that there are exceptions to the rule that scrub vegetation is a transitional stage between grassland and forest (Figure 2). The time frame for succession into forest depends on different variables and delayed reaction time (time lags). Some succession stages appear permanent as long as the disturbance regime remains: e.g. grazing.

We see the life-form based division of forest, scrub and grasslands in BioHab as rather tricky and in some cases too detailed. There is a risk that the same unit turns up in more than one category. Some members of this discussion group felt somewhat hesitant towards using a system which identifies forest types by tree species (one or in combination), particularly since the field layer reveals the forest types so much better. It is also a common Nordic approach to use field layer or a combination between field layer and tree species composition. When it comes to tree species composition, cultural factors are often decisive.

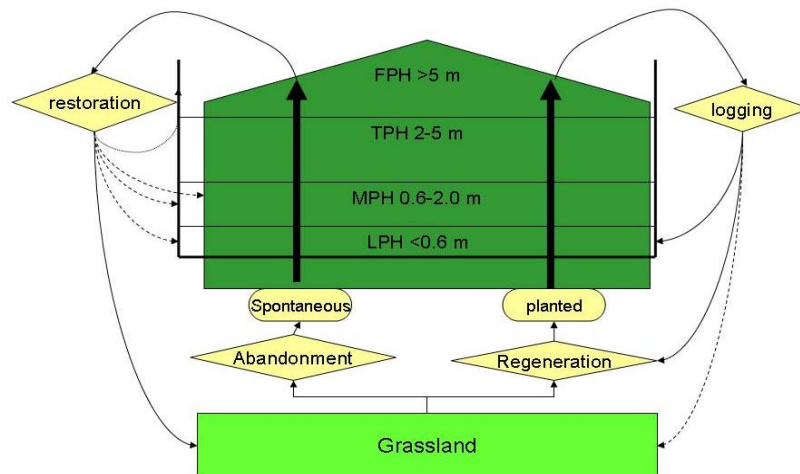
Figure 2. Height and time gradient in successional stages from open-forest and a description of predetermined succession sequences and exceptions of unstable scrubs in the Nordic region.



Within the group macrophanerophytes there is a category ‘*Picea abies* and *Abies* spp.’. The present definition of this category is odd, because *Picea abies* is widespread all over northern and central Europe. Within *Picea* forests, there should be also a combination ‘wet (peat forming) acid’ and probably also ‘wet (peat forming) neutral’, as these represent common types of North European spruce mires (spruce forest on peat land). The same combinations are also needed in the mixed forests, e.g. in the category ‘*Picea abies*/Broad leaved deciduous’ (this could be for example spruce-birch mire).

Figure 3. Differentiation of successional pathways between grassland and forest phanerophytes depending on management action. The path through life forms from grassland over scrub levels to forest may appear identical. However, disturbance regime and management history will have impact on species composition within the individual habitat patch.

Same pathway - different quality



1.3.2 Summary of Discussions from the Wetland/coastal – Cultural Group

1.3.2.1 General Discussion on Coastal Habitats

Definition of coastal in current BioHab list is a hangover from EUNIS with ambiguities. The group tried various ways to define coastal as a major category. Factors of importance may regard:

- distance to coast,
- saline influence,
- inundation by tides,
- coastal geomorphology

An alternative would be to restructure the habitat list with limnic, marine and terrestrial and add coastal as a column in terrestrial matrices. The group identified several situations in which those ideas would be problematic, such as distance, barriers, etc. So the question is: can ‘coastal’ be dropped?

Solution: if salinity is included in the matrix, then we don’t need a qualifier for coastal. In such a case, salinity should be the first criteria, then pH and nutrients

1.3.2.2 What is the Distinction between Qualifiers and Classifiers?

The group discussed other topics such as the role of core mapping classifiers and qualifiers. As part of this they asked; what is the core criterion for the field surveyors to follow beyond merely the patch size rules:

- a small core set of classifiers (life form, moistness, nutrient)?
- intuition?
- a larger set of classifiers? Or
- a combination of classifiers and qualifiers?

One idea was to restructure the BioHab approach along the following lines:

1. Classifiers = generally applicable
2. Global descriptors = inherent properties of habitats (independent variables)
3. Qualifiers = local properties (dependent variables).

1.3.2.3 General Discussion of Bogs and Mires

Some participants expressed their concern that BioHab does not attach great importance enough to the wetland system that covers substantial areas in large parts of the Nordic region. It is important not to lose the *Sphagnum* species in the life forms. How are they treated?

In the existing system coastal and wetland are not classified based on life forms, but on other criteria. An advantage of treating wetland as terrestrial is that no exception has to be made for wetlands. Since ‘grasslands’ are not used but life forms, it makes sense to remove ‘wetlands’ as a class of itself. If peat is always recorded it does not matter if it is recorded last, then we could differentiate life forms first. Then new points and questions arise:

- Additional columns for water saturated soil, peat forming or not peat forming.
- Differences in different countries definitions of mire, wetland, and bog were discussed.
- At what level in the field code should peat (and other similar issues) be entered?
- The top level issue should be ‘life form’ rather than issues such as ‘peat?’

How is peat depth included? Perhaps the information about habitat can be reached from species lists and soil samples with depth. One possibility could be to adopt the Finnish and Swedish definition of peat land where peat must be over 30 cm deep. There are varying definitions for peat land. Some definitions related to Finnish peat lands (direct citations from Euroala et al. 1984): *Mire* = any peat land or paludified vegetation together with its underlying peat. *Bog* = ombrotrophic mire. The best definitions of Swedish mires are found in Rydin et al. (1999). However, even there it is indicated that there are some principal uncertainties regarding how to describe the mire types of mountainous regions.

We suggest that if the group ‘mires etc.’ remains, the first distinction will be made between ombrotrophic and minerotrophic mires, and the minerotrophic ones will be further divided into acid, neutral and basic. The information about the mire complex (palsa mires, aapa mires, raised bogs etc.) could be in another property column.

1.3.2.4 Inland Surface Water

Inland waters were not discussed in-depth at this workshop, but the Nordic region already has a suggestion to a common classification of aquatic vegetation (Påhlsson 1998). The BioHab treatment of vegetation in inland water needs to be refined.

There might be a risk of overlap between inland surface water and water pools enclosed in wetland systems. In Finland, for example, these pools are not considered lakes as they are generally small and have a peat bottom. If these pools are generally less than 400 m², this problem is solved by generalising the pools into the adjacent wetland type. If the pools are larger, the implications of this definition need to be considered in the future.

Within the matrices we have made adjustments to sort out inconsistencies in terminology, i.e. in the titles of the matrices. Instead of saying ‘perennial grasses’ the group suggested ‘graminoids’.

1.3.2.5 Transition between Terrestrial and Open Water Vegetation

A reed bed with low standing water is a wetland (in European tradition), but how will *Phragmites* or *Scirpus* growing at 2 m depth with submerged aquatic vegetation be classified?

1.3.3 Summary of Discussions from Northern Boreal and Alpine – Cultural Group

The northern boreal and alpine group started out by trying to document whether the BioHab system can work for Nordic vegetation. Focus was placed on the life form representations of northern boreal and alpine habitats and the outcome was detailed worked examples of the matrices regarding Ellenberg values for wetness, pH and fertility (Table 3 and 4). The examples of habitat types for various life forms are referred to the same alphanumeric code as in tables 3 (3a-3j) and 4 (4a-4d) below. The code for each vegetation type (e.g. T9 or I3b) refers to vegetation types defined in Fremstad 1997.

1.3.3.1 Examples of Life Forms and Open Habitats in the Northern Boreal and Alpine Zones (Table 3)

Therophytes

3a. *Koenigia islandica* is a hallmark species in rich snow patch (T9). In Iceland, this species dominates along hydroelectric power dams (basic-neutral, wet).

3b. *Poa annua* is a dominating species in dry trampled/ruderal summer farming areas (I3b)

Geophytes

3c. *Equisetum arvense* is common in weed vegetation, dominated by perennials, on ploughed land (I4).

3d. *Anemone nemorosa* becomes a dominating species after abandonment and early encroachment of mesic acid meadows (G4).

Chamaephytes

3e. *Saxifraga oppositifolia* is a poorly competitive species growing on basic ground in screes and on instable ground and ground affected by

overland flow and interflow as well as snow patch vegetation (F1b, N3, R6c and T).

3f. *Silene acaulis* is a dominating species in basic R6c.

3g. *Cetraria nivalis*, *C. Cucullata*, *Racomitrium lanuginosum*, and *Alectoria ochroleuca* can be dominant species in wind prone hillocks (R). Correspondingly, in snow patch vegetation (i.e. T5 and T7) various moss species can dominate.

Perhaps could also high coverage of *Rhytidiadelphus squarrosus* in the bottom layer be mentioned for mesic intermediate – slightly basic meadows in northern continental areas (G4, G9).

According to the BioHab categories, it seems that only arbuscular and foliose lichens are accounted for, not crustose. However, it would be valuable in the Nordic perspective to distinguish between open land dominated by lichens (both *Cladina sp* and *Cetraria sp*), *Sphagnum* species, and remaining mosses/lichens. This distinction might be in parity with the distinction between geophytes and hemi-cryptophytes.

Hemi-cryptophytes

3h. Moist acid meadow (G4), Mesic-dry basic meadow in mountains and northern areas (G8), Wet-moist basic meadow (G12), *Trolleus europeus* (G13), *Menyanthes trifoliata* (in Iceland).

3i. Meadows characterised by *Descampsia caespitosa* (G3), *Nardus stricta* (G5), *Avenula pratensis* (G6), *Avenula pubescens* (G7), *Arrhenatherum elatius* (G10), and *Carex flacca* (G11).

Mixed grasslands

3j. Most of the meadow types (except for G3 and G5) mentioned in 3i above can be dominated by either grasses or herbs, so most of them can also be mentioned here. Whether they belong to either type (grass or herb dominated) is depending on the:

- 1) Current management regime, grazing (generally grass dominated) or mowing (unfertilized meadows are commonly herb dominated), and
- 2) Current stage of succession (management history and abandonment).

There are also non-shrub heaths, which have a mixture of herb and grass vegetation AND a more or less continuous cryptogam layer. How are these described in BioHab?

Conclusion: The Nordic grasslands mainly belong to the latter groups above, hemi-cryptophytes (either grass or herb dominated) or mixed grasslands. It is therefore difficult to separate them according to the pro-

posed list of BioHab categories, since meadow type vegetation may vary substantially with regards to grass versus herb dominance.

Table 3. Worked example of tentative positions of northern boreal and alpine zone habitats in the grassland matrix. Alpha-numeric code refers to description in text above.

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)	Xeric
Therophytes, >30% annual grass	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4	
eutrophic (Ellenberg fertility >7)			3b		
acid (ph <5.0) (Ellenberg 1-3)					
neutral (ph 5.1-7.0) (Ellenberg 4-6)	3a	3a			
basic (ph >7.1) (Ellenberg 7-9)	3a	3a			

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
>30% Geophytes	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
eutrophic (Ellenberg fertility >7)			3c	
acid (ph <5.0) (Ellenberg 1-3)			3c,d	
neutral (ph 5.1-7.0) (Ellenberg 4-6)			3c,d	
basic (ph >7.1) (Ellenberg 7-9)			3c,d	

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
Chamaephyte >30% non woody	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)				
neutral (ph 5.1-7.0) (Ellenberg 4-6)			3f	3f
basic (ph >7.1) (Ellenberg 7-9)		3e,f	3e,f	3f

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
Cryptogams >30%	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)	3g	3g	3g	3g
neutral (ph 5.1-7.0) (Ellenberg 4-6)	3g	3g	3g	3g
basic (ph >7.1) (Ellenberg 7-9)	3g	3g	3g	3g

	Wet (Ellenberg >7.0)	Seasonally wet * (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Forbes >70%				
eutrophic (Ellenberg fertility >7)	3h	3h	3h	
acid (ph <5.0) (Ellenberg 1-3)	3h	3h	3h	3h
neutral (ph 5.1-7.0) (Ellenberg 4-6)	3h	3h	3h	3h
basic (ph >7.1) (Ellenberg 7-9)	3h	3h	3h	3h

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
perennial grass >70%				
eutrophic (Ellenberg fertility >7)		1i	1i	1i
acid (ph <5.0) (Ellenberg 1-3)	3i	3i	3i	3i
neutral (ph 5.1-7.0) (Ellenberg 4-6)	3i	3i	3i	3i
basic (ph >7.1) (Ellenberg 7-9)	3i	3i	3i	3i

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Mixed grasslands				
eutrophic (Ellenberg fertility >7)	3j	3j	3j	3j
acid (ph <5.0) (Ellenberg 1-3)	3j	3j	3j	3j
neutral (ph 5.1-7.0) (Ellenberg 4-6)	3j	3j	3j	3j
basic (ph >7.1) (Ellenberg 7-9)	3j	3j	3j	3j

1.3.3.2 Examples of Scrub Habitats in the Northern Boreal and Alpine Zones (Table 4)

Low broadleaved evergreen scrub

Oksanen & Virtanen (1995) describe more than 40 types of plant communities on the northern heaths of Finland. A large part of these types usually have > 30 % of dwarf shrub (e.g. *Empetrum*, *Vaccinium*, *Betula nana*, sometimes *Phyllodoce caerulea* and *Arctostaphylos alpinus*).

4a. *Dryas octopetala* belongs to mesic-dry basic meadows in mountain and northern areas (G8). Dryas-grass-lichen variants on wind exposed hillocks (R3).

Low broadleaved winter deciduous scrub

4b. *Betula nana* is traditionally included in *Betula nana* – *Empetrum nigrum* (R2) in low broadleaved evergreen scrub. *Vaccinium myrtillus* can be dominating in *Vaccinium myrtillus*-*Phyllodoce caerulea* and *Empetrum nigrum* ssp. *hermaphroditum* heath (S3).

Low coniferous scrub

4c. *Juniperus communis* can be dominating in *Juniperus communis*-*Betula nana* heath (S2). *Juniperus communis* can dominate in abandoned meadows of the types *Nardus stricta* (G5).

Low ericoid scrub

4d. *Diapensia lapponica* (dominating in *Loiseleuria procumbens*-lichen/moss scrub R1a *Loiseleuria procumbens* –*Diapensia lapponica* variant), *Empetrum nigrum* coll. and *Cassiope tetragona* can be dominating in hillocky vegetation such as *Dryas octopetala*-*Cassiope tetragona*-mosses (R4) and *Cassiope hypnoides* in *Salix herbacea* snow patch (T4).

Low ligneous spiny chamaephytes

4e. *Thymus serpyllum* ssp. *tanaënsis* can dominate in pioneering vegetation on flooded ground (*Lactuca sibirica*-*Thymus serpyllum* ssp. *tanaënsis* variant Q2c). *T. praecox* Opiz ssp. *arcticus* occurs in Iceland (and in Norway in basic rock vegetation below the northern boreal zone).

Tall scrub versus forest

A large part of the northern mountain birch forests (*Betula pubescens* subsp. *czerepanovii*) does not reach a height of 5 m. If the basic rules for a forest are > 30 % of canopy cover and > 5 m height, mountain birch forests will be classified as scrub. and should be added in the species list (dominant) into the moist, mesic and dry categories of the ‘tall broad-leaved winter deciduous scrub’. Similarly, part of pine bogs (sparsely wooded) will belong to ‘Tall coniferous scrub’ if the group mires etc. was deleted (i.e. *Pinus sylvestris* should be added to indicators).

Table 4. Worked example of tentative positions of northern boreal and alpine zone habitats in the low scrub matrix. Alpha-numeric code refers to description in text above.

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
Broad leaved evergreen	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)				
neutral (ph 5.1-7.0) (Ellenberg 4-6)			4a	4a
basic (ph >7.1) (Ellenberg 7-9)			4a	4a

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Broadleaved deciduous				
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)	4b	4b	4b	
neutral (ph 5.1-7.0) (Ellenberg 4-6)	4b	4b	4b	4b
basic (ph >7.1) (Ellenberg 7-9)	4b	4b	4b	4b

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Coniferous				
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)			4c	4c
neutral (ph 5.1-7.0) (Ellenberg 4-6)			4c	4c
basic (ph >7.1) (Ellenberg 7-9)			4c	4c

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Ericoid				
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)		4d	4d	4d
neutral (ph 5.1-7.0) (Ellenberg 4-6)		4d	4d	4d
basic (ph >7.1) (Ellenberg 7-9)		4d	4d	4d

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Non leafy evergreen				
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)				
neutral (ph 5.1-7.0) (Ellenberg 4-6)				
basic (ph >7.1) (Ellenberg 7-9)				

	Wet (Ellenberg >7.0)	Seasonally wet* (Variable)	Mesic (Ellenberg 4.1-7.0)	Dry (Ellenberg 2.5-4.0)
	Ellenberg species value 9 +over		Ellenberg species value 5 - 8	Ellenberg species value 2- 4
Woody chamephytes				
eutrophic (Ellenberg fertility >7)				
acid (ph <5.0) (Ellenberg 1-3)				
neutral (ph 5.1-7.0) (Ellenberg 4-6)			4e	
basic (ph >7.1) (Ellenberg 7-9)				

1.3.4 Some Comments on Disturbance Regime and Pressure Effects on Life Forms Within the BioHab Project.

The importance of disturbance regime and history on vegetation structure was discussed at the workshop. Unfortunately there was not time enough to come to any general conclusions, but below follow some remarks:

During the discussions it was stressed that all monitoring of vegetation quality needs to start from factors that have a *structuring affect* on the vegetation over time. These factors can be divided into two major groups; stress (limited resources for growth), and disturbance (in terms of destruction or loss of biomass). To some extent, both these groups are included in BioHab already in the initial code system, which is positive:

Stress appears in the form of Ellenberg values for the habitat (nutrient level, acidity, and water regime).

Disturbance is only accounted for as the different life form's response to disturbance regimes – i.e. how the various life forms can cope with the loss of biomass regardless of the kind of disturbance regime. This could be regarded as a weakness in the BioHab approach. The current or past disturbance regime is often the decisive ecological factor governing the structure in an ecosystem.

So, the problem remains: Conservation value can differ greatly, related only to management, while life forms remain the same. We fear that important ongoing changes will not be monitored in BioHab unless disturbance and management (ongoing and history) is accounted for – the system might be too coarse. Disturbance and continuity in management should be qualifiers. Can disturbance gradients be generalized and brought to a classification level?

This could be solved in different ways within a system like BioHab. It was suggested that factors that in one way or other reveal the *disturbance regime* in terms of *natural* (fire, wave erosion, grazing by large wild herbivores) or *human* (grazing, mowing, burning, cutting etc.) could be used as *primary qualifiers*. It would also be of importance to grade the intensity of the disturbance in as a third dimension in the matrix basic-acid/dry-wet. It should be recognised that the species response to disturbance regime is as specific as the response on edaphic factors.

If species are to be used to characterize habitats it is important to stress the need to recognize early stages of succession where the first signs will be a subtle change in species composition without a shift in life forms. As an example: the species could, if carefully selected for the different climatic environmental zones (boreal, nemoral etc.) give early signals indicating that the system is changing in terms of quality, even if the coverage of hemichryptophytes according to coding has NOT changed. One example: A grassland with vital populations of *Euprasia* is something completely different from a grassland with *Geranium sylvestris* long before the shrubs and trees have expanded enough for us to call it scrub or forest.

Recommendation: BioHab needs disturbance gradients. Management indicator species will differ between the Nordic countries, not to mention between European countries; they can be related to environmental zones. We suggest using indicator species for management, rather than intuitive-based mapping of intact/grazed/non-grazed areas. Disturbance could be added as a column in the qualifiers.

A Danish example of grassland indicators (value for conservation):

There is an index for un-improved natural/semi-natural grassland with long management continuity in Denmark (Table 5). The index is common for acidic, basic and dry types of grassland. The first column represents negative indicators (minus 1 point). Second column represents common species with broad amplitude but preference for unimproved conditions (plus 1 point) and the third column represents less common species with strong preference for unimproved conditions (plus 2 points). For comparative use it is recommended to use the index on a fixed area of 100 m². A rule of thumb has been developed: If less than 6 points: it is not semi-natural grassland. 6-10 is most likely an abandoned field transitional to semi-natural grassland. 11-15 is probably a semi-natural grassland. Above 15 should be considered a semi-natural grassland habitat. This type of species properties were also used in the Swedish national inventory of ancient meadows and pastures (Ihse & Lindahl 2000), although the indicators were never formalised in terms of points and thresholds for improved versus unimproved grasslands.

Table 5. Danish index for prediction of grassland quality for environmental management (Ejrnæs & Bruun 1995).

-1	+1	+2	
Aphanes arvensis/microcarpa	Calluna vulgaris	Acinos arvensis	Lathyrus montanus
Epilobium angustifolium	Campanula rotundifolia	Anemone nemorosa	Leontodon hispidus
Cirsium arvense	Carex flacca	Antennaria dioica	Linum catharticum
Cirsium vulgare	Centaurea jacea	Arabis hirsuta	Nardus stricta
Elymus repens	Dianthus deltoides	Arnica montana	Phleum phleoides
Linaria vulgaris	Festuca ovina	Avenula pratensis	Platanthera chlorantha/bifolia
Lolium perenne	Galium saxatile/sterneri	Briza media	Polygala vulgaris/
Plantago major	Hieracium umbellatum	Campanula persicifolia	Polygala amarella
Poa annua	Lotus comiculatus	Carex pilulifera/caryophyllea/	Potentilla erecta
Poa trivialis	Luzula campestris	montana/ericetorum	Potentilla tabernaemontani/collina/heptaphylla/cinerea
Polygonum aviculare	Pimpinulla saxifraga	Cirsium acaule	Primula veris
Ranunculus repens		Danthonia decumbens	Pulsatilla pratensis/vulgaris
Rumex obtusifolius/crispus		Filipendula vulgaris	Scabiosa columbaria/canescens
Stellaria media		Genista anglica/	Scorzonera humilis
Viola tricolor/arvensis		Genista tinctoria	Silene nutans
		Geranium sanguineum	Succisa pratensis
		Helianthemum nummularium	Vaccinium myrtillus
		Hypochaeris maculata	Viola canina/hirta

2. Major Conclusions, Recommendations and Ideas for the Future

The impact of this workshop can primarily be evaluated by the development of the BioHab project. Since the ongoing project process is dynamic and in major parts at present closed to the public, it is not a simple task to describe the detailed outcome of our workshop. However, below you will find an attempt to conclude and evaluate our influence. Detailed evaluation of the impact can be received from the BioHab project coordinator Bob Bunce (bob.bunce@wur.nl).

2.1 Conclusions from the Workshop

- Preparations and achievements:
The workshop was appreciated by the participants. However, it was concluded by several that there should be a working group of a more permanent character to work more in-depth on these issues for a longer time. It was not easy to meet for only three days to discuss a proposed field handbook that was still in its early stages of development. One major conclusion is that information communication and preparations prior to workshop are vital for the outcome of discussions! Any future workshop including external experts must have at least half a day introduction about the target project. Of the same reason, it is vital that the field handbook and other information handed out to participants are well prepared and that all procedures are explained. Still, for a successful development of BioHab it was valuable to get input at this early stage.
- BioHab key structure and our influence on it:
conclusion is that qualifiers are of vital importance since there will in fact be limited degrees of freedom to alter the primary codes.
- Rules for dissolving the BioHab database:
One major conclusion from the Stockholm workshop was that qualifiers (primary and descriptive) are of vital importance to minimize the number of primary codes without losing important information regarding biodiversity. Biodiversity could only be monitored if both primary code and (primary) qualifiers are used together. This is the major reason for NOT dissolving the BioHab database on the primary code level alone.

- The matrix approach:
The workshop found the approach of matrices to illustrate the properties of categories highly valuable. This approach facilitated the work greatly and we think this would be the key to link BioHab to Nordic classification systems, where the matrix structure dry-wet/acid-basic is well established and built into the level 3 of the system for both forest types and open land types within the Nordic Vegetation Types developed by the Nordic Council of Ministers (Påhlsson 1998, 1999).
- Demand on the people carrying out the field work:
The people in the field need to be well experienced and well educated to accomplish the ambitions of BioHab: a consistent dataset to make pan-European estimates of biodiversity related measurements. Hence, field training with well defined and consistent instructions to the surveyors in field is essential.
- Use of spatial data and field preparations:
The workshop strongly recommends the use of aerial photographs since many small but important structures and changes can be easily detected in aerial photographs and with the use of historical documents land cover history profiles can thus be defined. Pre-classification of habitats in aerial photographs, preferably colour infrared, will greatly facilitate the accuracy and speed of field work.
- Scientific foundation of habitat descriptions:
The BioHab project needs relevant and scientifically based literature to refer to when defining habitats applicable for the Nordic region. The meeting has collected references provided in appendix 1.

2.2 Direct Impact on BioHab Project after the Workshop

Prior to the Stockholm workshop, BioHab had been through two major phases of development;

1. In the initial proposal it was planned to use only the various levels of EUNIS that could be consistently mapped in the field. However practical experience showed that life forms were necessary in order to transcend species and to remove the multiplicity of bio-geographical regions used in EUNIS.
2. The second stage was that the grasslands, scrub and forest in EUNIS did not have criteria that could be used consistently in the field. Instead environmental matrices were constructed to enable consistent divisions to be made, which could then be related to the EUNIS classes via a relational database

2.2.1 Implementation of Stockholm Workshop Outcome

1. During the Stockholm meeting it was pointed out that the approach used at the time in BioHab was inconsistent in that many of the categories outside grassland scrub and forest had actually mixtures of life forms, e.g. sand dunes, raised bogs and mires. These had been left as primary categories in BioHab to ensure compatibility with EUNIS, but it was recognised after the meeting that this was inconsistent. The decision was therefore made to remove any EUNIS derived categories and use life forms for all the General Habitat categories in BioHab. This has again decreased the preliminary number of habitat categories from approximately 500 to approximately 110.

The database will then enable direct comparisons to be made, parcel by parcel, between all major habitat classifications in Europe. It is recognised that in some situations it will not be possible to map all these classifications if a given patch may be outside the range of the classification. Example: this procedure will only involve adding some extra quality labels (descriptive qualifiers) to groups of patches, e.g. deciduous forest, tall scrub, dwarf scrub, cryptogams and water pools may all be labelled together as a 'raised bog'.

2. Primary codes are for practical mapping purposes. They can be converted into habitat classifications in three ways:

- Direct recording in future habitat mapping of current habitat classifications, i.e. 1:1 relationships
- By data base management into current or future classifications, i.e. mainly 1:1 relationships with in some cases qualifications
- By a relational database, either 1:1 or 1>1 or 1<1 or 1 not = 1

3. Recording fields of BioHab. If, a BioHab patch has different primary qualifiers within it then these should be mapped separately with appropriate secondary descriptive qualifiers. Therefore both primary code and primary qualifiers are obligatory!

- Primary code, based on the matrices (areal and linear) obligatory
- Primary qualifier obligatory
- Life form and species composition of units
- Other habitat classifications to do 1:1 comparisons
- Descriptive qualifiers

4. The concept of primary qualifiers was developed at the Nordic habitat workshop in Stockholm in order to provide the rule base for mapping existing habitat classifications and quality issues. The original procedure was only to include EUNIS and phytosociological associations under the fourth field. A further point made during the meeting was that experienced regional surveyors needed to map according to their regional classifications that had been developed for local objectives. Taken in conjunction with the fact that relational databases can not always give direct comparisons, the decision was made that a new habitat unit will be mapped in BioHab according to three basic rules:

- 30% and over cover of an individual species (>400 m²).
- Change in primary qualifier (All pan-European classifications, including EUNIS and regional/national classifications)
- Phyto-sociological associations

5. Some geo-referenced information from the GIS database e.g. for wooded pastures, Fennoscandian habitats may also need to be differentiated from the corresponding habitats elsewhere in Europe, e.g. Mediterranean deciduous wooded pastures.

6. Further work was also carried out subsequently on the constitution of Ericaceous vegetation following the discussion in the meeting and eventually has now been allocated to evergreen and deciduous categories.

7. A further discussion point was concerning the large park lands that were used for recreation in Stockholm. The final decision reached in late 2004 is that these should be categorized according to their life form within the artificial category, which is equivalent to urban or built up in other classifications. There are therefore now only two divisions in the whole of the BioHab key that are not based on life forms - artificial and crops and even then within these categories the divisions are on life forms. Non artificial bare ground or water is defined according to the absence of life forms (below 30% coverage). There are now only two

percentage bands used through the whole of the BioHab key, 30-70% and over 70%.

8. Marine, coastal, open water, wetland, and sparsely vegetated
It was proposed in the workshop that there was no justification for the maintenance for a different approach from life form and matrices for these groups of categories compared with grassland scrub and forest. The reason for their current status was to follow as closely as possible the EUNIS structure. However, with the core module of BioHab now allowing the primary qualifiers to enable direct mapping of EUNIS and other classifications, then this structure was no longer considered scientifically valid and consistent. A provisional set of matrices were drawn up to examine the integrity of this approach. In previous BioHab meetings several inconsistencies had already been noted in the wetland section involving transfer of EUNIS classes to grasslands e.g. saline vegetation not covered by water. These are not cross-overs in the sense of the EUNIS concerns because they will enable 1:1 comparisons to be made.

The workshop proposed that these categories become primary qualifiers. This is already consistent with the procedure described for scattered trees, tree cover 10-30%, and tree cover >30% in conjunction with grasslands in order to provide rules for the extraction of wooded pastures and meadows from open grasslands.

All the below proposed changes would have the effect of reducing the list of general habitats and would put all habitats except from urban, under the same set of rules. This would also facilitate the future development of a flexible BioHab system to include any future requirements. The qualifiers would be:

- *Marine*: below mean high water mark
- *Coastal*: either where there was a change in cover and management between the unit next to the shore and inland, or where the soil material had a recent marine origin. This would separate coastal dunes from inland dunes and for forests would separate those growing on rocks from those growing on marine sediments (sand, gravel and shingle). It is recognised that forests growing on bare rock surfaces would have to be covered by further qualifier e.g. wind pruned.
- *Open water*: Units >30% cover of water counts as open water (comparable with sparsely vegetated categories- the same rule applies that in this case plant cover of emergent vegetation is comparable to chasmophytic shrubs and is not included in the vegetation cover. There will be a separate matrix for emergent/floating and under water life forms. Running versus still water will be a primary qualifier. Tidal rivers are saline. Dammed water bodies are recorded as a primary code within constructed habitat and the life forms can be recorded within them.

- *Wetland*: A further column (to the left of wet) in the matrix of water saturated peat land as opposed to the wet categories will be water saturated for <70% of the year. Geomorphological units will be mapped as wider boundaries incorporating a series of life forms e.g. across a bog, rank vegetation and or forest >5m, mid scrub 0.6-2m, low scrub 0.05-0.6m, cryptogams >30%. Non peaty wetlands will be separated from the peat land. Saturated peaty / saturated non peaty.
- *Sparsely vegetated* (instead of 'unvegetated'): determined by <30% vegetation cover. Low cushion and crustose lichen and moss life forms are qualifiers to be excluded from the primary code for sparsely vegetated. Spreading bryophyte life forms e.g. *Racomitrium lanuginosum* and foliose lichens like *Cetraria islandica* are to be included under primary code for Cryptogamic non woody cover.

9. Other decisions that have been made subsequently are to include *Pinus* in a broad conifer category and to include *Fagus* with the winter deciduous, again to improve consistency. It has also been decided to allow all of the General Habitat categories to be recorded both as areal and linear features. It is recognized that some features may be recorded only as areal features or linear features within a given region. A separate list of linear features such as walls and fences has been added to the primary categories.

The field handbook has had much elaboration since the Stockholm workshop and has been field tested in Norway (north alpine zone), Austria (Alps), Greece (Thessalonica), and Spain (the Credo Mountains and Picos de Europa). An initial principal component analysis of the life form proportions has confirmed that the principal gradients are indeed those suggested by Raunkiaer. This analysis needs further input of boreal data.

Further editing of the field handbook is in progress and it will be field tested in June 2005 in Slovakia and hopefully in Sweden if funding can be raised.

Due to the fact that the workshop was held in the midst of project development, the BioHab General Habitat Categories for Europe will undergo further refinement and changes. This report is therefore not a final statement for the BioHab project. For up-to-date information regarding the progress of BioHab, please refer to the official website of the project: www.biohab.alterra.nl.

2.3 Nordic Networking after Workshop and Future Plans

Due to the complexity of the foci for the present workshop, we did not have the time to look ahead and start writing a new application for continuing funding of a Nordic platform/ network regarding habitat classification and monitoring as originally planned. However, it was concluded

as clearly interesting to continue the work and apply for further funding. At the end of the workshop, a question was posed by the organizer as to who would like to be a part of such a future Nordic platform/network. The following persons responded positively:

Ejrnæs, Rasmus, Denmark
 Ekstam, Urban, Sweden
 Glimskär, Anders, Sweden
 Groom, Geoff, Denmark
 Ihse, Margareta, Sweden
 Johansson, Eva, Sweden
 Kontula, Tytti, Finland
 Magnusson, Sigurdur H., Iceland
 Norderhaug, Ann, Norway
 Østebrøt, Akse, Norway
 Palo, Anneli, Estonia
 Skånes, Helle, Sweden
 Stabbetorp, Odd, Norway
 Stokland, Jogeir, Norway

After the workshop the following activities have taken place:

- Swedish, Norwegian, Finnish and Icelandic participants from the workshop were included as collaborators in an application to NMR ‘Indicators on status and development of Nordic habitats’ regarding mapping, classification and developments of indicators for nature types (biotopes/habitats)
- In July 2004, Bob Bunce, the coordinator of BioHab went on a field trip in mountainous Norway hosted by Jogeir Stokland and associates from NIJOS. This was to test the BioHab field handbook but also to give Bob field evidences of the peculiarities of north boreal alpine zone vegetation we discussed at the workshop.
- Margareta Ihse visited the Icelandic Institute of Natural History as an invited speaker in September 2004 to present Swedish vegetation mapping and monitoring.
- Helle Skånes visited colleagues at the Swedish Agricultural University, Umeå in December 2004 for discussions on future collaboration with the NILS project. The immediate plan is to set up a field test of BioHab during 2005.

Summary

The need for consensus regarding Nordic landscape related issues is great. The Nordic region, including the Baltic, has much in common, regarding physical conditions as well as cultural historical development and biodiversity status that on several points differ from the rest of Europe. Consequently, the Nordic countries share many habitats that follow climatic zonation rather than national borders. We therefore have much to learn from each other and major synergy effects to be gained from co-ordinating external contacts, such as participation in a larger EU project where only one or a few countries participate. The point of departure of this project was that the benefit of Nordic co-operation is great and that common efforts are more effective than national.

Today, knowledge about Nordic physical conditions and vegetation is extensive and all countries have developed classification systems of their own for mapping and monitoring landscapes and habitats. However, there is still no comprehensive work with systematic and scientific harmonisation between the existing and planned national and European classification systems to meet new international demands for sustainable development and its monitoring.

The aim of the workshop was to initiate a Nordic platform for harmonising habitat classifications across Europe and to strengthen the Nordic position within the ongoing EU FP5 concerted action project BioHab (contract no: EVK2-CT-2002-20018) where only Sweden, Denmark and Estonia represent the Nordic/Baltic region among a total of 13 participating countries. Since parts of the Nordic region are not included in the EU or the BioHab framework, we needed to confer with, and collect knowledge and experience from Nordic colleagues in the field.

The main aim was to create an overview of the ongoing work on classification and monitoring of habitats on a landscape level and to suggest constructive improvements of the BioHab categories. The workshop was held during three days in February 2004 with 20 invited experts and scientists representing six countries from the Nordic/Baltic region (Denmark, Estonia, Finland, Iceland, Norway and Sweden). In addition to this, and to ensure optimal communication with the BioHab team, the project coordinator participated in the workshop. The subject of the workshop was grand and we had to lower the ambitions to fully establish a Nordic future platform and to formulate a new application to NMD during the meeting. However, the workshop was positive to a future application and agreed that such a platform would be of Nordic interest.

To enable a congruent discussion, the workshop started out by giving a short background and description of BioHab and state-of-the-art presen-

tations of each participating country's approaches and actions on habitat classification and landscape monitoring.

The Nordic participants within BioHab have identified lacks in the EUNIS habitat list and the limitations of BioHab using categories based on EUNIS. The insufficiency regarded both lack of definition of existing habitats, as well as Nordic habitats being absent or mixed in EUNIS. This shortcoming was agreed upon by the participants of the workshop who also meant that the current EUNIS system is not optimal for the Nordic region. Since the connections between EUNIS and BioHab categories were not explicit at the meeting, the workshop focus was entirely placed on the BioHab categories in a Nordic context.

The workshop emphasised the importance of improving BioHab's recognition of the profound influence on habitats by human impact. The importance of ongoing and former land management on habitat quality was lively and emphatically discussed in all the group sessions as well as in plenary discussions.

It was confirmed that Nordic views on habitat classification and mapping seems to differ from the remaining participating countries within BioHab. A list of relevant literature (Appendix 1) was therefore compiled to support the scientific descriptions of Nordic habitats in the BioHab field hand book. This difference could be sensed in the scepticism expressed by several of the workshop participants regarding the continuous strong focus on Raunkiaer's life forms as primary classifier within BioHab. In the Nordic region, operational works using these life forms are scarce although many classification systems indirectly build on life forms criteria.

The workshop pointed out the significance of the Nordic Vegetation types developed by the Nordic Council of Ministers as a common denominator between the national and EU systems. Important in this context would be encourage work to update and refine the Nordic system to incorporate the parts regarding vegetation types of the cultural landscape added in 1999 into the digital database that has been built. This work would be a suitable project to be financed by the Nordic Council of Ministers. A tempting vision would be to see the Nordic Vegetation System online parallel or integrated into the Swedish virtual flora (<http://linnaeus.nrm.se/flora>). That way we would ensure a wide range of application and use of this excellent work also in a pan-European perspective.

The most important result of this workshop is that we contributed to the improvement of the general structure of the BioHab General Habitat Categories list and strengthen the Nordic position within the project. Following the workshop, the BioHab team has responded by firstly removing all the EUNIS derived categories and a procedure for mapping combinations of life forms. Secondly the BioHab field procedure now includes qualifiers to improve the detailed information recorded in the field. Thirdly a separate field has been included in the recording proce-

cedure to enable local experts to include any information, which they consider to be important. Since many of the comments and outcomes of this workshop documented here are of general application, their implementation on the BioHab system will add to the overall consistency and betterment of the BioHab field handbook.

Sammanfattning

Behovet av nordisk samordning i landskapsfrågor är stort. De nordiska länderna, inklusive Baltikum, delar till stor del naturgivna förutsättningar och markanvändningshistoria, samtidigt som dessa behandlats olika från ett nationellt perspektiv. Vi har därmed mycket att lära av varandra och mycket som med fördel kan samordnas vid kontakter utåt, t ex vid medverkan i större EU-projekt där endast ett eller ett par länder deltar. Utgångspunkten för detta projekt var att nyttan av nordisk samverkan är stor och att gemensamma insatser är mer effektiva än nationella.

Idag är kunskapen om Nordens naturgivna förutsättningar och vegetation stor och alla länder har utvecklat egna klassificeringssystem för kartering och övervakning av landskap och habitat. Det saknas emellertid fortfarande övergripande arbete med systematisk och vetenskapligt grundad harmonisering mellan existerande och planerade nationella och europeiska klassificeringssystem för att möta nya internationella krav på uttållig utveckling och dess övervakning.

Målsättningen med detta projekt var att initiera en Nordisk plattform för harmonisering av habitatklassificeringar över Europa och att stärka det nordiska perspektivet inom det pågående EU FP5 concerted action projektet BioHab (contract no: EVK2-CT-2002-20018) där endast Sverige, Danmark och Estland representerar den Nordiska regionen inklusive Baltikum bland totalt 13 deltagande nationer. Då delar av den nordiska regionen inte ingår i EU eller BioHabs nätverk, behöver vi samla kunskaper och erfarenheter från nordiska ämneskollegor.

Det främsta syftet var att skapa en överblick över pågående arbete kring klassificering och övervakning av habitat på landskapsnivå samt att ge konkreta förslag till förbättringar av BioHabs General Habitat Categories. Workshopen hölls under tre intensiva dagar i februari 2004 med 20 inbjudna experter och forskare från sex länder i den nordiska/baltiska regionen (Danmark, Estland, Finland, Island, Norge och Sverige). För att försäkra oss om optimal överföring av kunskap till BioHab teamet så deltog projektets koordinator. Ämnet för workshopen var stort och vi fick därför minska ambitionen att under mötet hinna bygga en framtida plattform och formulera en ny ansökan till NMD under själva mötet. Mötet var dock positivt till en framtida ansökan och menade att en sådan plattform är angelägen att skapa.

För att kunna samlas kring en gemensam diskussion gavs en kort bakgrundsbeskrivning av BioHab samt nationella *state-of-the-art* presentationer kring varje lands angreppssätt och utförande av habitatklassificering och landskapsövervakning.

BioHabs nordiska deltagare har identifierat luckor i EUNIS habiatlista liksom brister i BioHab vars kategorier bygger på EUNIS. Dessa brister rör både avsaknad av definitioner av existerande habitat samt att vissa nordiska habitat helt saknas eller finns med i flera klasser i EUNIS. Mötets deltagare var eniga om att dessa brister är problematiska och menade att EUNIS klassificeringssystem inte är optimalt för den nordiska regionen. Då kopplingarna mellan EUNIS och BioHab vid tiden för mötet inte var explicita kom workshopens fokus att helt läggas på BioHabs kategorier i ett nordiskt sammanhang.

Mötet framhöll vikten av att BioHab måste förbättra hanteringen av habitatens påverkan av pågående och tidigare markanvändning. Dessa faktorer diskuterades livligt och med eftertryck i samtliga gruppdiskussioner och gemensamma diskussioner.

Det bekräftades under workshopen att nordiska synsätt beträffande habitatklassificering och inventering på flera punkter skiljer sig från övriga deltagarländer i BioHab. Genom mötets försorg har en litteraturlista sammanställts (Bilaga 1) för att stödja den vetenskapliga förankringen av nordiska habitat i BioHabs fälthandbok. Denna skillnad återspeglas i den tveksamhet som uttrycktes av flertalet deltagare angående BioHabs fortsatt starka fokus på Raunkiaers livsformsbegrepp som primär klassificeringsgrund. I Norden arbetar man idag sällan direkt med denna indelning även om många klassificeringssystem indirekt bygger på livsformskriterier.

Vid mötet framhölls Nordiska ministerrådets vegetationstyper i Norden som en framkomlig väg att på ett samlat sätt koppla de nordiska habitat till ett pan-europeiskt klassificeringssystem. Viktigt i detta sammanhang vore att systemet uppdaterades och vidareutvecklades så att den del om kulturlandskapets vegetationstyper som tillkom år 1999 kunde inarbetas i den digitala databas som tidigare byggts upp. Detta skulle med fördel kunna ske inom ramen för ett projekt finansierat av Nordiska ministerrådet. En lockande vision vore att få se systemet Nordens vegetationstyper online, parallellt eller integrerat med den virtuella floran (<http://linnaeus.nrm.se/flora>). På så sätt skulle spridningen och användningen av detta utmärkta arbete kunna säkras också i ett pan-europeiskt perspektiv.

De viktigaste resultaten av denna workshop är att vi bidrog till att förbättra strukturen i BioHab på flera plan. Som en effekt av vår workshop har följande förbättringar av BioHab skett: 1) Alla kategorier som direkt bygger på EUNIS har tagits bort och en procedur att hantera kombinationer av livsformer har tagits fram. 2) BioHabs procedur i fält inkluderar nu sk "qualifiers" som förbättrar registreringen av detaljinformation. 3) Ett nytt fält i BioHabs kategorinyckel har lagts till där lokala experter kan lägga till ytterligare information som anses vara av vikt för habitatbeskrivningen. Då flera av kommentarerna och resultaten från workshopen som dokumenterats här är av generell karaktär, kommer deras implementering i BioHabs system även att bidra till att generellt förbättra BioHabs fälthandbok.

Workshop Program

February 19th

Time	Activity
10.00-10.30	Arrival, registration and coffee. Transfer of presentations to laptop
10.30-10.45	Welcome and presentation of the workshop and deliverables (Helle Skånes)
10.45-11.15	Background and current status of BioHab (Bob Bunce) <u>Short national state-of-the-art habitat classification presentations</u>
11.15-11.55	<i>Norway</i> , Jogeir Stokland
11.55-12.20	<i>Sweden</i> , Anders Glimskär
12.20-13.20	Lunch <u>National state-of-the-art habitat classification presentations cont.</u>
13.30-14.00	<i>Finland</i> , Tytti Kontula
14.00-14.20	<i>Estonia</i> , Anneli Palo
	short break
14.35-15.05	<i>Denmark</i> , Rasmus Ejrnæs
15.05-15.25	<i>Iceland</i> , Sigurdur H Magnusson
15.25-15.30	Coffee
15.30-18.00	Plenary discussions. Synchronisation of views and tasks. Introduction to group sessions
18.00-18.45	Hotel check-in
18.50	Departure for dinner (meet at hotel entrance)
19.30 ->	Workshop Dinner

February 20th

Time	Activity
09.15-09.35	Short summary from day 1 (Helle)
09.35-10.15	Discussion. Common gaps and problems. Introduction to group sessions II
10.15-10.30	Coffee and discussion
10.30-12.30	Group sessions II, solutions and BioHab categories and key
13.00-14.30	Lunch at Stora Skuggans vårdshus
14.30-15.30	short habitat walk in the National City park of Stockholm
15.30-18.30	Discussions, solutions and BioHab categories (incl. refreshment and coffee break)
19.45 ->	Restaurant Dinner down town for those who wish

February 21st

Time	Activity
09.00-09.30	Summary from group sessions II solutions (10 min/group).
09.30-10.30	Discussion, solutions and remaining problems.
10.00-10.20	Coffee
10.20-12.15	Deliverables: Workshop report/publication discussions.
12.15-12.30	Concluding remarks and closing of workshop
12.30-14.00	Lunch at Museum of Natural History
13.30-15.00	Summarising the workshop and departure

Participant List

Name / Country	Department	e-mail address
Bunce, Bob, The Netherlands	Alterra Green World Research, Wageningen	bob.bunce@wur.nl
Ejrnæs, Rasmus, Denmark	National Environmental Research Institute (DMU)	rej@dmu.dk
Ekstam, Urban, Sweden	Ekstam Consultant firm	urban.ekstam@comhem.se
Glimskär, Anders, Sweden	Swedish University of Agricultural Sciences (SLU)	anders.glimskar@nvb.slu.se
Groom, Geoff, Denmark	National Environmental Research Institute (DMU)	gbg@dmu.dk
Ihse, Margareta, Sweden	Stockholm University (SU)	margareta.ihse@natgeo.su.se
Inghe, Ola, Sweden	Swedish Environment Protection Agency	ola.inghe@naturvardsverket.se
Johansson, Eva, Sweden	Stockholm University (SU)	eva.johansson@natgeo.su.se
Kontula, Tytti, Finland	Finnish Environment Institute	tytti.kontula@ymparisto.fi
Magnusson, Borgthor, Iceland	Icelandic Institute of Natural History	borgthor@ni.is
Magnusson, Sigurdur H., Iceland	Icelandic Institute of Natural History	sigurdur@ni.is
Norderhaug, Ann, Norway	Norwegian Crop Research Institute	ann.norderhaug@planteforsk.no
Østebrøt, Akse, Norway	Directorate for Natur Management	akse.ostebrøt@dirnat.no
Påhlsson, Lars, Sweden	County Administration of Scania	lars.pahlsson@insatnet.nu
Palo, Anneli, Estonia	Environmental Protection Institute	ann@torvandi.ee
Skånes, Helle, Sweden	Stockholm University (SU)	helle.skanes@natgeo.su.se
Stabbetorp, Odd, Norway	Norwegian Institute for Nature Research (NINA)	odd.stabbetorp@nina.no
Stokland, Jogeir, Norway	Norwegian Institute of Land Inventory (NIJOS)	jogeir.stokland@nijos.no
Syrjänen, Kimmo, Finland	Finnish Environment Institute	kimmo.syrjanen@ymparisto.fi
Tuominen, Seppo, Finland	Finnish Environment Institute	seppo.tuominen@ymparisto.fi

Acknowledgements

The workshop was made possible thanks to generous funding by the Council of Nordic Ministers (NMD: Nordic working group on environmental monitoring and data compilation), Stockholm University, and Letterstedtska föreningen.

Appendix 1 Relevant publications on Nordic habitat classification

The list below was assembled by the delegates at the workshop and will support definitions of Nordic habitats in the BioHab General Habitat Categories list.

Denmark

- Aude, E. & Lawesson, J. E. 1998. Vegetation in Danish beech forests: the importance of soil, microclimate and management factors, evaluated by variation partitioning. *Plant Ecology* 134: 53-65.
- Carøe, I., Barfod, A. & Lawesson, J. E. 2000. Temporal dynamics of the ground vegetation in a Danish beech forest. *Nordic Journal of Botany* 20: 585-597.
- DANVEG 2002. A database of published and unpublished accounts of terrestrial vegetation in Denmark. <http://www.danveg.dk>.
- Degn, H.J. 2001. Succession from farmland to heathland: a case for conservation of nature and historic farming methods. *Biological Conservation* 97: 319-330.
- Dickmann, M., Eilertsen, O., Fremstad, E., Lawesson, J. E. & Aude, E. 1999. Beech forests in the Nordic Countries – a multivariate analysis. *Plant Ecology* 140: 203-220.
- Ejrnæs, R. & Bruun, H.H. 1995. Prediction of Grassland Quality for Environmental Management. *Journal of Environmental Management* 43: 171-183.
- Ejrnæs, R. 2000. Can we trust gradients extracted by Detrended Correspondence Analysis? *Journal of Vegetation Science* 11: 565-572.
- Ejrnæs, R., Aude, E., Nygaard, B., Münier, B. 2002. Prediction of habitat quality using ordination and neural networks. *Ecological Applications* 12: 1180-1187.
- Ejrnæs, R., Bruun, H.H., Aude, E. & Buchwald, E. 2004. Developing a classifier for the Habitats Directive grassland types in Denmark using species lists for prediction. *Applied Vegetation Science*, 7:71-80.
- Emborg, J., Christensen, M. & Heilmann-Clausen, J. 2000. The structural dynamics of Suserup Skov, a near-natural temperate deciduous forest in Denmark. *Forest Ecology and Management* 126: 173-189.
- Groom, G. and Stjernholm M. (2001): The Area Information System (AIS) : a Danish national spatial environmental database. Pp. 81-87 in: Groom, G. and Reed, T. (eds) Strategic Landscape Monitoring for the Nordic Countries. (TemaNord 2001:523). Copenhagen, Nordic Council of Ministers.
- Groven, R., Rolstad, J., Storaunet, K. O. & Rolstad, E. 2002. Using forest stand reconstructions to assess the role of structural continuity for late-successional species. – *Forest Ecology and Management* 164: 39-55.
- Jansen, L.J. M. (accepted for publication). Thematic harmonisation and analyses of Nordic data sets into Land Cover Classification System (LCCS) terminology. In: Groom, G. (ed) "Development in image application for Nordic landscape level monitoring". NMR Diverse Series. Copenhagen: Nordic Council of Ministers.
- Jensen, L. M., Hobitz, P., Reenberg, A. & Lawesson, J. 1998. A Quantitative Method for analysing landscape structure. *Danish J. Geography* 98: 88-93.
- Lawesson, J. E. 1998. Quantitative terrestrial vegetation ecology in Denmark. *J. Veg. Sci.* 9: 891-896.

- Lawesson, J. E., 2000. Danish deciduous forest types. *Plant Ecology* 151: 199-221
- Lawesson, J.E. 2002. Interpreting species distribution and biodiversity patterns in Denmark with GIS and advanced statistics. In: Shumny, V.K., Kolchanov, N.A. & Fedotov, A.M: (eds). *The First Workshop on Information Technologies Application to problems of Biodiversity and Dynamics of Ecosystems in North Eurasia*: 217-228. Russian Academy of Sciences, Siberian Branch, Novosibirsk. Abstract
- Lawesson, J. E. 2003. pH optima for Danish forest species compared with Ellenberg's reaction values. *Folia Geobotanica* 38:403-418.
- Lawesson, J. E. 2004. Ancient forests in Denmark and the importance of Tilia. Honnay, O.; Verheyen, K.; Bossuyt, B. & Hermy, M. (ed.). *Forest Biodiversity: Lessons from History for Conservation*. IUFRO Research series. CAB International, UK & New York - in press
- Lawesson, J. E. & Skov, F. 2002. The phytogeography of Denmark revisited. *Plant Ecology* 158: 113-122.
- Lawesson, J. E. & Wind, P. 2002. Oak dune forests in Denmark and their ecology. *Forest Ecology and Management* 164: 1-14.
- Munier, B., Nygaard, B., Ejrnæs, R. & Bruun, H.G. 2001. A biotope landscape model for prediction of semi-natural vegetation in Denmark. *Ecological Modelling* 139(2-3):221-233.
- Nygaard, B. & Ejrnæs, R. 2004. A new approach to functional interpretation of vegetation data. *Journal of Vegetation Science*, Vol 15:49-56.
- Rune, F. 1997: Decline of Mires in Four Danish State Forests During the 19th and 20th Century. – Forskningscentret for Skov- og Landskab, The research series 21, Hørsholm.
- Stoltze, M. & Pihl, S. 1998. Redlist 1997. Rare plants and animals in Denmark. Ministry of Energy and Environment, National Environmental Research Institute, The National Forest and Nature Agency. (In Danish). 219 p.
- Estonia
- Aaviksoo, K. 1993. Changes of plant cover and land use types (1950's to 1980's) in three mire reserves and their neighbourhood in Estonia. *Landscape ecology* 8(4): 287-301.
- Aaviksoo, K., Meiner, A. 1998. Using GIS and Remote Sensing in Land Cover Monitoring. – ISPRS Commission VII Symposium. Resource and Environmental Monitoring, Vol. XXXII, 7:53–59.
- Aaviksoo, K., Paal, J., Dišlis, T. 2000. Mapping of wetland habitat diversity using satellite data and GIS: an example from the Alam-Pedja Nature Reserve, Estonia. – Proc. Estonian Acad. Sci. Biol. Ecol. 49: 177-193.
- Andersson, L., Martverk, R., Kylvik, M., Palo A. ja A. Varblane. 2003. Woodland Key Habitat Inventory in Estonia 1999-2002. Tartu. 112 p. + 80 p.
- Laasimer, L. & Kull, T. (eds.) 1987. The plant cover of the Estonian S.S.R. Flora, vegetation and ecology. Valgus, Tallinn.
- Laasimer, L. 1975. Rare plant communities and their conservation problems. In: Laasimer, L. (ed.) Some aspect of botanical research in the Estonian SSR, pp. 62-73. Academy of Sciences, Tartu.
- Laasimer, L. 1981. Anthropogenous changes of plant communities and problems of conservation. In: Laasimer, L. (ed.) Anthropogenous changes in the plant cover of Estonia, pp. 18-31. Academy of Sciences, Tartu.
- Leibak E & Lutsar L 1996. Estonian coastal and floodplain meadows (Eestiranna-ja luhaniidud). Estonian Fund for Nature (Eestima Looduse Fond) and WWF Denmark. 244 pp. + annexes.
- Lõhmus, E. 1981. Anthropogenous forest site types on drained peatlands. In: Laasimer, L. (ed.) Anthropogenous changes in the plant cover of Estonia. pp. 77-90. Tartu.
- Mäemets, A. 1974. On Estonian lake types and main trends of their evolution. In: Kumari, E. (ed.) Estonian wetlands and their life, pp. 29-62. Valgus, Tallinn.
- Mander, Ü.. Regional assessment of the PEEN criteria in the Baltic countries. In: Support for the Establishment of the Pan-European Ecological Network in Central and Eastern Europe. Council of Europe. STRA-REP (98) 1998, 26, 68-92.
- Martin, G., Palo, A., Möller, K. 1998. Introduction to the marine and coastal environment in Estonia. Red List of Marine and Coastal Biotopes and Biotope Complexes of the Baltic Sea, Belt Sea and Kattegat. Compiled by H. von Nordheim & D. Boedeker. Baltic Sea

- Environment Proceedings, No. 75, HELCOM. S. 30 - 34.
- Masing, V. & Paal, J. 1998. Estonian wetlands – classification and biodiversity. – *Svensk Botanisk Tidskrift* 92: 147-161. (In Swedish, summary in English).
- Masing, V. 1975. Mire typology of the Estonian SSR. In: Laasimer, L. (ed.) Some aspects of botanical research in the Estonian SSR, pp. 123-136. Academy of Sciences, Tartu.
- Masing, V. 1984. Estonian bogs: plant cover, succession and classification. In: Moore, P.D. (ed.) *European mires*. pp. 120-148. Academic Press, London.
- Masing, V., Paal, J., Kuresoo, A. 2000. Biodiversity of Estonian wetlands. – In: B.Gopal, W.J.Junk, J.A.Davis (eds.) *Biodiversity in wetlands: assessment, function and conservation*. Vol. I. 2000 Backhuys Publishers, The Netherlands, pp.259-279.
- Meiner A (ed) 1999. Land Cover of Estonia. Implementation of CORINE Land Cover project in Estonia. Tallinn Estonian Environment Information Centre. 199 pp.
- Möller K 1998. CORINE Biotopes Estonia. Ministry of the Environment, Environment Information Centre, Tallinn. 80 pp. + annexes. (in Estonian and in English).
- Muru, K., Aaviksoo, K. 2001. Satellite monitoring of forests and natural grasslands in Estonia (on the basis of 3 nature protection areas). In: IALE European Conference 2001. Development of European Landscapes. Conference proceedings. Volume II. Tartu, 2001, pp. 750-755.
- Paal, J. 1998. Plant communities meriting protection in Estonia. I. Their criteria and network of typical communities. – *Estonia Martima* 3: 93-104.
- Paal, J. 1998. Plant communities meriting protection in Estonia. II. Rare plant communities. – *Estonia Martima* 3: 105-124.
- Paal, J., Ilomets, M., Fremstad, E., Moen, A., Børset, E. Kuusemets, V., Truus, L., Leibak, E. 1998. Estonian Wetland Inventory 1997. Publication of the Project “Estonian Wetlands Conservation and Management”. Eesti Loodusfoto, Tartu, 166 + xxviii p.
- Palang, H., O. Hiimäe, K. Sepp, M. Ivask, Ü. Mander 2000. Predicting the future of Estonian Landscapes: A scenario approach. In: Ü. Mander, R. Jongman (eds) *Landscape perspectives of land use change*. WIT Press, Southampton, Boston, pp. 107-130.
- Palo, A. & Kikas, T. 2003. Methodological problems of compiling digital vegetation site types maps: Case of Saare County, Estonia. *Journal for Nature Conservation*, Volume 11, Issue3. pp. 135-144.
- Palo, A. & Kikas, T., 2003. Methodological problems of compiling digital vegetation site types maps: case of Saare County, Estonia. *Journal for Nature Conservation*, 11:135-144.
- Pork, K. 1981. Anthropogenous dynamics of meadows in recent decades: protection of meadow communities. In: Laasimer, L. (ed.) *Anthropogenous changes in the plant cover of Estonia*, pp.46-63. Academy of Sciences, Tartu.
- Pärtel, M., Kalamees, R., Zobel, M., Rosén, E. 1999. Alvar grasslands in Estonia: variation in species composition and community structure. - *Journal of Vegetation Science* 10: 561-568.
- Rebassoo, H.-E. 1975. Sea-shore Plant Communities of the Estonian Islands. I, II. Academy of Sciences, Tartu.
- Sepp, K. 1999. The methodology and applications of agricultural landscape monitoring in Estonia. *Dissertationes Geographicae Universitatis Tartuensis*, 9. Tartu.
- Zobel, M. & Kont, A. 1992. Formation and succession of alvar communities in the Baltic land uplift area. *Nord. J. Bot.* 12: 249-256.
- Zobel, M. 1987. The classification of Estonian alvars and their plant communities. In: Laasimer, L. & Kull, T. (eds.) *The plant cover of the Estonian SSR*. Flora, vegetation and ecology, pp. 28-45. Valgus, Tallinn.
- Finland**
- Eurola, S., Hicks, S. & Kaakinen E. 1984: Key to Finnish mire types.- *Teoksessa: Moore, P. D. (ed.), European Mires:11-117*. Academic Press, London
- Eurola, S., & Virtanen, R., 1989: Key to the vegetation of the northern Fennoscandian fjelds. – *Kilpisjärvi Notes* 12:1-28
- Heikkinen, R.K. 1991. Multivariate analysis of esker vegetation in southern Häme, S Finland. *Annales Botanici Fennici* 28: 201-224.
- Hinneri, S. 1972. An ecological monograph on eutrophic deciduous woods

- in the SW Archipelago of Finland. *Annales Universitatis Turkuensis A II* 50: 1-131.
- Hämet-Anti, L. 1963: Zonation of the mountain birch forests in northernmost Fennoscandia. - *Ann. Bot. Soc. Zoo. Bot. Fenn. Vanamo* 34 (4):1-27
- Jalas, J. 1961b: Regionale Züge in der Felsenvegetation und- flora Ostskandians. - *Arch. Soc. Zoo. Bot. Fenn. Vanamo* 16 Suppl.: 38-49
- Kuusipalo, J. 1985. An ecological study of upland forest site classification in southern Finland. *Acta Forestalia Fennica* 192: 1-77.
- Lahti, T. 1995. Understorey vegetation as an indicator of forest site potential in Southern Finland. *Acta Forestalia Fennica* 246: 1-68.
- Lahti, T. & Väisänen, R.A. 1987. Ecological gradients of boreal forests in South Finland: an ordination test of Cajander's forest site type theory. *Vegetatio* 68:145-156.
- Maristo, L. 1941: Die Seetypen Finnlands auf floristischer und vegetationsphysiognomischer Grundlage. - *Ann. Bot. Soc. Zoo. Bot. Fenn. Vanamo* 15 (5):1-314
- Nieppola, J. 1993. Site classification of *Pinus sylvestris* L. forests in southern Finland. *Silva Fennica* 27:9-20.
- Oksanen, J. 1984. Lichen-rich forests and related communities in Finland: ordination and classification studies. University of Joensuu, Publications in Sciences 1:1-35.
- Ritaniemi, T., 1982: Botanical lake types in Finnish Lapland. - *Ann. Bot. Fenn.* 19:247-274
- Seppäo, P. 1985. The ecological classification of sorted forest soils of varying genesis in northern Finland. *Communicationes Instituti Forestalis Fenniae* 129:1-77.
- Tonteri, T., Hotanen, J.-P. & Kuusipalo, J. 1990a: the Finnish forest site type approach: ordination and classification studies of mesic forest sites in southern Finland. - *Vegetatio* 87: 85-98.
- Tonteri, T., Hotanen, J.-P. & Kuusipalo, J. 1990a. The Finnish forest site type approach: ordination and classification studies of mesic forest sites in southern Finland. *Vegetatio*, 87:85-98.
- Tonteri, T., Mikkola, K., & Lahti, T. 1990b. Compositional gradients in the forest vegetation. *Journal of Vegetation Science* 1: 691-698.
- Toivonen, H. & Leivo, A. 1993: Kasvillisuuskartoituksessa käytettävä kasvillisuus- ja kasvupaikkaluokitus. Kokeiluversio./ Klassificering av vegetation och växtplatser för vegetationskartering. Försöksversion.--Metsähallituksen luonnonsuojelujulkaisuja. Sarja A. No 14. 96 pp (in Finnish with Swedish summary).
- Tuominen, S., Eeronheimo, H., & Toivonen, H. 2001: Yleispiirteinen biotooppi-luokitus. A General Classification System for Finland's Biotopes. Metsähallituksen luonnonsuojelujulkaisuja. Sarja B. No 57. 60 pp (in Finnish with English summary).
- Iceland**
- Einarsson, S. (ed.), Magnusson, S., Olafsson, E., Skarphedinsson, K. H., Gudjonsson, G., Egilsson, K., and J.G. Ottosson, 2000. [The conservation value of proposed power project sites in northern part of the highland of Iceland] Náttúruverndargildi á virkjunarsvæðum norðan Jökla. Icelandic Institute of Natural History, Reykjavík. Report 00-009, 220 p. (*In Icelandic*).
- Magnusson, S.H., Olafsson, E., Gudmundsson, G.A., Gudjonsson, G., Egilsson, K., Kristinsson, H. and K.H. Skarphedinsson, 2001. [Karahnjúkar power project. Effects on vegetation, land arthropods and birds] Kárahnjúka-virkjun. Áhrif Hálslóns á gróður, smádyr og fugla. Icelandic Institute of Natural History, Reykjavík. Report 01-004 (LV-2001/020) (*In Icelandic*).
- Magnusson, S.H., Gudjonsson, G., Olafsson, E., Gudmundsson, G.A., Magnusson, B., Kristinsson, H., Egilsson, K., and K.H. Skarphedinsson, 2002. [Habitat types in four highland areas] Vistgerðir á fjórum hálendissvæðum. Icelandic Institute of Natural History, Reykjavík. Report 02-006. (*In Icelandic*).
- Steindorsson, S. 1945. Studies on the Vegetation of the Central Highland of Iceland. Botany of Iceland. Vol. III. Part 4. Copenhagen.
- Steindorsson, S. 1964. Vegetation in Iceland [Gróður á Íslandi]. Almenna bóka-félagið, Reykjavík. (*In Icelandic*).
- Norway**
- Fremstad, E. 1997. Vegetasjonstyper i Norge. - NINA Temahefte 12: 1-279
- Økland, R.H. 1990. Vegetation ecology: theory, methods and applications with

- reference to Fennoscandia. - *Sommerfeltia* Suppl. 1: 1-233.
- Økland, T. 1996. Vegetation-environment relationships of boreal spruce forest in ten monitoring reference areas in Norway. - *Sommerfeltia* 22: 1-349.
- Økland, T., Bakkestuen, V., Økland, R., & Eilertsen, O. 2001. Det norske konseptet for vegetasjonsøkologisk intensivovervåking. NIJOS-rapport 08/01: 1- 46.
- Moen, A. 1999. National Atlas of Norway: Vegetation. Norwegian Mapping Authority, Hønefoss.
- Norderhaug, A., Austad, I., Hauge, L. & Kvamme, M. (Eds.) 1999. Skjøtselsboka for kulturlandskap og gamle norske kulturmærker. Landbruksforlaget, Oslo.
- Vandvik, V. & Birks, H.J.B. 2002. Pattern and process in Norwegian upland grasslands - a functional analysis *Journal of Vegetation Science*, Vol 13:123-134.
- Sweden**
- Ahlcrona, E., Olsson, B. and Rosengren, M. (2001): Swedish CORINE land cover. Pp. 9599 in: Groom, G. and Reed, T. (eds) Strategic landscape monitoring for the Nordic countries. (TemaNord 2001:523) Copenhagen, Nordic Council of Ministers.
- Berg, Å., Ehnström, B., Gustafsson, L., Hallingbäck, T., Jonsell, M. & Weslien, J. 1994: Threatened plant, animal, and fungus species in Swedish forests: distribution and habitat associations. *Conservation Biology* 8: 718-731
- Berg, Å., Gärdenfors, U., Hallingbäck, T. & Norén, M. 2002: Habitat preferences of red-listed fungi and bryophytes in woodland key habitats in southern Sweden – analyses of data from a national survey. – *Biodiversity and Conservation* 11: 1479-1503.
- Eckstein, R.L. & Karlsson, P.S. 1997. Above- ground growth and nutrient use by plants in a subarctic environment: effects of habitat, life- form and species. *Oikos* 79(2): 311-324.
- Eckstein, R.L. 1999. Nutrient use strategies of plants of various life- forms in a subarctic environment nutrient conservation as an adaptation to infertile habitats. PhD thesis, Uppsala Univ., Uppsala, Sweden, 32 pp.
- Ekstam, U. & Forshed, N. 1992: Om hävdens upphör, (in Swedish with summary in English)
- Ekstam, U. & Forshed, N. 2002: Svenska Alvarmarker, historia och ekologi, Naturvårdsverkets förlag, Stockholm (in Swedish with)
- Fridman, J. & Walheim, M. 2000: Amount, structure, and dynamics of dead wood on managed forestland in Sweden. -*Forest Ecology and Management* 131: 23-36.
- Hansson, L. 2001: Key Habitats in Swedish Managed Forests. *Scandinavian Journal of Forest Research* 16(suppl.): 42-61.
- Ihse, M. & Blom, G. 2000: A Swedish countryside survey for monitoring of landscape features, biodiversity and cultural heritage - the LiM-project. In Mander, Ü. & Jongman R.G.H., (eds.): *Consequences of Land-use Changes* - Wit Press, Southampton and Boston, series Advances in Ecology, pp 39-74.
- Ihse, M. & Lindahl, C. 2000: A holistic model for landscape ecology in practice. The Swedish survey of ancient meadows and pastures. - *Landscape and Urban Planning*, 50:59-84.
- Karlsson, P.S., Eckstein, R.L. & Weih, M. 2000. Seasonal variation in 15N natural abundance in subarctic plants of different life-forms. *Ecoscience* 7 (3): 365 - 369.
- Löfroth et al, 1997: Svenska naturtyper i europeiska nätverket Natura 2000, (in Swedish with summaries in English)
- Niklasson, M. & Nilsson, S. G. 2002: A preliminary regional division for efficient biodiversity preservation based on disturbance regime, forest history and tree species distribution: the southern Swedish example. -*Reports in Ecology and Environmental Engineering* 1: 2002: 131-135.
- NILS National Inventory of Landscapes in Sweden: <http://www-nils.slu.se>.
- Nilsson, S. G. & Niklasson, M. 2002: An approach to quantitatively estimate biodiversity preservation potential at forest stand level. -*Reports in Ecology and Environmental Engineering* 1: 2002: 38-44.
- Nilsson, S. G., Arup, U., Baranowski, R. & Ekman, S. 1995: Tree-dependent lichens and beetles as indicators in conservation forests. – *Conservation Biology* 9: 1208-1215.
- Nilsson, S. G., Niklasson, M., Hedin, J., Aronsson, G., Gutowski, J. M., Linder, P., Ljungberg, H., Mitsukinski, G. & Ranius, T. 2002: Densities of large living and dead trees in old-growth temper-

- rate and boreal forests. -*Forest Ecology and Management* 161: 189-204.
- Nordén, B. & Appelquist, T. 2001: Conceptual problems of ecological continuity and its bioindicators. *Biodiversity and Conservation* 10: 779-791.
- Ohlsson, M., Söderström, L., Hörnberg, G., Zackrisson, O. & Hermansson, J. 1997: Habitat qualities versus long-term continuity as determinants of biodiversity in boreal old-growth swamp forests. - *Biological Conservation* 81: 221-231
- Rydin, H., Snoeijs, P., Diekmann, M., (ed) 1999: Swedish plant geography, Svenska Västgeografiska Sällskapet, Uppsala
- Rydin, H., Sjörs, H. & Löfroth, M., 1999. Mires. In: Rydin, H., Snoeijs, P., Diekmann, M., (ed) 1999: Swedish plant geography, Svenska Västgeografiska Sällskapet, Uppsala
- Skånes, H. 1996: Landscape Change and Grassland Dynamics, Doctoral thesis
- Vessby, K., Söderström, B., Glimskär, A. & Svensson, B. 2002: Species-richness correlations of six different taxa in Swedish seminatural grasslands. - *Conservation Biology* 16: 430-439.
- The Nordic region, whole or parts not covered at the Stockholm workshop**
- Ejrnæs, R. & Fredshavn, J. (eds.), 2004. Proceedings from the workshop: Mapping and monitoring in the Nordic countries. November 1-3, 2002, Fuglesø, NMR.
- Devilliers-Terschuren, P. and J. Devilliers-Terschuren, 1996. A classification of Palaearctic habitats. Council of Europe. Nature and environment. 78, 194 p.
- Devilliers-Terschuren, P. and J. Devilliers-Terschuren, 2001. Application and development of the Palaearctic habitat classification in the course of the setting up the Emerald Project – Iceland –. Council of Europe. Group of Experts for setting up of the Emerald Network Areas and Special Conservation Interest. 82 p.
- Ecological Bulletins 46, Boreal ecosystems and landscapes: structures, processes and conservation of biodiversity, ed. Hansson 1997
- Groom, G. & Reed, T., 2001. Strategic landscape monitoring for the Nordic countries, TemaNord, 2001:523, Copenhagen
- Jonsson, B. G. & Jonsell, M. 1999: Exploring potential biodiversity indicators in boreal forests. - *Biodiversity and Conservation* 8: 1417-1433
- Lawesson, J. E. 1999. *Quercus* forests in the Nordic countries, a preliminary overview. *Annali di Botanica* (Roma) LVII: 147-158.
- Lawesson (ed.), 2000. A concept for vegetation monitoring in the Nordic countries. TemaNord 2000:517, Copenhagen
- Lawesson, J. E. 2002. Nordic Vegetation Survey – A status of progress and future outlook. *Annali di Botanica* (Rome) - in press.
- Lawesson, J. E., Fosaa, A. M. & Olsen, E. 2003. Calibration of Ellenberg indicator values to the Faroe Islands. *Applied Vegetation Science*, Vol 6.1:53-62.
- Nordic Council of Ministers:
http://www.norden.org/pub/miljo/miljo/sk/TN98_510.asp
- Påhlsson, L. (ed). 1998. Vegetationstyper i Norden. TemaNord 1998:510. København.
- Påhlsson, L. (ed). 1999. Markanvändning och vegetation i nordiska odlingslandskap. TemaNord 1999: 555. København
- Svenning J-C (2002) A review of natural vegetation openness in north-western Europe. *Biological Conservation* 104:133-148
- Rolstad, J., Gjerde, I., Gundersen, V. S. & Sæterdal, M. 2002: Use of indicator species to assess forest continuity: a critique. - *Conservation Biology* 16: 253-257
- Stokland, J., Eriksen, R., Tomter, S.M., Korhonen, K., Tomppo, E., Rajaniemi, S., Söderberg, U., Toet, H. & Riis-Nielsen, 2003. Forest biodiversity indicators in the Nordic countries, TemaNord, 2003:514, Copenhagen.
- The Virtual flora: <http://linnaeus.nrm.se/flora/welcome.html>
- Other relevant papers concerning life forms**
- Mark Westoby, M., 1998. A leaf-height-seed (LHS) plant ecology strategy scheme, *Plant and Soil* 199: 213-227.

Appendix 2

BioHab Executive Summary



BioHab

A framework for the co-ordination of Biodiversity and Habitats

Contract Nr: EVK2-CT-2002-20018

Executive summary report 1st December 2002 - 30th November 2003

co-ordinator: Dr R.G.H. Bunce

home page: www.biohab.alterra.nl

Distributed as background material to NMR Habitat workshop in Stockholm February 19-21 2004

Executive Summary, Related to the Reporting Period

Objectives

To Identify an appropriate framework for coordination and integration of data from different sources and to construct a pilot database.

To coordinate habitats with available phytosociological information and to initiate the process of building descriptions understandable for a variety of users.

To ensure that the project has direct policy relevance, through the involvement of stakeholders, coordinators of other European projects and policy makers.

Scientific Achievements

Initially the BioHab project was intended to develop consistent definitions and descriptions for mapping EUNIS classes in the field. However, because the EUNIS classification explicitly uses different individual criteria and parameters at different levels in the hierarchy, it was not possible to determine a consistent set of rules for field mapping. Accordingly a combination of plant life forms and basic environmental parameters was developed to achieve a consistent level for field mapping for four of the ten level one EUNIS series, the other six are currently as level three. The field parameters have to be recognised in a single visit and need careful definition because a single word e.g. dry may have different meanings in different regions. Likewise within BioHab, local names e.g. maquis (FR) and erial (ES) are specifically avoided because they apply only to regional conditions. Similarly, biogeographical terms are not used because of their varying meaning in different regions. This approach is designed to link to subsequent axes determined by multivariate analysis of phytosociological data. Life forms are the only way to determine habitats, since the individual species vary across biogeographic zones e.g. from west to east Mediterranean, yet the structure of the vegetation in a given habitat stays constant.

The categories being developed are for field mapping, not a new habitat classification and are for subsequent integration with existing classes. Because of the proliferation of classifications a pilot relational database has been constructed between EUNIS and three classifications. This approach will be further developed in order to enable ready access and

comparisons between the principal existing European and regional habitat classifications. It is recognised that a flexible system is required to enable reporting of habitats at European, national and regional level. A list of categories was developed in 2003 in a series of field visits and a consultative process is currently underway to refine this provisional list. Field testing will take place during 2004 in the major European biogeographical regions. A second version of the Field Handbook will then be produced. A Bioelectronic Field Manual has also been tested for field mapping with direct links to GIS.

The field recording system will record disaggregated data from which subsequent database management will be able to report on habitat classes according to different classifications. Attention will be given to a modular system of field recording, so that on the one hand minimal data for habitats may be collected at low cost, whereas detailed data may be needed for other policy objectives. The production of a framework for coordination of habitats with other data e.g. vegetation, plants and birds, will demonstrate how integrated assessments of biodiversity can be made because habitats alone are only one measure of complexity. Assessment is also required at the landscape scale as well as for individual elements. Especial attention has been paid to linear features because of their importance at the landscape scale in highly managed landscapes. The BioHab categories provide a direct framework for detecting change, since the basic environmental parameters stay the same and only the structure of the vegetation alters, causing shifts between categories.

It is recognised that it may be necessary to accept new categories by applying the rules developed in BioHab for determining the present combinations. This is because knowledge in the consortium of the range of variation in the southern Accession countries and the Balkans is limited. Furthermore, it seems probable that Turkey will eventually join the EU and is likely to have distinctive habitats that are outside the current range of descriptions.

Also under construction is a database designed to provide descriptions of the habitat categories, using standard ecological criteria such as plant species, vegetation associations and environmental parameters. Access to phytosociological data via the SynBioSys network and other existing European data sets is central to this approach with strict standards being set for the meta data e.g. the precise location of the relevee and characteristics of the site.

The Environmental Classification of Europe, constructed by the Wageningen University Research Centre for the A Team EU Fifth Framework Project, at a 1 km² level using climate and topographical data, will be the framework used for integration of existing data. It will also be used to identify gaps and where future sampling may be required. These procedures have already been tested in the UK and Spain and will enable summaries to be presented for any biogeographical region once the data-

base has been constructed. A pilot project has shown how the regions can be described and the effect of sampling size on statistical error determined.

In the initial plan stakeholders were to be involved only at the beginning and end of the project. At the first stakeholder meeting it was emphasised that this was insufficient to obtain adequate feedback. Accordingly, an Advisory Group was set up which will meet about every six months during the project. The first meeting of this Group was in a Natura 2000 site near Madrid in which a clear separation was drawn between the use of habitats for descriptive purposes, as opposed to providing a statistical framework for assessment of resources and for monitoring change, so that real change can be separated from background noise. A visit to the EEA confirmed the role of the BioHab categories. Unique and rare types occupying small areas cannot be included within such a general monitoring framework. To conclude, the BioHab categories are not a new habitat classification, rather in conjunction with the Environmental Classification, they are designed to link existing habitat classifications with the long term objective of producing statistically robust estimates for habitat extent and change that transcend national boundaries and provide links to biodiversity.

Socio-economic Relevance and Policy Implications

This concerted Action is central to Key Action 1.1.4 and to Research Priority 2.2.3, as definition of habitats is fundamental to the conservation of biodiversity. This is due in part to the inherent importance of habitats in their own right, but also because they can be linked to measures of biodiversity, e.g. species number, ecosystem structure and genetic composition. The problems addressed in this Concerted Action concern developing consistent rules and definitions of habitats by organizing existing expertise. The decline in the extent and quality of habitats across Europe is widely recognised. However, despite many workshops and conferences, there is no strategic framework for linking national programmes or providing European figures for the extent of habitats. The production of such figures is fundamental for policy formulation for the maintenance and enhancement of biodiversity across Europe.

Conclusions

The first year of the BioHab project has set up the framework and determined the main structure that will be used in the next two years of the project. A series of initiatives have also been undertaken that will be further developed and tested in the coming year. Financial support from

Alterra and close involvement with other projects have enabled more staff time to be allocated to the project than provided by the original project budget.

Key words:

Environmental Classification, BioHab categories, Habitats, EUNIS, Life forms, Ellenberg values, relational database, Bio-electronic Field Manual, Field Handbook

Peer reviewed publications

- Brandt, J.J.E., Bunce, R.G.H., Howard, D.C., & Petit, S. (2002). General principles of monitoring land cover change based on two case studies in Britain and Denmark. *Landscape and Urban Planning*, **62**, 37-51.
- Bunce, R.G.H., Carey, P.D., Elena-Rosello, R., Orr, J., Watkins, J., & Fuller, R. (2002) A comparison of different biogeographical classifications of Europe, Great Britain and Spain. *Journal of Environmental Management*, **65**, 121-134.
- Smart, S.M., Bunce, R.G.H., Firbank, L.G., & Coward, P. (2002). Do field boundaries act as refugia for grassland plant species diversity in intensively managed agricultural landscapes in Britain. *Agriculture, Ecosystems and Environment*, **91**, 73-87.
- Firbank, L.G., Barr, C.J., Bunce, R.G.H., Furse, M.T., Haines-Young, R.H., Horning, M., Howard, D.C., Sheail, J., Sier, A.R.J., & Smart, S.M. (2003). Assessing stock and change in land cover and biodiversity in GB: an introduction to the Countryside Survey 2000. *Journal of Environmental Management*, **67**, 207-218.
- Sheail, J. & Bunce, R.G.H. (2003). The development and scientific principles of an environmental classification for strategic ecological survey in the United Kingdom. *Environmental Conservation*, **30**, 147-159.
- Smart, S.M., Clarke, R.T., van de Poll, H.M., Robertson, E.J., Shield, E.R., Bunce, R.G.H., & Maskell, L.C. (2003). National-scale vegetation change across Britain: an analysis of sample-based surveillance data from the Countryside Sur-

veys of 1990 and 1998. *Journal of Environmental Management*, **67**, 239-254.

Non refereed publications

- Bunce, R.G.H. 2003. The Principals of vegetation monitoring in Europe. *European Conference on vegetation Monitoring, WSL, Zurich*. (Paper Presentation)
- Bunce, R.G.H. & Howard, D.C., 2003. Habitat mosaics in Landscape Ecology. *IALE UK Workshop Grange-over-Sands* (Workshop Organizers)
- Daniel O., Desaulles A., Flisch R., Gaillard G., Herzog F., Hofer G., Jeanneret P., Nemecek T., Oberholzer H., Prasuhn V., Ramsauer M., Richner W., Schüpbach B., Spiess E., Vonarburg UP., Walter T., Weisskopf P. (2003) *Agrar-Umweltindikatoren - Machbarkeitsstudie für die Umsetzung in der Schweiz*. Zürich, Schriftenreihe der FAL 47. (*Presentation of the BioHab habitat mapping approach*)
- Howard, D.C., S. Petit & R. G. H. Bunce (2003) Monitoring multi-functional landscapes at a national scale – guidelines drawn up from the Countryside Survey of Great Britain In: J. Brandt and H. Vehre (Eds.) *Multifunctional landscapes Volume II Monitoring, diversity and management* Southampton: Wit Press, *Advances in Ecological Sciences Volume 15* (Book chapter)
- Jongman R., Rosello R.E., Howard D., Metzger M., & Bunce R. 2003. Environmental classification in Europe: coordinating ecological data and linking field monitoring. In: *Crossing frontiers: Landscape Ecology Down Under. Building bridges between cultures, disciplines and approaches. Abstracts IALE World Congress 2003, Darwin, Northern Territory, Australia, 13th-17th July 2003, compiled by Andrew Franks, Diane*

- Pearson and Kamil Waqar*, 62-63.
[S.l.]:IALE (Abstract)
- Mücher C.A., Bunce R.G.H., Jongman R.H.G., 2003. Presentation of Project on application of the Environmental Classification to the Identification of Environments and Landscapes in Europe. *Alterra Seminar*. (Paper Presentation)
- Mücher C.A., Bunce R.G.H., Jongman R.H.G., Klijn J.A., Koomen A., Metzger M. and Wascher D.M. 2003. Identification and characterisation of environments and landscapes in Europe. Wageningen, Alterra, 123 p. Alterra report 832
- Oszlányi J., Halada L., Bača A., 2003. A Framework for the Coordination of Biodiversity and Habitats. In: Abstracts of the 13th International Symposium on Problems of Landscape Ecological Research, 30 September – 3 October 2003, Mojmirovce, Slovak Republic.
- Krnáčová, Z., Hrnčiarová, T., Dobrovodská, M. (eds.). Bratislava: Institute of Landscape Ecology SAS, 2003, p. 89.
- Oszlányi J., Halada L., Bača A. 2003. BioHab - A Framework for the Coordination of Biodiversity and Habitats. Landscape Ecology – an International Integrating Tool in Environmental Issues. The 13th International Symposium on Problems of Landscape Ecological Research, 30 September – 3 October 2003, Mojmirovce, Slovak Republic. Institute of Landscape Ecology SAS. (poster)
- Oszlányi J., Halada L., Bača A. 2003. BioHab - A Framework for the Coordination of Biodiversity and Habitats. IVth Ecology Days, 7 - 8 October 2003 Banská Štiavnica, Slovakia. Slovak Ecological Society by Slovak Academy of Sciences (SEKOS). (poster)
- Pérez-Soba, M., Bunce, B., Mücher M. and Jongman R. 2003. BioHab: a consistent methodology linking habitats with land use and biodiversity. *Conference 'Framing Land Use Dynamics', 16-18 April 2003, Utrecht, The Netherlands. Session: Framing Ecological Scales in Land Use*. (Paper Presentation)
- Pérez-Soba, M., Woltjer, I., Stoker, J., Stortschi, I., Mücher C.A., Bunce, R.G.H., 2003. Bio-electronic Field Manual (PowerPoint Presentation)
- Future publications**
- Calvo, S. & Diaz, R. Relationships in European Land cover and habitat Classification; a case study in the Northern Mountains of Galicia (NW Iberian Peninsula) (Report to Alterra)
- Calvo, S. & Diaz, R. Access relational database between EUNIS and three other classifications (Computer Software)
- Jongman R.H.G., Bunce R.G.H., Metzger M.J., Mücher C.A. and Howard D.C. A statistical Environmental Classification of Europe: objectives and applications. Landscape Ecology (submitted to Landscape Ecology).
- Mateus, V. Countryside Landcover. Strategic Sampling Survey. (MSc Dissertation)
- Metzger M.J., Bunce R.G.H., Jongman R.H.G., Mücher C.A. & Watkins J.W. A statistical stratification of the environment of Europe. (Submitted to Journal of Global Ecology and Biogeography)