Silva Gabreta	vol. 13 (2)	p. 95–116	Vimperk, 2007

Vegetation of silver fir (*Abies alba*) forests in the Bohemian Forest and adjacent areas (Czech Republic)

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Abstract
The vegetation classification of silver fir forests in montane and hilly areas (the Bohemian Forest, the Novohradské Hory Mts. and their foothills) of southwestern Bohemia (Czech Republic) was carried out using the Braun-Blanquet approach based on 215 phytosociological relevés. Six associations within four alliances were distinguished according to floristic composition. *Vaccinio vitis-idaeae-Abietetum albae* (*Piceion excelsae*) and *Luzulo-Abietetum albae* (*Luzulo-Fagion*) represent acidophilous communities. Herb-rich fir-dominated forests (*Fagion sylvaticae*, *Galio-Abietenion*) are represented by mesotrophic *Galio rotundifolii-Abietetum albae* and by a very rare calciphilous association *Pyrolo secundae-Abietetum albae*. Fir forests in scree habitats (*Tilio-Acerion*) are evaluated as *Aceri-Carpinetum betuli* (in lower altitudes) and *Fraxino excelsioris-Aceretum pseudoplatani* (occurring in higher altitudes). Subassociations reflecting soil water supply and variants conditioned by altitude are distinguished within *Luzulo-Abietetum* and *Galio-Abietetum*. Floristic composition, fundamental soil characteristics, and distribution for each vegetation unit are presented. The fir forests occurring on soils with no influence of ground water table are considered to consitute semi-natural vegetation depending both on natural processes and on human impact. The stands with the dominance of *Abies alba* should be preserved as natural and, at the same time, cultural heritage.

Key words: Abies alba, coniferous forests, nature conservation, phytosociology, soil conditions

Introduction

Vegetation studies dealing with forests in the Bohemian Forest, in the Novohradské Hory Mts. and in their foothills have focused mainly on natural or near-natural communities – beech, spruce-beech and spruce forests (Kučera 1966, Sofron 1981, Pišta 1982, Neuhäuslová & Eltsova 2001, 2002, 2003, Neuhäuslová & Sofron 2005). *Abies alba*-dominated forests interpreted as a semi-natural, partially artificial vegetation type (Málek 1983, Míchal & Petříček 1999, Boublík 2005), have so far been studied only rarely.

Husová (1968, 1969) for instance described acidophilous community *Deschampsio flexuosae-Abietetum* and scree forests dominated by *Abies alba* (*Tilio platyphyllae-Abietetum*) in the eastern part of the study area (the Vltava River valley). Sofron (1988) and Nesvadbová & Sofron (1991) dealt with fir forests in the western part of the Bohemian Forest and its foothills. They reported different types of fir forests (acidophilous, scree stands, stands on waterlogged soils). The explanatory text to the map of potential natural vegetation of the Šumava National Park (Neuhäuslová 2001) mentions *Deschampsio flexuosae-Abietetum* and *Luzulo pilosae-Abietetum*. Grulich (2006) recorded several vegetation types – acidophilous,

herb-rich, scree, and calcicolous fir forests in the southeastern part of the study area. Kučera (1966) and Boublík & Douda (2004) analysed acidophilous *Abies alba*-dominated forests in the Novohradské Hory Mts. Seven vegetation types dominated by *Abies alba* (*Deschampsio flexuosae-Abietetum*, *Luzulo pilosae-Abietetum*, *Saniculo europaeae-Abietetum*, *Carici remotae-Abietetum*, *Aceri-Carpinetum abietetosum*, *Lunario-Aceretum lunarietosum*, and *Arunco-Aceretum abietetosum*) are mentioned in the study area in the Czech national vegetation survey (Husová in Moravec et al. 2000). In 2005 I published preliminary results of the phytosociological classification of fir forests in the Czech Republic and I also reported seven associations from southwestern Bohemia (Boublík 2005).

Walentowski (1998) and Walentowski et al. (2005) studied Bavarian fir forests in detail. Acidophilous fir forests (*Vaccinio vitis-idaeae-Abietetum* and *Luzulo luzuloidis-Abietetum*) were recorded in the Bavarian Forest (=Bayerischer Wald Mts.) (Walentowski 1998).

Present knowledge of fir forest vegetation of the studied area is fragmented and inconsistent. Hence, the main aims of this study are (i) to synthetize vegetation data for fir forests in the Bohemian Forest, in the Novohradské Hory Mts. and in their foothills, (ii) to describe floristic composition, variability, distribution, and fundamental ecological conditions of the distinguished vegetation types.

Study area

The study area is located in southwestern and southern Bohemia. According to the geomorphological division of the Czech lands by Demek (1987), this area includes the Bohemian Forest (Šumava), the Novohradské hory Mts., most of the Bohemian Forest foothills (Šumavské podhůří) and all of the Novohradské Hory foothills (Novohradské podhůří). The area is delimited by the settlements of Svatá Kateřina, Klatovy, Čečovice, Horažďovice, Strakonice, Vodňany, Plav, and Nové Hrady. The state boundary between the Czech Republic and Germany and Austria delimits the area in the south. Altitudes vary between ca 400 and 1378 m.

The area belongs to the moderately warm and cold climatic regions (Quitt 1971). The mean annual temperature varies between ca 2.5 and 8 ºC and the mean annual precipitation is ca 550–1450 mm (Syrový 1958, Tolasz et al. 2007). Relatively warm and dry climate is typical of the leeward (northeastern) side of the Bohemian Forest and its foothills (Chábera et al. 1985).

Geological substrate is dominated by Proterozoic or Palaeozoic migmatites, granites, granodiorites, and gneisses (Fusán et al. 1993, Babůrek et al. 2006). Mica schists occur in the western and in the eastern part, whereas granulites and serpentinites partly constitute the northeastern part of the study area. Nutrient-rich durbachites, that have a great influence on the vegetation composition of forests, form a massif near Želnava village. Crystalline limestones and amphibolites are typical of the Bohemian Forest foothills. Other rocks are rare and only locally distributed.

From the pedological point of view, different subunits of Cambisols predominate in the study area. Podzols occur especially in the higher altitudes, Planosols, Gleysols and Histosols are typical of flat terrains at all altitudes. Leptosols appear on rock outcrops and screes. Fluvisols occur in alluvia (Novák 1989–1993).

Material and methods

In this study, fir forests are defined as predominantly coniferous stands with at least 25% proportion of fir and less than 25% proportion of beech in tree layer. Relevés were recorded

and analysed using the Braun-Blanquet approach (Westhoff & van der Maarel 1973). Relevés were selected from the Czech National Phytosociological Database (Chytrý & Rafajová 2003) and from already published papers (86 relevés in total). In the period 2002–2005 I subjectively collected phytosociological data (129 relevés – 3 of them was published in Boublík & Douda 2004: Table 2, rels 1–3) in order to represent all of the main fir forest vegetation types in the study area regardless of stands' origin. Only relevés with recorded moss layer were used for the analysis. Two relevés of calcicolous fir forests (Grulich 2006: Table 1, rels 10, 11) constitute an exception in this regard, since they are very rare in the study area. All of my relevés are stored in the Czech National Phytosociological Database. The taxonomic soil classification and the determination of soil humus forms were carried out in the centre of each phytosociological relevé.

Relevés were stored using the TURBOVEG 2.0 programme (Hennekens & Schaminée 2001) and were classified using the TWINSPAN method (Hill 1979) within the JUICE programme (Tichý 2002). Pseudospecies cut levels were set up to 3 and values of cut levels to 0%, 5%, and 25%. Five relevés were selected as a minimum group size for division. Consequently, some relevés were subjectively reclassified. The diagnostic species for particular associations were determined using the phi coefficient as a measure of fidelity (Chytrý et al. 2002) in a synoptic table. The phi coefficient was adjusted for equal size of clusters (Tichý & Chytrý 2006). Only species with both significant concentration in particular vegetation units (using Fisher's exact test and significance level $p < 0.01$) and phi coefficient ≥ 0.25 were considered to be diagnostic species. Only constancy values were used in the short synoptic table describing internal variability of an association.

The species nomenclature follows Kubát et al. (2002) for vascular plant taxa and Kučera & Váňa (2003) for bryophytes. The nomenclature of soil groups and subunits follows ISSS-ISRIC-FAO (1998). The concept of humus forms is based on Němeček et al. (2001).

Results and discussion

Six associations belonging to four alliances and two classes are distinguished within fir forests vegetation. Two associations with a broad ecological range are divided into subassociations and altitudinal variants.

Syntaxonomical survey

Vaccinio-Piceetea Braun-Blanquet in Braun-Blanquet, Sissing & Vlieger 1939
- *Piceion excelsae* Pawłowski in Pawłowski, Sokołowski & Wallisch 1928
  - *Vaccinio-Abietenion* Oberdorfer 1962
    - *Vaccinio vitis-idaeae-Abietetum albae* Oberdorfer 1957

Querco-Fagetea Braun-Blanquet & Vlieger in Vlieger 1937
- *Luzulo-Fagion* Lohmeyer & Tüxen in Tüxen 1954
  - *Luzulo-Abietetum albae* Oberdorfer 1957
    - *L.-A. typicum* Seibert in Oberdorfer et al. 1992
    - *L.-A. deschampsietosum cespitosae* Walentowski 1998
- *Fagion sylvaticae* Luquet 1926
  - *Galio rotundifolii-Abietenion* Oberdorfer 1962
    - *Galio rotundifolii-Abietetum albae* Wraber (1955) 1959
      - *G.-A. typicum* Th. Müller in Oberdorfer et al. 1992
      - *G.-A. equisetetosum sylvatici* Feldner (1978) 1981 em. Walentowski 1998
    - *Pyrolo secundae-Abietetum albae* Oberdorfer 1957 ex Stoffler 1975
- *Tilio platyphylli-Acerion* Klika 1955
  - *Aceri-Carpinetum betuli* Klika 1941
  - *Fraxino excelsioris-Aceretum pseudoplatani* (Koch 1926) Rübel 1930 ex Tüxen 1937

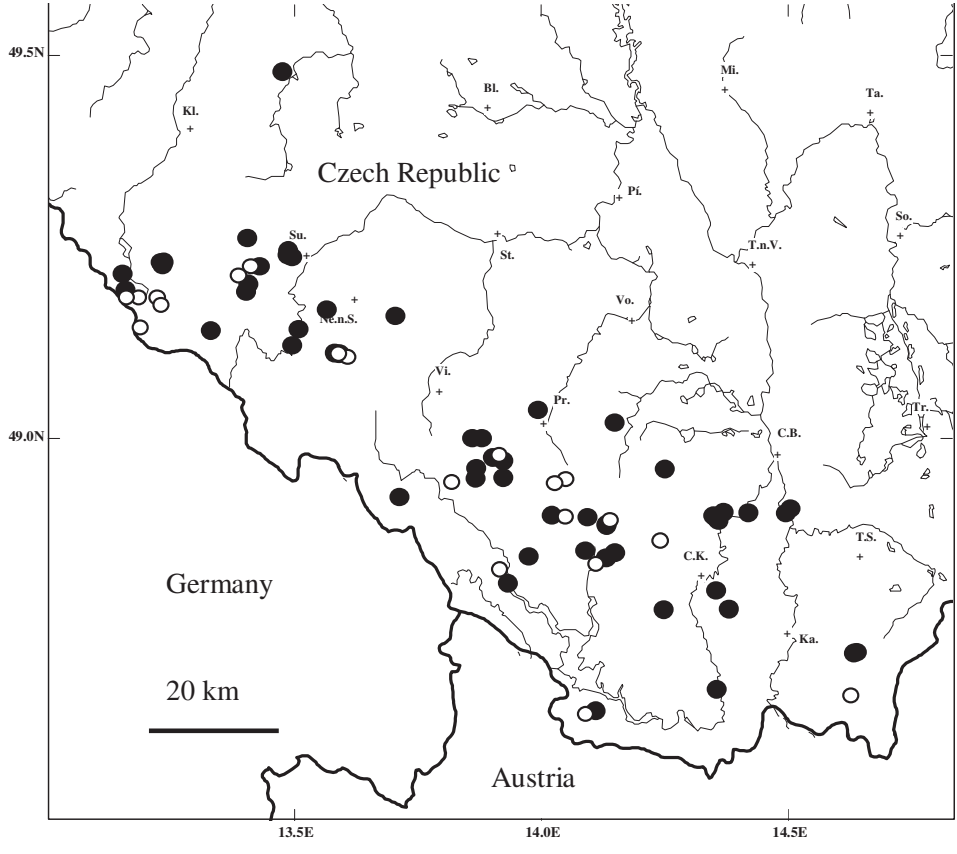
Vaccinio vitis-idaeae-Abietetum albae (Table 1, col. 1; Fig. 1)

This association represents acidophilous, species-poor pine-spruce-fir forests with an admixture of beech. *Vaccinium myrtillus* or *Avenella flexuosa* predominate in the herb layer. The stands occur on (Skeletic) Dystric Cambisols, (Entic, Skeletic) Podzols, or Dystric Leptosols with typical mor as the most frequent humus form. It can be found at altitudes of 625–1200 m. The presence of *Vaccinio-Piceetea* species (e.g. *Bazzania trilobata*, *Dicranodontium denudatum*, *Dicranum polysetum*) is the reason why *Vaccinio-Abietetum* is assigned into the *Vaccinio-Piceetea* class (similarly as in Seibert in Oberdorfer 1992, Walentowski 1998). The association has also been recorded in the southeastern part of the study area by Grulich (2006).

Luzulo-Abietetum albae (Table 1, col. 2; Fig. 1)

Luzulo-Abietetum is a poorly and rather negatively differentiated oligo-mesotrophic spruce--fir forest with an admixture of other tree species. *Avenella flexuosa*, *Calamagrostis arundinacea*, *Luzula luzuloides*, *Oxalis acetosella*, or *Vaccinium myrtillus* usually predominate

Fig. 1. Distribution of acidophilous fir forests in the study area. ○ – *Vaccinio vitis-idaeae-Abietetum albae* (*Piceion excelsae*), ● – *Luzulo-Abietetum albae* (*Luzulo-Fagion*).



in the herb layer. The difference between this association and *Vaccinio vitis-idaeae-Abietetum* consists in the presence of more nutrient-demanding species (e.g. *Dryopteris filix-mas*, *Moehringia trinervia*, *Mycelis muralis*, *Rubus* ser. *Glandulosi*, *Senecio ovatus*). The presence of nutrient-demanding herbs and woody species of lower altitudes (e.g. *Carpinus betulus*, *Quercus* sp. div., *Lonicera xylosteum*) in some Czech stands is the main reason why I assign the Czech stands of *Luzulo-Abietetum* to the *Querco-Fagetea* class (*Luzulo-Fagion* alliance) in contrast to most of German authors (Seibert in Oberdorfer 1992, Walentowski 1998, Walentowski et al. 2005).

Typical mor, mor-like moder, and typical moder represent the most frequent humus forms. Within the study area, it occurs at altitudes ranging from 410 to 1000 m. *Luzulo-Abietetum albae* is mentioned by Boublík & Douda (2004), Boublík (2005), and Grulich (2006). Under the name of *Deschampsio flexuosae-Abietetum* it is described in the Vltava river valley by Husová (1968, 1969), in the western part of the study area by Sofron (1988), Nesvadbová & Sofron (1991), and in the Šumava National Park by Sádlo in Neuhäuslová (2001).

Variability

1. *Luzulo-Abietetum albae typicum*
(Syn. *Deschampsio flexuosae-Abietetum deschampsietosum flexuosae* Husová 1983)
Stands of this typical subassociation are differentiated e.g. by *Luzula luzuloides*, *Hieracium murorum*, *Hypnum cupressiforme*, *Solidago virgaurea*. They occur on (Skeletic, Dystric) Cambisols and rarely on Leptosols and (Entic) Podzols.

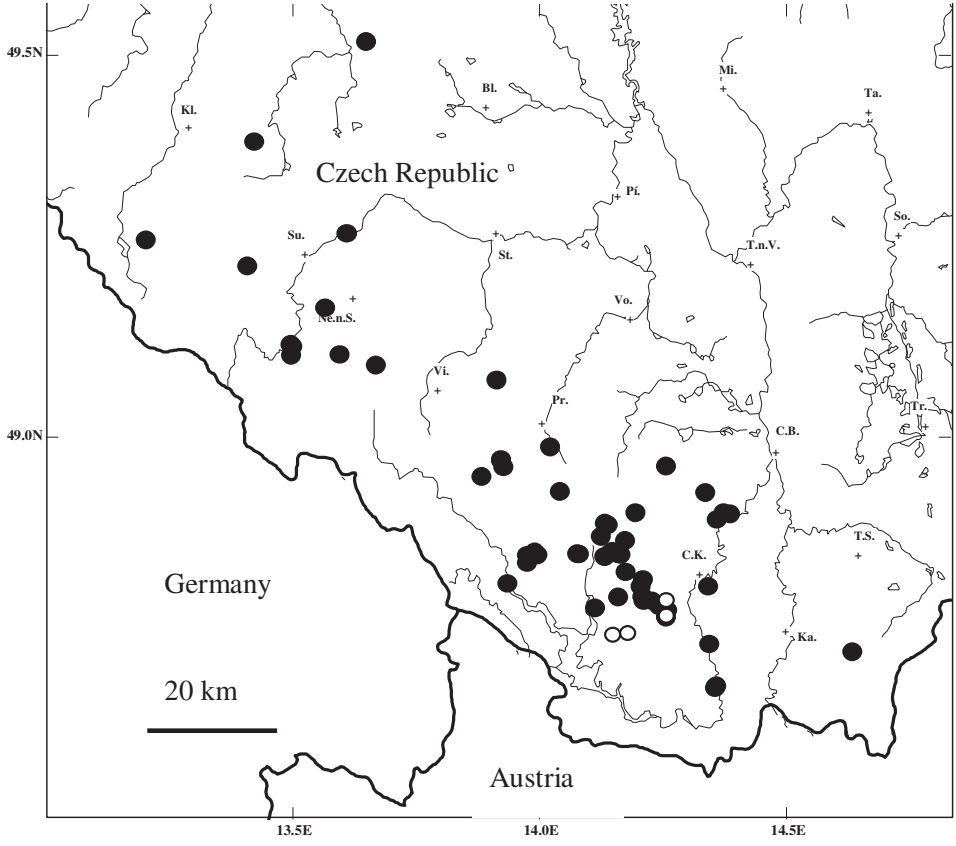
Two altitudinal variants can be distinguished:
Variant with *Senecio germanicus* (*Campanula persicifolia*, *C. rotundifolia*, *Corylus avellana*, *Impatiens parviflora, Polypodium vulgare*, *Rubus fruticosus* agg., *Senecio germanicus*, *S. sylvaticus*, *S. viscosus*) occurs in lower altitudes (410–670 m) in the eastern part of the study area, especially on the steep slopes of the Vltava and Malše River valleys.
Variant with *Lycopodium annotinum* (*Blechnum spicant*, *Calamagrostis villosa*, *Homogyne alpina*, *Luzula sylvatica*, *Lycopodium annotinum*, *Phegopteris connectilis*, *Soldanella montana*) occurs in higher altitudes of the Bohemian Forest (800–1000 m). It is a fir altitudinal analogy to montane spruce-beech forests (*Calamagrostio villosae-Fagetum* Mikyška 1972).

2. *Luzulo-Abietetum albae deschampsietosum cespitosae*
(Syn. *Luzulo pilosae-Abietetum* Mráz 1957)
This subassociation occurs very rarely (Hamry near Hojsova Stráž, Vrábče near Křemže) on Gleysols in the surroundings of forest springs or in terrain depressions. It is differentiated by hygrophilous species (e.g. *Bazzania trilobata*, *Carex brizoides*, *Chaerophyllum hirsutum*, *Equisetum sylvaticum*, *Mnium hornum*, *Polytrichum commune*, *Sphagnum capillifolium*) and in the Bohemian Forest also by (sub)montane species (e.g. *Blechnum spicant*, *Homogyne alpina*, *Soldanella montana*). In the Czech Republic, similar communities have been assigned to *Luzulo pilosae-Abietetum* Mráz 1957 association (cf. Husová & Moravec in Moravec et al. 2000). Because of the weak floristic differentiation of such stands from *Luzulo-Abietetum typicum* I follow the German approach, i.e. classification at the subassociation level (Seibert in Oberdorfer 1992, Walentowski 1998, Boublík & Zelený 2007).

Galio rotundifolii-Abietetum albae (Table 1, col. 3; Table 2; Fig. 2)

Mesotrophic *Abies*-forests are well differentiated by *Fagetalia* species (eg. *Carex digitata*, *Dryopteris filix-mas*, *Galeobdolon montanum*, *Gymnocarpium dryopteris*, *Impatiens noli-*

Fig. 2. Distribution of herb-rich fir forests (*Galio-Abietenion*) in the study area. ● – *Galio rotundifolii-Abietetum albae*, ○ – *Pyrolo secundae-Abietetum albae*.



-tangere, *Moehringia trinervia*, *Paris quadrifolia*, *Senecio ovatus*)[1]. In comparison with *Tilio-Acerion* communities, acidophilous species have higher constancies in *Galio-Abietetum* whereas nitrophilous species are scarcer. Humus forms are represented mainly by different moder subforms. The community occurs at altitudes of 440–950 m. In the study area, *Galio-Abietetum* is mentioned by Boublík (2005) and by Grulich (2006).

Variability

1. *Galio rotundifolii-Abietetum albae typicum*

Species composition corresponds to the description of the association. Hygrophilous species are missing (see below). The soils represented are mostly (Skeletic) Cambisols, rarely Leptosols or Entic Podzols.

[1] We cannot consider most of taxa presented in Table 1, col. 3, as the diagnostic species for the whole association *Galio-Abietetum*. These taxa have high fidelity values because of the high representation of relevés from stands in wet habitats (*Galio-Abietetum equisetetosum sylvatici*) within *Galio-Abietetum* in comparison with other units.

Based on floristic composition reflecting altitudinal gradient two variants can be distinguished[2]:
Variant with *Paris quadrifolia* (*Actaea spicata*, *Cardamine impatiens*, *Galium rotundifolium*, *Mercurialis perennis*, *Paraleucobryum longifolium*, *Paris quadrifolia*, *Poa nemoralis*) occurs at middle altitudes of the study area – (510–)600–850(–940) m. The variant corresponds to *Saniculo europaeae-Abietetum* Husová (1968) 1998 association (Husová in Moravec et al. 2000).
Variant with *Campanula persicifolia* (*Campanula persicifolia*, *C. rapunculoides*, *Chelidonium majus*, *Corylus avellana*, *Galium sylvaticum*, *Polypodium vulgare*). Similarly to *Senecio germanicus* variant within *Luzulo-Abietetum typicum*, we can find it especially on steep slopes in the Vltava river valley at altitudes of 440–580(–700) m. The variant corresponds to *Deschampsio flexuosae-Abietetum calamagrostietosum arundinaceae* Husová 1983 subassociation (Husová 1968, 1983).

2. *Galio rotundifolii-Abietetum albae equisetetosum sylvatici*
(Syn. *Carici remotae-Abietetum* Husová 1998)
Gleysols and Stagnic or Gleyic Cambisols represent the main soil types, which is mirrored in the floristic composition, i.e. the presence of hygrophilous species of forests springs (*Ajuga reptans*, *Equisetum sylvaticum*, *Myosotis palustris* agg., *Plagiomnium undulatum*, *Ranunculus repens* etc.). It also occurs, though very rarely, on brook banks on Fluvisols.

We can distinguish two variants conditioned by altitudinal gradient within the variability of this subassociation.
Variant with *Sanicula europaea* (*Dicranella heteromalla*, *Festuca gigantea*, *Galium odoratum*, *Rubus* ser. *Glandulosi*, *Sanicula europaea*, *Valeriana dioica*) occurs at lower altitudes (580–870 m) and it contains more mesotrophic species.
Variant with *Luzula sylvatica* (*Calamagrostis villosa*, *Doronicum austriacum*, *Luzula sylvatica*, *Phegopteris connectilis*, *Silene dioica*) can be found at altitudes of 780–950 m and it contains montane species.

Pyrolo secundae-Abietetum albae (Table 1, col. 4; Fig. 2)

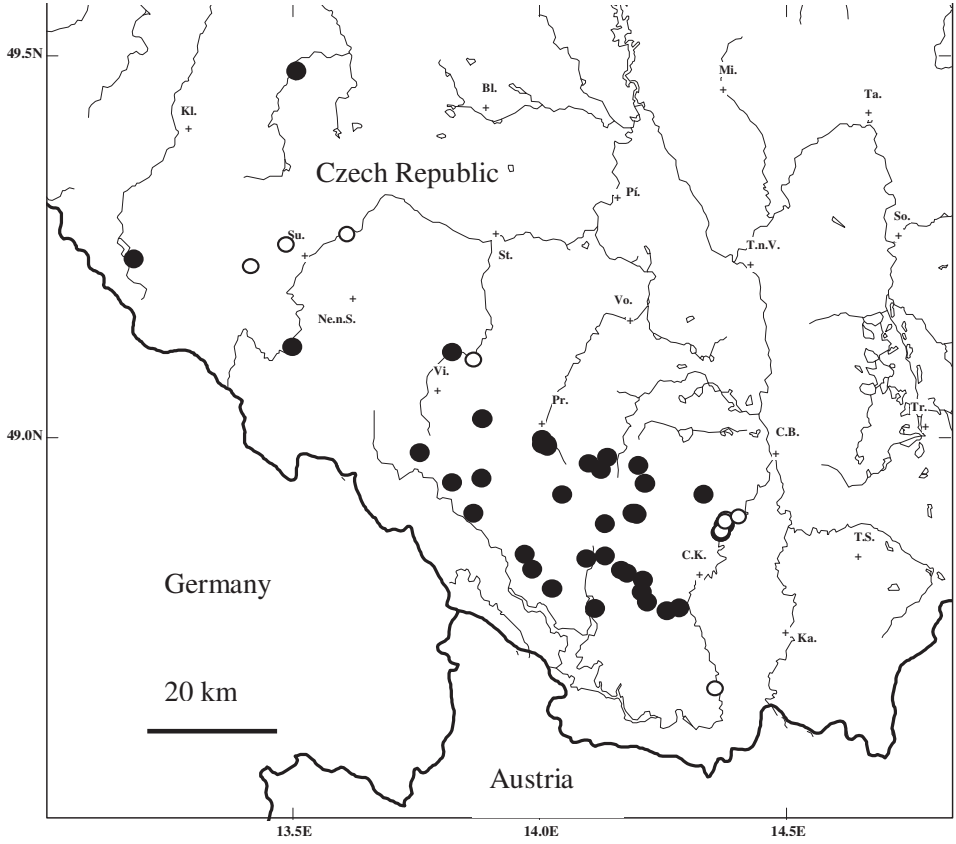
Calcicolous *Pyrolo secundae-Abietetum* is the rarest community of fir forests not only in the studied region, but also in the whole Czech Republic (Boublík 2005). It occurs in small stands in the Český Krumlov part of the Bohemian Forest foothills (Českokrumlovské Předšumaví) in the vicinity of Muckov, Mezipotočí, and Slavkov (Boublík 2005, Grulich 2006; see Fig. 2) at altitudes of 680–830 m. *Pyrolo-Abietetum* is differentiated by light-demanding species or by species with the centre of distribution in lower altitudes (e.g. *Campanula trachelium*, *Euphorbia cyparissias*, *Lathyrus vernus*, *Viola collina*) and in forest fringes (e.g. *Astragalus glycyphyllos*, *Brachypodium pinnatum*). Some species are shared with *Galio rotundifolii-Abietetum* and with fir forests in scree habitats. It grows on Rendzic Leptosols and Cambisols with moder humus form developed on crystalline limestones.

Aceri-Carpinetum betuli (Table 1, col. 5; Fig. 3)

Scree forests of lower altitudes (430–725 m) dominated by *Abies alba* with a high proportion of *Tilia platyphyllos* are assigned to *Aceri-Carpinetum abietetosum* (Mikyška 1952) Husová 1982 (= *Tilio platyphyllae-Abietetum* Husová 1968, Husová in Moravec et al. 2000). These

[2]Presumably, it could be possible to distinguish a montane variant of subassociation *Galio rotundifolii-Abietetum albae typicum*. A similar case is *Lycopodium annotinum* variant within *Luzulo-Abietetum typicum*. But we do not have enough relevés representing such stands.

Fig. 3. Distribution of scree fir forests (*Tilio-Acerion*) in the study area. ○– *Aceri-Carpinetum betuli*, ● – *Fraxino excelsioris-Aceretum pseudoplatani*.



stands contain many species of *Carpinion* forests (e.g. *Euphorbia dulcis*, *Galium sylvaticum*, *Hepatica nobilis*). (Skeletic) Cambisols and Leptosols with moder humus form are typical of the habitats on steep slopes. Stands can be found in the vicinity of Sušice, Lčovice, and in the Vltava river valley.

Fraxino excelsioris-Aceretum pseudoplatani (Table 1, col. 6; Fig. 3)
(Syn. *Mercuriali-Fraxinetum* (Klika 1942) Husová in Moravec et al. 1982)

Except for fir and spruce, *Fagus sylvatica* and *Acer pseudoplatanus* are common in the tree layer. *Fraxino-Aceretum* is differentiated from the previous association on one hand by the presence of *Fagion* species (*Festuca altissima*, *Galium odoratum*, *Paris quadrifolia*) and, on the other hand, by the absence of *Carpinion* species. Generally, it occurs at higher altitudes (650–975 m). More rarely, however, it can be found at altitudes around 450 m on northwestern and northern slopes in the Vltava River valley. The soils represented are (Skeletic) Cambisols and (Hyperskeletic) Leptosols with typical, mull-like, rarely also mor-like moder. Stands similar to *Mercuriali-Fraxinetum* (see synonym) are mentioned by Grulich (2006).

Important gradients in the vegetation classification of fir forests

In this paper, I use three main ecological gradients reflected in floristic composition for the classification of fir forests – nutrient supply, soil moisture, and altitude. However, I consider in agreement with Müller in Oberdorfer (1992), Seibert in Oberdorfer (1992), Walentowski (1998), and Walentowski et al. (2005) the gradient in nutrient supply as to be the basic one (see Boublík & Zelený 2007). It is used for the delimitation of vegetation units at the association level. Within each *Abietetum* association we can recognize subunits on waterlogged soils (Walentowski 1998, Boublík & Zelený 2007). Some authors distinguish hygrophilous communities at the association level as well. Nevertheless, the presence of such communities with similar floristic composition of hygrophilous species in different trophic levels does not support this approach.

Naturally, vegetation types conditioned by altitude can also be distinguished at the association level (similarly to the *Melampyro-Fagetum – Luzulo-Fagetum – Calamagrostio villosae-Fagetum* sequence in the case of Central European acidophilous beech forests – Willner 2002). But such an approach can be considered as non-consistent because of the fact that some species which define the associations conditioned by altitude do not necessarily occur at corresponding altitudes. In my study, this limitation is demonstrated by *Fraxino excelsioris-Aceretum* found at a surprisingly low altitude of 450 m where scree forests with *Carpinion* species (*Aceri-Carpinetum*) usually occur. However, in Central European phytosociology (Müller in Oberdorfer 1992, Wallnöffer et al. in Mucina et al. 1993, Husová in Moravec et al. 2000) it is usual to recognize the types conditioned by altitude within scree forests at the association (or even suballiance) level. Preference for classification based on this criterion (altitude) can be explained by similar nutrient supply within scree forests. In contrast beech and fir forests are characterized by a wider nutrient availability. For this reason nutrient gradient is frequently used as a basic classification criterion for beech and fir forests. If we applied this approach to the scree forests dominated by *Abies alba* (with similar nutrient availability at all altitudes), it would be possible to distinguish only one association (*Tilio platyphyllae-Abietetum*), but this assessment would bring chaos into this topic. Therefore, mainly for pragmatic reasons, in the case of scree forests I follow the differentiation according to associations conditioned by altitude.

Nevertheless, in the case of Central European fir forests assigned to *Piceion*, *Luzulo-Fagion* and *Fagion* alliances, I do not consider the altitudinal gradient as a sufficient reason for distinguishing communities at association level. Similarly, Müller in Oberdorfer (1992) distinguished montane acidophilous beech forests (described as *Calamagrostio villosae--Fagetum*) only as a subtype within *Luzulo-Fagetum*.

History of fir forests

Fir forests occur in habitats where beech, as a strong competitor, is able to grow and to create closed stands (Málek 1979, Boublík 2005). The habitats on waterlogged soils (*Luzulo--Abietetum deschampsietosum*, *Galio-Abietetum equisetetosum* in our case) where beech shows lower vitality could be considered as an exception (Ellenberg 1988, Walentowski 1998). Following the geobiocoenological (ecosystem) approach and the forest site typology, the fir stands (analysed in this study) are located in beech (4) and fir-beech (5), and marginally in spruce-(fir-)beech (6) vegetation belts (Buček & Lacina 1999, Plíva 1991). The current fir-dominated stands can probably be considered as a semi-natural vegetation determined both by natural conditions and processes and by human activities – e.g. forest pasture, litter raking, forest fragmentation (Málek 1979). Nevertheless, fir forests are probably an old component of the forest vegetation of the Bohemian Forest foothills. Palynological stu-

dies confirm high representation of fir and, on the other hand, lower occurence of beech in the early Subatlantic period (Rybníčková 1973, Rybníček & Rybníčková 1978). Moreover, it is likely that some of the currently existing stands arose on the abandoned fields and pastures, similarly to the situation in the Bílé Karpaty Mts. (Volařík 2006).

In spite of the seminatural character of fir forests, they are valuable component of cultural landscape and they need to be protected as cultural heritage. The protection of the genetic diversity of fir and different species co-occurring with fir is important as well. A significant decrease in game browsing intensity and a stop to the practice of clear-cuts are essential for the preservation of fir stands. In the case of the Bohemian Forest (especially the southeastern part of its foothills – Boletice Military Area and its surroundings), these conservation requirements are justified by the fact that the local fir forests are the most extensive fir stands in the Czech Republic.

Acknowledgements. I would like to thank V. Grulich, M. Lepší, D. Půbal, and A. Vydrová for calling my attention to different localities of fir forests, P. Lepší and D. Zelený for their help in field work, and J. Košnar for the determination of bryophytes. M. Lepší kindly prepared distribution maps and O. Matějka revised my English. I thank J. Douda and D. Zelený for their valuable comments on an earlier version of the paper. Discussions with J. Sádlo were, as always, of great value for me. The study was supported by the grant no. 206/05/0020 from the Grant Agency of the Czech Republic and by the long-term research plan AV0Z60050516 of the Academy of Sciences of the Czech Republic.

Vegetace jedlových lesů Šumavy a přilehlých území

Na základě floristického složení 215 fytocenologických snímků byla provedena curyšsko-montpellierskou metodou klasifikace vegetace jedlin v oblasti Šumavy, Novohradských hor a jejich podhůří. Bylo rozlišeno šest asociací v rámci čtyř svazů. *Vaccinio vitis-idaeae-Abietetum albae* (*Piceion excelsae*) a *Luzulo-Abietetum albae* (*Luzulo-Fagion*) reprezentují acidofilní společenstva. Druhově bohaté jedlové lesy (*Fagion sylvaticae*, *Galio-Abietenion*) jsou zastoupeny mezotrofní asociací *Galio rotundifolii-Abietetum albae* a vzácným vápnomilným společenstvem *Pyrolo secundae-Abietetum albae*. Jedlové lesy na suťových stanovištích (*Tilio-Acerion*) jsou hodnoceny jako *Aceri-Carpinetum betuli* (vyskytuje se v nižších polohách studovaného území) a *Fraxino excelsioris-Aceretum pseudoplatani* s výskytem soustředěným do vyšších nadmořských výšek. V rámci asociací *Luzulo-Abietetum* a *Galio-Abietetum* byly dále rozlišeny subasociace odrážející vodní režim půd a výškové varianty. Každá vegetační jednotka je charakterizována druhovým složením, základními půdními podmínkami a rozšířením ve studovaném území. Jedliny na „klimazonálních" půdách jsou považovány za polopřirozená společenstva závislá jak na přírodních podmínkách, tak na dlouhotrvajícím vlivu člověka. Porosty s dominancí jedle by měly být chráněny jako přírodní a kulturní dědictví. Právě v oblasti Šumavy se nacházejí nejrozsáhlejší porosty jedlin v rámci České republiky.

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Received: 23 April 2007
Accepted: 25 May 2007

Table 1. Combined synoptic table of fir forests associations. The percentage constancies and fidelities (×100, upper indices) of species are shown. The values of diagnostic species for particular associations are in bold. 237 species with constancies lower than 15% or occurring in only one column were omitted. The values for moss layer can slightly vary, since moss layer was not recorded for 2 relevés of *Pyrolo secundae-Abietetum*. Layers: 3 – tree layer, 2 – shrub layer, 1 – herb layer, j – juveniles, 0 – moss layer. Associations: VA – *Vaccinio vitis-idaeae-Abietetum albae*, LA – *Luzulo-Abietetum albae*, GA – *Galio rotundifolii-Abietetum albae*, PA – *Pyrolo secundae-Abietetum albae*, AC – *Aceri-Carpinetum betuli*, FA – *Fraxino excelsioris-Aceretum pseudoplatani*. The numbers of relevés used in Table 1 are listed in Appendix.

Association	**Layer**	**VA**	**LA**	**GA**	**PA**	**AC**	**FA**
No. of relevés		22	60	69	4	17	43
Vaccinio-Abietetum							
Vaccinium vitis-idaea	1	**27** $^{48.8}$	.	.	.	.	.
Leucobryum glaucum	0	**32** $^{41.5}$	10	3	.	.	.
Pleurozium schreberi	0	**55** $^{41.5}$	38 $^{22.8}$	16	.	.	2
Dicranodontium denudatum	0	**23** $^{40.6}$	2	1	.	.	.
Dicranum polysetum	0	**18** $^{37.2}$	2	.	.	.	.
Bazzania trilobata	0	**32** $^{34.1}$	13	6	.	6	.
Dicranum scoparium	0	**86** $^{31.8}$	73	62	.	29	53
Picea abies	3	**100** $^{27.6}$	73	83	50	47	81
Picea abies	2	**50** $^{25.2}$	33	25	25	6	14
Luzulo-Abietetum							
Hieracium lachenalii	1	.	**15** $^{28.2}$	6	.	.	.
Quercus robur	j	.	**27** $^{27.6}$	14	.	6	7
Galio-Abietetum							
Soldanella montana	1	.	10	**32** $^{42.0}$	.	.	2
Chaerophyllum hirsutum	1	.	2	**19** $^{35.1}$	.	.	2
Luzula pilosa	1	14	25	**48** $^{34.9}$	.	.	21
Equisetum sylvaticum	1	.	2	**16** $^{34.5}$	.	.	.
Myosotis palustris agg.	1	.	.	**13** $^{33.3}$	.	.	.
Gymnocarpium dryopteris	1	.	13	**29** $^{32.5}$	.	.	9
Veronica officinalis	1	.	13	**36** $^{32.5}$	.	6	19
Petasites albus	1	.	3	**30** $^{31.9}$	.	.	23
Plagiomnium affine	0	5	35	**86** $^{31.9}$	50	59	65
Viola sp.	1	.	.	**14** $^{31.7}$	.	.	2
Lonicera nigra	j	.	5	**35** $^{31.2}$	.	12	21
Athyrium filix-femina	1	5	47	**71** $^{29.2}$	25	41	47
Circaea alpina	1	.	.	**14** $^{28.8}$	.	.	5
Eurhynchium angustirete	0	.	23	**49** $^{28.2}$	.	18	47
Acer pseudoplatanus	j	5	20	**52** $^{28.2}$	25	6	42
Abies alba	j	73	78	**91** $^{26.8}$	25	41	65

Stellaria nemorum	1	.	2	**19** 25.2	.	.	14
Pyrolo-Abietetum							
Euphorbia cyparissias	1	.	.	1	**75** 83.5	.	.
Daphne mezereum	2	.	.	1	**75** 71.2	12	9
Rubus saxatilis	1	.	.	.	**50** 67.4	.	.
Tussilago farfara	1	.	.	1	**50** 66.2	.	.
Ranunculus nemorosus	1	.	2	1	**50** 62.9	.	2
Viola collina	1	.	.	3	**50** 60.5	6	.
Carex digitata	1	.	5	41 4.9	**100** 60.4	41	26
Aceri-Carpinetum							
Galium sylvaticum	1	.	3	6	.	**88** 86.1	2
Epilobium montanum	1	.	3	20	25	**94** 66.4	23
Chelidonium majus	1	.	3	6	.	**47** 56.2	2
Hepatica nobilis	1	.	.	4	25	**59** 55.7	.
Plagiothecium succulentum	0	.	.	.	.	**35** 53.5	2
Tilia platyphyllos	3	.	.	.	.	**35** 53.5	2
Daphne mezereum	j	.	.	3	.	**35** 53.0	.
Pulmonaria officinalis agg.	1	.	2	13	25	**76** 50.9	42 15.8
Geranium robertianum	1	.	3	25	50	**94** 49.9	65 23.4
Adoxa moschatellina	1	.	.	3	.	**41** 49.1	12
Euphorbia dulcis	1	.	.	.	.	**24** 45.2	.
Senecio germanicus	1	.	8	4	.	**35** 43.4	2
Polygonatum multiflorum	1	.	.	.	.	**24** 42.3	2
Campanula rapunculoides	1	.	.	9	.	**29** 42.3	.
Cardaminopsis arenosa	1	.	2	3	.	**24** 39.9	.
Lunaria rediviva	1	.	.	.	.	**24** 39.8	5
Polypodium vulgare	1	.	12	13	.	**41** 37.7	12
Plagiothecium denticulatum	0	.	2	1	.	**24** 36.8	5
Symphytum tuberosum	1	.	.	3	.	**29** 36.4	14
Asplenium trichomanes	1	.	.	.	.	**18** 35.7	2
Cystopteris fragilis	1	.	.	.	.	**18** 35.7	2
Metzgeria conjugata	0	.	.	.	.	**18** 35.7	2
Tilia cordata	j	.	2	1	.	**18** 34.7	.
Actaea spicata	1	.	.	25	75	**76** 34.3	58 17.5
Galeopsis speciosa	1	.	3	13	25	**41** 33.8	5
Melica nutans	1	.	8	33	50	**71** 33.6	47 11.0
Aethusa cynapium s.lat.	1	.	.	.	.	**12** 31.6	.
Salvia glutinosa	1	.	.	.	.	**12** 31.6	.

Tilia platyphyllos	2	.	.	.	.	**12** 31.6	.
Viola hirta	1	.	.	.	.	**12** 31.6	.
Lonicera xylosteum	2	.	2	9	25	**35** 30.7	5
Corylus avellana	2	.	13	20	75	**65** 30.0	26
Vicia sylvatica	1	.	.	.	25	**29** 28.3	7
Viola reichenbachiana	1	.	7	20	50	**59** 27.2	49 17.5
Fraxino-Aceretum							
Festuca altissima	1	.	8	32	.	6	**56** 46.2
Galium odoratum	1	.	.	17	25	29	**58** 39.6
Milium effusum	1	.	8	26	.	41	**51** 32.9
Dryopteris carthusiana	1	14	37	55	.	18	**65** 32.5
Isothecium alopecuroides	0	.	3	7	.	12	**26** 29.0
Festuca gigantea	1	.	.	9	.	.	**16** 27.1
Cardamine impatiens	1	.	.	20	.	24	**33** 26.6
Paris quadrifolia	1	.	.	22 20.3	.	6	**26** 26.3
Polygonatum verticillatum	1	.	2	7	25	.	**28** 25.9
Moehringia trinervia	1	.	23	57 17.9	25	53	**65** 25.9
Silene dioica	1	.	5	9	.	6	**21** 25.3
Galio-Abietenion + Tilio-Acerion							
Dryopteris filix-mas	1	.	30	78 20.8	25	100 40.3	98 38.2
Sambucus racemosa	2	.	15	30	25	47	49 21.1
Lonicera nigra	2	.	8	36 12.2	50	18	35
Galium rotundifolium	1	.	8	19	25	12	12
Urtica dioica	1	.	2	39	25	94 49.2	81 37.6
Mercurialis perennis	1	.	.	28	50	82 36.8	91 44.4
Asarum europaeum	1	.	.	20	25	59 33.1	53 27.7
Sanicula europaea	1	.	.	7	25	12	16
Galio-Abietetum + Tilio-Acerion							
Impatiens noli-tangere	1	.	3	43	.	82 47.2	67 33.0
Galeobdolon montanum	1	.	2	33	.	65 34.1	79 48.2
Myosotis sylvatica	1	.	.	23	.	29	30 21.3
Pyrolo-Abietetum + Aceri-Carpinetum							
Campanula trachelium	1	.	.	1	75 51.8	71 47.3	2
Lathyrus vernus	1	.	.	3	75 51.8	53 29.0	19
Others							
Abies alba	3	100	100	100	100	100	100
Avenella flexuosa	1	91 24.4	90 23.6	65	75	24	44
Sorbus aucuparia	j	77	85	88 19.2	50	59	51

Picea abies	j	73	72	72 16.9	50	18	37
Pinus sylvestris	3	45 20.5	20	25	50	6	7
Fagus sylvatica	3	41	13	9	25	12	42 19.2
Hypnum cupressiforme	0	36	70	65	25	82	56
Fagus sylvatica	j	36	40	35	50	12	28
Sorbus aucuparia	2	32	33	28	75	18	30
Oxalis acetosella	1	27	95	97 20.5	50	100	100 23.6
Maianthemum bifolium	1	23	37	57 20.3	50	18	26
Luzula luzuloides	1	18	73 23.3	71 21.2	50	29	42
Hieracium murorum	1	18	72 11.1	71 10.5	100	71	26
Fagus sylvatica	2	18	17	16	25	12	19
Rubus idaeus	1	14	67	88 16.9	100	71	88 16.9
Calamagrostis arundinacea	1	9	45	57 20.9	25	47	23
Sorbus aucuparia	3	9	2	4	25	12	2
Corylus avellana	j	5	22	49 21.6	25	47	19
Polytrichastrum formosum	0	77	82 27.4	87 32.1	.	12	49
Dryopteris dilatata	1	36	70	72	.	12	67
Abies alba	2	27	37	30	.	47	23
Hylocomium splendens	0	27	30	32	.	6	19
Plagiothecium sp.	0	18	32	33	.	6	35
Pohlia nutans	0	18	30 21.8	9	.	12	12
Dicranella heteromalla	0	14	20 18.3	7	.	6	5
Thuidium tamariscinum	0	9	25	30	.	24	26
Plagiochila asplenioides	0	9	10	20	.	24	2
Sambucus racemosa	j	5	30	36	.	24	30
Galeopsis bifida	1	5	22	7	.	12	26
Vaccinium myrtillus	1	95 40.5	87 32.6	75 22.5	25	.	19
Cladonia sp.	0	18	23 12.9	7	25	.	7
Epilobium angustifolium	1	9	15	6	50	.	7
Senecio ovatus	1	.	62	91 17.5	100	94	98 24.0
Mycelis muralis	1	.	38	72 21.7	50	59	70
Solidago virgaurea	1	.	38	41	25	47	19
Fragaria vesca	1	.	12	55 11.8	100	53	33
Viola riviniana	1	.	10	38 24.7	25	6	23
Campanula persicifolia	1	.	8	13	50	35	12
Convallaria majalis	1	.	7	7	25	6	2
Scrophularia nodosa	1	.	5	13	25	24	23
Rosa canina s.lat.	j	.	3	13	25	6	7

Taraxacum sect. *Ruderalia*	1	.	3	4	25	12	2
Acer pseudoplatanus	3	.	2	4	25	6	19 [14.4]
Betula pendula	j	32	20	16	.	.	7
Calamagrostis villosa	1	14	28 [24.9]	14	.	.	9
Carex pilulifera	1	14	23	19	.	.	9
Paraleucobryum longifolium	0	14	8	17	.	.	19
Frangula alnus	j	5	20 [24.6]	7	.	.	7
Campanula rotundifolia	1	.	12	7	25	12	.
Mnium spinosum	0	.	2	7	25	12	.
Deschampsia cespitosa	1	.	3	20 [15.2]	25	.	12
Dactylis glomerata agg.	1	.	3	9	50	.	9
Rosa pendulina	2	.	2	6	25	.	2
Prenanthes purpurea	1	.	45	46	.	53	47
Viscum album subsp. *abietis*	3	.	20	16	.	12	12
Rubus ser. *Glandulosi*	1	.	18	19	.	6	16
Atrichum undulatum	0	.	8	23	.	24	16
Galeopsis sp.	1	.	8	7	.	18	9
Rhizomnium punctatum	0	.	3	4	.	18	2
Poa nemoralis	1	.	7	25	.	24	28
Fraxinus excelsior	j	.	3	16 [21.0]	.	6	7
Sambucus nigra	2	.	3	14	.	18	16
Digitalis grandiflora	1	.	3	12	.	18	5
Plagiomnium undulatum	0	.	2	22	.	35	28
Sambucus nigra	j	.	2	13	.	18	7
Carex muricata agg.	1	.	2	4	.	24	12
Prunus avium	j	.	.	22 [13.6]	25	18	7
Acer pseudoplatanus	2	.	.	4	25	12	14
Bromus benekenii	1	.	.	3	50	6	12
Heracleum sphondylium	1	.	.	3	25	6	5
Stellaria media	1	.	.	1	25	6	7
Melampyrum pratense	1	23	20	16	.	.	.
Frangula alnus	2	.	10 [7.3]	1	25	.	.
Cirsium palustre	1	.	2	9	25	.	.
Lonicera xylosteum	j	.	.	4	25	12	.
Ajuga reptans	1	.	.	25 [11.8]	50	.	16
Ranunculus repens	1	.	.	14 [12.2]	25	.	5
Galium album	1	.	.	3	25	.	2
Prunus padus	j	.	.	6	25	.	2

Eurhynchium striatum	0	.	.	3	.	18	7
Veronica chamaedrys	1	.	.	4	25	.	.
Brachypodium pinnatum	1	.	.	3	25	.	.
Rosa canina s.lat.	2	.	.	1	25	.	.
Cirsium oleraceum	1	.	.	1	25	.	.
Astragalus glycyphyllos	1	.	.	.	25	6	.
Crataegus sp.	j	.	.	.	25	6	.
Acer platanoides	2	.	.	.	25	.	2

The numbers of relevés from the Czech National Phytosociological Database (managed by the Faculty of Science of the Masaryk university in Brno; Chytrý & Rafajová (2003), http://www.sci.muni.cz/botany/vegsci/dbase.php?lang=en) used for Table 1.
VA – *Vaccinio vitis-idaeae-Abietetum albae*
347859, 347863, 347887, 347902, 347949, 347960, 347961, 347964, 348036, 348158, 412288, 424830, 424835, 424839, 424842, 428937, 459714, 459716, 459718, 459734, 424841, 426846
LA – *Luzulo-Abietetum albae*
347608, 347610, 347611, 347612, 347818, 347821, 347822, 347826, 347828, 347854, 347858, 347860, 347861, 347864, 347871, 347890, 347897, 347898, 347901, 347950, 347955, 347956, 347958, 347962, 348023, 348024, 348026, 348028, 348034, 348037, 348038, 348088, 348089, 348090, 348097, 348099, 424813, 424834, 424836, 424837, 424838, 424844, 424846, 424847, 425257, 425485, 425487, 425488, 426837, 459075, 459076, 459695, 459705, 459707, 459723, 459725, 459727, 459729, 459730, 555526
GA – *Galio rotundifolii-Abietetum albae*
347571, 347572, 347573, 347575, 347576, 347577, 347578, 347581, 347582, 347600, 347601, 347602, 347603, 347606, 347607, 347609, 347719, 347820, 347827, 347853, 347855, 347856, 347857, 347865, 347866, 347868, 347869, 347870, 347872, 347873, 347875, 347876, 347878, 347886, 347891, 347892, 347893, 347894, 347895, 347896, 347900, 347917, 347918, 347951, 347953, 347954, 347959, 347963, 347973, 348019, 348020, 348027, 348030, 348033, 348035, 424820, 424822, 424823, 424848, 425258, 459073, 459078, 459082, 459686, 459687, 459738, 459741, 459749, 459791
PA – *Pyrolo secundae-Abietetum albae*
347604, 432858, 432859, 459657
AC – *Aceri-Carpinetum betuli*
347972, 348091, 348100, 424845, 425254, 425256, 459074, 460398, 460399, 460400, 460401, 460402, 460406, 460407, 460408, 460409, 555463
FA – *Fraxino excelsioris-Aceretum pseudoplatani*
347403, 347574, 347579, 347580, 347583, 347605, 347819, 347851, 347852, 347862, 347867, 347874, 347877, 347885, 347888, 347889, 347899, 347952, 347965, 348029, 348060, 348061, 348098, 424814, 424821, 459647, 459649, 459666, 459671, 459672, 459673, 459677, 459678, 459681, 459683, 459746, 459756, 459757, 459758, 459776, 459781, 460405, 460421

Table 2. Synoptic constancy (%) table of *Galio rotundifolii-Abietetum*. 197 taxa not reaching 26% or more constancy value in any column are not shown. Layers: 3 – tree layer, 2 – shrub layer, 1 – herb layer, j – juveniles, 0 – moss layer. *GA typicum* = *Galio-Abietetum typicum* (group 1 – variant with *Paris quadrifolia*, group 2 – variant with *Campanula persicifolia*). *GA equisetetosum* = *Galio-Abietetum equisetetosum sylvatici* (group 3 – variant with *Sanicula europaea*, group 4 – variant with *Luzula sylvatica*).

Subassociation	**Layer**	***GA typicum***		***GA equisetetosum***	
Group No.		1	2	3	4
No. of relevés		43	8	13	5
Mercurialis perennis	1	**35**	25	15	.
Prunus avium	j	**33**	.	8	.
Actaea spicata	1	**33**	12	15	.
Paris quadrifolia	1	**28**	.	15	20
Poa nemoralis	1	**28**	25	15	20
Paraleucobryum longifolium	0	**26**	.	8	.
Cardamine impatiens	1	**26**	12	15	.
Galium rotundifolium	1	**26**	.	15	.
Campanula persicifolia	1	7	**75**	.	.
Polypodium vulgare	1	9	**62**	.	.
Campanula rapunculoides	1	2	**62**	.	.
Galium sylvaticum	1	.	**50**	.	.
Corylus avellana	2	21	**50**	8	.
Chelidonium majus	1	.	**50**	.	.
Quercus robur	j	16	**38**	.	.
Galeopsis speciosa	1	9	**38**	15	.
Pohlia nutans	0	7	**38**	.	.
Scrophularia nodosa	1	12	**38**	8	.
Fagus sylvatica	3	.	**38**	15	20
Tilia cordata	2	.	**38**	.	.
Hylocomium splendens	0	**44**	**38**	.	.
Carex pilulifera	1	16	.	**46**	.
Viola reichenbachiana	1	19	.	**38**	20
Dicranella heteromalla	0	2	.	**31**	.
Rubus ser. *Glandulosi*	1	21	.	**31**	.
Sanicula europaea	1	2	.	**31**	.
Festuca gigantea	1	5	.	**31**	.
Valeriana dioica	1	.	.	**31**	.
Carex remota	1	.	.	**31**	20
Fagus sylvatica	2	12	25	**31**	.
Galium odoratum	1	16	12	**31**	.

Cardamine amara	1	.	.	**31**	20
Calamagrostis villosa	1	9	.	15	**80**
Luzula sylvatica	1	.	.	.	**60**
Silene dioica	1	5	.	15	**40**
Doronicum austriacum	1	2	.	.	**40**
Phegopteris connectilis	1	5	.	15	**40**
Sphagnum sp.	0	.	.	.	**40**
Crepis paludosa	1	.	.	8	**40**
Poa sp.	1	.	.	8	**40**
Rhizomnium punctatum	0	2	.	.	**40**
Soldanella montana	1	14	.	**85**	**100**
Ajuga reptans	1	14	.	**69**	**40**
Plagiomnium undulatum	0	12	.	**62**	**40**
Ranunculus repens	1	.	.	**62**	**40**
Equisetum sylvaticum	1	.	.	**54**	**80**
Myosotis palustris agg.	1	.	.	**46**	**60**
Deschampsia cespitosa	1	12	.	**46**	**60**
Chaerophyllum hirsutum	1	5	.	**46**	**100**
Stellaria nemorum	1	7	.	**38**	**100**
Atrichum undulatum	0	19	12	**38**	**40**
Plagiochila asplenioides	0	9	25	**38**	**60**
Chrysosplenium alternifolium	1	.	.	**38**	**40**
Caltha palustris	1	.	.	**31**	**40**
Abies alba	3	100	100	100	100
Rubus idaeus	1	98	75	77	60
Sorbus aucuparia	j	98	75	69	80
Oxalis acetosella	1	95	100	100	100
Abies alba	j	95	100	77	80
Senecio ovatus	1	95	62	92	100
Polytrichastrum formosum	0	88	75	92	80
Dryopteris filix-mas	1	86	100	46	60
Picea abies	3	81	88	77	100
Dryopteris dilatata	1	79	25	69	100
Plagiomnium affine	0	77	100	100	100
Hieracium murorum	1	77	75	54	60
Vaccinium myrtillus	1	77	38	85	100
Luzula luzuloides	1	72	100	69	20
Picea abies	j	70	50	85	100

Athyrium filix-femina	1	70	25	92	100
Avenella flexuosa	1	67	75	69	20
Calamagrostis arundinacea	1	60	100	23	40
Dicranum scoparium	0	60	62	62	80
Eurhynchium angustirete	0	60	25	38	20
Corylus avellana	j	56	62	31	20
Acer pseudoplatanus	j	56	12	54	80
Dryopteris carthusiana	1	53	75	54	40
Fragaria vesca	1	51	88	62	20
Prenanthes purpurea	1	49	38	23	100
Luzula pilosa	1	47	12	69	60
Veronica officinalis	1	42	12	38	20
Lonicera nigra	j	42	12	23	40
Solidago virgaurea	1	40	62	23	60
Impatiens noli-tangere	1	40	50	54	40
Festuca altissima	1	37	12	23	40
Lonicera nigra	2	35	50	15	80
Fagus sylvatica	j	35	12	46	40
Urtica dioica	1	33	38	46	80
Galeobdolon montanum	1	33	25	38	40
Gymnocarpium dryopteris	1	33	25	8	60
Sorbus aucuparia	2	26	62	15	20
Picea abies	2	21	38	23	40
Myosotis sylvatica	1	16	50	31	20
Epilobium montanum	1	14	38	31	20
Hypnum cupressiforme	0	81	62	38	.
Mycelis muralis	1	72	100	85	.
Moehringia trinervia	1	65	88	31	.
Carex digitata	1	47	50	31	.
Viola riviniana	1	47	25	31	.
Plagiothecium sp.	0	42	38	15	.
Sambucus racemosa	j	40	75	15	.
Melica nutans	1	37	25	38	.
Sambucus racemosa	2	33	62	15	.
Abies alba	2	30	50	31	.
Pinus sylvestris	3	23	38	31	.
Geranium robertianum	1	16	75	31	.
Maianthemum bifolium	1	63	.	54	100

Milium effusum	1	33	.	8	60
Thuidum tamariscinum	0	28	.	54	40
Petasites albus	1	26	.	38	100