Mitt. naturwiss. Ver. Steiermark	Band 133	S. 109–117	Graz 2003

The differentiation of anthropogenous forest communities: a synsystematical approach

by Stefan Zerbe[1]
With 3 tables

Accepted 23. February 2003

Abstract: Purely man-made deciduous and coniferous forests dominated by native as well as non-native tree species cover large areas in Central Europe. Although there is a long tradition and continuity in phytosociology to study flora and vegetation of anthropogenous forests, synsystematic and syntaxonomy of forest communities are still mainly restricted to forests considered natural and semi-natural. However, purely man-made forests also have to be considered as a part of the vegetation and can thus be integrated into the Braun-Blanquet system of vegetation. Taking man-made coniferous and deciduous forests in Central Europe as an example, a synsystematical approach is presented here. On the basis of vegetation studies in anthropogenous *Picea abies*, *Pinus sylvestris*, and *Populus ×euramericana* stands in Germany, their specific phytosociological character is outlined. The Galio harcynici-Piceetum, Pleurozio schreberi-Pinetum, and the *Salix cinerea-* and *Calamagrostis canescens-Populus ×euramericana* communities are differentiated employing phytosociological criteria and are integrated into the Braun-Blanquet system of vegetation. Within the investigated man-made forest communities, ecologically diagnostic species indicate different site conditions (e.g. soil water condition, nutrient supply) and stand history. Moreover, this contribution stresses the fact that the synsystematical approach of phytosociology has clearly to be distinguished both, conceptionally and methodically, from an assessment of naturalness.

Zusammenfassung: Beitrag zur Synsystematik und Syntaxonomie von Forstgesellschaften. – Anthropogene Laub- und Nadelholzbestände, die von sowohl einheimischen als auch von nichteinheimischen Baumarten aufgebaut werden, nehmen in Mitteleuropa einen Großteil der Waldflächen ein. Obwohl sich die Pflanzensoziologie seit vielen Jahrzehnten intensiv mit der Flora und Vegetation von Forstgesellschaften beschäftigt, basiert die Synsystematik und Syntaxonomie von gehölzdominierten Pflanzengesellschaften weitgehend auf natürlichen bzw. naturnahen Waldgesellschaften. Allerdings sind auch rein anthropogene Gehölzbestände als Teil der Vegetation zu sehen und können somit in das pflanzensoziologische System Braun-Blanquets integriert werden. In der vorliegenden Studie wird ein synsystematischer bzw. syntaxonomischer Ansatz am Beispiel mitteleuropäischer Nadel- und Laubholzforsten diskutiert. Auf der Grundlage von vegetationskundlichen Untersuchungen in Fichten- (mit *Picea abies*), Kiefern- (mit *Pinus sylvestris*) und Hybridpappelforsten (mit *Populus ×euramericana*) Deutschlands wird der spezifische vegetationskundliche Charakter dieser Aufforstungen hervorgehoben. Nach der pflanzensoziologischen Methode von Braun-Blanquet wird das Galio harcynici-Piceetum, das Pleurozio schreberi-Pinetum und die *Salix cinerea-* bzw. die *Calamagrostis canescens-Populus ×euramericana*-Gesellschaft differenziert und in das Gliederungssystem Braun-Blanquets integriert. Innerhalb der Assoziationen bzw. Gesellschaften werden unterschiedliche standortsökologische Verhältnisse im Hinblick auf z.B. den Bodenwasserhaushalt und die Nährstoffverfügbarkeit und eine unterschiedliche Bestandesgeschichte durch entsprechende diagnostische Arten angezeigt. Es wird herausgestellt, dass der pflanzensoziologische Ansatz mit dem Ziel einer floristisch-vegetationskundlichen bzw. standortsökologischen Differenzierung von Pflanzengesellschaften sowohl konzeptionell als auch methodisch klar von einer Einschätzung der Naturnähe von Vegetationsbeständen zu trennen ist.

1. Introduction

Since many centuries forests and forest sites in Central Europe have been more or less strongly changed through human impact. Nowadays, man-made deciduous and coniferous forests with native (e.g. *Quercus petraea*, *Picea abies*, and *Pinus sylvestris*) as well as

[1] Institute of Ecology, Technical University of Berlin, Rothenburgstr. 12, D-12165 Berlin, Germany, Tel. ++49 30 314 71194, Fax. ++49 30 314 71355; e-mail Stefan.Zerbe@TU-Berlin.de

non-native tree species (e.g. *Pseudotsuga menziesii*, *Prunus serotina*, and *Populus* ×*euramericana*) are covering large areas in the lowlands and in the mountains. Although there is a long tradition in phytosociology studying flora and vegetation of man-made forests (in German: „Forste"; Buchwald 1951, Meisel-Jahn 1955, Schlüter 1965, Sissingh 1975, etc.), synsystematic and syntaxonomy of forest communities (see Tüxen 1950 for „Forstgesellschaften") are still too much restricted to natural and semi-natural forests. Additionally, the phytosociological differentiation of forest communities and an assessment of naturalness are often conceptionally and methodically not clearly distinguished (e.g. Oberdorfer 1992, Türk 1993).

As long the tradition of studying the vegetation of anthropogenous forest communities is, as long lasts the discussion about their position in the Braun-Blanquet system of vegetation (Meisel-Jahn 1955, Jurko 1963, Kowarik 1995, Zerbe & Sukopp 1995). A generally accepted solution has not yet been found. This becomes apparent with many regional and supraregional vegetation surveys, in which purely man-made forest communities are often neglected (e.g. Oberdorfer 1992, Pott 1995, Mucina & al. 1993, Härdtle & al. 1997).

However, with regard to (1) their high frequency of occurrence in the Central European landscapes, often dominating the woodland character, (2) to applied purposes like forestry and silviculture, nature conservation and landscape planning, and (3) to the changes of native plant communities through the introduction and plantation of non-native species it is important to differentiate and classify anthropogenous forest communities within the Braun-Blanquet system of vegetation just as it is done with the plant communities of meadows, heaths, fields, and other anthropogenous vegetation types.

2. Purely man-made forests as part of the vegetation

When we discuss the integration of purely man-made forests (for a definition of „Forst" see Zerbe & Sukopp 1995) into vegetation classification systems, we firstly have to clarify, whether these anthropogenous forests are part of the vegetation. On the basis of a definition given by Westhoff & Van der Maarel (1973) and Westhoff (1979) vegetation is defined by Zerbe & Sukopp (1995: 13) as a system of plant populations, growing in coherence with their sites and forming part of the ecosystem together with the site factors and all other forms of life occurring on these sites. Thus, the interactions between plants, site factors and other organisms are pointed out as one of the main characteristics of vegetation.

A good example to prove the ecological interactions within anthropogenous forests are stands of *Robinia pseudoacacia* L. (Black locust), a non-native tree species in Europe which has been introduced from Northern America in the 17th century (Lohmeyer & Sukopp 1992). The role of the leguminosa Black Locust, whether spontaneously established (Kohler & Sukopp 1964) or planted as forest tree (Scamoni 1960, Jurko 1963), in changing the site conditions and the understorey vegetation through their ability to live in symbiosis with nitrogen-fixing bacteria of the genus *Rhizobium* is well investigated (Gemeinhardt 1959 and 1960, Hofmann 1961). The influence of *Robinia pseudoacacia* growing on sites poor in nitrogen with oligotrophic plant communities leads to an accumulation of humus rich in nitrogen and therefore to a vegetation, which is dominated by species with a high nitrogen demand like *Galium aparine*, *Urtica dioica*, *Chelidonium majus*, *Sambucus nigra*, etc. (Kowarik 1992, 1995).

Additionally, the strong influence of coniferous trees, like Norway spruce and Scots pine, which have been afforested for timber production on sites formerly covered by deciduous woodland has been intensively investigated with regard to changes of the upper soil and the understorey vegetation (Genssler 1959, Passarge 1962, Nihlgård

1971, Ellenberg & al. 1986, Zerbe 1993, etc.). Compared with stands of deciduous trees (e.g. beech), lower pH-values, higher C/N ratios, and lower decomposition rates of the needle litter were as a rule recorded for the organic layers. Typical changes of the vegetation in these man-made coniferous forests are the higher coverage of the herb and moss layer, an increase in species numbers, the occurrence of plant species of coniferous forest communities (e.g. in spruce afforestations species of the order Piceetalia and the alliance Piceion, like *Bazzania trilobata*, *Plagiothecium undulatum*, *Trientalis europaea*), and an increase in number and abundance of species of heaths (Nardo-Callunetea), like *Calluna vulgaris*, *Galium saxatile*, and *Rumex acetosella*.

Thus, also purely man-made forests have to be considered as part of the vegetation and therefore can on principle be integrated into the Braun-Blanquet system of vegetation.

3. Investigation sites and methods

Anthropogenous forest stands were investigated in different regions of Germany. In Brandenburg (NE Germany) vegetation studies were carried out in Scots pine afforestations (*Pinus sylvestris*) on pleistocene sandy soils (Zerbe et al. 2000) and in hybrid poplar afforestations (*Populus ×euramericana*) on lowland moors (Zerbe & Vater 2000, Zerbe 2003). In several German silicate mountain ranges (N-Eifel, Solling, Central Thuringian Forest, Spessart) Norway spruce afforestations (*Picea abies*) as well as Scots pine afforestations on oligotrophic and acidic sandy soils were investigated (Zerbe 1993, 1995, 1999a). Spruce and pine have been afforested on large areas in the Central European lowlands and mountains as a consequence of the devastation of forests and forest sites through excessive land use in historical times. Poplar was mainly afforested in Germany since the beginning of the 1940ies as mitigation of the timber deficiency during and after World War II (Böcker & Koltzenburg 1996).

The present phytosociological analysis is based on 163 vegetation relevés carried out in spruce, 99 in pine, and 59 in poplar afforestations according to the method of Braun-Blanquet (1964). So stands afforested with native tree species (*Picea abies* and *Pinus sylvestris*) as well as stands with a non-native tree species (*Populus ×euramericana*) were taken into consideration (for the original vegetation relevés see the cited literature). The results are discussed against the background of similar investigations of anthropogenous forests carried out by Seibert (1954), Stockmar (1984), Knapp (1990), Augustin (1991), Reif & Leonhardt (1991), Kürschner & Runge (1997), and many others.

The nomenclature of the higher syntaxa (classes, orders, and alliances) follows Oberdorfer (1992). The nomenclature of the vascular plants follows Wisskirchen & Haeupler (1998) and that of the bryophytes Frahm & Frey (1992).

4. Anthropogenous forest communities in Central Europe: examples from the German lowland and mountain ranges

4.1 Phytosociological differentiation of coniferous afforestations with spruce and pine

The investigation of the spruce and pine afforestations in the German lowland and mountain ranges reveals two coniferous forest associations, which can be clearly distinguished by phytosociological means from the deciduous forest communities (mainly beech forests), occurring in the investigated areas.

The Galio harcynici-Piceetum as spruce forest community is widely spread on oligotrophic and acidic soils in the mountains, e.g. above sandstone, slate, or porphyr.

Tab. 1: Phytosociological differentiation of anthropogenous Norway spruce and Scots pine forests on the association and sub-association level.
Pflanzensoziologische Differenzierung der Fichten- und Kiefernwälder auf Assoziations- und Subassoziationsniveau.

Associations	Galio harcynici-Piceetum			Pleurozio schreberi-Pinetum		
Diagnostic species	*Dicranum scoparium*, *Dryopteris dilatata*, *Galium saxatile*, *Lepidozia reptans*, *Lophocolea bidentata*, *Lophocolea heterophylla*, *Plagiothecium curvifolium*			*Fagus sylvatica*, *Pleurozium schreberi*, *Pteridium aquilinum*		
Sub-associations	G.-P. leucobryetosum	G.-P. typicum	G.-P. oxalidetosum	P.-P. dicranetosum	P.-P. typicum	P.-P. oxalidetosum and P.-P. scleropodietosum
Diagnostic species	*Calluna vulgaris*, *Leucobryum glaucum*	- -	*Oxalis acetosella* (*Rubus idaeus*, *Rubus fruticosus* agg.)	*Dicranum polysetum*, *Leucobryum glaucum*, *Ptilidium ciliare*	- -	*Dryopteris dilatata*, *Dryopteris filix-mas*, *Oxalis acetosella*, *Scleropodium purum*

On the association level the Galio harcynici-Piceetum is characterised by the frequent occurrence of the vascular plants *Dryopteris dilatata* and *Galium saxatile* (= *Galium harcynicum*) and the bryophytes *Dicranum scoparium*, *Lepidozia reptans*, *Lophocolea bidentata*, *L. heterophylla*, and *Plagiothecium curvifolium* (Table 1). These species differentiate the spruce forest community against the Luzulo luzuloidis-Fagetum Meusel 1937, which is the natural beech forest community on oligotrophic and acidic sites in the Central European mountain ranges (e.g. Matuszkiewicz 1984, Oberdorfer 1992, Ellenberg 1996). The close synsystematic and synecological relationship between the anthropogenous Galio-Piceetum and other spruce forest communities within the order Vaccinio-Piceetalia is not only indicated by *Picea abies*, but also by the most frequently occurring *Vaccinium myrtillus*. However, species of the alliance Piceion abietis are only rare (e.g. *Bazzania trilobata* and *Plagiothecium undulatum*) or missing in the Galio-Piceetum (e.g. *Homogyne alpina*, *Luzula sylvatica* ssp. *sieberi*, *Soldanella montana*).

Within the association Galio-Piceetum three sub-communities indicate the different nutrient supply in the upper soil layers. The sub-community with *Leucobryum glaucum* and *Calluna vulgaris* (Galio-Piceetum leucobryetosum) is growing on very nutrient poor sites with thick and biologically inactive raw humus layers, often being a consequence of litter use in historical times. On the contrary, *Oxalis acetosella*, often together with *Rubus idaeus*, and *R. fruticosus* agg., indicates relatively high nutrient supply on these oligotrophic sites (Galio-Piceetum oxalidetosum). The central sub-community (Galio-Piceetum typicum) forms the transition between the "nutrient poor" and the "nutrient rich" sub-community.

The Pleurozio schreberi-Pinetum as pine forest community growths on oligotrophic and acidic soils on mountain sites (Zerbe 1999a) as well as on lowland sites (Zerbe & al. 2000). In the light pine stands, the often very homogeneous herb and moss layers is reaching high cover values up to 100 %. The understorey vegetation is characterised by high frequencies and abundance of *Vaccinium myrtillus*, *Deschampsia flexuosa*, and *Pleurozium schreberi*, accompanied by *Pteridium aquilinum*. Whereas the species composition of the Galio-Piceetum has more the character of a forest community within the Piceetalia, the Pleurozio-Pinetum has to be considered as a forest community within the Quercetalia robori-petraeae. Additionally to the diagnostic species of the order Quercetalia (e.g. *Carex pilulifera*, *Deschampsia flexuosa*, *Polytrichum formosum*, *Veronica officinalis*), this is indicated by the spontaneous rejuvenation of *Quercus petraea* and *Qu. robur* with frequencies up to 100 % (Zerbe 1999b, Zerbe & al. 2000, Zerbe 2002). The phytosociological relationship of the Pleurozio-Pinetum to the sub-alliance Dicrano-Pinenion (alliance Dicrano-Pinion) with the association Leucobryo-Pinetum Matuszk.

1962 is only weak (see also Heinken 1995 for the *Avenella flexuosa-Pinus sylvestris* community in the NW German lowland). With the exception of *Leucobryum glaucum* and *Dicranum polysetum*, which are differentiating species for a sub-community within the Pleurozio-Pinetum (Table 1), other diagnostic species can only be found with very low frequencies or are missing (e.g. *Cladonia* div. spec., *Ptilidium ciliare*). In addition, *Fagus sylvatica* as species of the class Querco-Fagetea only rarely occurs within the Dicrano-Pinenion (see Oberdorfer 1992: Table 260). However, in the Pleurozio schreberi-Pinetum *Fagus sylvatica* is one of the most frequent tree species (up to 100 %) of the spontaneous tree rejuvenation (Zerbe 1999b), thus also indicating, that this anthropogenous forest community has to be considered as a substitute community ("Ersatzgesellschaft" sensu Tüxen 1942) of the Luzulo luzuloidis-Fagetum in the mountains and the Luzulo pilosae-Fagetum Matuszk. et Matuszk. 1973 in the lowlands.

Similar to the Galio harcynici-Piceetum the sub-communities within the Pleurozio-Pinetum are indicating different nutrient supplies. They are ranging from very nutrient poor sites, indicated by the occurrence of *Dicranum polysetum*, *Leucobryum glaucum*, and *Ptilidium ciliare* (Pleurozio-Pinetum dicranetosum polyseti), to relatively nutrient rich sites, which are indicated by *Oxalis acetosella*, *Scleropodium purum*, *Dryopteris dilatata*, and *D. filix-mas* (Pleurozio-Pinetum oxalidetosum in the NE German lowland and Pleurozio-Pinetum scleropodietosum puri in SW Germany) with a central sub-community (Pleurozio-Pinetum typicum) as the transition (Table 1).

4.2 Phytosociological differentiation of poplar plantations

Phytosociologically, the vegetation of poplar stands (*Populus ×euramericana*) on lowland moors in SE Brandenburg shows close relationships to the natural communities Carici elongatae-Alnetum Koch 1926 ex. Tx. 1931 and Pruno-Fraxinetum Oberd. 1953. However, the investigation reveals the specific phytosociological character of the poplar plantations. Within the alliance Alnion (Alnetea), *Bidens frondosa*, *Calystegia sepium*, *Rubus caesius*, *Salix cinerea*, and *Thalictrum flavum* differentiate the *Salix cinerea-Populus euramericana* community against the Carici elongatae-Alnetum (Table 2), both forest communities growing on sites with stagnating wetness throughout the year. These species, preferring light growth conditions, indicate the higher light intensities in the poplar plantations in comparison with the Carici elongatae-Alnetum (Zerbe 2003). *Carex elongata*, character species of the Carici elongatae-Alnetum, was not found in the *Salix cinerea-Populus ×euramericana* community. Within this poplar forest community, *Humulus lupulus*, *Phalaris arundinacea*, *Poa trivialis*, *Prunus padus*, and *Symphytum officinale* indicate the transition to sites, characterised by more strongly changing wetness

Tab. 2: Phytosociological differentiation of plantations dominated by the Black poplar hybrid *Populus ×euramericana* on the community and sub-community level.
Pflanzensoziologische Differenzierung von Hybridpappelplantagen auf Assoziations- und Subassoziationsniveau.

Communities	*Salix cinerea-Populus* x *euramericana* community		*Calamagrostis canescens-Populus* x *euram.* community	
Diagnostic species	*Bidens frondosa, Calystegia sepium, Rubus caesius, Salix cinerea, Thalictrum flavum*		*Brachypodium sylvaticum, Calamagrostis canescens, Eupatorium cannabinum, Impatiens parviflora, Scrophularia nodosa, Symphytum officinale*	
Sub-communities	central	with *Symphytum officinale*	with *Alnus glutinosa*	with *Cirsium arvense*
Diagnostic species	- -	*Humulus lupulus, Phalaris arundinacea, Poa trivialis, Prunus padus, Symphytum officinale*	*Alnus glutinosa*	*Alopecurus pratensis, Cirsium arvense*

conditions (Alno-Ulmion), thus forming the *Symphytum officinale* sub-community (see Passarge 1957 and Weber 1978 for the *Symphytum officinale* sub-community within the Carici elongatae-Alnetum).

Within the alliance Alno-Ulmion (Querco-Fagetea), *Brachypodium sylvaticum*, *Calamagrostis canescens*, *Eupatorium cannabinum*, *Impatiens parviflora*, *Scrophularia nodosa*, and *Symphytum officinale* differentiate the *Calamagrostis canescens-Populus ×euramericana* community (Tab. 2) from the Pruno-Fraxinetum, both forest communities growing on sites with more or less strongly changing wetness conditions during the year. As it was found for the *Salix cinerea* poplar forest, in the *Calamagrostis canescens-Populus ×euramericana* community species, which prefer light growth conditions, are more frequent compared to the Pruno-Fraxinetum, such as species of the classes Molinia-Arrhenatheretea, Bidentetea, and Phragmitetea. According to the development stage and stand age of the poplar afforestations two sub-communities can be distinguished. The *Cirsium arvense* sub-community with *Cirsium arvense* and *Alopecurus pratensis* indicates the stands mostly younger than 35 years old and being afforested on meadows, pastures, and fallow land (Zerbe 2003). On the contrary, older stands, where succession has lead to the establishment of more trees and shrubs, form the *Alnus glutinosa* sub-community.

5. Discussion and conclusion

The examples of coniferous and deciduous afforestations show, that purely man-made forests can be integrated into the Braun-Blanquet system of vegetation as well as near-natural and natural forest communities. The examples include afforestations with native tree species (see also Zerbe 1999a for the *Vaccinium myrtillus-Quercus petraea* community) as well as a non-native tree species. The possibility of the classification of vegetation stands with non-native tree species has been proofed already in the 1960ies by Jurko (1963) with the example of anthropogenous Black Locust forests (see also Kohler & Sukopp 1964, Jurko & Kontris 1982). The Chelidonio-Robinietum was integrated into the new class Robinietea. Additionally, Sissingh (1975) has recorded the Dryoptero-Pseudotsugetum as anthropogenous Douglas fir forest community in the Netherlands (for stands of the non-native Douglas fir in Germany see Zerbe 1999a and Zerbe & al. 2000). Examples of associations with non-native herbs are given by Kopecki (1967) and Dettmar & Sukopp (1991).

Synsystematic and syntaxonomy of the investigated anthropogenous forest communities are given in Table 3 with a selection of phytosociologically diagnostic species. Whereas the poplar forest communities can be integrated into the existing alliances Alnion (within the class Alnetea) and Alno-Ulmion (Querco-Fagetea), Zerbe (1999) proposed the integration of the Galio harcynici-Piceetum into a new alliance Galio-Piceion (Vaccinio-Piceetea) and of the Pleurozio schreberi-Pinetum into a new alliance Pleurozio-Pinion (Querco-Fagetea). The phytosociological classification can be derived accordingly to the occurrence of the diagnostic species for the syntaxa.

As it is well investigated in natural and semi-natural forest communities, also within these man-made forest communities ecologically diagnostic species indicate different site conditions. So, within the coniferous forest communities the different nutrient supply on the oligotrophic and acidic sites is indicated by ecological indicator species, which are differentiating species for the sub-communities (Table 1). For the ecological subdivision of the investigated poplar forests in sub-communities both different soil water conditions and different succession stages (and stand history) are decisive, accordingly indicated by differentiating species (Zerbe 2003).

On the association level the diagnostic species can not be considered as character species sensu Braun-Blanquet (1964; see also Bergmeier & al. 1990, Dierschke 1992

Tab. 3: Synsystematic and syntaxonomy of the investigated anthropogenous forest communities (examples given in Table 1 and 2) with a selection of diagnostic species. Classes, orders and alliances according to Oberdorfer (1992) and Zerbe (1995 and 1999).
Synsystematik und Syntaxonomie der untersuchten anthropogenen Forstgesellschaften (Beispiele siehe Tabellen 1 und 2) mit ausgewählten diagnostischen Arten. Klassen, Ordnungen und Verbände nach Oberdorfer (1992) and Zerbe (1995 and 1999).

Forest type	Spruce forest	Pine forest	Poplar forest	
Association/ community	**Galio harcynici-Piceetum Zerbe 1995**	**Pleurozio schreberi-Pinetum Zerbe 1999**	***Salix cinerea-Populus* x *euramericana* community**	***Calamagrostis canescens-Populus* x *euramericana* community**
Occurrence in Germany	mountain ranges	lowland and mountain ranges	north-eastern German lowland	
Site conditions	oligotrophic, acidic sandy soils		peaty soils of lowland moors	
Alliance	Galio-Piceion abietis Zerbe 1999 *Galium saxatile*	Pleurozio-Pinion sylv. Zerbe 1999 *Fagus sylvatica*, *Pleurozium schreberi*	Alnion glutinosae Malc. 29 em. Müll. et Görs 58 (u. Moor 58) *Iris pseudacorus*, *Lycopus europaeus*, *Lythrum salicaria*, *Thelypteris palustris*	Alno-Ulmion Br.-Bl. et Tx. 43 *Galium aparine*, *Impatiens noli-tangere*, *Poa trivialis*, *Prunus padus*, *Urtica dioica*
Order	Piceetalia abietis Pawl. in Pawl. et al. 28 *Trientalis europaea*, *Vaccinium myrtillus*	Quercetalia robori-petraeae Tx. (31) 37 *Carex pilulifera*, *Deschampsia flexuosa*, *Polytrichum formosum*, *Veronica officinalis*	Alnetalia glutinosae Tx. 37 em. Th. Müll. et Görs 58 and Alnetea glutinosae Br.-Bl. et Tx. 43 *Calamagrostis canescens*, *Frangula alnus*, *Galium palustre*, *Lysimachia vulgaris*	Fagetalia sylvaticae Pawl. in Pawl. et al. 28 *Fraxinus excelsior*, *Impatiens parviflora*, *Scrophularia nodosa*
Class	Vaccinio-Piceetea Br.-Bl. in Br.-Bl. et al. 39 *Picea abies*	Querco-Fagetea Br.-Bl. et Vlieg. 37 em. *Corylus avellana*, *Quercus petraea* et *robur*		Querco-Fagetea Br.-Bl. et Vlieg. 37 em. *Brachypodium sylvaticum*, *Quercus robur*

and 1999). They are differentiating species, which can occur also in other forest communities, with high frequencies (e.g. *Galium saxatile* in light oak, pine or fir forests, Oberdorfer 1994). Especially with regard to the synsystematic of natural and semi-natural forest communities it is often pointed out (Matuszkiewicz 1984, Müller 1991, Oberdorfer 1992), that several associations can be clearly differentiated and classified by groups of phytosociologically diagnostic species, but have no character species (e.g. Aceri-Fagetum Rübel 1930 ex J. et M. Bartsch 1940, Galio odorati-Fagetum Rübel 1930 ex Sougnez et Thill 1959, Milio-Fagetum Burrichter et Wittig 1977). Dierssen (1990: 61) concluded, that the occurrence of at least one character species within an association is expedient, but could not always be realised.

It has to be accentuated, that the synsystematical approach of phytosociology has to be conceptionally and methodically clearly distinguished from an assessment of the naturalness of plant communities (Zerbe & Sukopp 1995), the latter being an important basis for e.g., applied purposes like forestry, nature conservation, and landscape planning. Within the Braun-Blanquet system, only the species composition of vegetation stands is decisive for their classification as plant communities, not their naturalness (Dierschke 1986).

For the assessment of the naturalness of plant communities several concepts with different temporal perspectives are available. In a present-day perspective, information about the naturalness of forest communities can be derived from the stand structure (e.g. stump shoots, branch formation of the tree layer), the growth quality of the trees, the spontaneous rejuvenation of tree species, the species composition of the different vegetation layers (e.g. occurrence of phytosoicologically diagnostic species, frequency of disturbance indicator species), edaphic conditions (e.g. structure and quality of the organic layer), the comparison with other forest stand types under similar site conditions, the stand history (e.g. derived from forest documents and historical maps), and the vegetation history of the region under investigation.

References

Augustin H. 1991: Die Waldgesellschaften des Oberpfälzer Waldes. – Hoppea 51: 1–314.

Bergmeier E., Härdtle W., Mierwald U., Nowak B. & Peppler C. u. Mitarb. v. Flintrop T. 1990: Vorschläge zur syntaxonomischen Arbeitsweise in der Pflanzensoziologie. Kieler Not. Pflanzenkde. – Schleswig-Holst. u. Hamburg 20: 92–103.

Böcker R. & Koltzenburg M. 1996: Pappeln an Fließgewässern. – Landesanst. f. Umweltsch. Baden-Württ. (Hrsg.), Karlsruhe: pp140.

Braun-Blanquet J. 1964: Pflanzensoziologie. Grundzüge der Vegetationskunde. – 3. Aufl., Wien, 865 pp.

Buchwald K. 1951: Wald- und Forstgesellschaften der Revierförsterei Diensthoop, Forstamt Syke bei Bremen. – Angew. Pflanzensoz. 1: 1–72. Stolzenau/Weser.

Dettmar J. & Sukopp H. 1991: Vorkommen und Gesellschaftsanschluß von *Chenopodium botrys* L. und *Inula graveolens* (L.) Desf. im Ruhrgebiet (Westdeutschland) sowie im regionalen Vergleich. – Tuexenia 11: 49–65.

Dierschke H. 1986: Pflanzensoziologische und ökologische Untersuchungen in Wäldern Süd-Niedersachsens. III. Syntaxonomische Gliederung der Eichen-Hainbuchenwälder, zugleich eine Übersicht der Carpinion-Gesellschaften NW-Deutschlands. – Tuexenia 6: 299–323.

Dierschke H. 1999: Klassifikation und systematische Ordnung von Pflanzengesellschaften. – Ber. d. Reinh.-Tüxen-Ges. 11: 19–38.

Dierssen K. 1990: Einführung in die Pflanzensoziologie. – Wiss. Buchges., Darmstadt, 241 pp.

Ellenberg H. 1996: Vegetation Mitteleuropas mit den Alpen. – 5. Aufl., Ulmer, Stuttgart, 1096 pp.

Ellenberg H., Mayer R. & Schauermann J. (Eds.) 1986: Ökosystemforschung – Ergebnisse des Sollingprojekts 1966–1986. – Ulmer, Stuttgart, 507 pp.

Frahm J.-P. & Frey W. 1992: Moosflora. – 3. Aufl., Ulmer, Stuttgart, 528 pp.

Gemeinhardt H. 1959/60: Bodenmikrobiologische Beiträge zum Robinienproblem. – Arch. Forstwes. 8 (1959): 1078–1116; 9 (1960): 1082–1104.

Genssler H. 1959: Veränderungen von Boden und Vegetation nach generationsweisem Fichtenanbau. – Diss. Univ. Hann.-Münden, 191 pp.

Härdtle W., Heinken Th., Pallas J. & Welss W. 1997: Querco-Fagetea (H5). Sommergrüne Laubwälder Teil 1: Quercion roboris, Bodensaure Eichenmischwälder. – Synopsis der Pflanzengesellschaften Deutschlands 2: 1–51.

Heinken T. 1995: Naturnahe Laub- und Nadelwälder grundwasserferner Standorte im niedersächsischen Tiefland: Gliederung, Standortsbedingungen, Dynamik. – Diss. Bot. 239: 1–311.

Hofmann G. 1961: Die Stickstoffbindung der Robinie (*Robinia pseudacacia* L.). – Arch. Forstwes. 10: 627–632.

Jurko A. 1963: Zmena pôvodných lesných fytocenóz introdukciou agáta. – Cs. Ochr. Prir. 1: 56–75.

Jurko A. & Kontris J. 1982: Phytocoenological and ecological characteristics of acacia-woods in the little Carpathians. – Biológia 37: 67–74.

Knapp H.D. 1990: Die Seelensdorfer Heide bei Brandenburg – eine landschaftsgeschichtlich-geobotanische Studie. Teil 1 und 2. – Gleditschia 18 (1): 37–63; 18 (2): 285–307.

Kohler A. & Sukopp H. 1964: Über die Gehölzentwicklung auf Berliner Trümmerschuttstandorten. – Ber. Dt. Bot. Ges. 76: 389–406.

Kopecki K. 1967: Die flußbegleitende Neophytengesellschaft Impatienti-Solidaginetum in Mittelmähren. – Preslia 39: 151–166.

Kowarik I. 1992: Einführung und Ausbreitung nichteinheimischer Gehölzarten in Berlin und Brandenburg. – Verh. Bot. Ver. Berlin Brandenbg. Suppl. 3: 1–188.

Kowarik I. 1995: Anthropogene Wälder und Forsten auf naturnahen und urban-industriellen Standorten. – Ber. d. Reinh.-Tüxen-Ges. 7: 47–67.

Kürschner H. & Runge S. 1997: Vegetationskundliche Untersuchungen ausgewählter Binnendünen- und Talsandstandorte im Dahme-Seengebiet (Brandenburg) und ihre Entwicklungspotentiale. – Verh. Bot. Ver. Berlin u. Brandenburg. 130: 79–110.

Lohmeyer W. & Sukopp H. 1992: Agriophyten in der Vegetation Mitteleuropas. – Schr.-R. Vegetationskde. 25: 1–185.

Matuszkiewicz W. 1984: Die Karte der potentiellen natürlichen Vegetation von Polen. – Braun-Blanquetia 1: 1–99.

Meisel-Jahn S. 1955: Die Kiefernforstgesellschaften des nordwestdeutschen Flachlandes. – Angew. Pflanzensoz. 11: 1–126, Stolzenau/Weser.

Mucina L., Grabherr G. & Wallnöfer S. 1993: Die Pflanzengesellschaften Österreichs, Teil III: Wälder und Gebüsche. – Fischer, Jena, Stuttgart, New York, 353 pp.

Müller T. 1991: Zur synsystematischen Stellung des Luzulo-Fagetum. – Hoppea 50: 189–202.

Nihlgård B. 1971: Pedological influence of spruce planted on former beech forest soils in Scania, South Sweden. – Oikos 22: 302–314.

Oberdorfer E. 1992: Süddeutsche Pflanzengesellschaften. Teil IV. Wälder und Gebüsche. – 2. Aufl., Fischer, Jena, Stuttgart, New York, Textband 282 pp., Tabellenband 580 pp.

Oberdorfer E. 1994: Pflanzensoziologische Exkursionsflora. – 7. Aufl., Ulmer, Stuttgart, 1050 pp.

Passarge H. 1957: Waldgesellschaften des nördlichen Havellandes. – Wiss. Abh. Dt. Akad. Landwirtschaftswiss. 26: 1–139.

Passarge H. 1962: Zur Gliederung und Systematik der Kiefernforstgesellschaften im Hagenower Land. – Arch. Forstwes. 11: 275–308.

Pott R. 1995: Die Pflanzengesellschaften Deutschlands. – 2. Aufl., Ulmer, Stuttgart, 622 pp.

Reif A. & Leonhardt A. 1991: Die Wald- und Forstgesellschaften im Fichtelgebirge. – Hoppea 50: 409–452.

Scamoni A. 1960: Waldgesellschaften und Waldstandorte. – 3. Aufl., Akademie-Verlag, Berlin, 326 pp.

Schlüter H. 1965: Vegetationskundliche Untersuchungen an Fichtenforsten im Mittleren Thüringer Wald. – Die Kulturpflanze 13: 55–99.

Seibert P. 1954: Die Wald- und Forstgesellschaften im Graf Görtzischen Forstbezirk Schlitz. – Angew. Pflanzensoz. 9: 1–63. Stolzenau/Weser.

Sissingh G. 1975: Niederländische Nadelforsten und ihr Humus als Substrat für ihre Vegetation. – In: Tüxen R. (Ed.): Vegetation und Substrat, 317–329.

Stockmar S. 1984: Vegetationskundliche Untersuchungen in Fichtenwäldern und Fichtenforsten des Nordharzes. – Tuexenia 4: 267–278.

Türk W. 1993: Pflanzengesellschaften und Vegetationsmosaike im nördlichen Oberfranken. – Diss. Bot. 207: 1–290.

Tüxen R. 1942: Ersatzgesellschaften. – Rundbr. Zentralst. Vegetationskartierung d. Reiches 12.

Tüxen R. 1950: Neue Methoden der Wald- und Forstkartierung. – Mitt. Flor.-Soz. Arbeitsgem., N.F. 2: 217.

Weber H.E. 1978: Vegetation des Naturschutzgebietes Balksee und Randmoore (Kreis Cuxhaven). – Natursch. Landschaftspfl. Nieders. 9: 1–168.

Westhoff V. 1979: Phytosociology in the Netherlands: History, present state, future. – In: Werger, M.J.A. (Ed.): The study of vegetation, 82–121.

Westhoff V. & Van der Maarel E. 1973: The Braun-Blanquet-approach. – In: Whittaker, R.W. (Ed.): Handbook of vegetation science V: 617–726.

Wisskirchen R. & Haeupler H. 1998: Standardliste der Farn- und Blütenpflanzen Deutschlands. – Ulmer, Stuttgart, 765 pp.

Zerbe S. 1993: Fichtenforste als Ersatzgesellschaften von Hainsimsen-Buchenwäldern. Vegetation, Struktur und Vegetationsveränderungen eines Forstökosystems. – Ber. Forschungszentr. Waldökosyst., Ser. A, 100: 1–173.

Zerbe S. 1995: Die Vegetation der Fichtenforste im Buntsandstein-Spessart. – Schr.-R. Vegetationskunde (Festschrift H. Sukopp) 27: 341–351.

Zerbe S. 1999a: Die Wald- und Forstgesellschaften des Spessarts mit Vorschlägen zu deren zukünftigen Entwicklung. – Mitt. Naturwiss. Mus. Aschaffenburg 19: 1–354.

Zerbe S. 1999b: Konzeptionelle Überlegungen zur zukünftigen Entwicklung von Nadelholzforsten aus vegetationsökologischer Sicht. – Arch. Naturschutz u. Landschaftsforsch. 37: 285–304.

Zerbe S. 2002: Restoration of natural broad-leaved woodland in Central Europe on sites with coniferous forest plantations. – For. Ecol. Manage. 167: 27–42.

Zerbe S. 2003: Vegetation and future natural development of plantations with the Black poplar hybrid *Populus ×euramericana* Guinier introduced to Central Europe. – For. Ecol. Manage. 179: 293–309.

Zerbe S., Brande A. & Gladitz F. 2000: Kiefer, Eiche und Buche in der Menzer Heide (N-Brandenburg). Veränderungen der Waldvegetation unter dem Einfluß des Menschen. – Verh. Bot. Ver. Berlin Brandenburg 133: 45–86.

Zerbe S. & Sukopp H. 1995: Gehören Forste zur Vegetation? Definition und Abgrenzung eines vegetationskundlichen und kulturhistorischen Begriffes. – Tuexenia 15: 11–24.

Zerbe S. & Vater G. 2000: Vegetationskundliche und standortsökologische Untersuchungen in Pappelforsten auf Niedermoorstandorten des Oberspreewaldes (Brandenburg). – Tuexenia 20: 55–76.