Phytosociology in Denmark - A review

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ABSTRACT – As a contribution to the European Vegetation Survey, this paper reviews the development of phytosociology in Denmark.

Phytosociology in Denmark was initiated by WARMING and by RAUNKIÆR in the 1890's, with the production of important papers on how to describe vegetation units and to measure them. Then followed a long period of collection of vegetation data and development of data treatment methods, such as the similarity index by SØRENSEN in 1948. Few of the studies were strictly phytosociological, but rather informal floristic vegetation descriptions and ecological accounts, often with most emphasis on species-environment relationships. A few papers deal with community ecology and syntaxonomy, often as part of regional revisions. A stringent and consequent approach to describe plant communities in Denmark is much needed, but yet to be adopted.

An updated view of the past and recent types of plant communities and their ecology and status is badly needed for any future planning of land-use and conservation actions, management and monitoring.

KEY WORDS – association, history, sociation, syntaxonomy.

INTRODUCTION

Phytosociology, ie. the discipline in which vegetation units such as communities are arranged and defined in a consistent manner, applying a set of internationally agreed definitions as depicted in the Code of Phytosociological Nomenclature (Barkman, Moravec & Rauschert, 1986) is gaining new momentum in recent years; among other reasons because it has been realised at scientific and administrative levels that, in order to map, monitor and compare the plant communities within a country, and across Europe, concise, standardised and strict nomenclatural rules have to be applied. Modern syntaxonomy provides such a framework (Dierschke, 1995).

The current situation for phytosociology in Denmark is meagre, very few papers have been produced and most of these are of a more general, informal descriptive and ecological type. Most community work of relevance to Denmark has been carried out in Central Europe, resulting in syntaxa descriptions and indicator species and values not fully applicable to a north European context (Diekmann, 1995). It is therefore important to obtain a general view of any such

Danish studies on plant communities and syntaxa, before new projects in phytosociology in Denmark, and more widely in Europe, are initiated.

The aim of the present paper is thus to summarise, in so far as it is possible, Danish scientific literature on phytosociology – both in the strict sense, but also more informally – provided that the studies are applicable to phytosociology and apply a community-view (association, sociation, community type, etc). Floristic works with mere species-lists, without any attempt at synthesis, are therefore not included. Works dealing with Greenland and the Faeroe Islands are not included in this paper, but for Greenland see Daniels (1994).

The beginning of phytosociology in Denmark (the Warming & Raunkiær period 1891-1928)

The first works on Danish phytosociology largely described the vegetation by means of life form and physiognomy. In 1891 the Danish professor of botany in Copenhagen, Eugen Warming, published the important work on psammophile formations and, in 1895, on phytosociology: «Plantesamfund. Grundtræk af den økologiske plantegeografi» (Plant communities. Basic characteristics of the ecological plant geography), with later editions in English, German, Polish and Russian. However, these important works, and others, seem to have been overlooked by several phytosociologists including Braun-Blanquet (1964) and Tüxen (1960). It should be mentioned that as early as 1905 Warming discusses the classification of plant communities, nomenclature (Warming 1918a & b) and the «formation» term (Warming 1919, 1923) along with the ecological base units. Warming (1906, 1907/1909, 1916, 1919) published monographic treatments of beach vegetation, dune vegetation and forests.

The phytosociological methods introduced by Warming's contemporary C. Raunkiær are well-known, eg. the Raunkiær circling procedure, yet other works by Raunkiær are all seemingly unknown in international literature, as they are written in Danish.

These include studies on the formation and its statistics (Raunkiær 1910, 1918), descriptions of several «facies», investigations of the formations at Skagen (Raunkiær, 1914), and the description of the valens method (= importance value) (Raunkiær, 1917) and later on «Dominansareal, artstæthed og formations-dominanter» (Dominance area, species density and formation-dominants) (Raunkiær, 1928).

At the beginning of the 20th century several other contemporary phytosociologists published important accounts on Danish plant units, preferably called sociations by many of the authors (for a discussion of sociation versus association see Moravec, 1993). Petersen (1896) described the vegetation of the raised bog of Lille Vildmose, Mentz (1900, 1916) dealt with bog vegetation, Ostenfeld (1905) with the limnic communities along Randers Fiord, Olsen (1915) with *Sphagnum* bogs and Grøntved (1927) with semi-natural grasslands.

Development of methods (the Böcher-Iversen-Sørensen period 1929-1960)

Several new methods, indices and forms of analysis were proposed in this period, particularly by Thorvald Sørensen, well-known for introducing the technique of comparing vegetation data by means of similarity indices applied on the vegetation of Danish commons (Sørensen 1948). In this simple form of classification, Sørensen described associations belonging to the orders *Brometalia, Corynephoretalia, Arrhenatheretalia, Molinietalia, Juncetalia maritimi* and *Isoetatalia.* Other works by Sørensen are also of high phytosociological importance (eg. Sørensen, 1954).

Bornebush, originally a German forester, came to Denmark and described forest vegetation (Bornebusch, 1923-26; 1931). Johannes Iversen is particularly known for his studies of fresh-water plants (Iversen, 1923), but his doctoral dissertation (Iversen, 1936) shows how to classify plant communities. He also published descriptions from eg. estuaries and as many as 42 sociations from Skallingen.

Many other contributors to Danish phytosociology of this period could be mentioned. Tyge W. Böcher produced several phytosociological accounts from Denmark (1935, 1943,1952a & b) and additionally, the important «Beiträge zur Pflanzengeographie und Ökologie dänischer Vegetation» (Böcher, 1945), along with other studies on dune vegetation and in Møn and the important papers on slope and dune vegetation of northern Jutland (Böcher, Christensen & Christiansen, 1948; Böcher, 1954). Hansen (1932) studied heath vegetation, Sissingh (1941) gave strict phytosociological accounts of Danish *Fagetalia,* with relevés on *Fraxino-Carpinion* and *Vaccinio-Piceion.* Beeftink (1959) worked on the salt-marsh vegetation of Skallingen and Mikkelsen (1949) on the salt vegetation of the Isefjord. The Swede Lindquist (1938) reported on Beech forest of Møn, Olsen (1938, 1943) on forest communities, Køie (1938, 1954) on sociations in artificial conifer plantations and the use of area coverage to characterise plant groups, respectively. Jessen (1939) dealt with the vegetation and several sociations of the raised bog of Store Vildmose. Clausen (1957) carried out a two-dimensional vegetation classification of dune vegetation from Hansted, and a comparison with available methods suggested by Sørensen, Bray, Whittaker and others. This is probably the first time ordination was applied in Danish vegetation science.

A. Hansen (1961) produced a useful bibliography of various types of floristic and phytosociological literature. Passarge (1966) described in great detail *Myrtillo-, Luzulo-* and *Asperulo-Fagion* from Jutland.

B. Hansen (1966) described 10 sociations from the raised bog of Draved Kongsmose.

Informal crypto-phytosociology (the modern period 1970-1995)

The recent decades of Danish phytosociology have in general been characterised by informal, and often mostly floristic accounts, by a variety of

authors, who usually publish only few phytosociological papers: hence the name of this period. A few strict syntaxonomic accounts have been released by Sissingh (1970) on Danish beech forests (*Melico-Fagetum, Fago-Quercetum*), Willems, Delft & Rijke (1981) on limestone communities (*Festuco-Brometea*), Willems (1982) on *Mesobromion* communities and Runge (1983) on communities of the Bornholm island.

Gravesen (1972) described informally a number of communities of Tipperne, Western Jutland. Lawesson (1995) in a general paper, discussed the application of GIS and remote sensing in phytosociology.

Revisions, monographs and regional works, including Denmark

Several regional works on particular vegetation types and taxa refer to Danish literature and relevés, but the documentation is often weak. Diemont (1938) published an account of beech forests in Germany and mentioned *Querceto-Carpinetum elymetosum* from Jutland.

Tüxen (1960) on the systematics of *Fagus* forests of North Europe, deals with *Trientalis-Fagetum* p.p. of Denmark. Müller (1962) treated the *Trifolio-Geranietea sanguinei,* covering taxa in Denmark, while Moore (1968) treated bogs and wet heaths of northern Europe, including Denmark.

Barkman (1985) reported on juniper scrub in northern Europe, and Westhoff, Hobohm & Schaminée (1993) produced a red list of plant communities of the Wadden Sea area, including many from Denmark, but the paper lacks documentation.

In the series of «Ecosystems of the World», accounts by Dijkema, Doing & Maarel (1993) and Jensen (1993) deal with plant communities in the broad sense of the Wadden and North Sea areas of Denmark.

In their treatment of *Cynosurion cristati* Tx. 1947, Zuidhoff, Rodwell & Schaminée (1995) indicate the presence of 3 associations in Denmark, but lack documentation.

The most recent attempt of a view of Nordic vegetation types is «Vegetationstyper i Norden» (Types of vegetation in Scandinavia) edited by Påhlsson (1995). Yet, being an important attempt of synthesis, the lack of stringent nomenclature, documentation and updating makes the application of this book difficult.

Conclusion

Important contributions to the concepts and methods of phytosociology were given by prominent Danish botanists such as Warming and Raunkiær in the 1890's, with the production of important papers on how to describe vegetation units and measure them. Then followed a long empirical and descriptive period, and the

development of methods for analysis, such as the similarity index by Sørensen (1948). Many sociations, associations and stands were described by Sørensen, Iversen, Böcher, Sissingh and others. The studies were mostly informal floristic vegetation descriptions and ecological accounts, often with an emphasis on species environment relationships and plant physiology, focusing on soil texture, pH and species response to changed nutrient and land-use regimes. A few papers, mostly by foreign scientists, have dealt with community ecology and syntaxonomy, often as part of regional revisions. However, the number of such stringent syntaxonomical papers have been few and dispersed, without a coherent and thorough examination of the material available. The substantial amount of local literature from Denmark, unfortunately published in Danish, is rarely referred to, albeit often containing important historical and recent information on flora and vegetation.

Only by using such literature, of which most has been summarised in this paper, is it possible to make an up-dated view of the past and recent types of plant communities, their ecology, dynamics and status in Denmark. A well-documented sensus of Danish plant communities is of the utmost importance in order to optimise management of land-use, nature planning and conservation actions and monitoring.

Denmark still awaits the writing of a complete and consistent book on its vegetation types and plant communities or syntaxa. As part of the European Vegetation Survey initiative and the Nature Quality project, of which NERI is the leading national institution, a first check-list of Danish plant communities is being prepared. In this way, it is hoped to achieve a national view of the diversity of Danish plant communities, its bearing on types described from adjacent areas, and thus to put Denmark back on the phytosociological map of Europe, as indeed it was, previously.

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