Leif Andersson

Habitat classification in the light of disturbance and succession

Classification and systematics are important activities in all scientific work. The classification of chemical substances, elementary particles and biological species seems at first sight a solid and well established scientific approach, at least when compared to the classification of vegetation, habitats or ecosystems. Never the less classification of vegetation and habitats are necessary for many purposes. Vegetation classification has been carried out for more than 100 years in Europe. The methods and results differ from country to country. One important question in this article is whether there can be such a 'Columbi egg' among the classification systems, that can serve as tool for all purposes. In particular the use of habitat classification as a tool for selecting habitat types for high conservation priority is discussed. Some examples of features missing in most habitat classifications when used for this purpose are also discussed.

CLASSIFICATION OF VEGETATION IN EUROPE

The classification of vegetation has a long history in Europe. Disparate classification attempts in central Europe were replaced by the more strict system of the Braun-Blanquet school in the beginning of the last century (Braun-Blanquet 1921, 1964). This system, called plant sociology, phytosociology or geobotany by different authors, has during its long time of practice, evolved rules for naming and describing vegetation (Barkman *et al.* 1986). This system, or minor variations of it, has been adopted as the main vegetation classification in many European countries, mostly in central and southern Europe. A very large number of works on vegetation classification and vegetation description have been published (Ellenberg 1996, Pott 1992, Oberdorfer 1992-93, Peinado Lorca, & Rivas-Martinez 1987, Horvat *et al.* 1974). The classification of vegetation in these various works do not totally correspond, particularly if those from different countries are compared.

In Eastern Europe vegetation classification has also been developed in a similar way to the plant sociology tradition (e.g. Paal 1997, Rasomavicius 1998).

In the Nordic countries (Sweden, Finland, Denmark, Norway and Iceland) vegetation classification has followed other paths. Forest classification started early, especially in Finland (e. g. Cajander 1909). In the beginning of the 20th century, attempts were made to follow the Central European Braun-Blanquet school (Du Rietz 1921) although local Nordic systems soon dominated the classification work (Kalliola 1973, Sjörs 1967). In Norway the important work of Nordhagen and later Kielland-Lund were more closely related to the central European plant sociology (e.g. Nordhagen 1936 and Kielland-Lund 1981). A synthesis of vegetation classification in the Nordic countries was made (Nordiska Ministerrådet 1984, Påhlsson 1994) and has been used in many projects - e.g. the Swedish Wetland Inventory (Göransson et al 1983) and the Swedish Meadows and Pastures Inventory (Naturvårdsverket 1987). In spite of being a Nordic classification system, it has been little used in Finland and Denmark.

The need for a uniform classification covering larger geographical areas has been more pronounced when the planning of nature protection is carried out on a European Union scale. For mapping, protection planning, ecosystem monitoring and other purposes the Corine Biotopes have been developed (Devillers *et al.* 1991) within the Corine (Co-ordination of Information on the Environment) project. Corine Biotopes were compiled before the Nordic countries of Sweden and Finland became members of the European Union. No countries belonging to the boreal biome were therefore represented when they were developed.

The Rio Convention on Biodiversity of 1992, signed and ratified by the EU and all its member states, has led to new undertakings to preserve biodiversity. An instrument to fulfil this duty within the European Union is the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) and the development of the Natura 2000 Network (EU Commission 1999). This classification can not be considered a structured system, merely a gathering of types from different classification systems (and all possible levels from these) sometimes even including new inventions that do not correspond to any other systems.

After 1991 the Corine Biotopes developed further, in several steps, to cover other parts of Europe and to be a classification system suitable for the Habitats Directive and the Natura 2000 Network. Devillers &

Devillers-Terschuren 1993 made a substantial step towards an integration of different vegetation classification systems covering the whole Palearctic. Recently this work has been developed further in the framework of EUNIS (Davies & Moss 1999).

CLASSIFICATION OF HABITATS IS NOT IDENTICAL WITH THE CLASSIFICATION OF VEGETATION

According to the author's point of view, classification of habitats should not be confused with the classification of vegetation. A classification of habitats must also express and describe the habitats and the conditions necessary for animals and other non-photosynthesising organisms. This follows clearly from all existing ecological definitions of the habitat concept, although the vegetation in most cases plays a major and basic role in habitat classification.

To be able to describe the habitats of most organisms in an appropriate way, other quantitative and qualitative data are necessary in addition to the specification of vegetation type. A thorough description of habitat demands for forest living invertebrates, fungi, lichens, mosses and birds requires, in most cases, data about the age of trees, frequency of very old trees and abundance of coarse woody debris (CWD). Such elements in forests have not been taken into account in existing habitat classifications within the European Union (Davies & Moss 1999, European Commission 1999, Devillers & Devillers-Terschuren 1993, European Council 1992, Devillers *et al.* 1991).

Also, the occurrence of microhabitats (elements) depending on certain hydrological, edaphic or geological conditions, such as boulders, rock outcrops, small streams and other elements, is often crucial for a lot of organisms.

Disturbances (natural or induced by man) and the subsequent successional stages result in vegetation types and habitat types that are seldom found in vegetation classification systems. Such successions are important for a large number of species. The history (disturbance, land use) of the actual habitat is therefore an important factor when describing a habitat. One example is that of all species adapted to succession after forest fires. Fire scarred trees, burnt CWD, denuded burnt ground, etc are particular elements in such successions. Forest fire is an important disturbance factor necessary for the existence of several forest types (Syrjänen *et al* 1994). Burnt forests and succession after forest fires is missing from most vegetation classification systems. The very wide "habitat" Western Taiga used in the Natura 2000 is the only case where this is taken into account. However, this "Western Taiga" covers almost all natural and semi-natural forest land in the Boreal zone in Europe and is of little use for mapping and for calculating the representativeness of different boreal mesic and dry forest sites.

Herbivory of grazers and browsers is another important disturbance factor, particularly in the nemoral biome. This disturbance produces, given enough impact, time and intensity, a mosaic structure with high biodiversity related both to open grassland ecosystems and to tree and shrub layers (Olff *et al*1999). Hence it is important to be able to express the quantity of mosaic structure in a landscape as well as the individual habitat types of the components.

Mowing is a human activity and a disturbance type that has formed many sites with beautiful ground flora. Many meadows are however, also valuable because of the occurrence of very old trees and groups of flowering shrubs. This combination of values connected to both grassland and tree/shrub layer is not reflected in existing habitat classification systems.

Complexes of different types, such as the wooded pastures and wooded meadows mentioned above, are described in very general words, not reflecting their values and variations.

Inundation (flooding) creates particular vegetation types and these are relatively well covered by present habitat classification systems.

PURPOSES OF DIFFERENT CLASSIFICATION SYSTEMS

Why are there all these different classification systems? What is their purpose? What are their objectives? And are the target users really using them? Have there been any evaluations made by the end users of the classification systems?

This article is not going to evaluate the different applications of all these classification systems, although their use as tools to select types and sites for protection priority will be discussed later. In **Table 1** the possible contexts where different classification systems can be used, according to their respective authors, are listed. In most major works following the phytosociological tradition, the authors have omitted a discussion about the use of the presented vegetation classification system.

TABLE I.
CONTEXTS WHERE DIFFERENT HABITAT CLASSIFICATIONS ARE PROPOSED FOR USE

(mainly EUNIS and Vegetation types of the Nordic countries)

- **Tools for analysis of biodiversity in the landscape**
- **Units in inventories**
- **Units in mapping**
- **Assessment of suitable landuse**
- **Assessment of ecological tolerance**
- **Description of landscapes**
- **Habitats for particular species**
- **Assessment of protection priority for sites**
- **Communication tools between different users and different countries**
- **Ecological research**
- **Overview of habitat distribution**
- **Support the development of the Natura 2000 network**

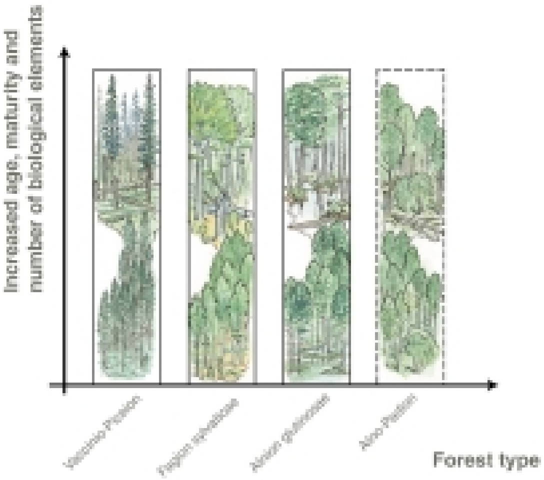

FIG. 1

Figure 1. *Stands of the same forest type according to different classification systems can have very different values from the conservation point of view. The biological elements are old trees, dead wood on the ground and standing dead wood, stools etc. Illustration: Martin Holmer.*

Most vegetation classification systems are not constructed for a certain purpose, to be a tool in a specified application. Historically the intention to provide a scientific description has been the dominating purpose. Most vegetation classification systems have been used for different purposes, mainly mapping of vegetation. In such cases it has been necessary to use higher levels than associations (in the phytosociological tradition) and the corresponding levels in other systems. The scales of the maps and the complexity and variation of the actual vegetation has forced the user to make such adaptations.

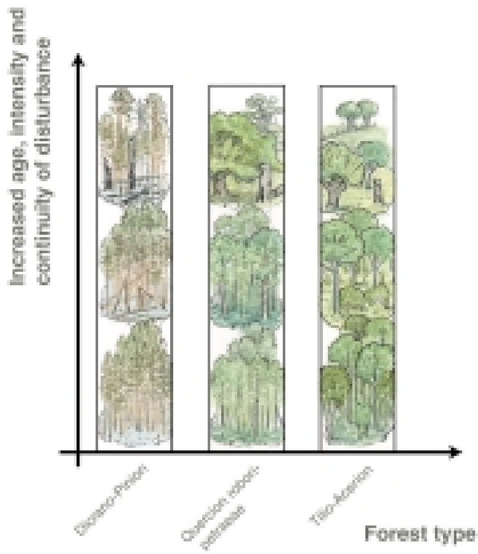

FIG. 2

Figure 2. *The influence of age, and continuous and intensive disturbance, changes forests to new shapes. Through this process they evolve new types of biological elements making the habitat suitable for other organisms. Old fire sites in pine stands with so-called cohort successional dynamics create old fire-scarred pines in the stands. Intensive grazing creates a mosaic landscape of grassland, scrub and trees, sometimes as giant solitary trees. Illustration: Martin Holmer.*

HABITAT CLASSIFICATION AS A TOOL FOR SELECTING HABITATS OF HIGH PROTECTION PRIORITY

A habitat classification that has as its primary purpose to be a tool for selection of sites and areas important for the preservation of the biodiversity of all organisms must necessarily be different from existing vegetation classification systems.

The Swedish Woodland Key Habitat Inventory is one example of a very pragmatic classification of tree-covered site types. The objective of the inventory is to identify and delineate sites with verified or probable existence of red-listed species (Nitare & Norén 1992). To separate these areas from other forests, occurrences of CWD, different types of old trees (these are called Key Elements), elements caused by water, topography, geology and disturbances (these are called Landscape Elements) as well as particular successional stages are used as criteria. The concept of Landscape Elements was developed in the Estonian Woodland Key Habitat Inventory (Andersson *et al.* 1999) but these elements are used in Woodland Key Habitat Inventories in all countries. This inventory focuses on forest qualities that, in the Nordic and Baltic countries, are believed to have the highest protection priority.

Within the Natura 2000 context, many important habitat types for biodiversity are placed outside the priority types in the Habitat directive.

One very important example from Sweden is wooded pastures with giant oaks. These pastures, containing trees with an age of many hundreds of years, are among the most species-rich site types in the south Swedish landscape. They are also one of the richest site types for Red Data Book species. However, it is only when the oaks have an age of about 300 years or more that the sites have this high value. The combination of old oaks and other vegetation, such as semi-natural grassland and groups of shrubs is also of particular value. Fennoscandian Wooded pastures are included in the Natura 2000 types but not as a priority type. Fennoscandian wooded meadows are another important ecosystem to preserve in the Hemiboreal zone. These are included in the Natura 2000 as a priority type but are lacking in other classifications. In other regions of Europe, like the mountains of northern Spain, the Baltics and in Montenegro (Yugoslavia), wooded meadows of extremely high protection value also exist. Why are the wooded meadows in Cantabria and Asturia in northern Spain not of the highest priority in Europe? They must even be of international importance!

To select sites in order to fulfil the undertaking to preserve the biodiversity, the existing habitat classifications need to be improved. The existing European habitat classifications are mainly classifications of vegetation and are in need of supplementary descriptive data. Something must be wrong when only such an unstructured and inconsistent system as Natura 2000 manages to focus on some (but not all!) complex habitats like wooded meadows, old taiga forests etc.

Below are given some examples of additions that could improve the present habitat classifications to provide tools for selecting habitats for protection.

- Add data about Biological Key Elements like coarse dead wood, old trees, trees with holes etc.
- Add data about Disturbance such as fire, grazing, mowing, inundation etc.
- Add data about Landscape Elements built up of rocks, stones, water, soils etc.
- Add some New Habitat types that are succession stages.
- Add the possibility to express Mosaic Structures between different habitat types •

BIBLIOGRAPHY

Andersson, L., Ek, T., Külvik, M., Palo, A. & Martverk, R. (1999). Inventory of Woodland Key Habitats. Methodology. National Forestry Board, Estonia & County Forestry Board, Östra Götaland, Sweden.

Barkman, J.J., Moravec, J. & Rauschert, S. (1986). Code der Pflanzensoziologischen Nomenklatur. 2. Aufl. *Vegetatio* 67: 145-195.

Braun-Blanquet, J. (1921). Prinzipen einer Systematik der Pflanzengesellschafften auf floristischer Grundlage. Jb. St. *Gallen Naturw*. Ges. 57: 305-351.

Braun-Blanquet, J. (1964). Pflanzensoziologie. 3:e Aufl. Wien - New York.

Cajander, A.K. (1909). Ueber Waldtypen. *Acta Forest. Fenn.*1.

Davies, C.E. & Moss, D. (1999). EUNIS Habitat Classification. Draft Final Report. Institute of Terrestrial Ecology. UK.

Devillers, P. & Devillers-Terschuren, J. (1993). A classification of palaearctic habitats and preliminary list of priority habitats in Council of Europe member states. Report. Council of Europe. Strasbourg.

Devillers, P., Devillers-Terschuren, J. & Ledant, J.-P. (1991). CORINE biotopes manual. Habitats of the European Community. A method to identify and describe consistently sites of major importance for nature conservation. Data specifications - Part 2. Office for Official Publications of the European Communities. Luxembourg.

Du Rietz, (1921). Zur methodologischen Grundlage der Modernen Phlanzensoziologie. Holthausen, Wien.

Ellenberg, H. (1996). Vegetation Mitteleuropas mit den Alpen. 5. Auflage. Ulmer. Stuttgart.

European Commission, Dg Environment (1999). Interpretation Manual of European Union Habitats. Eur 15/2.

Göransson, C., Hellman, K., Johansson, C.E., Löfroth, M., Månsson, M. & Ots, T. (1983). Inventering av Sveriges våtmarker (VMI). Metodik för våtmarksinventering. Statens naturvårdsverk rapport. *SNV PM* 1680. Solna.

Horvat, I., Glavac, V. & Ellenberg, H. (1974). Vegetation Südosteuropas. Stuttgart.

Kalliola, R. (1973). Suomen kasvimaantiede. Werner Söderström Osakeyhtiö. Porvoo. Helsinki.

Kielland-Lund, J. (1981). Die Waldgesellschaften SO-Norwegens. *Phytocoenolog*. 9:53-250.

Naturvårdsverket (1997). Ängs- och hagmarker i Sverige [Meadows and pastures in Sweden]. *Rapport* 4819.

Nitare, J. & Norén, M. (1992). Nyckelbiotoper kartläggs i nytt projekt vid Skogsstyrelsen. [Woodland key-habitats of rare and endangered species will be mapped in a new project of the Swedish National Board of Forestry.] *Svensk Bot. Tidskr.* 86 (3):219-226.

Nordhagen, R. (1936). Versuch einer neuen Einteilung der subalpinen und alpinen Vegetation Norwegens. Bergens Mus. Arb. 7.

Nordiska Ministerrådet. (1984). Vegetationstyper i Norden [Vegetation types in the Nordic countries]. Köpenhamn.

Oberdorfer, E. (1992-1993). Süddeutsche Pflanzengesellschaften. Teil I-IV. Gustav Fischer Verlag. Jena.

Olff, H., Vera, F.W.M., Bokdam, J., Bakker, E.S., Gleichman, J.M., De Maeyer, K. & Smit, R. (1999). Shifting Mosaics in Grazed Woodlands Driven by Alternation of Plant Faciliation and Competition. *Plant Biol.* 1 (1999):127-137.

Paal, J. (1997). Eesti taimkatte kasvukohatüüide klassifikatsion. Tartu Ülikooli Botaanika ja Ökoloogia Instituut. Tartu.

Peinado Lorca, M. & Rivas-Martinez, S. (Eds.) (1987). La vegetacion de Espãnja. Universidad de Alcala de Henares.

Pott, R. (1992). Die Pflanzengesellschaften Deutschlands. Ulmer. Stuttgart.

Påhlsson, L. (Ed.) (1994). Vegetationstyper i Norden. TemaNord 1994:665. Köpenhamn.

Rasomavicius, V. (ed) (1998). Lietuvos augalija [Vegetation of Lithuania]. Kaunas - Vilnius, Sviesa Publishers.

Sjörs, H. (1967). Nordisk växtgeografi [Nordic phytogeography]. 2. uppl. Stockholm.

Syrjänen, K., Kalliola, R., Poulasmaa, A. & Mattson, J. (1994). Landscape structure and forest dynamics in continental Russian European taiga. Annales Zoologici Fennici 31: 19-34.

The Council Of European Community (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

LEIF ANDERSSON
Pro Natura
Halnagården
SE-545 93 Töreboda, Sweden
E-mail: leif.andersson@pro-natura.net

Figure 3. *An oak pasture with oaks of several hundred years age. The field layer has a poor vascular flora due to some fertilizing but the oaks have a very high biodiversity with many threatened associated species. The site type is difficult to classify within existing habitat classification systems but the conservation value is undeniable. Tunhem, the province of Västergötland, Sweden.*