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RECUEIL DE TRAVAUX DE GEOBOTANIQUE / REVIEW OF GEOBOTANICAL MONOGRAPHS

30

POTENTIAL NATURAL VEGETATION OF THE CZECH REPUBLIC

Zdenka Neuhäuslová

in co-operation with

J. Moravec, M.Chytrý, V. Ložek, K. Rybníček, E. Rybníčeková
M. Husová, V. Grulich, J. Jeník, J. Sádlo, J. Jirásek, J. Kolbek, J. Wild

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PUBLICATION DU DEPARTEMENT DE BOTANIQUE ET ÉCOLOGIE DE L'UNIVERSITÉ DE CAMERINO ET DE LA STATION INTERNATIONALE DE PHYTOSOCIOLOGIE DE BAILLEUL SOUS L'ÉGIDE DE L'ASSOCIATION AMICALE DE PHYTOSOCIOLOGIE ET DE L'ASSOCIATION INTERNATIONALE POUR L'ÉTUDE DE LA VÉGÉTATION

BRAUN-BLANQUETIA

Un héritage est enrichissant et ouvre de nouvelles possibilités créatrices. Mais il en découle en contre partie l'obligation de ne pas gaspiller le patrimoine reçu. Ceux qui, aujourd'hui étudient la végétation grâce à la phytosociologie peuvent utiliser des méthodologies bien au point et tirer profit d'un ensemble cohérent de connaisances.

C'est le résultat du travail méthodique de nombreux chercheurs de qualité pendant plusieurs décennies. Aujourd'hui, nous nous trouvons face à des problèmes qui ne sont sans doute pas tout à fait nouveaux mais qui paraissent infiniment plus graves que dans le passé: primauté de la technique, spécialisation, pénurie de matières premières, d'énergie et d'espace, crise de l'environnement...

Il se développe ainsi des problèmes spécifiques divers pour lesquels il est nécessaire de trouver des réponses nouvelles. Les chercheurs sont placés devant un véritable défi et il dépend de leur savoir et de leur imagination de montrer si la Science de la végétation est capable d'apporter une contribution appréciable à la solution de ces problèmes.

La tradition phytosociologique dans ce contexte constitue une base essentielle. La conception typologique de la végétation et la clarté du système qui en découle, l'habitude des chercheurs de vivre en contact étroit avec la végétation, les recherches basées sur l'observation condition antithétique de l'expérimentation, sont les traits caractéristiques de la phytosociologie.

Les lignes directrices qui nous ont été transmises par les maîtres de la Science de la végétation, Josias Braun-Blanquet et Reinhold Tüxen avant tout, constituent actuellement une part importante de notre patrimoine d'idées. Notre but est de valoriser cet héritage et d'honorer la mémoire du premier de ces maîtres et fondateur de la phytosociologie moderne par une nouvelle série de publications.

Pourront y trouver place des monographies étudiant concrètement la végétation selon les enseignements de J. Braun-Blanquet et R. Tüxen qui, à travers la créativité des auteurs, produiront de nouveaux fruits.

Disciples nous-mêmes de J. Braun-Blanquet et ayant collaboré à son activité, nous pensons qu'à travers cette série de publications son héritage restera vivant dans l'esprit originel et avec de nouvelles idées.

Sécretariat général de la publication:

Prof. Roberto Venanzoni
Dipartimento di Botanica ed Ecologia
Via Pontoni 5, 62032 Camerino (Italia)
Tel. 0737/404503 Fax 0737/404508
e-mail: botanica@camserv.unicam.it

Sécretariat d'édition: Laura Carimini
e-mail: carimini@camserv.unicam.it

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J. BRAUN-BLANQUET
Drawn from a photograph by François M. Dansereau

PREFACE

The detailed study of the vegetation of the Czech Republic and the associated compilation of the map is linked to similar projects in many other European countries: it has been stimulated by the collaborative pan-European projects entitled "The Map of Natural Vegetation of Europe" and "The European Vegetation Survey".

A complete vegetation survey of the Czech Republic has not been published or prepared in full. However, much information on individual vegetation units and their distribution, and a number of vegetation monographs of protected areas with vegetation maps have been published during the last 30 years, since the edition of the Atlas of Maps of the Reconstructed Natural Vegetation of the Czech Republic was published (Mikyška *et al.*, 1968-1972). Since then, vegetation research and mapping has seen considerable progress (see the chapter: "Vegetation research in the Czech Republic") and has stimulated attempts to compile a detailed vegetation survey of the Czech Republic (see Moravec, 1998) and a new map - the Map of Potential Natural Vegetation and its Explanatory text.

This study on the potential natural vegetation of the Czech Republic and its associated vegetation map at a scale of 1:500000 is a collective work of many Czech, Moravian and Silesian specialists. It was supported by the Grant Agency of the Academy of Science of the Czech Republic within the framework of grant project No. A605413. We acknowledge their support with thanks. Thanks are also due to Dr. J. Cross, National Parks and Wildlife Service, Dublin, for the revision of the English summary.

The following authors co-operated on the compilation of the text: V. Grulich - Phytogeography; M. Husová - characteristics of mapping units 13, 23, 27, 41, 42; M. Chytrý - MU 29, 31, 32, 35, 40 and, with J. Kolbek, 30, 33, 34; J. Jeník - MU 46; J. Jirásek - MU 43-45; J. Kolbek - MU 28; V. Ložek - Geology, Geomorphology, Soils; J. Moravec - MU 14-22, 24, 25; E. Rybníčková and K. Rybníček - Vegetation development in the last 15000 years; K. Rybníček also MU 47-50; J. Sádlo (with V. Ložek) - Influence of habitat conditions on the vegetation; J. Wild - all figures (maps) and other data elaborated by GIS; and Z. Neuhäuslová - remaining parts of the General section and MU 1-12, 26, 36, 37, and, with J. Sádlo, 38, 39.

Průhonice, december 1998

Zdenka Neuhäuslová

BASIC INFORMATION ON THE CZECH REPUBLIC

Topography

The Czech Republic is situated in Central Europe between c. 48°33 and 51°03 N and c. 12°06 and 18°51 E. Its total area covers 78 864 km^2. It occupies the historical territory of Bohemia, Moravia and part of Silesia. The lowest altitudes, c. 116 m a.s.l., occur in N Bohemia, the highest occur in the Krkonoše Mountains (Sněžka 1602 m) in Bohemia and in the Hrubý Jeseník Mts. (Praděd 1492 m) in Moravia.

Geology

The chemistry and physical properties of the geological substrate markedly influence the flora and vegetation. This influence is more or less modified by geomorphological and climatic factors.

The geological structure of the Czech Republic is characterized by two basic units: the Bohemian Massif, which forms the whole of Bohemia, Silesia and the NW part of Moravia, and the Western Carpathians in the remaining part of Moravia. Both units are separated by the Carpathian foredeep which grades into the N European Lowland to the North and into the Pannonian Basin to the South.

The Bohemian Massif is formed from crystalline, Proterozoic and Lower Palaeozoic rocks which are folded and partly metamorphised. The crystalline complex consists mostly of acidic metamorphic rocks, principally various types of gneiss, phyllites and micaslates, locally granulites and basic amphibolites. It also includes large massifs of predominantly acidic plutonic rocks (granites, granodiorites). As a whole it represents an area with poor, mostly acidic substrates and as a result has a relatively low diversity of flora and vegetation. The same is also true of the metamorphic Palaeozoic and Proterozoic rocks. The non-metamorphic Proterozoic and Lower Palaeozoic (Barrandian) rocks cover large areas between Prague and Plzeň with an extension to the southwest.

They include a complex of sediments and vulcanites, some of which have extreme properties and which contribute to the diversity of the habitats. Of the alkaline rocks Silurian and Devonian limestones in the Český kras (Bohemian Karst) are important. Various basalts carry a rich flora, especially the Palaeozoic diabases and Proterozoic spilites (in contrast to Ordovician quartzites, hard Cambrian conglomerates or Proterozoic lydites). Large areas of Moravia are covered by slates, siltstones and conglomerates of the Lower Carboniferous including several isolated deposits of Devonian limestones, particularly the Moravský kras (Moravian Karst), which has fully developed karst phenomena.

Large areas in N, Central and W parts of Bohemia, as well as in Central and NE Moravia, consist of Upper Carboniferous and Permian continental sediments. These are predominantly coarse-grained arcose sandstones and claystones, which are mostly poor in lime with the exception of certain horizons of Permian age (e.g. Rokytná conglomerates in Moravia).

Of the Mesozoic substrates, Cretaceous sediments are very important for the development of the flora and vegetation of the Republic. They are represented by nutrient-poor, rather resistant and base-deficient thick-bedded sandstones ("Quadersandstein"), forming so-called "rock cities" in N Bohemia, and more or less calcareous sedimentary deposits from clays to sandstones, which are widespread over the northern part of Bohemia. Many calciphilous plants in Bohemia are associated with these substrates (e.g. *Cypripedium calceolus*, *Globularia punctata*), whereas the sandstone "rock cities" are characterized by unique phytocoenoses poor in species, but including a number of relict elements (*Pinus sylvestris* stands, *Ledum palustre*, *Viola biflora*).

During the Tertiary period the poor, sandy and clay sediments of the NW and S Bohemian basins were formed. Basalt was laid down at the foot of the Krušné hory Mts. (Ore Mts.) and today it forms the Doupovské hory Mts. and České středohoří Upland. Numerous small deposits occur throughout N Bohemia. At present, these areas of young vulcanites form centres of a rich flora and vegetation.

The Moravian Western Carpathians mostly consist of Lower Tertiary flysh, which is characterized by alternating bands of sandstones, siltstones and claystones, less frequently of marls. Rock outcrops are few but there are many landslides. Of prime importance are the Jurassic limestones which form the Pálava Hills in S Moravia. These carry a very rich xerothermophilous vegetation. Jurassic limestones also occur on the outer margin of the Carpathians, particularly near Štramberk in NE Moravia. The Carpathian foredeep is filled by marine sandy to clayey deposits mostly covered by species-rich xerothermophilous vegetation (e.g. *Crambe tataria* and *Amygdalus nana* in S Moravia).

Quaternary sediments covering older rocks occur mostly in the lowlands and colline belts. Calcareous loess covers extensive areas, being replaced at 300-350m by lime-deficient loess-like deposits (dust loam). The larger streams are bordered by terraces consisting of gravels and sands formed mostly from resistant acidic rocks.

Glacial deposits from the North European ice sheets can be found in northernmost Bohemia and in Silesia, including the surroundings of Ostrava, as well as in the NE part of the Moravská brána (Moravian Gate). They consist mostly of lime-deficient sands, gravels and pebble tills.

In the Holocene, sandy loams were deposited in the floodplains of larger streams and mud infilled former oxbow lakes. Raised bogs formed at higher elevations and transition mires or fens developed in a number of basins. The valley of the Elbe (Labe) river is characterized by calcareous fens, some of them representing the final stages in the infilling of former lakes, where lake marl was deposited. These localities provide important relict habitats for a unique vegetation type with a number of very rare and endangered species, e.g. *Cladium mariscus* or *Pinguicula bohemica* (Hrabanov near Lysá nad Labem).

A map of soil substrates (Fig. 1) completes the geological, as well as pedological characteristics of the Czech Republic.

Geomorphology

The basic geological units differ in their relief. The Western Carpathians are dominated by dissected highlands with deeply eroded valleys separated by narrow ridges and with pronounced altitudinal differences over small areas. The Bohemian Massif is characterized by large areas of rather monotonous uplands at different altitudinal levels, from which block mountains protrude. The Sudetes Mountains consist mostly of steep slopes with summit plateaus (e.g. the Krkonoše Mts.); in their lower parts, e.g. the Nízký Jeseník Mts. and Oderské vrchy Hills, represent extensive elevated plateaus dissected by many valleys. The uplands in central Bohemia are characterized by steep, frequently canyon-like valleys of the larger rivers (Vltava, Berounka, Sázava etc.) with

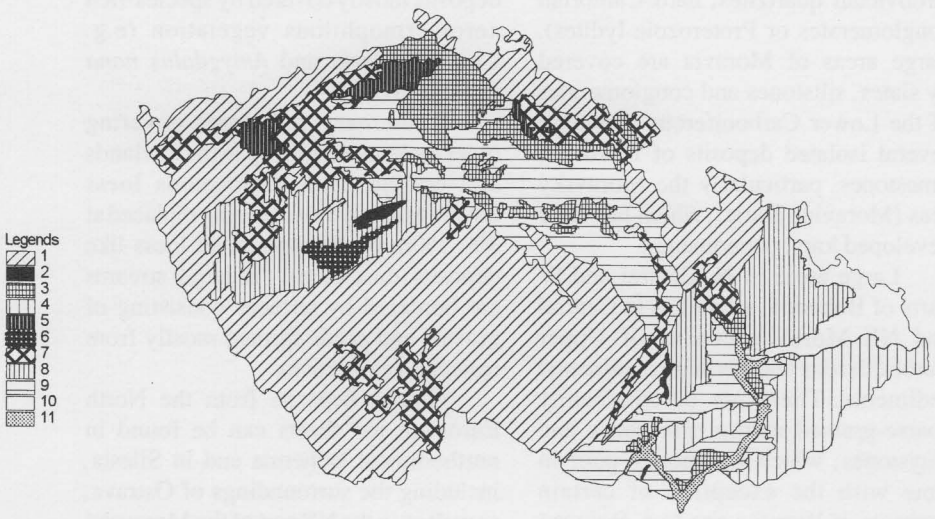

Fig. 1 – Map of soil substrates of the Czech Republic: 1 - Crystalline complex and acidic vulcanites, 2 - Palaeozoic and Jurassic limestones, 3 - Thick-bedded sandstones, river gravel-sands and blown sands, 4 - Carpathian flysh, 5 - Mostly basic Tertiary and Permian vulcanites, 6 - Nutrient-poor hard sandstones, quartzites and conglomerates, 7 - Continental clay and sandy sediments of Permo-Carboniferous, Cretaceous and Tertiary ages, 8 - Palaeozoic and Proterozoic slates and greywackes, 9 - Marine lime-rich sediments of Cretaceous (Bohemia) and Tertiary (Moravia) age, 10 - Quaternary loams, gravels, sands and moraine deposits of the Ostrava area, Moravská brána Gate and Frýdlant spur, 11 - Alluvial sediments of large rivers.

numerous rock outcrops providing suitable habitats for the vegetation of "rock steppes" (phytocoenoses of *Festuca pallens* and *Aurinia saxatilis*, *Dictamnus albus*, relict stands of *Saxifraga rosacea* etc.). In the Šumava (Bohemian Forest) and Brdy Mts. large ridges separated by open valleys predominate (in contrast to the Sudetes). Several glacial corries in the Šumava and Krkonoše provide very important habitats for a number of glacial relics.

The relief is strongly influenced by the mode of deposition of particular geological units. Folded rocks generally form hilly relief, whereas horizontal deposits are characterized by plateaus at various levels, deeply incised valleys, escarpments and large flat areas. Such relief is widespread on near-horizontal Upper Cretaceous rocks of the Bohemian Massif. The thick-bedded sandstones ("Ashlar", "Quadersandstein") form a unique relief with a dense network of narrow canyons, locally forming the so-called "rock cities" whose best known example is represented by the area of the Labské pískovce (Elbsandsteingebirge, Elbe Sandstones).

Other pronounced elements of the Bohemian landscape are the Upper Tertiary vulcanites forming typical mountains in the NW and N of Bohemia. The České středohoří Uplands are characterized by a number of basalt and trachyte conic or dome-shaped hills, while the Doupovské hory Mts. consist of basalt lava plateaus and superficial pyroclastic deposits. The karstlands have characteristically diverse habitats with canyons, chasms, lapiés and numerous bare rock outcrops as well as dry valleys.

River terraces are typical on the flat relief of the lowlands and basins, as are also sand dunes and river meanders with oxbows at various stages of development. The fluvial and eolian sands are characterized by dry and acidic arenic soils covered by unique psammophilous vegetation.

The major geomorphological units of the Czech Republic are indicated in Fig. 2.

Soils

In view of the wide variety of geological substrates (see Fig. 1) and landforms as well as the long-term human impact in certain areas the soil cover of the Czech lands shows a high degree of diversity. The most frequent soil types from the planar to the montane belts are various types of brown forest soils. In warmer areas at lower elevations a number of varieties of cambisols occur, depending on the mineral content of the substrates. On the basalts of N and NW Bohemia eutrophic cambisols are typical; on terraces and eolian sands in the lowlands arenic cambisols occur and at lower, warmer and drier levels, cambisols are replaced by luvisols and brown earths on eolian loams, particularly on calcareous loess. At higher elevations acidic cambisols prevail with dystric cambisols and cambisol podsols nearer the summits. The last are characteristic of the supramontane belt with natural spruce forests where they grade into typical montane podsols nearer the summits. On sandy substrates at lower elevations, particularly in the Ralsko area and in the Protected Landscape Area of the Labské pískovce in N Bohemia, arenic podsols have developed. Most peat bogs are also situated in areas of podsolic soils, particularly in the montane and supramontane belts of the Český les, Krušné hory and Krkonoše Mts.

In warm, dry areas at lowland to colline levels, chernozems, typically developed on loess, dominate. In moister marginal parts of the chernozem areas they grade into decalcified phaeozems. On lime-rich Cretaceous substrates in the broad valleys of the Ohře and Elbe rivers pararendzinas have developed, and in places with a hydric regime, hydromolisols. Typical rendzinas are limited to the limestones of karst areas where they grade into relict soils of a terra fusca type occurring on the plateaus.

In the floodplains of the larger streams alluvial soils (fluvisols) predominate. Gleys are frequent in valley-bottoms and in certain basins, especially in S Bohemia. On heavy loams and clays pseudogley soils have developed. Their formation is controlled by permeating rainwater during moist phases. Pseudogleyed luvisols are widespread around the city of Ostrava.

Of prime importance from the botanical viewpoint are shallow humic soils (rankers and regosols) on non-calcareous substrates. They occur on rocky slopes in warm river canyons as well as on neovolcanic hills. Their poor acidic varieties have developed on quartzites, siliceous conglomerates, lydites and certain types of slates, whereas on basic rocks, particularly on basalts, diabases and spilites, nutrient-rich rankers occur, which locally even grade into calcareous humic soils of pararendzina character. These are characterized by calciphilous vegetation ("*Seslerieta*" with *Saxifraga paniculata* in the Berounka and lower Vltava valleys). A unique variety of shallow humic ranker soils on serpentine rocks provides the only suitable habitat for a number of species occurring exclusively on this type of substrate (*Asplenium cuneifolium*, *Cerastium alsinifolium*, *Minuartia smejkalii*).

Climate

The climate of the Czech Republic is characterized by the following data based on long-term measurements: mean annual temperature in the warmest parts of S Moravia and Central Bohemian lowlands, as well as in the centre of Prague ≥9°C; in the coldest areas of the N Bohemian and N Moravian mountains > 0°C (Sněžka Mt. in the Krkonoše Mts. 0.2°C, Praděd Mt. in the Hrubý Jeseník Mts. 0.9°C). The lowest mean monthly temperature (January, February) recorded is -11° to -14.6°C in 1942, frequently with absolute minimum < -35°C. The mean number of summer days/year (max. temperature ≥25°C) in the warmest lowlands of Bohemia ≥50, in S Moravia ≥60, at highest montane levels = 0. The mean number of frost days/year (minimum temperature ≤-0.1°C) varies between ≤100 in the lowlands and ≥ 180 in the highest mountains; the mean number of ice days/year (maximum temperature ≤ -0.1°C) ≤ 30 in the lowlands and ≥ 100 at high-montane levels.

The mean annual precipitation varies between c. 450 mm in the rain shadow of the Krušné hory Mts. (surroundings of the town of Žatec) and c. 1600 mm at the highest levels (see Vesecký *et al.*, 1958, 1961).

Based on climatic differences, three climatic regions can be distinguished in the Czech Republic (Quitt, 1971):

1) The warm region (W) at the lowest and driest levels, with two subunits - W4 with a very long, very warm, dry summer, with a warm spring and autumn, and a short, moderately warm and (very)dry winter with a very short snow cover; and W2, with a shorter, less warm and less dry summer and with a (moderately) warm spring and autumn. In the subregion W4, covering the warmest part of the S Moravian Pannonicum, Pannonian vegetation is typical: *Fraxino pannonicae-Ulmetum*, *Fraxino-Populetum*, *Primulo veris-Carpinetum*, *Pruno mahaleb-Quercetum pubescentis*, *Quercetum pubescenti-roboris*, *Carici fritschii-Quercetum*. In the subregion W2, the *Lathyro pannonici-Quercetum pubescentis*, the subacidophilous thermophilous oak woodlands (*Potentillo albae-Quercetum*, *Sorbo torminalis-Quercetum*) are mapped as well as most alluvial woodlands of large river valleys in Bohemia and Central Moravia (*Querco-Populetum*, *Querco-Ulmetum*), and most of the *Melampyro-Carpinetum* (see Fig. 3).

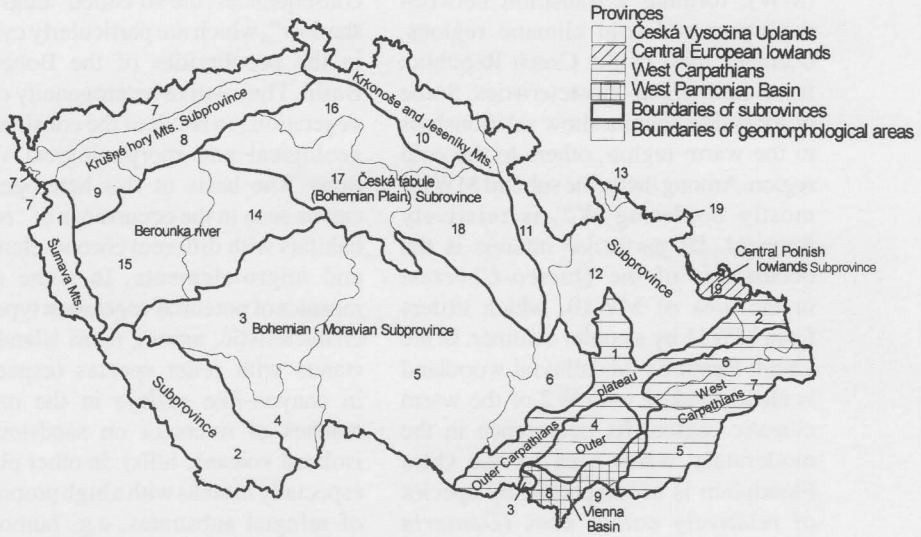

Fig. 2 — Higher geomorphological units of the Czech Republic: **Česká vysočina Uplands Province**: Šumava Mts. Subprovince: Geomorphological areas: 1. Český les Mts. and foothills, 2. Šumava Mts. and foothills, Novohradské hory Mts. and foothills. Bohemian-Moravian Subprovince: 3. Středočeská (Central Bohemian) Uplands, 4. S Bohemian (Českobudějovická and Třeboňská) Basins, 5. Českomoravská (Bohemian-Moravian) Uplands (incl. Železné hory Mts.), 6. Brněnská Uplands. Krušné hory Mts. Subprovince: 7. Krušné hory Mts., 8. Krušné hory foothills (Cheb Basin, Doupovské hory Mts., České středohoří Uplands), 9. Karlovarská vrchovina (incl. Slavkovský les) Uplands. Krkonoše and Jeseníky Mts. Subprovince: 10. Krkonoše Mts. (incl. Lužické and Jizerské hory Mts. and Ještědsko-kozákovský hřbet), 11. Orlické hory Mts. and foothills (incl. Broumovská vrchovina Uplands), 12. Jeseníky Mts. (incl. Králický Sněžník and Rychlebské hory Mts.), 13. Krkonoše and Jeseníky foothills. Subprovince of the Berounka river: 14. Brdy Mts. (incl. Křivoklátská vrchovina and Džbán Uplands and Prague plateau), 15. Plzeňská pahorkatina Hills and Uplands. Česká tabule Subprovince: 16. Severočeská tabule (N Bohemian) Plain (incl. Ralská pahorkatina Uplands), 17. Středolabská tabule (Central Bohemian) Plain (Dolnooharská, Jizerská and Středolabská tabule Plains), 18. Východočeská tabule (E Bohemian) Plain (incl. Východolabská and Orlická tabule Plains). **Central European lowlands Province**: Central Polnish lowlands Suprovince: 19. Slezská nížina (Silesian lowlands). **West Carpathians Province:** Outer Carpathians Plateau Subprovince: 1. Western (incl. Hornomoravský úval Valley) and 2. Northern Outer Carpathians Plateau. Outer West Carpathians Subprovince: 3. S Moravian Carpathians, 4. Středomoravské Karpaty (Central Moravian Carpathians), (incl. Ždánický les and Chřiby Mts.) 5. Slovak-Moravian Carpathians (incl. Bílé Karpaty and Javorníky Mts.), 6. W Beskydy foothills, 7. Západní Beskydy (W Beskydy Mts.), (incl. Moravskoslezské Beskydy Mts.). **West Pannonian Basin Province**: Vídeňská pánev (Vienna Basin) Subprovince: 8. Jihomoravská (S Moravian) Basin (Dolnomoravský úval Valley), 9. Záhorská nížina Lowland.

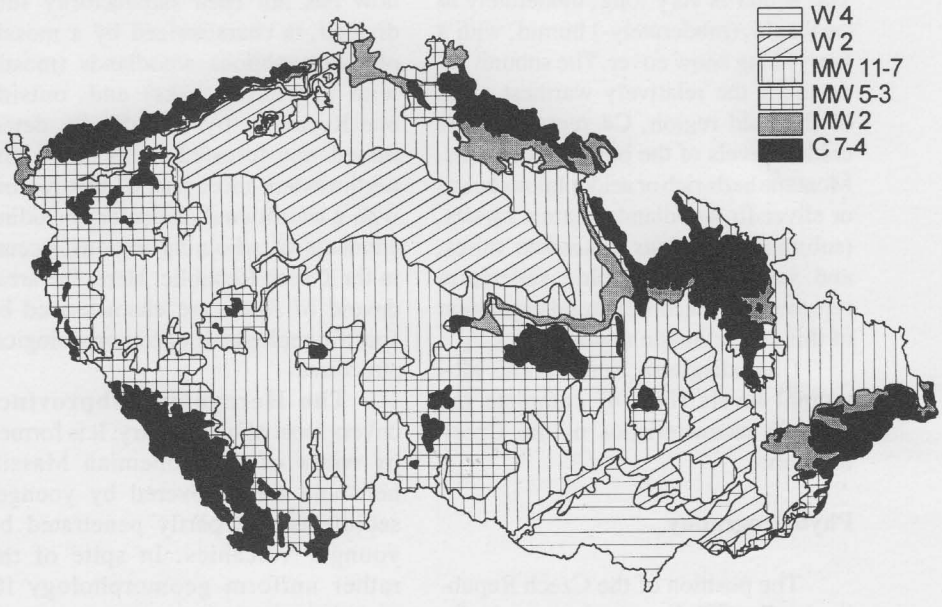

Fig. 3 — Climatic regions of the Czech Republic (Quitt 1971, simplified).

2) The moderately warm region (MW), forming a transition between the warm and cold climatic regions, occupies most of the Czech Republic. It has no marked characteristics. Some of its eight subunits show relationships to the warm region, others to the cold region. Among them, the subunit MW11, mostly bordering W2, is relatively frequent. Of particular interest is the occurrence of the *Querco-Ulmetum* in the area of MW10, which differs from MW11 by a cooler summer. In the Czech Republic this alluvial woodland is clearly linked with W2 of the warm climatic region. Its occurrence in the moderately warm area of the Odra Floodplain is accompanied by species of relatively colder sites (*Dentaria glandulosa*, *Ranunculus lanuginosus* etc.). The levels of MW11-7 correspond more or less to the oak altitudinal belt. In MW5-3, characterized by a short, moderate to moderately-cold and moderately-dry summer, with a moderate spring and autumn, and with a "normally long" winter (see Quitt, 1971), relatively cold types of acidophilous oak- or oak-hornbeam woodlands and submontane beech woodlands can be found. The coldest areas of the MW region, occupied by MW2, with humid summers and high annual precipitation, are covered by various types of acidophilous or herb-rich beech woodlands.

3) To the cold climatic region (C) belong mostly montane to alpine levels of the Czech and Moravian mountains. This region, with three subunits, is characterized by a very short to short, (moderately-) cold and humid summer, (moderately) cold spring and autumn. The winter is very long, moderately to very cold, (moderately-) humid, with a (very) long snow cover. The subunit C7 occupies the relatively warmest areas of the cold region, C4 represents the coldest levels of the border mountains. Montane herb-rich or acidophilous beech or silver-fir woodlands, spruce forests, (sub)montane *Pinus rotundata* mires, and subalpine and alpine vegetation represent the potential natural vegetation of this cold climatic region.

Climadiagrams from various altitudinal levels (Fig. 4) complete the climatic characteristics of the Czech Republic.

Phytogeography

The position of the Czech Republic in Central Europe has markedly influenced the post-glacial development of the vegetation. Its situation north of the Alps has certain chorological consequences, the so-called "migration shadow", which are particularly evident in the peculiarities of the Bohemian Basin. The relative heterogeneity of our vegetation is a result of the considerable geological and morphological variations. The basis of this heterogeneity can be seen in the occurrence of "relict" habitats with different chrono-elements and migro-elements. In some areas mosaics of potential vegetation types are characteristic, among them island-like stands with relict species (especially in canyon-like valleys in the middle reaches of rivers or on sandstone or isolated volcanic hills). In other places, especially in areas with a high proportion of refugial substrates, e.g. humolites, karstic limestones, serpentines or sands, large areas of relict vegetation have developed.

Four phytogeographical subprovinces can be distinguished in the Czech Republic, all of which extend also into the neighbouring states. Only one of them, the Hercynian subprovince, occurs here with all theoretically possible vegetation altitudinal belts. The three remaining subprovinces occur only on the margins of the Republic and therefore many vegetation types of these units are absent within the state.

The Hercynian, West Carpathian and Polonian subprovinces belonging to the Central European region are characterised by the complete range of vegetation altitudinal belts and by the predominance of oak and beech woodlands. The Pannonian subprovince belongs to the separate Pontic-S Siberian Region.

This last region, which until now has not been satisfactorily subdivided, is characterized by a mosaic of thermophilous woodlands (mostly with prevailing oaks) and, outside our Republic, by climatically determined non-forested areas. Only the northwestern-most part of this region, with a transitional character, including elements of adjoining regions, occurs in the Czech Republic. Here, the areas devoid of forest are characterized by specific geological or geomorphological structures.

The Hercynian subprovince covers most of our country. It is formed by rocks of the Bohemian Massif, here and there covered by younger sediments and partly penetrated by younger volcanics. In spite of the rather uniform geomorphology its varied geological structure creates a pronounced vegetation mosaic. On the lowest sites thermophilous oak woodlands occur, the largest areas being covered by communities of the *Quercion petraeae* (principally the *Potentillo albae-Quercetum*, accompanied in the warmest areas by the *Quercion pubescenti-petraeae* communities, with many sub-Mediterranean elements). Of the oak-hornbeam woodlands, the *Melampyro nemorosi-Carpinetum* occupies large areas but this association is absent in the southern part of Bohemia, being replaced by the endemic *Stellario-Tilietum*, which is differentiated by the absence of *Carpinus betulus* and *Quercus petraea*. Locally, on plains in Central and E Bohemia with light to medium-heavy, occasionally gleyed, soils on relatively mineral-rich impermeable substrates, *Tilio-Betuletum* occurs. All *Carpinion* communities have a well-balanced mixture of Central-European and Eurasiatic species. In contrast, on sites with mostly light, sandy and nutrient-poor soils, acidophilous oak woodlands occur, partly also oak-pine stands with frequent Eurasiatic, boreo-continental species.

At higher altitudes, on nutrient-rich substrates herb-rich beech woodlands of the *Eu-Fagenion* suball. are typical, mainly the *Dentario enneaphylli-Fagetum*. On mineral-poor substrates, they are replaced by acidophilous beech and fir communities (*Luzulo-Fagion*). The *Luzulo-Fagetum* is potentially an extensive community, the *Luzulo pilosae-Abietetum* and *Deschampsio flexuosae-Abietetum* occur locally. Herb-rich fir forests (*Galio-Abietenion*), formerly typical in some areas, are now very rare. Higher levels are covered by *Calamagrostio villosae-Fagetum*. Here also the proportion of Central European and Eurasiatic species is more or less the same but widely distributed species are more frequent in acidophilous woodland.

Areas subject to flooding are occupied by alluvial woodlands but their phytogeographical importance is less than that of oak-hornbeam and beech woodlands. In some basins or large valleys (E and S Bohemia) alder carrs of the *Alnion glutinosae* are frequent.

At the highest levels the potential vegetation is formed by spruce forests of the *Piceion excelsae* or the *Athyrio alpestris-Piceion* but these units only cover relatively small areas. Natural spruce stands also occur at lower levels in waterlogged habitats, mostly adjoining acidophilous beech woodlands (*Calamagrostio villosae-Fagetum*, *Luzulo-Fagetum*).

Scree and ravine forests only cover small areas (at lower levels *Tilio-*

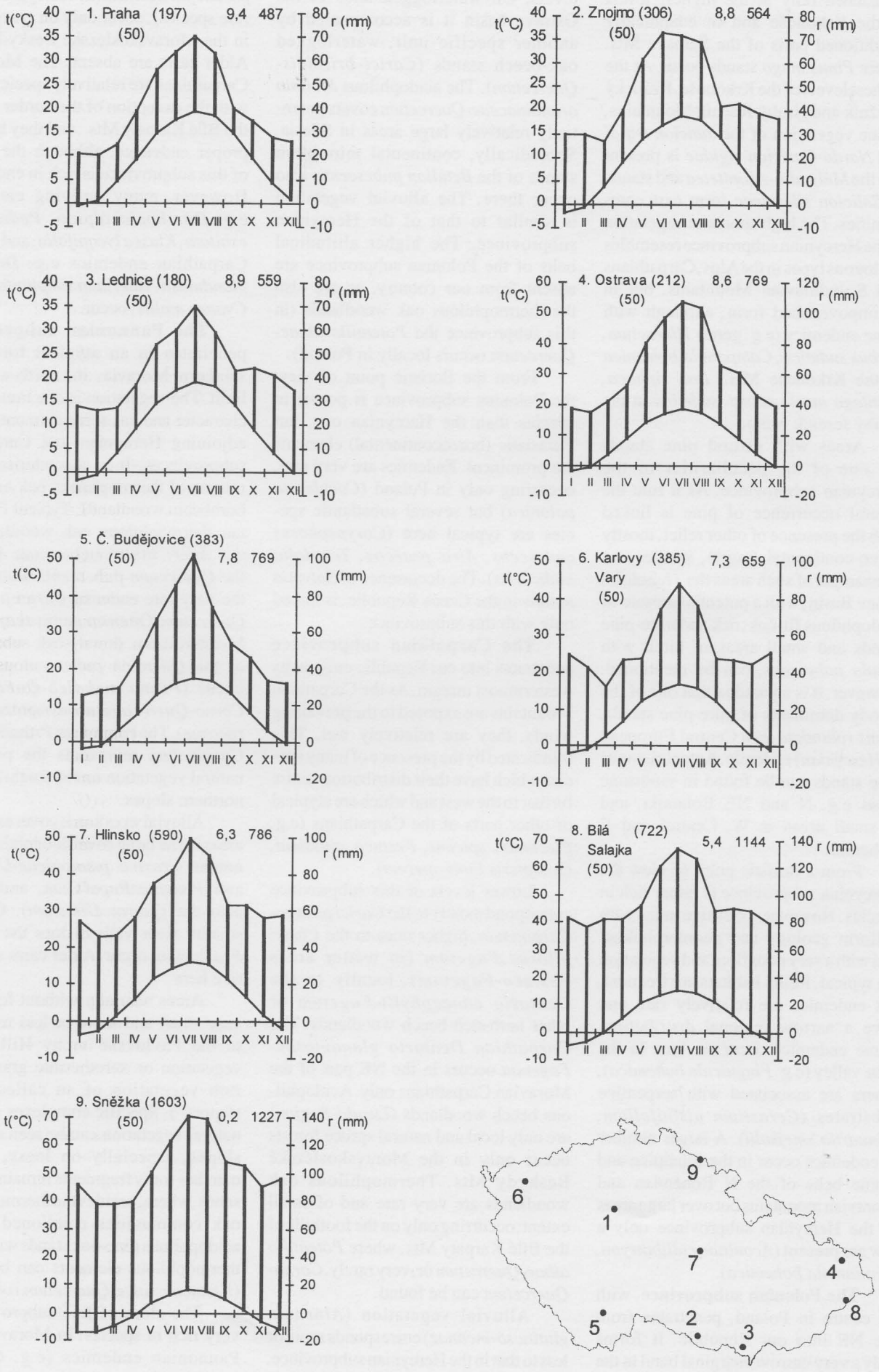

Fig. 4 – Climadiagrams of selected stations at different altitudinal belts: 1-3 = warm region (W), 4-6 = moderately warm region (MW), 7-9 = cold region (C). Nr. 1-9 on the map - climatic stations.

Acerion communities, at montane levels *Acerenion* units). The upper timberline is reached only at the highest levels of the Krkonoše and in edaphically conditioned parts of the Šumava Mts. where *Pinus mugo* stands occur. At the highest levels of the Krkonoše, Králický Sněžník and Hrubý Jeseník Mountains, alpine vegetation of the *Juncion trifidi* and *Nardo-Caricion rigidae* is present and the *Mulgedio-Aconitetea* and stands of *Salicion silesiacae* form carr communities. The high-montane vegetation of the Hercynian subprovince resembles analogous types in the Alps, Carpathians and Scandinavian Mountains, but in an impoverished form, although with some endemics (e.g. genus *Hieracium*, *Sorbus sudetica*, *Campanula bohemica* in the Krkonoše Mts., *Poa riphaea*, *Plantago atrata* subsp. *sudetica* in the Hrubý Jeseník Mts.).

Areas with natural pine stands are one of the peculiarities of the Hercynian subprovince. As a rule the natural occurrence of pine is linked with the presence of other relict, mostly boreo-continental (taiga), species. As an example of such areas the Třeboňská pánev Basin, with a potential mosaic of acidophilous fir-oak, oak and mire-pine stands and small areas of birch with *Betula pubescens*, can be mentioned. However, it is a paradox that one of the woody dominants of mire-pine stands, *Pinus rotundata*, is a Central European (= *Hercynian*) endemic. Autochthonous pine stands can be found in sandstone areas e.g. N and NE Bohemia, and in small areas in W, Central and E Bohemia.

From a floristic point of view the Hercynian subprovince is rather rich in species. However, extensive areas with uniform geology and geomorphology and with a very poor flora and vegetation are typical. Relict habitats are frequent, but endemics are relatively rare and have a narrow regional distribution. Some endemics occur on fens in the Elbe valley (e.g. *Pinguicula bohemica*), others are associated with serpentine substrates (*Cerastium alsinifolium*, *Minuartia smejkalii*). A larger number of endemics occur in the subalpine and alpine belts of the N Bohemian and Moravian mountains but over large areas of the Hercynian subprovince only a few are present (*Aconitum callibotryon*, *Gentianella bohemica*).

The Polonian subprovince, with its centre in Poland, penetrates from the NE into our Republic. It forms only a very narrow, marginal band in the Silesian Plain, the surroundings of Opava and Ostrava and the Odra Floodplain. In the Czech Republic it is characterised by a typical *Tilio-Carpinetum* at lower levels. On waterlogged sites in the Ostrava basin it is accompanied by another specific unit, waterlogged oak-beech stands (*Carici brizoidis-Quercetum*). The acidophilous *Molinio arundinaceae-Quercetum* covers potentially relatively large areas in Silesia. Sporadically, continental mire-birch stands of the *Betulion pubescentis* also occur there. The alluvial vegetation is similar to that of the Hercynian subprovince. The higher altitudinal belts of the Polonian subprovince are absent from our country, as are also the thermophilous oak woodlands (in this subprovince the *Potentillo albae-Quercetum* occurs locally in Poland).

From the floristic point of view the Polonian subprovince is poorer in species than the Hercynian one, but Eurasiatic (boreocontinental) elements are prominent. Endemics are very rare, occurring only in Poland (*Cochlearia polonica*) but several subatlantic species are typical here (*Corynephorus canescens*, *Aira praecox*, *Teesdalia nudicaulis*). The occurrence of *Salvinia natans* in the Czech Republic, is linked only with this subprovince.

The Carpathian subprovince penetrates into our Republic only on its westernmost margin. As the Carpathian Mountains are exposed to the prevailing winds, they are relatively wet. This is indicated by the presence of many species which have their distribution centre further to the west and which are atypical of other parts of the Carpathians (e.g. *Blechnum spicant*, *Festuca altissima*, *Oreopteris limbosperma*).

Lower levels of this subprovince correspond mostly to the *Carici pilosae-Carpinetum*, higher ones to the *Carici pilosae-Fagetum* (in wetter areas *Festuco-Fagetum*), locally to the *Dentario enneaphylli-Fagetum* or other herb-rich beech woodlands. The *Carpathian Dentario glandulosae-Fagetum* occurs in the NE part of the Moravian Carpathians only. Acidophilous beech woodlands (*Luzulo-Fagion*) are only local and natural spruce forests occur only in the Moravskoslezské Beskydy Mts. Thermophilous oak woodlands are very rare and of small extent, occurring only on the foothills of the Bílé Karpaty Mts. where *Potentillo albae-Quercetum* or, very rarely, *Corno-Quercetum* can be found.

Alluvial vegetation (*Alnenion glutinoso-incanae*) corresponds more or less to that in the Hercynian subprovince. Willow woodlands of the *Salicion elaeagno-daphnoidis*, accompanied by *Phalaridion arundinaceae* communities dominated by *Calamagrostis pseudophragmites* (in Hercynia a very rare species), occur only on gravel soils in the Moravskoslezské Beskydy Mts. Alder carrs are absent. The Moravian Carpathians are relatively species-poor, with the exception of the border area of the Bílé Karpaty Mts., and they have no proper endemics, although the centre of this subprovince is rich in endemics. However, many outlying elements, e.g. *Danthonia alpina*, *Pedicularis exaltata*, *Klasea lycopifolia*, and typical Carpathian endemics e.g. *Dentaria glandulosa*, *Valeriana simplicifolia* and *Cyanus mollis*, occur.

The Pannonian subprovince penetrates in an atypical form into southern Moravia, its north-westerly limit. The vegetation is of a transitional character and has some elements of the adjoining Hercynian and Carpathian subprovinces. It is characterised by a mosaic of thermophilous oak and oak-hornbeam woodlands. Typical Pannonian thermophilous oak woodlands of the *Aceri tatarici-Quercion* include the *Quercetum pubescenti-roboris* and the very rare endemic *Carici fritschii-Quercetum*. On steep, sunny slopes, sub-Mediterranean downy-oak woodlands of the *Quercion pubescenti-petraeae* occur (*Pruno mahaleb-Quercetum*, *Corno-Quercetum euonymetosum verrucosae*). The Pannonian *Primulo veris-Carpinetum* represents the potential natural vegetation on the foothills or on northern slopes.

Alluvial woodlands cover extensive areas in the large river floodplains (Pannonian *Fraxino pannonicae-Ulmetum* and *Fraxino-Populetum*, and partly also the *Querco-Ulmetum*). Only in smaller river valleys does the *Pruno-Fraxinetum* occur. Alder carrs are very rare here.

Areas naturally without forest are very small and more or less restricted to the Pavlovské vrchy Hills (rock vegetation or xerothermic grass-herb-rich vegetation of so called "rock steppes"). Specific complexes of near-natural vegetation can be seen on steep slopes, especially on loess, in salt marshes (only fragments remain) and on sands, where, besides the thermophilous oak communities mentioned above, acidophilous pine-oak stands with many thermophilous elements can be found (*Festuco ovinae-Quercetum roboris*).

The flora of this subprovince is very rich in species. In Moravia some Pannonian endemics (e.g. *Cirsium brachycephalum*) can be seen. W Pannonian endemics are very rare (e.g.

Artemisia pancicii subsp. *austriaca*, *Festuca dominii*), but many Pontic-Pannonian to S Siberian species are common, e.g. *Crambe tataria*, *Hypericum elegans*, *Taraxacum serotinum*, *Iris pumila*, *Amygdalus nana*, *Kochia prostrata*, *Phlomis tuberosa*, *Orobanche caesia*, *Crepis pannonica*, locally also Perialpidic species, e.g. *Arenaria grandiflora*, *Daphne cneorum*, *Sesleria albicans*, *Minuartia setacea* etc.

Land use

Of the total area of the Czech Republic, agricultural land occupies more than 55%, of which more than 75% is arable land and more than 19% are pastures and meadows. Forest soils cover 33.2%. The main agricultural areas are concentrated in the large river valleys along the rivers Elbe, Morava and Dyje.

On arable land, wheat, barley, maize, sugarbeat, rape (at lower levels), potatoes, flax, beans, peas, rye, oats (at higher level), fodder crops, and in the surroundings of Žatec also hops, are the most frequent agricultural products. Vegetables (cabbages, carrots, tomatoes, onions, cucumbers) and orchards of apple-, pear-, plum-, walnut- and cherry-trees, and, in the warmest areas, apricots are planted, too. Vineyards are concentrated in the warmest areas (S Moravia, S slopes of the České středohoří Uplands).

Nature conservation

In the Czech Republic nature conservation has a long tradition. The first protected areas - the second oldest in Europe - were established in 1838 (Žofín and Hojná Voda primeval forests in the Novohradské hory Mts., S Bohemia). This was followed in 1858 by the establishment of the Boubín primeval forest (Šumava Mts., SW Bohemia) as a reserve.

At present, six categories of protected areas are distinguished: National Parks, Protected Landscape Areas, National Nature Reserves, Nature Reserves, National Natural Monuments and Natural Monuments (see Kos et Maršáková 1993, 1997).

National Parks (further NP) represent large areas of national and/or international scientific or educational importance, with mostly natural ecosystems.

Protected Landscape Areas (PLA) are large areas with a harmonious landscape and characteristic relief, important stands of natural forest and meadow ecosystems and historical monuments. Their final appearance is a result of the influence of natural factors and human activity. They represent the most typical parts of a landscape.

National Nature Reserves (NNR) are smaller areas with exceptional natural values, with nationally or internationally important and unique ecosystems.

Nature Reserves (NR) are smaller areas analogous to the foregoing, but with regional importance only.

National Natural Monuments (NNM) are small areas where only one element is protected, e.g. an important geological phenomenon, geomorphological form, endangered plants or animals of national or international importance.

Natural Monuments (NM) are small areas analogous to the foregoing, but with regional importance only.

The number of protected areas has risen markedly in the last two decades. Up to the end of 1996 3 National Parks (covering 1.41% of the total area of the Republic), 24 Protected Landscape Areas (13.22%) and 1757 protected small areas (1.05%) have been registered.

Methods

The phytosociological research of the vegetation was conducted according to the principles of the Zürich-Montpellier approach (Braun-Blanquet 1964). The Map of Potential Natural Vegetation was compiled according to the method proposed by Tüxen (1956) and refined by other authors (Trautmann 1966, Neuhäusl 1975b, 1994, Kowarik 1987, Härdtle 1995 etc). The mapping units were based on the floristic-phytosociological differentiation of the vegetation units (Braun-Blanquet 1964, Moravec *et al.* 1994, 1995). They represent individual associations or their groups; only in special cases do they represent complexes of higher syntaxa (e.g. mires, alpine and subalpine vegetation). The units represent natural, stabilized plant communities (climax vegetation), reflecting present-day natural habitat conditions or conditions which have been irreversibly changed by human activities.

Remnants of natural or near-natural vegetation associated with certain habitat conditions formed the basis for the compilation of the map. The potential natural vegetation was then mapped in areas where it is now absent by extrapolation on the basis of analogous altitude, relief, geology, pedology, climate and hydrology. Correlations between the natural vegetation and its anthropogenic derivatives were used (e.g. the occurrence of subcontinental to continental flooded meadows of the alliances *Cnidion venosi* and *Veronico longifoliae-Lysimachion vulgaris* indicate the sites of Pannonian floodplain woodlands - *Fraxino pannonicae-Ulmetum*, *Fraxino-Populetum*, etc.). In deforested areas the occurrence of scattered woody species in the landscape served as indicators of the natural vegetation, e.g. lanes or orchards with well-growing *Juglans regia*, *Cerasus avium* or *Tilia* species indicate sites of oak-hornbeam or lime-oak woodlands, but not acidophilous oak woodlands.

The Map of Reconstructed Natural Vegetation, at a scale of 1:200000, compiled between 1947 and the early 1960s (Mikyška 1968, 1968-1972), which used similar principles of habitat analogy, was a valuable aid for the compilation of the Map of Potential Natural Vegetation. However, it was necessary to pay attention to irreversible changes of habitat resulting from human activity, which are not taken into account in the compilation of the Map of Reconstructed Natural Vegetation.

A generalisation of the latter maps provided a rough draught for a revision based on field work, data in the literature, and geological, pedological and physical-geomorphological maps. This revision, together with a thorough analyses of all phytosociological maps and studies, both published or in manuscript form, provided the basis for the compilation of the Map of Potential Natural Vegetation. The Map of Reconstructed Vegetation has 19 mapping units, whereas the Map of Potential Natural Vegetation contains 50 units of the potential natural vegetation and 1 unit of areas strongly influenced by human activity.

The names of the syntaxa correspond to those of Moravec *et al.* (1995), those of mire communities follow the paper by Rybníček *et al.* (1984), the names of taxa the proposal of Holub (1982 - vascular plants), Liška (1982 - *Lichenes*) and Zittová, Váňa et Herben (1982 - Bryophyta). The classification of soils follows the proposals of Novák *et al.* (1991-1993) or Mückenhausen (1959), that of the higher geomorphological units of the Czech Republic those of Demek *et al.* (1987).

VEGETATION DEVELOPMENT OF THE CZECH REPUBLIC IN THE LAST 15000 YEARS

Our present vegetation is a result of its long-term development which began in the far distant geological past following the evolution of the first primitive plants. However, the critical time span for an understanding of the present state of the flora and vegetation covers the last 15000-12000 years only. Around the middle of this period human interference, combined with natural environmental factors, started to be at least of the same importance as, for example, short-term climatic oscillations.

This survey is based on the results of pollen, macroscopic and other palaeoecological analyses which have already been summarized by Rybníčková (1985), Rybníček and Rybníčková (1994, 1998) and Rybníčková and Rybníček (1996).

Simplified palaeovegetational maps show the succession and changes of palaeovegetation types during the last 15000 years. Their description follows two major altitudinal levels of our country. The lowlands and neighbouring hills up to about 400 (-500) m represent one developmental entity; the submontane and montane regions form the second one. Though our conclusions principally concern the development of natural vegetation, anthropic influences are also discussed and we believe that these findings could lead to a reassessment of the traditional principles of constructing the potentional natural vegetation.

Late Glacial (late Weichselian), 15000 -10000 B.P.

This was a complex period of rapid climatic oscillations between cold and dry (Dryas zones DR1, DR2, DR3) and comparatively mild and humid (Bölling, BÖ and Alleröd, AL) periods. For the vegetation of the period 11000-10500 B.P., see Fig. 5.

Current results allow us to reconstruct a loess- and/or rock-steppe vegetation with *Artemisia*, *Chenopodiaceae*, *Poaceae*, *Centaurea* spec.div., *Helianthemum* and other heliophilous plants in the lowlands. *Pinus sylvestris* (incl. *Pinus mugo* agg.?), *Betula pubescens* agg., *B. pendula*, *Populus* cf. *tremula*, *Juniperus* and possibly also *Picea abies* were the only trees present. Pollen of *Hippophae* and *Ephedra* are found regularly. The spread of birch and pine, which may have formed more or less compact stands of forest-steppe, probably occurred during the warmer periods of the BÖ and AL.

At higher elevations of the uplands and lower mountains krummholz vegetation of birch with pine and heliophilous herbs is reconstructed during the cold oscillations of the DR1-DR3. A dominance of pine is assumed in the warmer periods of the BÖ and AL. The summits of the Krkonoše, Jeseníky and Šumava Mts. were probably covered with dwarf-shrub tundra or arctic-alpine desert with lichens and mosses. However, there is no direct evidence for this hypothesis.

Alluvial sites, both in the lowlands and uplands, were covered with tall-herb communities of *Veratrum*, *Trollius*, *Filipendula*, *Polemonium*, *Petasites*, *Caltha* and *Cyperaceae* (mostly tall sedges). *Salix* seems to have been the only shrub present.

Preboreal (PB), 10000-9000 B.P. (Fig. 6)

The Preboreal is the first climatic-vegetation period of the current interglacial, the Holocene. It is characterized by a rapid increase of temperature after the last cold period, DR3. Nevertheless, the warming was not long enough to cause corresponding changes in the composition of the vegetation; only an increase in the extent, density and representation of existing forest-steppe stands occurred. Consequently, the extent of open steppe vegetation decreased. *Alnus* seems to be the only tree which spread newly in alluvial habitats.

Boreal (BO), 9000-7500 B.P. (Fig. 7)

A general increase of temperature and humidity continued during the second vegetation-climatic period of the Holocene.

Corylus avellana and species of *Quercus* and *Ulmus* spread into the country during this period. The loess steppes were replaced by forest stands of pine, birch and oak, in all cases with *Corylus avellana*. On alluvia we can reconstruct alder and willow stands, later with an admixture of oak.

Uplands and montane regions were covered with birch and pine forests with hazel and *Picea abies* started to spread above 500-600 m a.s.l. Krummholz pine-birch stands with *Corylus* grew at the highest elevations. Pine was probably represented by *Pinus mugo* agg. there.

Atlantic (AT), 7 500-4 500 B.P. (Fig. 8)

This, the so-called climatic optimum, was warmer and more humid than the present situation in Central Europe and was similar to that which we know from the oceanic parts of the Continent now. At least at the beginning, this period had the highest percentage cover of forest in the Holocene.

Mixed, mostly mesophilous, woodlands of *Quercus*, *Tilia*, *Ulmus* and *Corylus* covered the lower vegetation belts. It is probable that southern slopes would have been covered with thermophilous oak woodlands with a dense herb layer. Alluvial sites were covered with stands of hardwood floodplain forests with *Quercus* cf. *robur*, *Ulmus* cf. *laevis* and *Fraxinus excelsior*. Present palaeoecological data do not document any great extremes in the hydrological regime. Dense forests in the upper reaches of rivers eliminated great variations in flow and potential floods in our large river valleys.

Mixed montane forests with *Ulmus* (*glabra*), *Tilia* (*cordata*), *Fraxinus excelsior* and *Acer* (*pseudoplatanus*) can be reconstructed as a dominant type in the uplands. The succesive immigration of *Fagus sylvatica* and *Abies alba* has been documented. Spruce forests prevailed above about 800 m. Alder stands, in most cases with spruce, were common in the uplands and mountain valleys.

Sub-Boreal (SB), 4 500-2 500 B.P. (Fig. 9)

The climate of the period displayed several rather rapid oscillations between comparatively warm/humid and cold/dry periods. Because of the maximum spread of several hygrophilous trees (*Alnus glutinosa*, *Picea abies*) we assume a general prevalence of colder and more humid conditions.

Mixed mesophilous oak forests and thermophilous oak forests persisted in the lower parts of the country and on alluvia we can also reconstruct similar vegetation to that which occurred during the Atlantic period.

Mixed beech stands with *Fagus sylvatica*, *Abies alba* and *Picea abies* developed fully at the end of the period. The previous mixed deciduous mountain forests of *Ulmus*, *Tilia*, *Fraxinus* and *Acer* survived only under more extreme edaphic conditions (e.g. screes, steep stony slopes, etc.), and at present they represent something like Atlantic relicts. The mountain spruce forests reached their maximum extent and a continuous krummholz belt with *Pinus mugo* agg. covered the uppermost ridges. An open subalpine vegetation probably occurred only on extreme sites, e.g. rocks, avalanche slopes, etc.

Sub-Atlantic (SA), 2 500 B.P. to the present (Fig. 10)

The climate and natural soils were similar to those of the present; however, several warmer and colder climatic oscillations have been documented (e.g. "Little Climatic Optimum" during the medieval period and the "Little Ice Age" between ca. 1600-1850 A.D.).

The former mixed mesophilous oak forest was invaded by *Carpinus betulus* which was spreading westwards and the hornbeam-oak forests occupied the lower parts of the country. Thermophilous oak forests survived on the southern slopes of hills in the xerothermic regions of southern Moravia and Central Bohemia. Irregular and often catastrophic floods were caused by the successive deforestation of the uplands after their colonization and they changed previously meso-hygrophilous alluvial forests into hygro-hydrophilous forests similar to those which existed until recently.

Mixed hornbeam-oak forests also covered the lower parts of the uplands and mixed beech forest (*Fagus sylvatica*, *Abies alba*, *Picea abies*) of the *Eu-Fagion* developed and dominated the higher uplands and mountains.

The distinct belt between the hornbeam-oak and mixed beech forests was occupied by silver fir forests (*Abies alba*) with pine (on drier soils) or spruce (on humic pseudogley soils). The uppermost ridges of the Krkonoše and partly also the Šumava Mts. were covered by stands of *Pinus mugo* and other heliophilous types of subalpine vegetation. Mountain valleys were covered with *Alnus glutinosa* and/or *A. incana* with *Picea abies*.

Anthropic influences on the natural development of the vegetation

The first important anthropic influences on the previously more or less natural development of the vegetation date back to the middle Holocene (Atlantic). They are connected with the appearance of Neolithic agricultural settlements between about 7000 and 6500 years ago, which led to successive deforestation and transformation of the former woodland into a cultivated landscape. Grazing, including forest grazing, associated with the agricultural revolution, also had a major impact on the vegetation.

At the beginning of this anthropic era deforestation was not very extensive. Agricultural activities were limited to a few family and/or tribal settlements inside the forest complexes, where their members built houses, cultivated small

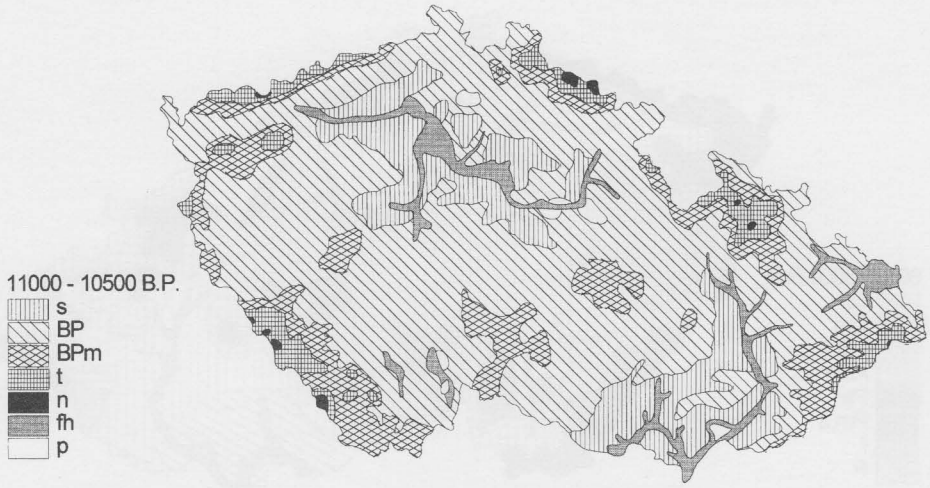

Fig. 5 – Palaeovegetation at the end of the Late Glacial: s - loess steppe, BP - open birch and pine forest, BPm - krummholz stands of (dwarf ?) pine and birch, t - mountain dwarf shrub tundra, n - nival vegetation, snow, glaciers, fh - tall-herb floodplain vegetation, p - open psammophytic vegetation.

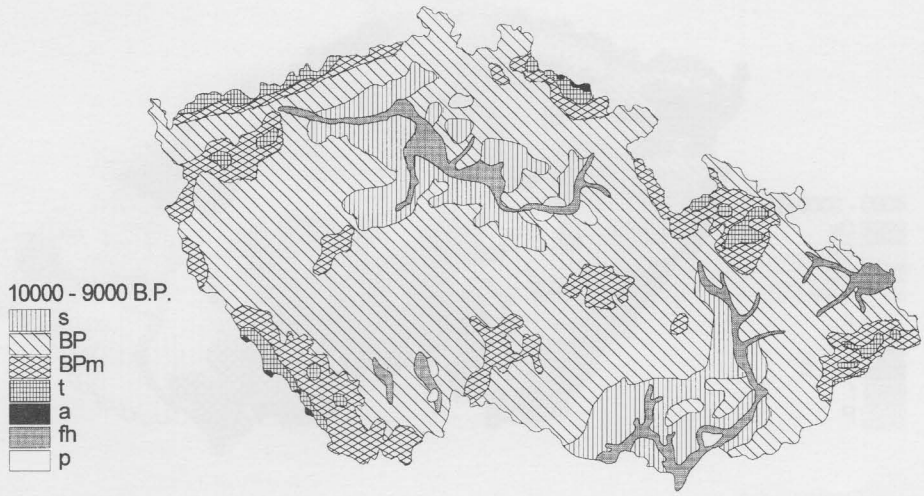

Fig. 6 – Palaeovegetation of the Preboreal: s - loess steppe, BP - open birch and pine forest, BPm - krummholz stands of (dwarf ?) pine and birch, t - mountain tundra, a - alpine vegetation, fh - tall-herb floodplain vegetation, p - open psammophytic vegetation.

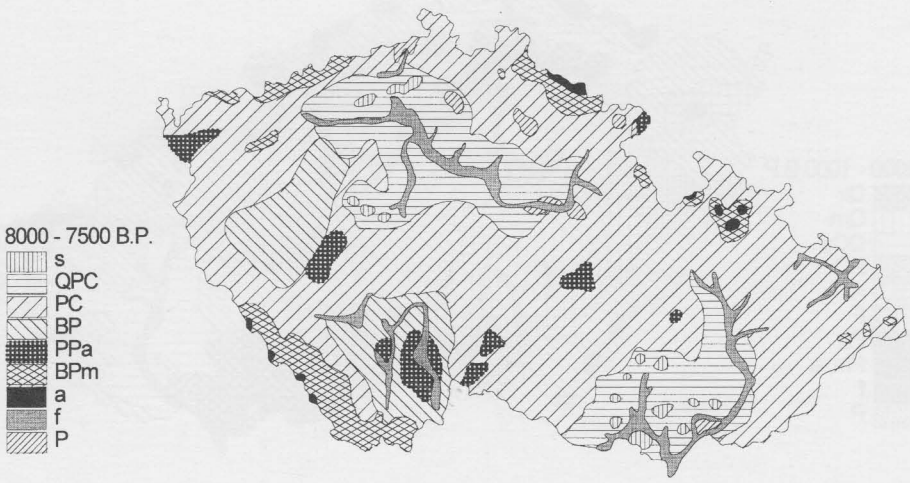

Fig. 7 – Palaeovegetation of the Boreal: s - relicts of loess steppe, QPC - mixed pine, oak and hazel forest, PC - pine and hazel forest, BP - birch and pine forest, PPa - pine and spruce forest with hazel, BPm - krummholz pine and birch stands with hazel, a - alpine vegetation, f - alder and willow floodplain forest, P - pine forest on sandstone.

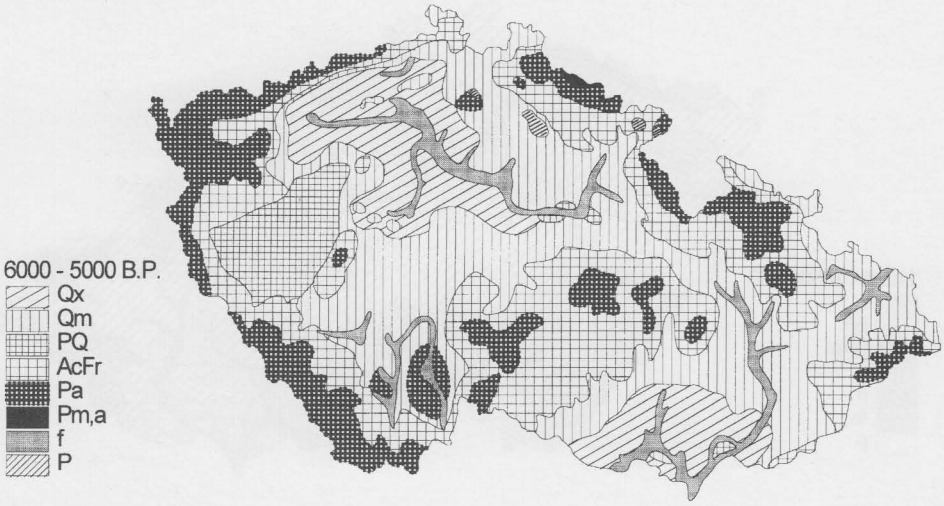

Fig. 8 – Palaeovegetation of the Atlantic: Qx - thermophilous oak forest, Qm - mesophilous mixed oak forest, PQ - pine and oak forest, AcFr - mixed deciduous mountain forest (elm, ash, lime, maple), Pa - spruce forest, Pm, a - subalpine and alpine vegetation, f - hardwood floodplain forest (oak, elm, ash), P - relict pine stands on sandstone rocks.

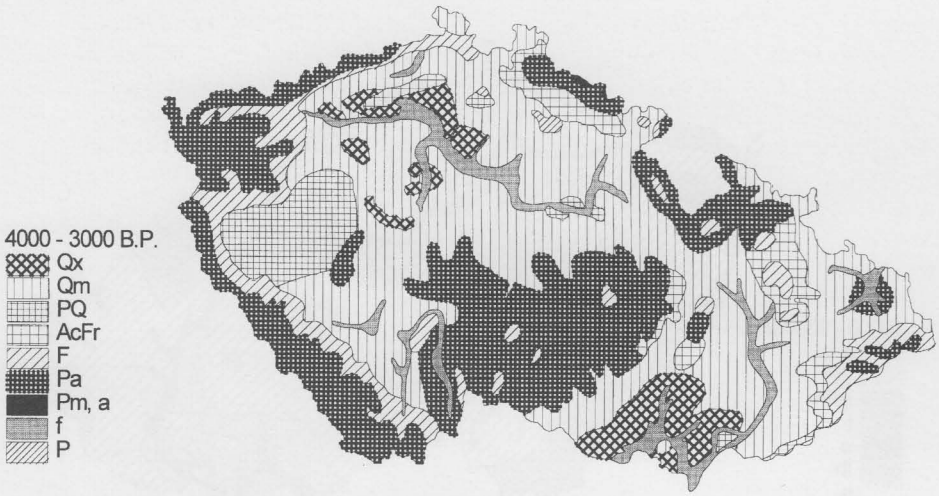

Fig. 9 – Palaeovegetation of the Sub-Boreal: Qx - thermophilous oak forest, Qm - mesophilous mixed oak forest, PQ - pine and oak forest, AcFr - mixed deciduous mountain forest (elm, ash, lime, maple), F - mixed beech forest (beech, fir, spruce), Pa - spruce forest, Pm, a - subalpine, alpine vegetation, f - hardwood floodplain forest, P - relict pine stands on sandstone rocks.

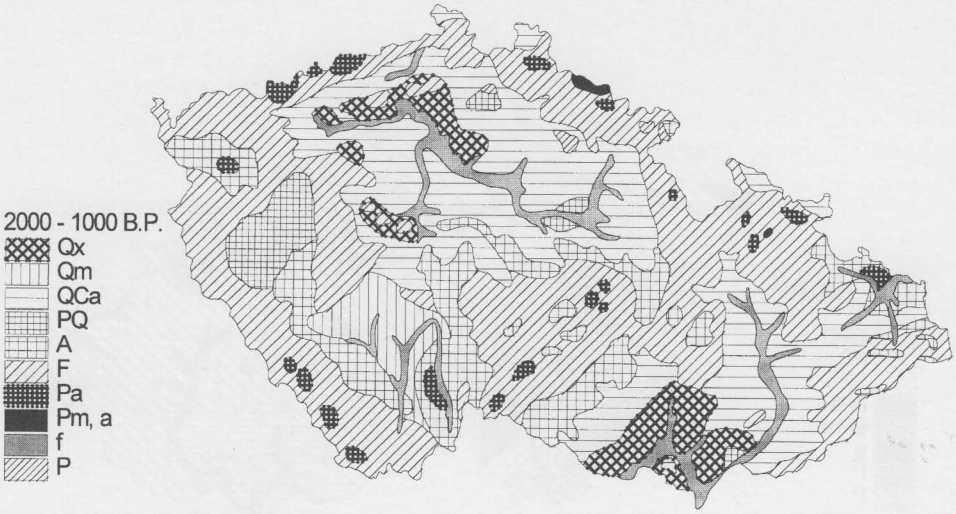

Fig. 10 – Palaeovegetation of the Sub-Atlantic: Qx - thermophilous oak forest, Qm - mesophilous mixed oak forest, QCa - hornbeam-oak forest, PQ - pine-oak forest, A - silver fir forest, F - mixed beech forest (beech, fir, spruce), Pa - spruce forest, Pm, a - subalpine and alpine vegetation, f - hardwood floodplain forest, P - relict pine forest on sandstone rocks.

fields and grazed domestic animals. Accepting this picture of early Neolithic human activity and taking into account the density of the population, the possible number of domestic animals and the technical ability of the Neolithic people, no great anthropic interference in the natural state of the vegetation could be expected.

Large-scale deforestation and stabilization of settlements first took place in the Bronze Age some 4000 years ago. At the same time colonization of the country impinged upon or spread into the uplands. Substitute anthropogenic communities of fields, meadows, pastures and also ruderal sites developed. Burning, mowing, ploughing and grazing retarded forest regeneration. General deforestation also caused several mesoclimatic changes which supported the secondary spread of xerothermic plants and xerothermic vegetation at lower altitudes. On the other hand, a general increase in humidity, waterlogging and even paludification took place in the uplands.

The process of deforestation which resulted in a secondary increase of about 100m in the limit between the oak and beech belts in our uplands, ceased during the Middle Ages. Use of beech timber for charcoal production and over-exploitation of coniferous trees for mining purposes were other negative human impacts on our vegetation in the Medieval Period. Selective cutting of beech and the better regenerative ability of spruce in the mountain region, in combination with the climatic deterioration of the "Little Ice Age", could have contributed to the formation of the present mountain spruce forests, between about 1100 and 1350 m, which we usually assume to be climax.

The building of fish-ponds caused the disappearance of several natural wetlands. On the other hand it promoted the secondary spread of aquatic, swamp and mire plants in and around these new secondary ecosystems.

Mountain vegetation, especially in the Krkonoše and Jeseníky Mts., was influenced by cattle and sheep grazing during the summer from about the 16th - 17th centuries onwards. The natural forest limit decreased and many former stands were converted into mountain meadows and/or pastures.

Forest grazing, 'harvesting' of forest litter and burning of secondary grasslands caused consequent changes in the trophy and physical qualities of the soils. Together with the introduction of monospecific forest plantations, it resulted in the general impoverishment

and acidification of the vegetation and the soil both in the lowlands and uplands.

The recent introduction of several exotic and expansive trees and herbs (e.g. *Robinia pseudacacia*, *Ailanthus altissima*, *Acer negundo*, *Pinus strobus*, *Impatiens parviflora*, *I. glandulifera*, *Heracleum mantegazzianum*, etc.) is another factor influencing the present state of our vegetation, but the role of these plants has not yet been fully appreciated.

The increasing general eutrophication of our landscapes supports the formation and spread of nitrophilous communities and the expansion of their elements, such as *Urtica dioica*, *Galium aparine*, *Anthriscus sylvestris*, *Sambucus nigra*, *S. racemosa*, *Rubus* sp. div. and other similar plants.

The historical background as a basis for the construction of potential natural vegetation

We believe that any knowledge about the history of vegetation and, especially, about human impacts on the natural vegetation is a very important tool for understanding not only the present but also the possible future potential natural vegetation.

Taking into account the past and present cenotic functions of trees such as *Abies alba* and *Ulmus* sp. div., it cannot be expected that they would be such important constituents of potential communities as they were several centuries ago. However, in many areas (e.g. Biosphere Reserve and PLA Křivoklátsko, Šumava Mts., Silesia, Moravskoslezské Beskydy Mts.), a high proportion of silver-fir in the forest stands can still be found. In contrast, trees such as *Fraxinus excelsior*, *Acer pseudoplatanus*, *Carpinus betulus*, *Alnus glutinosa*, *Picea abies* and *Corylus avellana* are expansive at present, and would therefore probably play a major role in future potential natural forests. Moreover, the introduced trees and herbs mentioned above will hardly disappear from our flora and they will certainly play an important role in the potential vegetation, even though it is constructed as natural.

All our evaluations of the past and present state of the vegetation and its environment remain at a hypothetical level when we try to make a prognoses for the future. This potential reality depends on an unknown degree of future anthropic interference and on unknown natural climatic changes. However, following the present warming trends, models of potential impacts of global warming on vegetation developments have been elaborated (see e.g. Brzeziecki *et al.* 1995).

Vegetation research in the Czech Republic

Research on our vegetation has a long tradition. Many studies devoted to plant formations or to the phytogeographical analysis of the vegetation have been published, particularly from the second half of the 19th century until the 1920s (see citations of older botanical publications, e.g. Futák et Domin 1960).

Phytosociological research was started in the twenties by K. Domin, professor of Charles University in Prague. In 1923 he published his book on the methodology of plant sociology with special reference to meadows and pastures. The first phytosociological studies of our vegetation were also published at this time according to the principles of the Zürich-Montpellier school (e.g. Klika 1928, Zlatník 1928). The representatives of this approach contributed markedly to the knowledge of the vegetation in our Republic. In 1944 J. Klika and E. Hadač compiled the first list of Central European plant communities. J. Klika, cooperating with many other botanists, educated the new generation of phytosociologists (R. Neuhäusl, J. Holub, M. Husová, Z. Neuhäuslová, K. Kopecký etc.). R. Mikyška, head of the Laboratory of Geobotany at Průhonice, and Klika's friend and colleague, concentrated all the above mentioned students in this Laboratory. J. Jeník, author of many textbooks on vegetation science and of a synthetical study on the alpine vegetation of N Bohemia and N Moravia, also belongs to Klika's students.

J. Dostál at the University of Prague also contributed to the education of young phytosociologists (e.g. J. Moravec, while J. Vicherek and K. Rybníček were students of J. Šmarda at the Masaryk University in Brno). J. Podpěra, professor at the Masaryk University, influenced the scientific development of E. Balátová very early in her career.

Among the first phytosociological works published up to the end of the fifties were studies on woodlands, "rock steppe" vegetation and mires. From the sixties onwards further progress in vegetation studies occurred. Many new journals appeared, as well as the book series "Vegetace ČSSR", with series A devoted to phytosociological research in the Czech Republic and series B to Slovakia, in which very large studies could be published. Phytosociological teams operated from several institutes, and studies were concentrated principally on woodlands (Mikyška, Neuhäusl, Moravec, Husová, Neuhäuslová), alpine vegetation (Jeník), mires (Neuhäusl, Rybníček) and meadows (Balátová, Moravec, Blažková).

In 1967, a survey of the higher syntaxa of the former Czechoslovakia, completed by phytosociological, ecological and synchorological data, was published (Holub *et al.* 1967). From this survey, gaps in our vegetation research could be ascertained.

Since the 2nd half of the sixties many synthetical studies on different syntaxa have been published (see References). The development of phytosociological and synecological studies could be seen in the bibliographical series Bibliographia botanica čechoslovaca, Bibliographia syntaxonomica čechoslovaca, or in the journal Excerpta botanica, sect. B (Sociologica), in which a series of specialized phytosociological bibliographies from the Czech Republic (or former Czchoslovakia) were also published.

In the last two decades Red lists of plant communities of the Czech Republic have been published (Moravec *et al.* 1983, 1995). However, knowledge of many Czech syntaxa sometimes remains very patchy.

The co-operation of Czech phytosociologists in the pan-European project "European Vegetation Survey", coordinated by the Institute of Botany at Průhonice in close co-operation with the Department of Systematic Botany and Geobotany, Masaryk University in Brno, represents a new chapter in research into our vegetation. The work on this project will gradually cover all syntaxa. Among the first results of this co-operation are the synthetical studies on *Picea abies* and *Pinus mugo*-communities (Jirásek 1996a, b), as well as a survey of thermophilous (Chytrý et Horák 1997, Chytrý 1997) and acidophilous oak woodlands (Moravec 1998). A large volume on the *Quercо-Fagetea* has been published by Moravec *et al.* (2000). Further information with abundant references can be found in Neuhäuslová *et al.* (1998).

Influence of habitat conditions on the vegetation

The diversity of the vegetation of the Czech Republic is determined by a complex of geological, climatic and historical factors. Altough the area of country is not large, the diversity of its vegetation is considerable. The character

of its vegetation cover, the number of communities and the pattern of the vegetation mosaic can be explained by the following:

1. The general features of the vegetation are determined by the location of the country in the temperate broadleaved deciduous forest biome.

2. This biome developed in Central Europe by the coevolution of natural processes and human activity from the Neolithic period onwards. Therefore, the contemporary Czech landscape is a result of this interaction and the relations between habitats and the vegetation are in many sites obscured by long-term human activity. Before the onset of human activities, the prevailing natural vegetation was forest, and open vegetation was restricted to extreme habitats (mires, rocks, subalpine belt) in mosaic with these forests.

3. The Bohemian Massif, which forms the greater part of the Czech Republic, has a somewhat special position in Europe. This area represents the easternmost part of the Central European highlands, which are situated between the N European lowlands, repeatedly covered by ice sheets during Pleistocene glacials, and the Alps to the south, which were also glaciated. Thus the Czech lands form a non-glaciated region separating the N European Plain from the Alps as well as oceanic western Europe from the continental East, particularly from the adjacent Carpathians and the warm, dry Pannonian Basin. In summary, the Czech Republic is a European biogeographical crossroads of prime importance. Due to its geographical location and environmental history it forms an "island" characterized by a rich biota with a number of unique features and a high biodiversity.

4. The diversity of geological substrates is very high. Rocks of all periods from the Proterozoic to the Quaternary are present and most periods are represented by a varied complex of rocks, including sedimentary, eruptive and metamorphic rocks, both soft and hard, acidic and basic. Rocks of extreme ecological properties are also present, such as basic limestone, marlite, basalt and palaeobasalt, ultramafic serpentine and, on the other hand, extremely hard and nutrient-poor sandstone, quartzite and lydite.

The sharp vegetation boundary between the Bohemian Massif and Pannonian Basin between the towns of Znojmo and Brno is a good example of the dependence of the vegetation on the geology. The relief and climate of this area change gradually from the lowlands to the uplands, but the soft and moderately basic Tertiary and Quaternary sediments of the Pannonian Basin are replaced suddenly, often within several hundreds metres, by granitoids and metamorphic rocks of the Bohemian Massif. This geological change is marked by a pronounced change in the vegetation. The former geological unit is characterized by arable land with the potential occurrence of the thermophilous *Primulo-Carpinetum* and *Corno-Quercetum*, whereas the latter is now covered by a mosaic of arable land, meadows and woodland with the potential prevalence of the mesophilous *Melampyro-Carpinetum*.

5. In general, the relief of the Czech landscape is heterogeneous and diverse although it lacks mountain massives with great altitudinal differences. The average altitude of the Republic is between 200 to 600m and it is characterized by the prevalence of peneplains with moderately rolling surfaces. The great differences in the vegetation are often caused by small changes in the relief, which influence the soil and climate.

The mountain ridges bordering the country have elevations mostly over 1000m. In the highest of them (Krkonoše, Jeseníky and Králický Sněžník Mts.) the subalpine belt is preserved as a well-developed relict from the glacial period.

The Krkonoše Mts. are a mountain range of rather limited area with a maximum altitude of 1602 m. The three main levels are illustrated in Fig. 11. On the summits there are relict cryogenic soils with alpine communities of the *Juncetea trifidi*, which are dependent on extremely windy conditions and a very thin snow cover. At a slighty lower level there is a high plateau which carries a mosaic of *Pinus mugo* scrub (*Pinion mughi*), grassland (*Nardion*) and peatlands (*Chamaemoro-Pinetum mughi*). The *Pinus* scrub extends lower on the exposed, windward, western slopes than on the more sheltered eastern slopes where they are partly replaced by the *Athyrio-Piceetum*. The plateau is bordered by steep glacial cirques with extreme habitats of rocks and avalanche slopes (*Asplenietea*, *Mulgedio-Aconitetea*) and the timberline is considerably lower than outside the cirques. The slopes are covered by spruce and beech woodlands (*Calamagrostio villosae-Piceetum* and *Calamagrostio villosae-Fagetum*).

Another vegetation phenomena can be demonstrated in the western part of the **Krušné hory Mts.**, in the vicinity of the villages of Stráž nad Ohří and Boží Dar (Fig. 12). This block mountain range of gneiss and granite consists of an extensive high-level plateau with protruding basalt and granite summits (Klínovec, 1244m) and steep, stepped slopes. In the foothills cut by the valley of the Ohře (Eger) river, Tertiary basalts are present.

The altitudinal gradient is extremely steep (the altitude rises 900 m in 8 km) and the vegetation gradient includes both thermophilous vegetation of "rock steppes", and montane peatland. The contemporary vegetation consists mainly of spruce plantations. In the potential vegetation the prevailing communities are various types of beech woods. The *Calamagrostio villosae-Fagetum* is common at higher altitudes. It surrounds complexes of mountain peatlands and waterlogged spruce woodland (*Sphagnetalia medii*, *Sphagno-Piceetum*, *Mastigobryo-Piceetum*), which are associated with shallow depressions, and climax spruce woodland (*Calamagrostio villosae-Piceetum*) restricted to hills on the plateau.

The *Luzulo-Fagetum* is typical of lower altitudes where it prevails over the *Violo reichenbachianae-Fagetum*. In the Ohře valley the basalt cover forms rocky slopes which are often colonized by *Sorbo torminalis-Quercetum*, including small stands of primary, open vegetation (mainly *Alysso-Festucion pallentis*). The *Aceri-Carpinetum* is also present on slopes covered by basalt scree. The *Melampyro-Carpinetum* occurs on gentle slopes near the river and the *Stellario-Alnetum* is associated with the narrow floodplain of the Ohře river.

The uniform peneplain of the Bohemian Massif is dissected by deeply incised valleys of the larger rivers (e.g. Vltava, Berounka, Oslava, Dyje). These deep and narrow valleys have specific mesoclimatic and microclimatic conditions. An extremely diverse mosaic of different geological and climatic conditions makes possible the co-existence of plant communities having considerably different demands. For example, the valley of the upper reaches of the Vltava river near Zlatá Koruna village is rich in *Carpinion* woodland dominated by *Tilia cordata* on the sunny slopes, whereas in the shady and cool valley bottom, small patches of natural subclimax spruce woodland on block screes are developed.

The influence of the relief on the vegetation pattern can be demonstrated also in the karstlands. The **Pálava Hills**

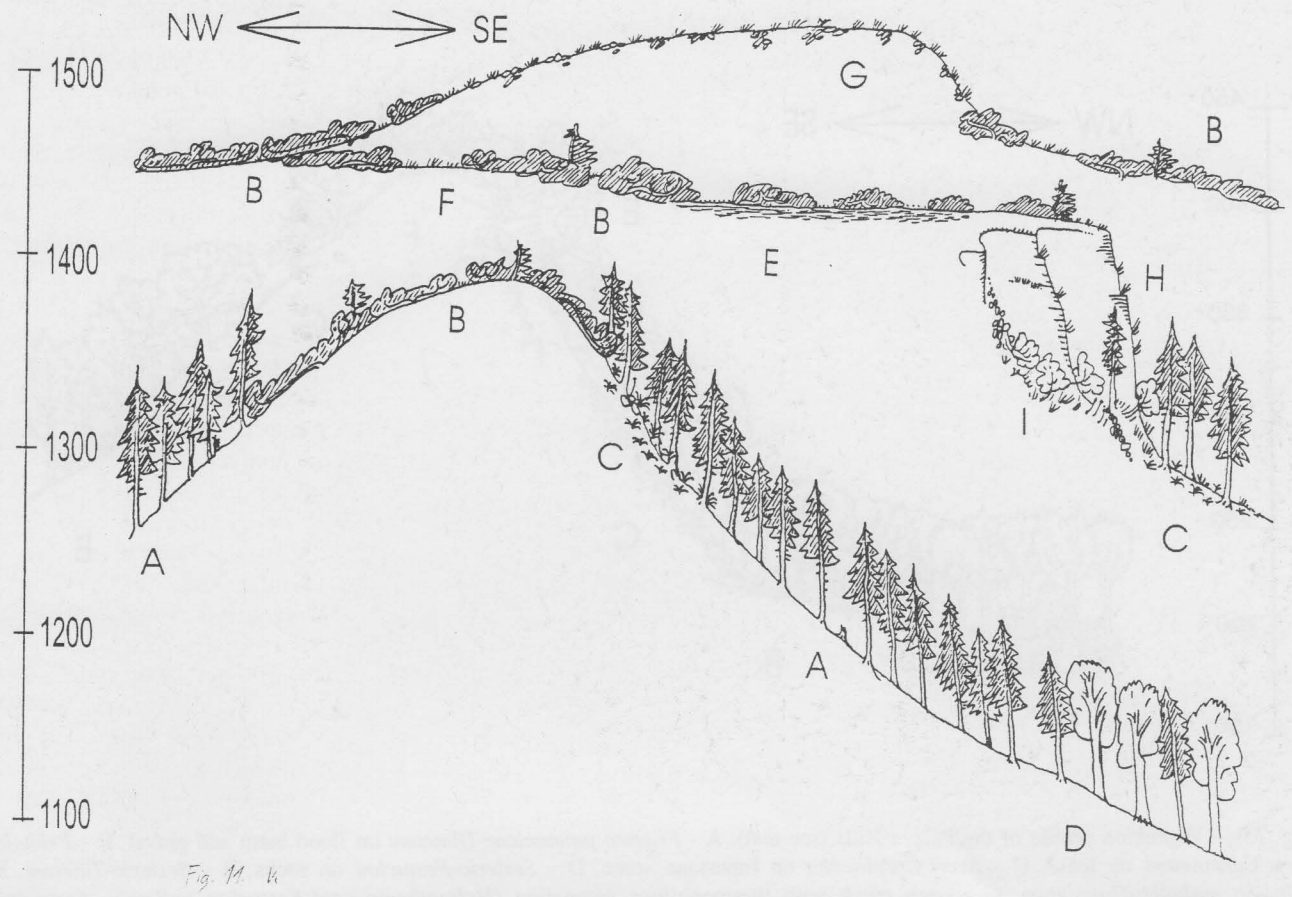

Fig. 11 — Vegetation profile of the Krkonoše Mts. (see text): A - *Calamagrostio villosae-Piceetum*, B - *Vaccinio myrtilli-Pinetum mughi*, C - *Athyrio-Piceetum*, D - *Calamagrostio villosae-Fagetum*, E - peatland with *Chamaemoro-Pinetum mughi*, F - *Nardion*, G - *Juncetea trifidi*, H - *Asplenietea*, I - *Mulgedio-Aconitetea*.

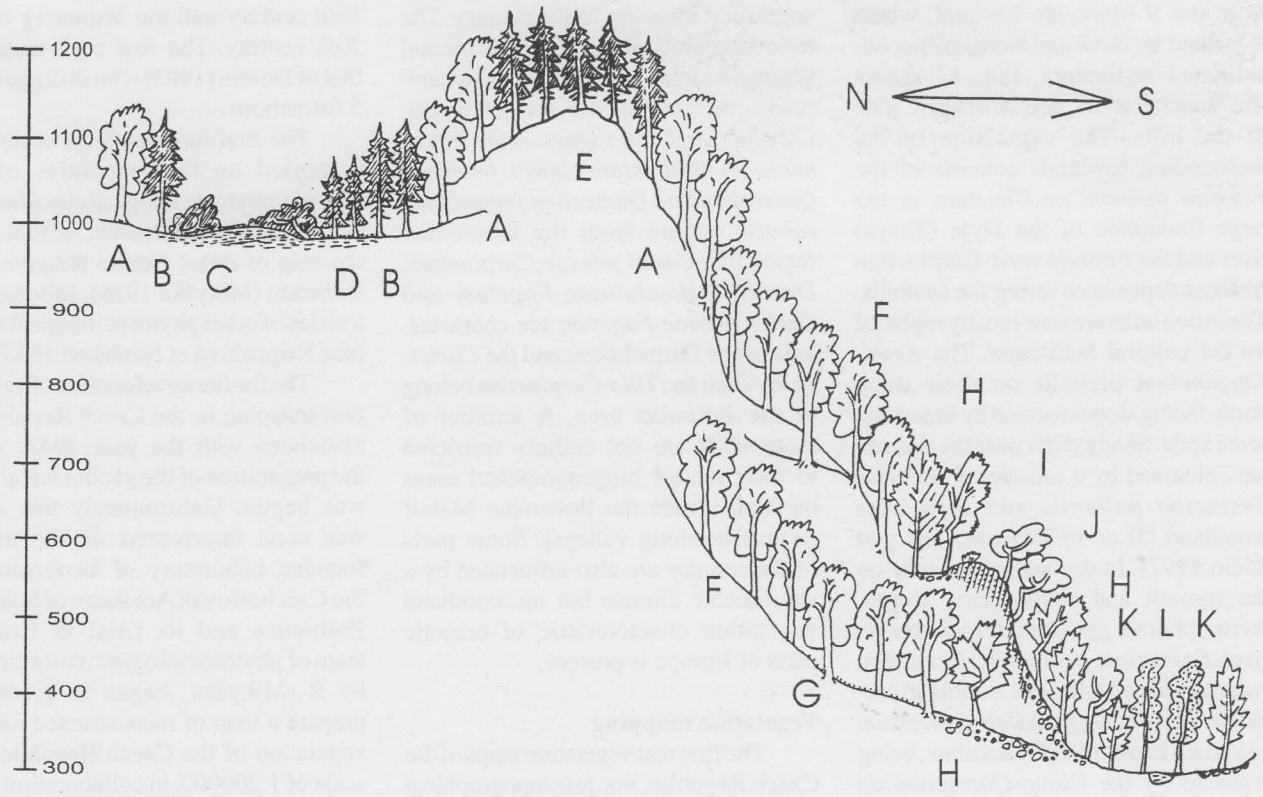

Fig. 12 — Vegetation profile of the Krušné hory Mts. (see text): A - *Calamagrostio villosae-Fagetum*, B - *Mastigobryo-Piceetum*, C - *Sphagnetalia medii*, D - *Sphagno-Piceetum*, E - *Calamagrostio villosae-Piceetum*, F - *Luzulo-Fagetum*, G - *Violo reichenbachianae-Fagetum*, H - *Aceri-Carpinetum* on scree soil, I - open patch with thermophilous vegetation (e.g. *Alysso-Festucion pallentis*), J - *Sorbo torminalis-Quercetum* on basalt ground, K - *Melampyro-Carpinetum*, L - *Stellario-Alnetum*.

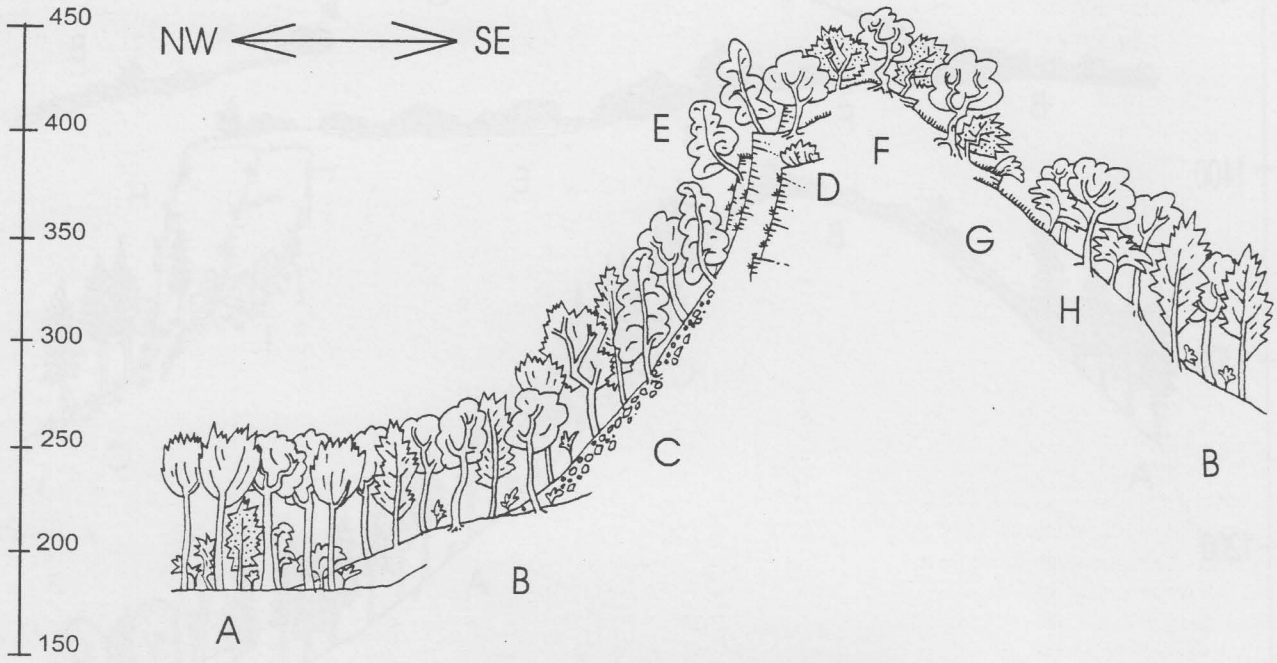

Fig. 13 — Vegetation profile of the Pálava Hills (see text): A - *Fraxino pannonicae-Ulmetum* on flood loam and gravel, B - *Primulo veris-Carpinetum* on loess, C - *Aceri-Carpinetum* on limestone scree, D - *Seslerio-Festucion* on rocks, E - *Seslerio-Tilietum*, F - *Pruno mahaleb-Quercetum*, G - open patch with thermophilous vegetation (*Helianthemo cani-Festucion pallentis*, *Festucion valesiacae*), H - *Corno-Quercetum*.

(Fig. 13) is a small range consisting of several tectonic blocs of Jurassic limestones protruding conspicuously from the S Moravian lowland, which is formed by flysh and Neogene unconsolidated sediments. Fig. 13 shows the situation in the northern part of the hills. The vegetation of the surrounding lowlands consists of the *Fraxino pannonicae-Ulmetum* in the large floodplain of the Dyje (Thaya) river and the *Primulo veris-Carpinetum* on loess deposits covering the foothills. These two units are now mostly replaced by the cultural landscape. The *Aceri-Carpinetum* prevails on their steep north-facing slopes formed by limestone scree soils. Shady cliffs near the summit are colonized by a mosaic of *Seslerio-Festucion pallentis* and rock lime woodland (*Seslerio-Tilietum* Chytrý et Sádlo 1997). In dry and warm sites on the summit and south-facing slopes, thermophilous grassland (*Helianthemo cani-Festucion pallentis*, *Festucion valesiacae*) occur but oak woodland prevails. The *Pruno mahaleb-Quercetum* colonizes extreme rocky habitats, being replaced by the Corno-*Quercetum* on deeper soils. On the lower part of the slopes the *Primulo veris-Carpinetum* occurs again.

* **The juxtaposition** of several biogeographical provinces i.e. the Pannonian, Carpathian, Polonian, whose western boundaries occur in the Czech Republic, also contribute to the vegetation diversity of the country. The following units of the potential natural vegetation are associated with these landscapes: the *Fraxino-Ulmetum*, *Primulo-Carpinetum*, *Corno-Quercetum*, *Pruno mahaleb-Quercetum*, *Carici fritschii-Quercetum* and *Quercetum pubescenti-roboris* extend from the Pannonian region; the *Carici pilosae-Carpinetum*, *Dentario glandulosae-Fagetum* and *Carici pilosae-Fagetum* are characteristic of the Carpathians; and the *Carici-Quercetum* and *Tilio-Carpinetum* belong to the Polonian area. A number of these units are not entirely restricted to their related biogeographical areas but also invade the Bohemian Massif (especialy along valleys). Some parts of the country are also influenced by a sub-oceanic climate but no woodland vegetation characteristic of oceanic parts of Europe is present.

Vegetation mapping

The first real vegetation maps of the Czech Republic, not just topographical maps with some vegetation elements such as are known from the 17th century, date from 19th century. These maps were strongly influenced by chorological maps. The classification of the vegetation into basic formations (e.g. woods, meadows) was first depicted on vegetation maps from the end of the 19th century and the beginning of the 20th century. The first such map was that of Domin (1903) who distinguished 5 formations.

The first modern, large scale map compiled on the principles of the floristic-phytosociological classification of the Zürich-Montpellier school, was the map of Běleč Nature Reserve in E Bohemia (Mikyška 1926), followed by a series of other phytosociological maps (see Krippelová et Neuhäusl 1963).

The further development of vegetation mapping in the Czech Republic is associated with the year 1947, when the preparation of the geobotanical map was begun. Unfortunately this work was soon interrupted. In the newly founded Laboratory of Geobotany of the Czechoslovak Academy of Science, Průhonice and its filial in Brno, a team of phytosociologists, co-ordinated by R. Mikyška, began to gradually prepare a map of reconstructed natural vegetation of the Czech Republic at a scale of 1:200000, in collaboration with botanists and foresters from different institutions of our Republic. 21 sheets of geobotanical maps were published in 1972 (Mikyška *et al.* 1968-1972).

As a result of the generalisation of this map, a new map of reconstructed vegetation was compiled without, however, any explanatory text summarizing the new information (Moravec and Neuhäusl 1976). During the last thirty years many vegetation maps have been compiled (see special bibliographies on Czechoslovak vegetation maps in Excerpta Bot., Stuttgart, sect.B - Sociol.). Their evaluation, as well as that of much new phytosociological and synchorological information, stimulated the compilation of the Map of Potential Natural Vegetation, which synthesizes all the new data, and its accompanying textbook containing detailed characteristics of all mapping units (see Neuhäuslová *et al.* 1998).

The first steps in the compilation of the Map of Potential Natural Vegetation of the Czech Republic at the scale of 1: 2500000 were taken by Neuhäusl for the pan-European project "Map of the Natural Vegetation of Europe". In spite of its small scale this map gives more detailed information on our vegetation than the maps of reconstructed vegetation produced between 1968 and 1972. However, because of its small scale, the large mapping units could not represent the contemporary state of knowledge.

Among more detailed mapping projects the Map of Reconstructed Natural Vegetation of Prague (4 sheets at a scale of 1:25 000, Moravec, Neuhäusl *et al.* 1990), and maps of large (protected) areas (e.g. Neuhäusl et Neuhäuslová 1979, Sofron 1990, Chytrý et Vicherek 1995, Kolbek, Moravec *et al.* 1995, 1997) should be mentioned.

Potential natural vegetation of the Czech Republic

In this chapter, data on potential natural vegetation occurring on the Map of Potential Natural Vegetation of the Czech Republic at a scale of 1:500000 are summarized. 50 vegetation units have been characterized in detail. The individual units are incorporated into higher phytosociological categories (see below).

Note: In the order to avoid constant repetition some headings are abbreviated and certain terms abbreviated or omitted, e.g. climatic region - W2 is written only as W2 . A full version is given only in the first unit, which serves as a template for all other units.

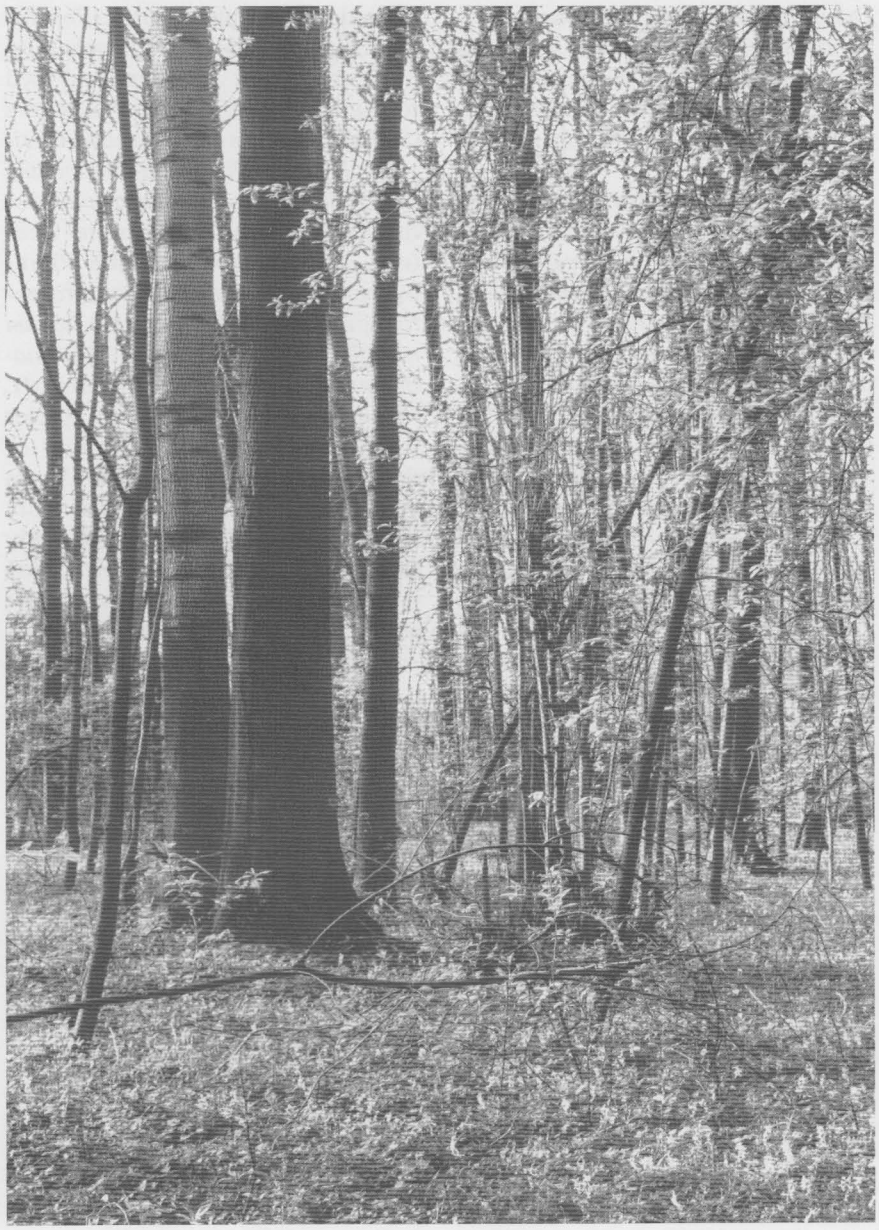

Fig. 14 — Bird cherry-ash woodland (*Pruno-Fraxinetum* Oberdorfer 1953), partly in complex with alder carrs (*Alnion glutinosae* Malcuit 1929).

Alluvial woodlands (*Alnion incanae* Pawłowski in Pawłowski, Sokolowski et Wallisch 1928)

Hygrophilous to mesohygrophilous broadleaved, very rarely mixed, woodland (with an admixture of *Picea abies*), periodically or episodically flooded and frequently influenced by flowing groundwater, on alluvial and gley soils from lowland to montane levels. Area of potential natural distribution - 6.2% of the total area of the Republic.

1. Bird cherry-ash woodland (*Pruno-Fraxinetum* Oberdorfer 1953), partly in complex with alder carrs (*Alnion glutinosae* Malcuit 1929), Fig. 14.

Synonyms: *Fraxinetum* Mikyška 1960, *Ulmeto-Quercetum* Málek 1961 p.p. (*brachypodietosum silvaticae*).

Structure and species composition: Three- to four-layered, species-rich stands dominated by *Fraxinus excelsior*, less frequently by *Alnus glutinosa* (on moister sites), *Tilia platyphyllos* or *T. cordata* (on drier sites), with a frequent admixture of *Padus avium* or *Quercus robur*. Shrub layer species-rich and sometimes very dense. *Euonymus europaea*, *Fraxinus excelsior* and *Padus avium* are the most frequent species. Field layer also well developed with a predominance of hygrophytes and mesohygrophytes (*Aegopodium podagraria*, *Cirsium oleraceum*, *Crepis paludosa*, *Deschampsia cespitosa*, *Glechoma hederacea*, *Impatiens noli-tangere*, *Lysimachia vulgaris*, *Stachys sylvatica*). Mesophytes also occur frequently (*Brachypodium sylvaticum*, *Melica nutans*, *Poa nemoralis*, *Viola riviniana* etc.). In the Oderská niva Floodplain, NE Moravia, the presence of *Veratrum lobelianum*, *Symphytum tuberosum*, *Isopyrum thalictroides*,

Dentaria glandulosa, *Hacquetia epipactis* and *Galanthus nivalis* is typical. *Plagiomnium undulatum* is the most common species of the ground layer, in some stands covering up to 30% of the area.

Diagnostic species combination: Differential species: E2 (shrub layer) - *Euonymus europaea*, *Ribes rubrum*, *Grossularia uva-crispa*, *Humulus lupulus*, E1 (field layer) - *Angelica sylvestris*, *Colchicum autumnale*, *Chaerophyllum aromaticum* or *Listera ovata*.

Species with high constancy: E3, E2 (tree and shrub layers) - *Fraxinus excelsior*, E2 - *Padus avium*, E1 (field layer) - *Aegopodium podagraria*, *Festuca gigantea*, *Geum urbanum*, *Glechoma hederacea*, *Pulmonaria officinalis* agg., *Stachys sylvatica*, *Urtica dioica*.

Floristic differences from most closely related units: *Quercus robur* and *Tilia cordata* in the tree layer separate this unit from other alluvial woodlands of the *Alnenion glutinoso-incanae*. From the *Ulmenion* communities (*Querco-Ulmetum* or *Fraxino pannonicae-Ulmetum*) it is distinguished by its diff. species (see above), elements of the *Alnenion glutinoso-incanae* suball. (*Crepis paludosa*, *Chareophyllum hirsutum* or *Geum rivale*) and by the absence or very low presence of *Ulmenion* species (*Ulmus leavis*, *U. minor*, *Gagea lutea*, *Corydalis cava*).

Adjoining potential natural vegetation: *Ulmenion* comm. (*Querco-Ulmetum*, *Fraxino pan.-Ulmetum*), oak-hornbeam and lime-oak woodlands (*Carpinion* all.), and all units of acidophilous oak woodlands of the *Genisto germanicae-Quercion* all.

Habitat: Climatic region - MW (mostly warmer MW11, MW10) rarely W, colline levels (220-320 m). Floodplains of smaller rivers and streams mostly on the border of large lowlands, borders of fens, shallow depressions with slow flowing groundwater. Gley soils, anmoors or fluvisols (brown vega, less frequently, smonitza) are typical.

Distribution: Potential natural distribution (further PND) - c. 3.3% of the total area of the Republic. Borders of the Česká tabule Plain, also Pražská plošina Plateau, Českomoravská vrchovina Uplands, borders of broad Moravian river valleys, Opavská and Podbeskydská Hills, Ostravská pánev Basin (Fig. 14, 15/1).

Land use, nature conservation: Natural or near-natural stands cover c. 5% of the potential area, mostly managed as coppices, frequently replaced by plantations of poplar hybrids (*Populus* ssp.). Many stands used as pheasantries. Most of the area deforested and used for agriculture. Productive meadows (*Scirpo-Cirsietum cani*, *Angelico-Cirsietum oleracei*, *Filipendulo-Geranietum palustris*, *Alopecuretum pratensis*) frequently drained and in some areas (e.g. Východolabská tabule Plain) ploughed and resown with more productive grasses (*Dactylis glomerata*, *Lolium multiflorum*, *L. temulentum*, *Arrhenatherum elatius*, *Festuca pratensis*, *Phleum pratense*), followed by species impoverishment and spreading of the weed *Rumex obtusifolius*. Use as pastures (*Lolio-Cynosuretum*) only local. Arable land used principally for cereals, sugarbeet, maize, less frequently rape, fodder plants, poppies or cabbages. A part of the deforested area built up.

In flat, productive plains, the *Pruno-Fraxinetum* is a very strongly endangered type of Czech vegetation. The replacement of natural woody species, above all by poplar hybrids, clear-felling and agriculture contribute to the decrease in area.

(Near-)natural stands: Východolabská tabule Plain - pheasantry Uhersko near the village Trusnov; Oderská niva Floodplain, frequent.

Rare and endangered syntaxa: in deforested areas *Silaetum pratensis*.

Rare and endangered taxa: *Arum maculatum*, *Listera ovata*, *Primula elatior*, *Astrantia major*, *Cucubalus baccifer*, *Daphne mezereum*, *Melica picta*, *Ophioglossum vulgatum*, on non-forest soil *Allium angulosum*, *Silaum silaus*.

References: Mikyška (1963), Neuhäusl et Neuhäuslová (1983), Neuhäusl et Neuhäuslová-Novotná (1979), Neuhäuslová-Novotná (1979), Neuhäuslová-Novotná in Moravec *et al.* (1982), Turoňová (1985), Sedláčková (1985a, b, 1987).

Typical relevé: Neuhäuslová-Novotná (1979): 150-155, tab. 1, rel. 10 (Cidlinská tabule Plain), 228 m, plain, cover E3 - 80%, E2 - 70%, E1 - 70%, E0 - 15%.

E3 (tree layer) - 4: *Fraxinus excelsior*, 2: *Quercus robur*, +: *Acer campestre*, *Padus avium*, r: *Ulmus minor*, E2 (shrub layer) - 3-4: *Padus avium*, 2: *Rubus idaeus*, *Swida sanguinea*, 1: *Crataegus laevigata*, *C. monogyna*, *Corylus avellana*, +: *Acer campestre*, *Fraxinus excelsior*, r: *Euonymus europaea*, *Ligustrum vulgare*, *Ribes rubrum*, *Ulmus minor*,

E1 (field layer) - 3-4: *Adoxa moschatellina**, 2: *Aegopodium podagraria*, *Colchium autumnale*, *Galium aparine*, *Impatiens noli-tangere*, *Milium effusum*, *Pulmonaria obscura*, *Padus avium*, *Rubus caesius*, *Stachys sylvatica*, 1: *Anemone nemorosa**, *Brachypodium sylvaticum*, *Carex sylvatica*, *Circaea lutetiana*, *Convallaria majalis*, *Paris quadrifolia*, *Stellaria holostea*, *Viola odorata*, +: *Anemone ranunculoides**, *Festuca gigantea*, *Fraxinus excelsior*, *Gagea lutea**, *Galepsis tetrahit*, *Glechoma hederacea*, *Impatiens parviflora*, *Poa nemoralis*, *Ranunculus auricomus*, *Scrophularia nodosa*, *Urtica dioica*, r: *Alliaria petiolata*, *Carex remota*, *Crepis paludosa*, *Deschampsia cespitosa*, *Euonymus europaea*, *Geranium robertianum*, *Geum urbanum*, *Heracleum sphondylium*, *Humulus lupulus*, *Lysimachia vulgaris*, *Moehringia trinervia*, *Polygonatum multiflorum*, E0 (ground layer) - 2: *Atrichum undulatum*, 1: *Plagiomnium undulatum*, *P. affine*.

Invasive and expansive species: *Aster novi-belgii*, *Carex brizoides*, *Galium aparine*, (*Urtica dioica*), *Glechoma hederacea*, *Grossularia uva-crispa*, *Impatiens glandulifera*, *Pteridium aquilinum* (in degraded stands, cf. Mikyška 1968), *Reynoutria* sp. div. incl. *R.* x *bohemica*, *Sambucus nigra*, *Solidago canadensis*, *S. gigantea*, locally *Telekia speciosa* (areas of Prague).

2. Bird cherry-pedunculate oak and -alder woodland (*Quercus robur-Padus avium* comm., *Alnus glutinosa-Padus avium* comm.) with *Carex brizoides*, partly in complex with alder carrs (*Carici elongatae-Alnetum* Schwickerath 1933), reed swamps and tall-sedge communities (*Phragmito-Magnocaricetea* Klika in Klika et Novák 1941).

Structure: Alluvial oak woodland dominated by *Quercus robur* with an admixture of *Padus avium* and *Tilia cordata*, alder woodland (on wetter sites) by *Alnus glutinosa* with an admixture of *Salix fragilis*. Sometimes *Fraxinus excelsior* planted. Besides *Padus avium*, in the shrub layer *Sambucus nigra* or *Corylus avellana* more or less regularly present, less frequently *Rubus idaeus*, *R. fruticosus* agg. or *Viburnum opulus*. Field layer dominated by *Carex brizoides* or *Urtica dioica* (on wetter sites). Other hygrophilous and mesophilous species, e.g. *Aegopodium podagraria*, *Anthriscus sylvestris*, *Deschampsia cespitosa*, *Festuca gigantea*, *Geum urbanum*, *Moehringia trinervia*, *Phalaris arundinacea*, *Impatiens noli-tangere*, *Lamium maculatum*, *Scrophularia nodosa*, or (on drier sites) *Poa*

nemoralis also frequently present. *Humulus lupulus* is the only liane.

Waterlogged alder carrs (*Carici elongatae-Alnetum*) have a predominance of *Alnus glutinosa* in the canopy and less nutrient-demanding shrubs (*Frangula alnus*, *Salix cinerea*, less frequently *Padus avium*) in the shrub layer. In the field layer *Carex elongata*, *C. brizoides*, *Calamagrostis canescens*, *Deschampsia cespitosa*, *Dryopteris carthusiana*, *Lysimachia vulgaris*, *Thelypteris palustris*. *Humulus lupulus* typical, liane.

Diagn.: *Quercus robur-Padus avium* comm. and *Alnus glutinosa-Padus avium* comm.: E3 - *Quercus robur*, *Alnus glutinosa*, E2 - *Padus avium*, *Sambucus nigra*, E1 - *Carex brizoides*, *Aegopodium podagraria*, *Alliaria petiolata*, *Deschampsia cespitosa*, *Festuca gigantea*, *Geum urbanum*, *Impatiens noli-tangere*, *Phalaris arundinacea*, *Urtica dioica*.

Carici elongatae-Alnetum: E3 - *Alnus glutinosa*, E2 - *Frangula alnus*, *Humulus lupulus*, E1 - *Carex elongata*, *Deschampsia cespitosa*, *Dryopteris carthusiana*, *Galium palustre*, *Lycopus europaeus*, *Lysimachia vulgaris*, *Thelypteris palustris*.

Differences: From the *Pruno-Fraxinetum*, absence of ash and, in contrast, frequent dominance of *Quercus robur* in the canopy and regular and mostly dominant occurrence of *Carex brizoides* in the field layer.

Adjoining PNV: Acidophilous oak woodlands (*Abieti-Quercetum*, *Vaccinio vitis-idaeae-Quercetum*), mires, less frequently *Stellario-Tilietum*.

Habitat: MW (mostly warmer MW10), (supra)colline levels (mostly 370-460 m). Relatively frequently flooded, flat relief, on fluvisols or gley soils of different textures: from light gravelly-sandy soils (the Třeboňská pánev Basin) to heavy clay soils (the Českobudějovická pánev Basin).

Distribution: PND - 0.7%. S Bohemian basins, small areas in the Šumava Foothills, the Táborská pahorkatina Hills and Javořická vrchovina Uplands (Fig.15/2). It is assumed that it would occur in the Chebská kotlina depression, W Bohemia.

Land use: Near-natural woodlands very rare, mostly managed as coppices, sometimes used as pheasantries, frequent poplar plantations. *Calthion* meadows partly ploughed and resown with grass mixtures ("Mähäcker"), less frequently used as arable land or built up (after drainage).

Communities very strongly endangered. The disturbance of the natural water regime in floodplains, further agriculture and to some extent recreational activities, pose the most serious threat.

(Near-)natural stands: *Carici elongatae-Alnetum*: Českobudějovická pánev Basin - NNR Černiš near České Budějovice.

Rare and endangered syntaxa: *Quercus robur-Padus avium* comm., *Alnus glutinosa-Padus avium* comm., of non-forest vegetation *Hottonietum palustris*, *Nymphaeion* comm.

Rare and endangered taxa: *Hottonia palustris*, *Thelypteris palustris*.

References: Jeník (1974).

Typical relevé: Comm. *Quercus robur-Padus avium*: Neuhäuslová (1970 ms.), rel. Nr. 22/70, Českobudějovická pánev Basin, village Protivín, floodplain below the castle, 385 m, plain, 5.6.1970. E3 - 65%, E2 - 35%, E1 - 95%, E0 - 0%.

E3 - 3: *Quercus robur*, 2: *Tilia cordata*, 1: *Acer platanoides*, *Alnus glutinosa*, +: *A. incana*,

E2 - 2: *Sambucus nigra*, *Padus avium*, 1: *Fraxinus excelsior*, +: *Alnus incana*, *Tilia cordata*, r: *Sorbus aucuparia*,

E1 - 3: *Aegopodium podagraria*, *Urtica dioica*, 2: *Anemone nemorosa**, *Anthriscus sylvestris*, *Ficaria bulbifera**, *Galium aparine*, *Glechoma hederacea*, *Milium effusum*, *Pulmonaria obscura*, 1: *Geum urbanum*, *Poa nemoralis*, +: *Acer platanoides*, *Ajuga reptans*, *Athyrium filix-femina*, *Carex brizoides*, *C. sylvatica*, *Deschampsia cespitosa*, *Festuca gigantea*, *Geranium robertianum*, *Moehringia trinervia*, *Oxalis acetosella*, *Padus avium*, *Quercus robur*, *Tilia cordata*, *Veronica chamaedrys*, r: *Alopecurus pratensis*, *Angelica sylvestris*, *Brachypodium sylvaticum*, *Heracleum sphondylium*, *Phyteuma nigrum*, *Rubus caesius*, *Stellaria holostea*, *Symphytum officinale*.

Invas., expans.: *Carex brizoides*, *Galium aparine*, *Impatiens glandulifera*, *I. parviflora*, *Reynoutria japonica*, *R. sachalinensis*.

3. Spruce-alder woodland (*Piceo-Alnetum* Rubner ex Oberdorfer 1957)

Synonyms: *Alnetum glutinosae* Málek 1961 p.p. (*piceetosum*).

Structure: Four-layered stands with a predominance of *Alnus glutinosa* and a regular admixture of *Picea abies* in the canopy, in natural stands also with *Sorbus aucuparia* and a weak admixture of *Betula pendula* and *B. pubescens*. *Alnus incana* sometimes planted. In the shrub layer, besides regenerating woody species, *Frangula alnus* occurs. Field layer dominated by *Calamagrostis villosa*, *Chaerophyllum hirsutum*, *Crepis paludosa*, *Equisetum sylvaticum*, *Oxalis acetosella*, less frequently *Galeobdolon montanum*, *Athyrium filix-femina*, in the vernal aspect sometimes *Anemone nemorosa* prevails. Less nutrient-demanding species, further hygrophilous elements of alluvial woodlands and *Fagetalia* species are frequent. Ground layer formed by mosses and *Sphagnum* species, well-developed, covering up to 75% of the total area of the stands.

Diagn.: Dif.: E3, E2 - *Picea abies*, E1 - *Calamagrostis villosa*, *Caltha minor*, *C. laeta*.

Species with high constancy: E3 - *Alnus glutinosa*, E3,2 - *Picea abies*, E1 - *Chaerophyllum hirsutum*, *Deschampsia cespitosa*, *Equisetum sylvaticum*, *Lysimachia nemorum*, *Myosotis palustris* agg., *Oxalis acetosella*, *Ranunculus repens*.

Differences: From the waterlogged *Mastigobryo-Piceetum*, or *Carici remotae-Abietetum*, absence of *Abies alba* in spruce-alder woodlands, and frequent occurrence of *Alnus glutinosa* and species of alluvial woodlands and hygrophilous *Fagetalia* elements (*Chaerophyllum hirsutum*, *Lysimachia nemorum*, *Carex sylvatica*, *Chrysosplenium alternifolium*, *Festuca gigantea*, *Stachys sylvatica* etc.). From other alluvial woodlands, very well-developed ground layer.

Adjoining PNV: Alder carrs (*Carici elongatae-Alnetum*), alluvial woodland (*Arunco-Alnetum glutinosae*, *Carici remotae-Fraxinetum*), waterlogged spruce and fir woodlands (*Mastigobryo-Piceetum*, *Carici remotae-Abietetum*), acidophilous beech woodlands (*Luzulo-Fagetum*, *Calamagrostio villosae-Fagetum*), rarely acidophilous oak woodland (*Vaccinio vitis-idaeae-Quercetum*, or *Abieti-Quercetum*).

Habitat: Colder MW3, (sub)montane levels (c. 500-850 m) on flat sites with slow flowing streams. Wet to alternately waterlogged, insufficiently aerated acidic gley soils (wet or brown gley, rarely typical gley or anmoor), with sufficient nutrient reserves.

Distribution: PND - 0.1%. Typical in the Česká vysočina Uplands, large area especially in the Český les Mts. Less frequently in other S Bohemian border mountains, as well as in the higher mountains of Central and N Bohemia, the Českomoravská vrchovina Uplands and N Moravian Mts. (Fig.15/3).

Land use: Usually managed as coppices with well-growing *Alnus*

glutinosa and *Picea abies* of a low quality, endangered by frequent wind throw. Mostly replaced by pure spruce or grey alder plantations, or by *Calthion* meadows (*Polygono-Cirsietum palustris*, *Angelico-Cirsietum palustris*) of low productivity (partly abandoned meadows with *Carex brizoides* and *Deschampsia cespitosa*).

Stands of this unit are mostly endangered by unsuitable management (pure spruce plantations) and drainage.

(Near-)natural stands: Český les Mts. - NR Hůrka, NR Haltrava; Hornosvratecká vrchovina Uplands; Železné hory Mts.

Rare and endangered syntaxa: *Piceo-Alnetum*.

Rare and endangered taxa: *Leucojum vernum* and *Dactylorhiza fuchsii* (very rarely).

References: Kučera, Jirásek et Višňák (1994), Mráz (1959), Neuhäuslová-Novotná in Moravec *et al.* (1982), Sofron (1990).

Typical relevé: Neuhäuslová-Novotná in Moravec *et al.* (1982): Tab. 7, rel. 8 (Hornosvratecká vrchovina Uplands), 700 m, aspect SE, slope 5°, E3 - 85%, E2 - 20%, E1 - 80%, E0 - 5%.

E3 - 5: *Alnus glutinosa*, 1: *Fraxinus excelsior*, +: *Picea abies*, r: *Pinus sylvestris*,

E2 - 2: *Sorbus aucuparia*, 1: *Alnus glutinosa*, *Picea abies*, +: *Rubus idaeus*, *Sambucus racemosa*, r: *Alnus incana*,

E1 - 3: *Athyrium filix-femina*, 2: *Caltha minor*, *Deschampsia cespitosa*, *Myosotis nemorosa*, *Stachys sylvatica*, 1: *Angelica sylvestris*, *Asarum europaeum*, *Chaerophyllum hirsutum*, *Galium palustre*, *Oxalis acetosella*, *Picea abies*, *Senecio fuchsii*, +: *Calamagrostis villosa*, *Carex remota*, *Equisetum sylvaticum*, *Glyceria fluitans*, *Juncus effusus*, *Sorbus aucuparia*, r: *Aegopodium podagraria*, *Anemone nemorosa*, *Carex sylvatica*, *Dactylis glomerata*, *Epilobium montanum*, *Festuca gigantea*, *Fragaria vesca*, *Impatiens noli-tangere*, *Lysimachia nemorum*, *Luzula pilosa*, *Mycelis muralis*, *Scrophularia nodosa*, *Urtica dioica*, *Viola reichenbachiana*, *V. riviniana*,

E0 - +: *Atrichum undulatum*, *Plagiomnium affine*, *P. undulatum*, *Polytrichum formosum*, *Rhizomnium punctatum*.

Invas., expans.: *Calamagrostis villosa*, *Carex brizoides*.

4. Poplar-pedunculate oak woodland (*Querco-Populetum* Neuhäuslová-Novotná 1965), partly in complex with elm-pedunculate oak woodland (*Querco-Ulmetum* Issler 1926)

Synonyms: *Fraxino-Populetum* sensu Neuhäuslová-Novotná in Moravec *et al.* 1982 p.p.

Structure: Poplar-oak woodland represented by three-layered stands dominated by *Quercus robur* and *Populus nigra*. Here and there, old specimens of these woody species can be seen. Sometimes *Padus avium* and the economically prefered *Fraxinus excelsior* also occur. In older stands, a dense, but species-poor shrub layer is present, with frequent *Padus avium* and *Sambucus nigra*. Dense field layer dominated by hygrophilous herbs. Well-developed vernal aspect dominated by *Galanthus nivalis* or *Leucojum vernum* with *Scilla vindobonensis*, being replaced later by *Ficaria bulbifera* (on moist sites) or *Corydalis cava* and *Gagea lutea* (in higher, relatively drier parts of the floodplain). Summer aspect dominated by *Urtica dioica* (over 2 m tall), at higher levels by *Aegopodium podagraria*, less frequently *Stellaria nemorum* or *Glechoma hederacea*. The prevalence of *Anthriscus sylvestris* indicates an open canopy. Ground layer mostly only very weakly developed.

Structure and species composition of elm-oak woodland in complex with poplar-oak woodland: see characteristics of the following unit.

Diagn.: Dif.: E3 - *Populus nigra*, E2 - *Sambucus nigra*, E1 - *Ficaria bulbifera*, *Stellaria nemorum*, (*Anthriscus sylvestris*).

Species with high constancy: E3 - *Fraxinus excelsior* (planted), E2 - *Padus avium*, *Sambucus nigra*, E1 - *Aegopodium podagraria*, *Anthriscus sylvestris*, *Circaea lutetiana*, *Corydalis cava*, *Dactylis glomerata*, *Festuca gigantea*, *Ficaria bulbifera*, *Gagea lutea*, *Galium aparine*, *Geum urbanum*, *Glechoma hederacea*, *Impatiens noli-tangere*, *Lamium maculatum*, *Poa trivialis*, *Stellaria nemorum*, *Urtica dioica*.

Differences: From elm-oak woodland, occurrence of *Populus nigra* and absence or very low presence of *Ulmus minor* and *U. laevis* in the canopy, dominance of *Sambucus nigra* and *Padus avium* in the shrub layer and high occurrence of hygrophytes in the field layer (*Stellaria nemorum*, *Circaea lutetiana*, *Festuca gigantea*, *Gagea lutea*, *Lamium maculatum*, *Impatiens noli-tangere* etc.).

Salicetum albae is typical in old ox-bows in poplar-oak woodlands, and waterlogged alder carrs (*Alnion glutinosae*) occur in elm-oak woodlands.

Adjoining PNV: Bird cherry-ash woodland (*Pruno-Fraxinetum*), oak-hornbeam woodland and lime-oak woodland (*Melampyro nemorosi-Carpinetum*, *Tilio-Betuletum*), thermophilous oak woodland with *Potentilla alba* (*Potentillo albae-Quercetum*).

Habitat: W2, lowlands lower than 220 m. Frequently flooded parts of large river floodplains, with flat relief and a network of old ox-bows, on immature fluvisols with a weakly differentiated soil profile and a pronounced fluctuation of the groundwater table during the year.

Distribution: PND - 0.2%. Floodplains of the rivers Elbe and Ohře (lower reaches) between Mělník - Terezín - Budyně n.O., small areas in other parts of the Elbe river and in the Hornomoravský úval Valley (C Moravia), see Fig.15/4.

Land use: Near-natural stands very rare, mostly deforested or used for *Fraxinus excelsior* or poplar hybrids plantations, partly as *Alopecurus* meadows, or legumes or maize fields.

The river-bank- and soil-protective function of these stands and their role in the diversity of the landscape are very important. Partly used as pheasantries and refuges for deer and birds in the prevailing agricultural landscape.

(Near-)natural stands: Středolabská tabule Plain - NR r por.

Rare and endangered syntaxa: *Querco-Populetum*.

Rare and endangered taxa: *Galanthus nivalis*, *Leucojum vernum*, *Ficaria calthifolia*, *Scilla vindobonensis*, *Senecio fluviatilis*, *Ulmus laevis*.

References: Neuhäuslová-Novotná (1965), Pivničková (1981).

Typical relevé: Neuhäuslová-Novotná (1965): tab. suppl. 1, rel. 25 (Mělnická kotlina depressions), 156 m, plain. E3 - 70%, E2 - 50%, E1 - 55%, E0 - 5%.

E3 - 5: *Quercus robur*,

E2 - 3: *Sambucus nigra*, 1: *Padus avium*,

E1 - 3: *Aegopodium podagraria*, *Corydalis cava**, *Stellaria nemorum*, 2: *Ficaria bulbifera**, *Galium aparine*, 1: *Gagea lutea**, *Galanthus nivalis**, *Glechoma hederacea*, *Impatiens noli-tangere*, *Lamium maculatum*, +: *Anthriscus sylvestris*, *Chelidonium majus*, *Dactylis glomerata*, *Galeopsis tetrahit*, *Geum urbanum*, *Sambucus nigra*, *Urtica dioica*, r: *Impatiens parviflora*, *Quercus robur*, *Veronica hederifolia*,

E0 - +: *Brachythecium rutabulum*, *Plagiomnium undulatum*.

Invas., expans.: *Impatiens glandulifera* (frequently dominates in woodland of the Hornomoravský úval

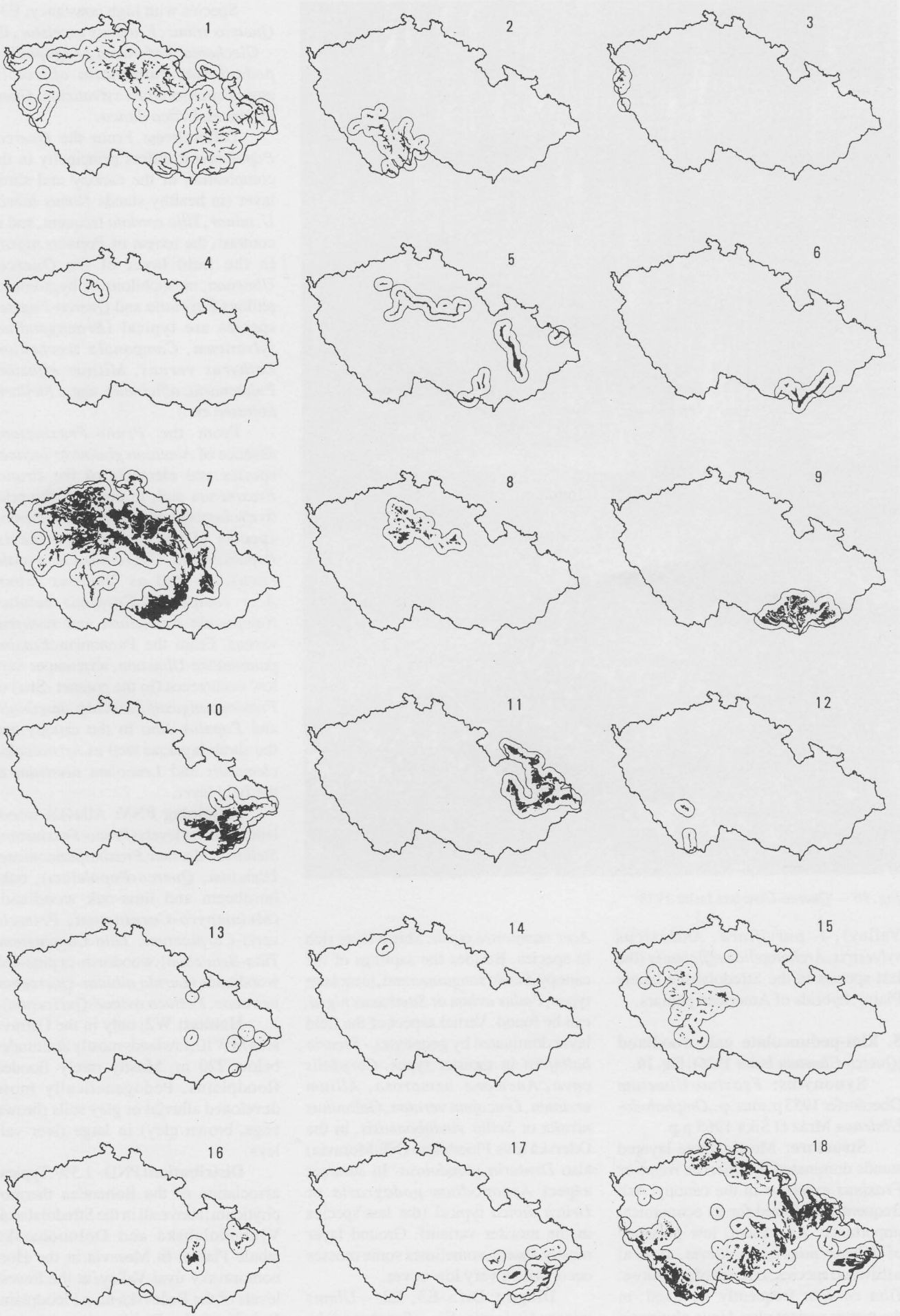

Fig. 15 — Potential natural distribution of mapping units 1-18. The lines surrounding the potential natural distribution of the individual mapping units represent buffer zones of a width of 10 km.

Fig. 16 — Querco-Ulmetum Issler 1926.

Valley), *I. parviflora*, *Anthriscus sylvestris*, *Archangelica officinalis* (the last species in the Středolabská tabule Plain), hybrids of American poplars.

5. Elm-pedunculate oak woodland (*Querco-Ulmetum* Issler 1926), Fig. 16.

Synonyms: *Fraxino-Ulmetum* Oberdorfer 1953 p.max.p., *Omphalodo-Ulmetum* Mráz et Šika 1965 p.p.

Structure: Mostly three-layered stands dominated by *Quercus robur* or *Fraxinus excelsior* in the canopy. Ash frequently preferred for its economical importance. At present, low presence of *Ulmus minor*, *U. laevis*, typical hardwood species, as result of graphiose. *Tilia cordata* frequently admixed, in the wetter variant also *Alnus glutinosa*. Other softwood species (*Salix alba*, *Populus nigra*) present with a low cover; in the drier variant *Carpinus betulus* or *Acer campestre* occur. Shrub layer rich in species. Besides the saplings of the canopy, *Swida sanguinea* and, in moister types, *Padus avium* or *Sambucus nigra*, can be found. Vernal aspect of the field layer dominated by geophytes - *Ficaria bulbifera* in moister types, *Corydalis cava*, *Anemone nemorosa*, *Allium ursinum*, *Leucojum vernum*, *Galanthus nivalis* or *Scilla vindobonensis*, in the Oderská niva Floodplain (NE Moravia) also *Dentaria glandulosa*. In summer aspect *Aegopodium podagraria* or *Urtica dioica* typical (the last species in the moister variant). Ground layer mostly absent, sometimes some mosses occur with a very low cover.

Diagn.: Dif.: E3, E2 - *Ulmus minor*, *U. laevis*, E1 - *Brachypodium sylvaticum*, *Campanula trachelium*, *Milium effusum*, *Pulmonaria officinalis* agg.

Species with high constancy: E3 - *Quercus robur*, *Fraxinus excelsior*, E1 - *Glechoma hederacea*, *Aegopodium podagraria*, *Pulmonaria officinalis* agg., *Brachypodium sylvaticum*, *Geum urbanum*, *Urtica dioica*.

Differences: From the *Querco-Populetum* it differs principally in the composition of the canopy and shrub layer (in healthy stands *Ulmus laevis*, *U. minor*, *Tilia cordata* frequent, and in contrast, the retreat of *Populus nigra*). In the field layer of the *Querco-Ulmetum*, mesophilous or hygromesophilous *Fagetalia* and *Querco-Fagetea* species are typical (*Brachypodium sylvaticum*, *Campanula trachelium*, *Lathyrus vernus*, *Milium effusum*, *Pulmonaria officinalis* agg., *Stellaria holostea* etc.).

From the *Pruno-Fraxinetum*, absence of *Alnenion glutinoso-incanae* species and elements of the *Pruno-Fraxinetum* and, in contrast, the relatively frequent occurrence of *Ulmenion* species (*Ulmus minor*, *U. laevis*, *Populus nigra*, *Gagea lutea*, *Corydalis cava*), as well as *Quercus robur*, *Acer campestre*, *Carpinus betulus*, *Campanula trachelium* and *Lathyrus vernus*. From the Pannonian *Fraxino pannonicae-Ulmetum*, absence or very low occurrence (in the contact zone) of *Fraxinus angustifolia* subsp. *danubialis* and *Populus alba* in the canopy and the shrub layer, as well as *Aristolochia clematitis* and *Leucojum aestivum* in the field layer.

Adjoining PNV: Alluvial woodlands at lower levels (*Pruno-Fraxinetum*, *Stellario-Alnetum*, *Fraxino pannonicae-Ulmetum*, *Querco-Populetum*), oak-hornbeam and lime-oak woodlands (*Melampyro-Carpinetum*, *Primulo veris-Carpinetum*, *Tilio-Carpinetum*, *Tilio-Betuletum*), woodrush- or pine-oak woodlands (*Luzulo albidae-Quercetum petraeae*, *Festuco ovinae-Quercetum*).

Habitat: W2, only in the Ostrava area MW10, lowlands mostly at altitudes below 220 m. Mostly rarely flooded floodplains. Pedogenetically more developed alluvial or gley soils (brown vega, brown gley) in large river valleys.

Distribution: PND - 1.5%. Typical association of the Bohemian thermophyticum, above all in the Středolabská, Východolabská and Dolnooharská tabule Plains. In Moravia in the Hornomoravský úval Valley, at the lowest levels of the Bečevská niva Floodplain, N half of the Dyjskosvratecký úval Valley and Ostravská pánev Basin. Southwards it peters out (Fig. 15/5, 16).

Land use: Natural stands very rare (c. 5% of area), mostly plantations (*Fraxinus excelsior*, *Quercus rubra*, *Acer pseudoplatanus* or fast-growing poplar hybrids).

Much of the area of potential distribution used for agriculture, mostly as arable land (legumes, maize, cereals, rape, sugarbeet or clover, alfalfa etc.), less frequently as productive meadows (*Alopecuretum pratensis*, moister types of *Arrhenatheretum elatioris*). In the Východolabská tabule Plain, a large area of meadows ploughed and resown with productive grasses. The stands also used as pheasantries and small areas are built up.

At present, the remnants of elm-oak woodlands strongly endangered. Their further survival is conditional upon the maintenance of a natural water regime, with episodic floods. Drainage, accompanied by a lower productivity of the habitat, will result in the replacement of these communities by oak-hornbeam woodlands. Natural stands protect the river banks and soil against erosion, positively influence the mesoclimate, provide habitat and shelter for deer and many small mammals and contribute to the biodiversity of this largely agricultural landscape.

(Near-)natural stands: Středolabská tabule Plain - NNR Libický luh and Veltrubský luh near Kolín; NR Hornomoravský úval Valey - PLA Litovelské Pomoraví, e.g. NNR Vrapač, NNR Žebračka near Přerov; Ostravská pánev Basin - PLA Poodří, NNR Polanská niva.

Rare and endangered syntaxa: *Querco-Ulmetum* and small areas of wetlands in complex with this unit (*Carici acutiformis-Alnetum*, *Hottonietum palustris*, *Beruletum angustifoliae*).

Rare and endangered taxa: *Allium ursinum*, *Arum maculatum*, *A. orientale*, *Corydalis solida*, *Cucubalus baccifer*, *Dentaria glandulosa*, *Epipactis purpurata*, *E. albensis*, *Galanthus nivalis*, *Iris pseudacorus*, *Leucojum vernum*, *Omphalodes scorpioides*, *Scilla vindobonensis*, rarely *Hacquetia epipactis*; from adjoining communities *Daphne mezereum*, *Primula elatior* or *Lilium martagon*; in non-forest area *Cnidium dubium*, *Lathyrus palustris*, *Silaum silaus*, *Thalictrum lucidum*, *Viola elatior*.

References: Bednář (1964), Kincl (1992 ms.), Mezera et Samek (1954), Neuhäuslová-Novotná (1965), Neuhäuslová-Novotná in Moravec *et al.* (1982).

Typical relevé: Neuhäuslová-Novotná (1965): 440 a-d, rel. 41 (Dolnooharská tabule Plain), 158 m, plain, E3 - 80 %, E2 - 3%, E1 - 85 %, E0 - 5 %.

E3 - 3: *Tilia cordata*, 2: *Fraxinus excelsior*, 1: *Quercus robur*, r: *Ulmus laevis*,

E2 - +: *Sambucus nigra*, r: *Padus avium*,

E1 - 3: *Aegopodium podagraria*, *Corydalis cava**, 2: *Gagea lutea**, *Mercurialis perennis*, *Scilla vindobonensis**, 1: *Circaea lutetiana*, *Ficaria bulbifera**, *Galium aparine*, *Geum urbanum*, *Pulmonaria obscura*, *Stellaria holostea*, +: *Anthriscus sylvestris*, *Brachypodium sylvaticum*, *Dactylis glomerata*, *Deschampsia cespitosa*, *Fraxinus excelsior*, *Glechoma hederacea*, *Leucojum vernum*, *Poa nemoralis*, *Urtica dioica*, *Veronica chamaedrys*, r: *Acer platanoides*, *A. pseudoplatanus*, *Ajuga reptans*, *Alliaria petiolata*, *Chaerophyllum temulum*, *Festuca gigantea*, *Galeopsis tetrahit*, *Lamium maculatum*, *Lathyrus vernus*, *Poa trivialis*, *Sambucus nigra*, *Scrophularia nodosa*, E0 - 1: *Brachythecium rutabulum*.

Invas., expans.: *Impatiens parviflora*, *I. glandulifera*, *Rubus caesius*, *Urtica dioica*, *Carex brizoides*, *Reynoutria japonica*, *R. sachalinensis*, *Helianthus tuberosus*, *Archangelica officinalis*.

6. Pannonian elm-ash woodland (*Fraxino pannonicae-Ulmetum* Soó in Aszód 1936 corr. Soó 1963) in complex with poplar-ash woodland (*Fraxino-Populetum* Jurko 1958)

Synonyms: *Querco-Fraxinetum oxycarpae* et *Ulmo-Fraxinetum* Horák 1960, *Fraxino oxycarpae-Ulmetum* Šika et Mráz 1964.

Structure: More or less natural elm-ash woodland with a very pronounced vertical structure, three- or four- layered. Tree and field layer frequently further divided into sublayers. Canopy dominated by *Fraxinus angustifolia* subsp. *danubialis* and *Quercus robur*; in the lower tree layer *Tilia cordata*, *Ulmus minor* and *U. laevis* occur frequently. An admixture of *Fraxinus excelsior* and poplars can be found (*Populus nigra*, *P. alba*, or *P.* x *canescens*, the last especially frequent in poplar-ash woodlands). *Alnus glutinosa* appears in moist habitats, *Carpinus betulus* and *Acer campestre* at higher levels of the floodplain. Besides the regenerating woody species of the canopy, *Swida sanguinea* and *Sambucus nigra* frequent in the dense shrub layer. Of the lianes *Humulus lupulus* and *Vitis sylvestris* occur rarely. Field layer relatively open, but in stands with a more open shrub layer it forms a closed cover. Vernal aspect dominated by *Corydalis cava*, *Ficaria bulbifera* and frequently *Leucojum aestivum* (diff. species). Summer aspect with *Glechoma hederacea*, *Urtica dioica*, *Rubus caesius*, and in open stands, *Brachypodium sylvaticum*. Hygrophytes and telmatophytes abundant. In stands strongly influenced by man invasive species predominate. Ground layer often very open, cover rarely > 10%.

In poplar-ash woodlands the native poplar species and *Fraxinus angustifolia* subsp. *danubialis* are typical, and there is an absence of mesophilous woody species (*Carpinus betulus*, *Tilia cordata*, *Acer campestre*) and elms in the canopy. *Sambucus nigra* frequent in the shrub layer and *Lamium maculatum* and *Stellaria nemorum* in the field layer, whilst mesophilous woodland species (*Brachypodium sylvaticum*, *Milium effusum*, *Pulmonaria officinalis* etc.) are rare.

Diagn.: Dif.: E3, E2 - *Fraxinus angustifolia* subsp. *danubialis*, *Populus alba*** , *P.* x *canescens*** , *P. nigra*** , E1 - *Iris pseudacorus*, *Phalaris arundinacea*, *Aristolochia clematitis*, *Leucojum aestivum*.

Species with high constancy: E3 - *Quercus robur*, E3, E2 - *Fraxinus angustifolia* subsp. *danubialis*, E2 - *Ulmus minor*, E1 - *Circaea lutetiana*, *Glechoma hederacea*, *Rubus caesius*, *Symphytum officinale*, *Urtica dioica*.

Differences: From elm-oak woodland (*Querco-Ulmetum*), dominance or frequent occurrence of *Fraxinus angustifolia* subsp. *danubialis* and predominance of hygrophilous species.

Adjoining PNV: Alluvial woodlands of lower levels (*Querco-Ulmetum*, *Pruno-Fraxinetum*), oak-hornbeam woodland (*Primulo veris-Carpinetum*), pine-oak woodland (*Festuco ovinae-Quercetum roboris*), subcontinental thermophilous oak woodlands (*Carici fritschii-Quercetum*, *Quercetum pubescenti-roboris*).

Habitat: W4 (the warmest dry climatic subregion of the Republic), lowlands < 200 m. Frequently flooded. The soils are gleys, less frequently (in higher parts of floodplain) fluvisols (brown vega), very rarely anmoor. Heavier clay or clay-loamy soils rich in nutrient are mostly neutral or weakly alkaline.

Distribution: PND - 0.6%. S-Moravian Pannonicum represents the northernmost occurrence of this

vegetation, with its centre of distribution in the Pannonian area of Hungary. Mapped in the Dolnomoravský úval Valley as far as Napajedla and in the Dyjskosvratecký úval Valley as far as the village of Vranovice in the north, and southwestwards to the confluence of the rivers Jevišovka and Dyje. (Isolated, sometimes sizeable, stands of *Fraxinus danubialis* in floodplains of the Svratka river in the city of Brno and in the Hornomoravský úval Valley as far as the town of Přerov, see Fig. 15/6).

Land use: Although broadleaved woodlands are relatively frequent in the area of this unit, most of the forest area is used for plantations of poplar hybrids and other introduced woody species (*Juglans nigra*, *Quercus robur* f. *slavonica*). Deforested areas used as productive meadows (*Cnidion venosi*, *Veronico longifoliae-Lysimachion vulgaris*, *Molinion*, *Alopecurion*), less frequently as arable land (cereals, maize).

Both the *Fraxino pannonicae-Ulmetum* and *Fraxino-Populetum* represent very valuable remnants of wetland vegetation, declining as a result of human activities (plantations of introduced woody species, changes of water regime). Large areas of these woodlands destroyed by the building of the Nové Mlýny reservoirs, but some remnants of very valuable stands resembling primeval lowland alluvial woodlands can still be found there. Large areas used for plantations of economically preferred woody species (see above). Pure oak or ash plantations frequently attacked by pests and diseases. Stag-headed ash trees are common (result of a drop in groundwater level to 2 m). As well as graphiose of elms, many woody species are dammaged by tracheomycosis.

Besides their high productivity, these stands are very important in the hydrology of the S Moravian landscape: they ameliorate the relatively arid climate, regulate the water economy and reduce soil erosion. The natural stands contribute to the high biodiversity of S Moravia. Also aesthetic value (*Leucojum aestivum*).

(Near-)natural stands: Dolnomoravský úval Valley - PLA Soutok Moravy, NNR Cahnov and Ranšpurk.

Rare and endangered syntaxa: *Fraxino pannonicae-Ulmetum*, *Fraxino-Populetum* and *Salicetum albae* represent rare communities. Their substitute meadow communities (all. *Cnidion venosi* and *Veronico longifoliae-Lysimachion vulgaris*) are strongly endangered and some may already be extinct. The *Molinion* communities are also very rare (*Gentiano pneumonanthis-Molinietum litoralis*, *Silaetum pratensis*, *Serratulo-Festucetum commutatae*).

Rare and endangered taxa: *Aristolochia clematitis*, *Carex melanostachya*, *Leucojum aestivum*, *Platanthera bifolia*, *Primula elatior*, in substitute meadow communities *Allium angulosum*, *Anthemis austriaca*, *Cnidium dubium*, *Euphorbia palustris*, *E. lucida*, *Filipendula ulmaria* subsp. *picbaueri*, *Gratiola officinalis*, *Iris sibirica*, *Juncus atratus*, *Lathyrus palustris*, *Lythrum virgatum*, *Plantago altissima*, *Pseudolysimachion longifolium*, *Scutellaria hastifolia*, *Senecio erraticus*, *Silaum silaus*, *Thalictrum flavum*, *T. lucidum*, *Viola elatior*, *V. pumila*, *V. stagnina*, on drier sundy elevations *Armeria vulgaris*, *Cruciata pedemontana*, *Inula germanica*, *Iris variegata*, *I. graminea*, *Stipa borysthenica*.

References: Horák (1960), Neuhäuslová-Novotná in Moravec *et al.* (1982), Penka *et al.* (1985, 1991), Průša (1985).

Typical relevé: Neuhäuslová-Novotná in Moravec *et al.* (1982): Tab. 11, rel. 3 (Dolnomoravský úval Valley), 175 m, plain, E3 - 80%, E2 - 60%, E1 - 60%, E0 - 7%.

E3 - 3: *Fraxinus angustifolia* subsp. *danubialis*, *Quercus robur*, +: *Acer negundo*, *Tilia cordata*,

E2 - 4: *Swida sanguinea*, 2: *Tilia cordata*,

E1 - 3: *Glechoma hederacea*, 2: *Circaea lutetiana*, *Dactylis glomerata*, *Geum urbanum*, *Rubus caesius*, *Viola reichenbachiana*, 1: *Brachypodium sylvaticum*, *Fraxinus angustifolia* subsp. *danubialis*, *Leucojum aestivum*, *Lysimachia nummularia*, *Swida sanguinea*, *Urtica dioica*, +: *Acer campestre*, *Aegopodium podagraria*, *Ajuga reptans*, *Carex acutiformis*, *C. sylvatica*, *Deschampsia cespitosa*, *Festuca gigantea*, *Iris pseudacorus*, *Rhamnus catharticus*, *Rumex sanguineus*, *Tilia cordata*, *Ulmus minor*, r: *Aristolochia clematitis*, *Aster* cf. *lanceolatus*, *Carex remota*, *Colchicum autumnale*, *Crataegus monogyna*, *Filipendula ulmaria*, *Galium aparine*, *Hypericum hirsutum*, *Lapsana communis*, *Ranunculus repens*, *Scrophularia nodosa*,

E0 - 2: *Eurhynchium swartzii*, 1: *Plagiomnium affine*, *P. cuspidatum*.

Invas., expans.: *Aster* cf. *lanceolatus*, *Solidago gigantea*, *Impatiens parviflora*, *Rubus caesius*, *Urtica dioica*.

Oak-hornbeam and lime-oak woodlands (*Carpinion* Issler 1931)

Mostly mesophilous, broadleaved, rarely mixed woodlands with *Abies alba* or *Picea abies* on mesotrophic to eutrophic habitats from lowlands to colline, very rarely submontane, levels. Area of PNV - 29.4% of the total area of the Republic.

7. Oak-hornbeam woodland with *Melampyrum nemorosum* (*Melampyro nemorosi-Carpinetum* Passarge 1957, Fig. 15/7 and 17).

Synonyms: *Querco-Carpinetum* or *Galio-Carpinetum* auct. bohem. p. max. p., *Querco-Carpinetum bohemicum* Klika 1932.

Structure: Closed oak-hornbeam woodlands dominated by *Quercus petraea* and *Carpinus betulus*, with a frequent admixture of *Tilia cordata* (in moister habitats *T. platyphyllos*), *Quercus robur* and nutrient-demanding broadleaved woody species (*Fraxinus excelsior*, *Acer pseudoplatanus*, *A. platanoides*, *Cerasus avium*). At higher or inversion levels *Fagus sylvatica* and *Abies alba* occur. In open stands shrub layer formed by regenerating species of the canopy and mesophilous forest species (*Swida sanguinea*, *Crataegus monogyna*, *C. laevigata*, *Ligustrum vulgare*). Field layer dominated by mesophilous species, principally herbs (*Hepatica nobilis*, *Galium sylvaticum*, *Campanula persicifolia*, *Lathyrus vernus*, *L. niger*, *Lamium galeobdolon* agg., *Melampyrum nemorosum*, *Mercurialis perennis*, *Asarum europaeum*, *Pyrethrum corymbosum*, *Viola reichenbachiana* etc.), less frequently grasses (*Festuca heterophylla*, *Poa nemoralis*).

Diagn.: Dif.: E1 - *Hepatica nobilis*, *Festuca heterophylla*.

Species with high constancy: E3 - *Carpinus betulus*, *Quercus petraea*, E1 - *Anemone nemorosa*, *Hepatica nobilis*, *Hieracium murorum*, *Lathyrus vernus*, *Melica nutans*, *Poa nemoralis*, *Stellaria holostea*.

Differences: From the *Tilio-Betuletum*, frequent occurrence of nutrient-demanding species of the order *Fagetalia* (see above); from the *Carici pilosae-Carpinetum*, absence or only rare occurrence of *Carex pilosa* (mostly in the contact zone, but frequent in SW Moravia), *Melica uniflora*, *Dentaria bulbifera* and *Fagus sylvatica* (in the canopy or shrub layer).

Adjoining PNV: Alluvial woodlands of planar and colline levels (*Ulmenion*, *Pruno-Fraxinetum*, *Stellario-Alnetum*, *Carici remotae-Fraxinetum*), other *Carpinion* communities, acidophilous oak woodlands (*Genisto*

germanicae-Quercion), scree and ravine woodlands (*Aceri-Carpinetum*, *Lunario-Aceretum*), downy oak and subxerophilous thermophilous oak woodlands (*Quercetalia pubescenti-petraeae*), herb-rich, calcareous and acidophilous beech woodlands (*Eu-Fagenion*, *Cephalanthero-Fagenion*, *Luzulo-Fagetum*).

Habitat: Mostly MW11-7, less frequently W2, colline, rarely supracolline levels ([200] 250-450 m), rarely on sunny slopes up to 550 m (e.g. Biosphere Reserve Křivoklátsko). Climax vegetation of planar to supracolline levels with its optimum at colline levels, on different relief forms - lowland plains, slopes of various aspects or shallow depressions. The soils, developed on different geological substrates from acidic substrates to crystalline limestones, loess or alluvial sediments, correspond to various types - mostly cambisols (eutrophic to oligotrophic), with a wide range of nutrient reserves and pH, or luvisols, both types sometimes gleyed or pseudogleyed. Ranker-cambisols also occur in contact with scree woodlands or the *Sorbo torminalis-Quercetum*. Soils on calcium-rich shallow substrates correspond to rendzina, those on alluvial sediments to brown gley.

Distribution: PND - 19,2%. In the past the *Melampyro-Carpinetum* represented the most extensive unit of oak-hornbeam woodlands in the Czech Republic, with centres of distribution in W (Plzeňská pahorkatina Hills), N (Mostecká pánev Basin, České středohoří Uplands), Central and E Bohemia (plateaus Pražská plošina, Česká tabule) and Central Moravia (Boskovická brázda and Bobravská vrchovina Uplands). The eastern limit is the line from Znojmo - Brno - N part of the Hornomoravský úval Valley.

Land use: At present, near natural stands are very rare. The area of potential distribution mostly used for agriculture (gradually deforested since the Neolithic period). Forest pasture, coppice management and later the planting of unsuitable woody species (principally conifers) caused their decline.

In urban agglomerations small areas used as parks or other types of urban greenery or, on the outskirts, for planting near-natural stands or introduced woody species, gardens or orchards. Large areas used as arable land (sugarbeet, cereals, fodder crops or rape, less frequently legumes).

The *Melampyro-Carpinetum* belongs to vegetation types endangered by human influence, namely by replacement with coniferous plantations. The very small areas of near-natural stands in the agricultural landscape at present strongly influenced by eutrophication. The protection of remnants of these woodlands and their expansion in the Czech landscape is necessary for the functioning of ecosystem processes and successfull restoration of the landscape.

Fig. 17 — Melampyro nemorosi-Carpinetum Passarge 1957.

(Near-)natural stands: Křivoklátská vrchovina Uplands - PLA Křivoklátsko; PLA Český kras - forest estates Třebotov, Koda, Karlštejn; Východolabská tabule Plain; NP Podyjí.

Rare and endangered syntaxa: on non-forest soils *Carici humilis-Callunetum*, *Ononido spinosae-Cirsietum acaulis*, on arable land *Caucalido daucoidis-Conringietum orientalis*, *Lathyro-Adonidetum aestivalis*.

Rare and endangered taxa: *Abies alba*, *Astrantia major*, *Carex umbrosa*, *Cyclamen europaeum*, *Daphne mezerum*, *Epipactis purpurata*, *Erythronium dens-canis*, *Lilium martagon*, *Melittis melissophyllum*, *Primula veris*. On arable land: *Adonis aestivalis*, *Caucalis daucoides*, *Conringia orientalis*, *Silene noctiflora*.

References: Chytrý et Vicherek (1995), Klika (1928, 1932), Mikyška (1972), Neuhäusl in Moravec *et al.* (1982), Neuhäusl et Neuhäuslová-Novotná (1968, 1969, 1972a), Neuhäuslová-Novotná (1964), Samek (1964).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1969): Tab. 1, rel. 17 (Východolabská tabule Plain), 260 m, E, 50, E3 - 95%, E2 - 5%, E1 - 70%, E0 - 3%.

E3 - 4: *Carpinus betulus*, 2: *Quercus robur*, 1: *Q. petraea*,

Fig. 18 — Tilio-Betuletum Passarge 1957.

E2 - +: *Carpinus betulus*, *Ligustrum vulgare*, *Quercus robur*, r: *Crataegus monogyna*,

E1 - 3: *Anemone nemorosa**, *Milium effusum*, *Poa nemoralis*, 2: *Anemone ranunculoides**, *Corydalis cava**, *Ficaria bulbifera**, *Galium sylvaticum*, *Pulmonaria obscura*, *Stellaria holostea*, 1: *Fragaria vesca*, *Tilia cordata*, +: *Acer campestre*, *Euonymus europaea*, *Festuca heterophylla*, *Heracleum sphondylium*, *Hieracium murorum*, *H. sabaudum*, *Ranunculus auricomus*, *Scrophularia nodosa*, *Veronica chamaedrys*, *Viola riviniana*, r: *Campanula trachelium*, *Carpinus betulus*, *Festuca gigantea*, *Galeobdolon montanum*, *Geum urbanum*, *Lathyrus niger*, *Melica nutans*, *Rosa canina*, *Rubus fruticosus* agg., *Sorbus aucuparia*.

E0 - *Atrichum undulatum*.

Invas., expans.: *Calamagrostis arundinacea*, *Convallaria majalis*, *Impatiens parviflora*, *Aegopodium podagraria*, *Melampyrum nemorosum*, *M. pratense*, *Robinia pseudacacia*, *Rubus fruticosus* agg., *Reynoutria japonica* (frequently in N Bohemia), *R. sachalinensis*, on the Pražská plošina Plain also *Reynoutria* x *bohemica*, *Urtica dioica*.

Remarks: The almost deforested area in the Broumovská vrchovina Uplands, with analogous habitat conditions, is incorporated into this unit. Of the woody species of this unit *Tilia cordata*, *Acer pseudoplatanus* and *Acer platanoides* occur there. On the basis of habitat analogy, the occurrence of *Carpinus betulus* and *Quercus robur* is also assumed with *Carex brizoides* and *C. umbrosa* in the field layer. The soils are pseudogleyed cambisols on Neogene deposits. The occurrence of this unit is mapped in the adjoining part of Poland.

8. Lime-oak woodland (*Tilio-Betuletum* Passarge 1957), Fig.18.

Synonyms: *Tilio-Quercetum* Passarge 1962.

Structure: Two- or three-layered, relatively species-poor stands, transitional to acidophilous oak woodlands. Canopy dominated by *Quercus petraea*, rarely *Q. robur* with *Tilia cordata* (as subdominant), rare occurrence or absence of *Carpinus betulus*, conditioned by nutrient-poor soils. Less nutrient-demanding woody species (*Betula pendula*, *Sorbus aucuparia*) occur sporadically. Open shrub layer dominated by *Tilia cordata*, field layer by grasses (*Poa nemoralis*, or together with *P. angustifolia*, *Calamagrostis arundinacea*, *Holcus mollis*, *Melica nutans*, *Dactylis polygama*) and less nutrient-demanding species (e.g. *Anemone nemorosa*, *Hieracium murorum*, *Scrophularia nodosa*, *Viola riviniana*). *Plagiomnium undulatum* occurs regularly in the ground layer, but with a very low cover.

Diagn.: Dif.: E1 - *Carex pallescens*, *C. pilulifera*, *C. umbrosa*, *Deschampsia flexuosa*, *Holcus mollis*, *Hypericum montanum*, *Poa angustifolia*.

Species with high constancy: E3 - *Quercus robur*, E3, E2 - *Tilia cordata*, E1- *Anemone nemorosa*, *Carex montana*, *Festuca ovina*, *Fragaria vesca*, *Moehringia trinervia*, *Poa nemoralis*, *Scrophularia nodosa*, *Veronica officinalis*, *Viola riviniana*.

Differences: From the *Melampyro-Carpinetum*, absence or weak occurrence of *Carpinus betulus*, and retreat of nutrient-demanding species, principally those of the *Fagetalia* (*Daphne mezereum*, *Pulmonaria officinalis* agg., *Phyteuma spicatum*, *Ranunculus lanuginosus*, *Viola reichenbachiana*, *Mercurialis perennis*, *Hepatica nobilis*, *Campanula persicifolia*), further *Pyrethrum corymbosum*, *Melittis melissophyllum* and presence of diagnostic species of the *Tilio-Betuletum*; from acidophilous oak woodland of the *Genisto-Quercion*, frequent occurrence of *Tilia cordata* in the canopy and mesophilous species *Stellaria holostea*, *Scrophularia nodosa*, *Moehringia trinervia*, *Melica nutans* in the field layer.

Adjoining PNV: *Melampyro-Carpinetum*, alluvial woodlands at lower levels (*Pruno-Fraxinetum*, *Stellario-Alnetum*, *Querco-Ulmetum*), acidophilous oak woodlands (*Luzulo albidae-Quercetum petraeae*, *Festuco ovinae-Quercetum roboris*, *Molinio arundinaceae-Quercetum*).

Habitat: Mostly W2, warm and relatively dry areas in the lowlands and colline levels of Bohemia. The *Tilio-Betuletum* is an edaphic climax on relatively nutrient-poor, mostly drier soils. Typical are medium-rich terrace sands, gravelly-sands and loamy, psamic eolic sediments and other light substrates on mineral-rich impermeable sediments (e.g. Cretaceous sediments). Decalcified loess loams and loamy weathered substrates of Proterozoic and Ordovician slates with sufficient nutrient reserves and a suitable soil moisture regime are frequent. The soils are cambisols (mesotrophic to oligotrophic brown earths), partly gleyed, or acidic luvisols.

Distribution: PND - 1.0%. Pražská plošina and Česká tabule Plain in a belt near the Elbe river between the town of Terezín to the surroundings of the town of Pardubice (Fig.15/8).

Land use: The area of this unit partly covered by broadleaved or coniferous woodlands, or partly deforested. Of coniferous species, mostly *Pinus sylvestris* and *P. strobus* are planted (the last becoming invasive in the Nymburská kotlina Basin); of broadleaved species, *Quercus rubra*. Deforested areas are used as arable land (cereals, strawberries, nut trees, orchards). An extensive part of the Pražská plošina Plateau is built up (urban or industrial agglomerations).

Natural woods and plantations of economically preferred woody species mostly used as recreational areas. In pure pine plantations, raw humus has accumulated, the diversity is lowered and degradation of the upper soil horizons can be seen.

The recreational use of many stands causes strong anthropogenous stress. Natural remnants very rare.

(Near-)natural stands: Pražská plošina Plateau, near the village of Klánovice, Prague.

Rare and endangered syntaxa: substitute communities *Pulsatillo pratensis-Avenochloetum pratensis*, *Consolido- Anthemidetum austriacae*.

Rare and endangered taxa: *Carex umbrosa*, *Platanthera bifolia*, in non-forest vegetation *Anthemis austriaca*, *Myosurus minimus*, *Pulsatilla pratensis*.

References: Neuhäusl et Neuhäuslová-Novotná (1968, 1971, 1979). Neuhäusl in Moravec *et al.* (1982), Neuhäusl in Moravec, Neuhäusl *et al.* (1992).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1968): 250-252, tab. 14, rel. 43 (Nymburská kotlina Basin), 190 m, plain, E3 - 80%, E2 - 50%, E1 - 40%, E0 - 2%.

E3 - 4: *Quercus petraea*, 2: *Tilia cordata*,

E2 - 3: *Tilia cordata*,

E1 - 3: *Poa nemoralis*, 2: *Anemone nemorosa*, *Dactylis polygama*, *Viola riviniana*, 1: *Convallaria majalis*, *Melica nutans*, +: *Carex pilulifera*, *Epilobium montanum*, *Hieracium murorum*, *Holcus mollis*, *Luzula luzuloides*, *Milium effusum*, *Platanthera bifolia*, *Poa angustifolia*, *Polygonatum multiflorum*, *Quercus petraea*, *Scrophularia nodosa*, *Stellaria holostea*, *S. media*, *Tilia cordata*, r: *Brachypodium sylvaticum*, *Carex montana*, *Cerasus avium*, *Deschampsia flexuosa*, *Grossularia uva-crispa*, *Hypericum montanum*, *Luzula pilosa*, *Moehringia trinervia*, *Rubus fruticosus* agg., *Sorbus aucuparia*, *Veronica officinalis*.

E0 - +: *Atrichum undulatum*, r: *Polytrichum formosum*.

Invas., expans.: *Padus serotina*, *Pinus strobus*, *Impatiens parviflora*, *Rubus fruticosus* agg., *Calamagrostis epigejos*, *Convallaria majalis*, or *Reynoutria* x *bohemica* (Pražská plošina Plateau).

9. Pannonian oak-hornbeam woodland with *Primula veris* (*Primulo veris-Carpinetum* Neuhäusl et Neuhäuslová ex Neuhäuslová-Novotná 1964)

Synonyms: *Polygonato latifolii-Carpinetum* Michalko et Džatko 1965.

Structure: Two- or three-layered stands dominated by *Carpinus betulus*, *Quercus petraea* or *Q. robur*, with many thermophilous species (*Cornus mas*, *Euonymus verrucosa*, *Pulmonaria mollis*, *Buglossoides purpurocaerulea* etc.). Shrub and field layers rich in species, with many mesophilous elements and species common to thermophilous oak woodlands (see below).

Diagn.: Dif.: E3, E2 - *Acer campestre*, E2 - *Cornus mas*, *Euonymus verrucosa*, *Ligustrum vulgare*, *Rhamnus catharticus*, *Sorbus torminalis*, E1 - *Carex michelii*, *Chamaecytisus supinus*, *Buglossoides purpurocaerulea*, *Polygonatum latifolium*, *Pulmonaria mollis*, *Viola mirabilis*.

Species with high constancy: E3, E2 - *Carpinus betulus*, E3 - *Quercus petraea*, *Q. robur*, E2 - *Acer campestre*, E1 - *Clinopodium vulgare*, *Campanula persicifolia*, *C. rapunculoides*, *Convallaria majalis*, *Dactylis polygama*, *Fragaria vesca*, *Galium odoratum*, *G. sylvaticum*, *Geum urbanum*, *Melica uniflora*, *Poa nemoralis*, *Polygonatum multiflorum*, *Scrophularia nodosa*.

Differences: From the adjoining oak-hornbeam woodlands, frequent occurrence of differentiating thermophilous elements (see above).

Adjoining PNV: Thermophilous oak woodlands (*Quercetalia pubescenti-petraeae*), lowland alluvial woodlands (*Ulmenion*, *Pruno-Fraxinetum*), oak-hornbeam (*Melampyro-Carpinetum*, *Carici pilosae-Carpinetum*) and pine-oak woodlands (*Festuco ovinae-Quercetum roboris*).

Habitat: W4, in the warmest climatic subregion of the Moravian Pannonian area linked with relatively cold and moist, lower colline levels. Mostly moderate shady slopes and large valley bottoms at altitudes of c. 200-330 m, rarely on plains or on steep slopes. Deep, heavy soils with a favourable water and air regime, developed on loess or calcium-rich Tertiary sediments, corresponding to mesotrophic luvisols, rarely cambisols (eutrophic brown earth) or degraded chernozems.

This community was constructed on corresponding habitats on Miocene sediments in deforested areas of large Moravian river valleys.

Distribution: PND - 2.4%. Clearly associated with the Pannonian area of S Moravia. Its western and northern borders are formed more or less by the line Znojmo - Brno; eastwards it extends to the warm, lower slopes of the Bílé Karpaty Mts., southwards to the state boundary (Fig. 15/9).

Land use: Woodlands, managed as medium- or low-productive coppices, are very rare and restricted to areas unsuitable for agriculture. Many stands strongly damaged by mouflon (Pavlovské vrchy Hills). Most of the potential area of distribution deforested and used as arable land (cereals, maize, rarely vineyards).

Near-natural stands very rare. They protect against soil erosion, play an important role in the water economy, increase the biodiversity and reduce desiccation of the warm and dry Pannonian landscape. Aesthetic importance (flowers) of many thermophilous herbs and shrubs.

(Near-)natural stands: PLA Pálava, Kobylsko.

Rare and endangered syntaxa: on non-forest soil *Potentillo albae-Brachypodietum pinnati*, *Brachypodio-Molinietum*, *Verbasco austriaci-Inuletum ensifoliae*, *Caucalido daucoidis-Conringietum orientalis*, *Lathyro-Adonidetum aestivalis*.

Rare and endangered taxa: *Carex michelii*, *Dictamnus albus*, *Lilium martagon*, *Melittis melissophyllum*, *Primula veris*, *Pulmonaria mollis*, *Vicia dumetorum*, on non-forest soil

Adonis aestivalis, *Caucalis platycarpos*, *Conringia orientalis*, *Lathyrus hirsutus*, *Orchis mascula*, *O. militaris*, *Orobanche minor*, *Thymelea passerina*.

References: Neuhäusl et Neuhäuslová (1968), Neuhäusl in Moravec *et al.* (1982), Chytrý et Vicherek (1995).

Typical relevé: Neuhäusl et Neuhäuslová (1968): tab. 6 - suppl., rel. 20 (Pavlovské vrchy Hills), 310 m, SE, 100, E3 - 80%, E2 - 10%, E1 - 60%, E0 - 0%

E3-4: *Quercus petraea*, 1: *Quercus robur*, *Tilia cordata*, +: *Carpinus betulus*,

E2 - 2: *Corylus avellana*, 1: *Carpinus betulus*, *Fraxinus excelsior*, *Cornus mas*, *Crataegus monogyna*, *Ligustrum vulgare*, *Lonicera xylosteum*, *Quercus petraea*, *Tilia cordata*, r: *Acer campestre*, *Crataegus laevigata*, *Rhamnus catharticus*, *Staphylea pinnata*, *Sorbus torminalis*, *Swida sanguinea*,

E1 - 2-3: *Convallaria majalis*, 2: *Dactylis polygama*, *Festuca heterophylla*, *Galium sylvaticum*, *Poa nemoralis*, 1: *Carpinus betulus*, *Fragaria vesca*, *Lathyrus niger*, *Pulmonaria officinalis*, *Quercus petraea*, +: *Acer campestre*, *Calamagrostis arundinacea*, *Clinopodium vulgare*, *Campanula persicifolia*, *C. rapunculoides*, *C. trachelium*, *Carex montana*, *Hepatica nobilis*, *Hieracium sabaudum*, *Isopyrum thalictroides*, *Lathyrus pratensis*, *L. vernus*, *Melampyrum nemorosum*, *Melica uniflora*, *Melittis melissophyllum*, *Pyrethrum corymbosum*, *Rhamnus catharticus*, *Solidago virgaurea*, *Taraxacum officinale* agg., *Viola mirabilis*, r: *Buglossoides purpurocaerulea*, *Carex muricata* agg., *Cerasus avium*, *Corylus avellana*, *Fallopia convolvulus*, *Geum urbanum*, *Hieracium murorum*, *Hypericum montanum*, *Lonicera caprifolium*, *L. xylosteum*, *Melica nutans*, *Neottia nidus-avis*, *Prunus spinosa*, *Rosa* sp., *Sedum telephium* agg., *Sorbus domestica*, *S. torminalis*, *Stellaria media*, *Viburnum lantana*, *Vicia dumetorum*.

Invas., expans.: *Impatiens parviflora*, *Robinia pseudacacia*.

10. Carpathian oak-hornbeam woodland with *Carex pilosa* (*Carici pilosae-Carpinetum* Neuhäusl et Neuhäuslová-Novotná 1964)

Synonyms: *Querceto-Carpinetum caricetosum pilosae* auct. bohemoslov. p. max. p., *Querceto-Carpinetum carpaticum* Klika 1943 p.p.

Structure: Two- or three-layered stands dominated by *Carpinus betulus* on moister sites, or *Quercus petraea* on drier sites, with frequent *Tilia cordata* and *Fagus sylvatica* in the canopy and a poorly developed shrub layer. In the field layer mesophilous forest species prevail, principally *Carex pilosa* with *Dentaria bulbifera* in the vernal aspect.

Diagn.: Dif.: E3-E1 - *Fagus sylvatica*, E1 - *Carex pilosa*, *Dentaria bulbifera*, *Euphorbia amygdaloides*, *Symphytum tuberosum*.

Species with high constancy: E3, E2 - *Carpinus betulus*, *Quercus petraea*, E1 - *Carex digitata*, *C. pilosa*, *Euphorbia amygdaloides*, *Fragaria vesca*, *Galium odoratum*, *Lathyrus vernus*, *Melica uniflora*, *Poa nemoralis*, *Veronica chamaedrys*, *Viola reichenbachiana*.

Differences: From the *Melampyro-Carpinetum*, diff. species of the *Carici pilosae-Carpinetum*, and presence of *Salvia glutinosa* and *Melica uniflora*; from the *Primulo veris-Carpinetum*, absence of thermophilous species of this last unit and presence of hygromesophilous species of the *Carici-Carpinetum*. From the *Melico-Fagetum*, presence of *Lathyrus niger* or *Knautia drymeia*.

Adjoining PNV: Alluvial woodlands of lower levels (*Querco-Ulmetum*, partly *Alnenion glutinoso-incanae*), other oak-hornbeam woodlands (*Carpinion*), acidophilous oak woods (*Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*), herb-rich and acidophilous beech woods (*Melico-Fagetum*, *Carici pilosae-Fagetum*, *Festuco altissimae-Fagetum*, *Dentario enneaphylli-Fagetum*, *Dentario glandulosae-Fagetum*, *Luzulo-Fagetum*, *Carici brizoidis-Quercetum*), subxerophilous oak woodland (*Potentillo albae-Quercetum*).

Habitat: MW11-7, less frequently W2, at colline to supracolline levels of the Carpathians. Very rarely, on relatively warm sunny slopes, it reaches 550 m. Brown forest soils (brown earths, cambisols, luvisols) with favorable soil moisture and nutrient reserves, rarely brown rendzinas.

Distribution: PND - 4%. Lower levels of the Western Carpathians only; northern border crosses the Moravská brána Gate and the southwestern and southeastern limit of the Nízký Jeseník Mts., southwestern limit is on the boundary of the Pannonian S Moravian area, western boundary in the Drahanská vrchovina Uplands adjoins the Hercynian *Melampyro-Carpinetum* (Fig.15/10).

Land use: Natural or near-natural stands are managed mostly as coppices. The potential area of distribution partly used as spruce, rarely pine or birch plantations, meadows and pastures (*Arrhenatherion*, *Cynosurion*, *Bromion erecti*). Only a small area is built up.

This woodland represents a relatively frequent community, declining as a result of human influence, above all by the replacement of natural woody species with coniferous plantations, which cannot fullfil the functions of natural stands (soil protection, maintenance of biodiversity and nutrient cycling in ecosystems).

(Near-)natural stands: Many locations in the Ždánický les Hills, PLA Bílé Karpaty Mts. and Chřiby Mts.

Rare and endangered syntaxa: of non-forest vegetation *Brachypodio-Molinietum*.

Rare and endangered taxa: *Aremonia agrimonioides*, *Astrantia major*, *Cephalantera damasonium*, *C. longifolia*, *Dactylorhiza fuchsii*, *D. sambucina*, *Daphne mezereum*, *Epipactis microphylla*, *E. muelleri*, *E. purpurata*, *Gymnadenia conopsea*, *Hacquetia epipactis*, *Isopyrum thalictroides*, *Lilium martagon*, *Melittis melissophyllum*, *Orchis pallens*, *Primula veris*, *Pulmonaria mollis*, *Staphyllea pinnata*, *Scilla kladnii* (Carpathian subendemic), *Vicia pisiformis*, in meadows *Orchis militaris*, *O. mascula* subsp. *signifera*.

References: Kincl (1992 ms.), Neuhäusl et Neuhäuslová (1968), Neuhäusl et Neuhäuslová-Novotná (1972).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1972): Tab. 2 - suppl., rel. 34 (Středomoravské Karpaty Mts. - Litenčická pahorkatina Hills), 365 m, S, 30, E3 - 90%, E2 - 3%, % E1 - 80%, E0 - 3%.

E3 - 3-4: *Quercus petraea*, 3: *Carpinus betulus*, +: *Larix decidua*, *Tilia cordata*,

E2 - 1: *Tilia cordata*, r: *Carpinus betulus*,

E1 - 3: *Carex pilosa*, *Melica uniflora*, 2-3: *Galium odoratum*, *Isopyrum thalictroides** , 2: *Dentaria bulbifera**, *Poa nemoralis*, *Pulmonaria officinalis*, 1: *Anemone ranunculoides**, *Carpinus betulus*, *Lathyrus vernus*, *Neottia nidus-avis*, *Quercus petraea*, *Symphytum tuberosum*, +-1: *Euphorbia amygdaloides*, *Polygonatum multiflorum*, +: *Campanula rapunculoides*, *Carex digitata*, *Convallaria majalis*, *Hacquetia epipactis*, *Maianthemum bifolium*, *Melica nutans*, *Sanicula europaea*, *Scrophularia nodosa*, r: *Acer campestre*, *Ajuga reptans*, *Athyrium filix-femina*, *Carex sylvatica*, *Cerasus avium*, *Dactylis polygama*, *Fagus sylvatica*.

Invas., expans.: *Clematis vitalba*, *Impatiens parviflora*, *Galium aparine*.

11. Lime-rich oak-hornbeam woodland (*Tilio-Carpinetum* Traczyk 1962)

Synonyms: *Querco-Carpinetum* sensu Vicherek 1956 et Neuhäusl 1963a.

Structure: Three-, rarely four-layered lime-rich oak-hornbeam stands with a natural admixture of *Picea abies*, *Populus tremula* and *Sorbus aucuparia* in the canopy. Dense shrub layer, many hygrophilous and mesophilous woodland species in both the shrub and field layers (*Sambucus nigra*, *Padus avium*, *Stachys sylvatica*, *Stellaria holostea*, *Carex brizoides*, *Galeobdolon luteum*, *Oxalis acetosella*, *Poa nemoralis* or *Asarum europaeum*, *Galium odoratum*). Very open and poorly developed ground layer covers mostly less than 10% of the area.

Diagn.: Dif.: E3 - *Picea abies* (natural!), *Populus tremula*, *Sorbus aucuparia*.

Species with high constancy: E3, E2 - *Carpinus betulus*, *Quercus robur*, *Tilia cordata*, E2 - *Corylus avellana*, E1 - *Anemone nemorosa*, *Athyrium filix-femina*, *Campanula trachelium*, *Galeobdolon luteum*, *G. montanum*, *Maianthemum bifolium*, *Oxalis acetosella*, *Poa nemoralis*, *Polygonatum multiflorum*, *Scrophularia nodosa*, *Viola reichenbachiana*.

Differences: From the *Melampyro-Carpinetum* and *Carici pilosae-Carpinetum*, natural occurrence of *Picea abies*, *Populus tremula* and *Sorbus aucuparia* and retreat of thermophilous elements; from the *Melampyro-Carpinetum*, more frequent presence of hygrophilous species of alluvial woodlands (*Padus avium*, *Sambucus nigra*, *Stachys sylvatica*, *Circaea lutetiana* etc.).

Adjoining PNV: Oak-hornbeam woodlands (*Melampyro-Carpinetum*, *Carici pilosae-Carpinetum*), acidophilous oak woodlands (*Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*, *Molinio arundinaceae-Quercetum*), alluvial woodlands (*Querco-Ulmetum*, *Pruno-Fraxinetum*), waterlogged oak-beech woods (*Carici brizoidis-Quercetum*), herb-rich and woodrush-beech woodlands (*Melico-Fagetum*, *Luzulo-Fagetum*).

Habitat: MW11-7. Plains or moderate slopes at colline levels (250-400 m), with deep, heavy, pseudogleyed brown soils (brown earths, cambisols or luvisols) or pseudogleys with differences in soil moisture, acidity and nutrient reserves typical for individual subassociations.

Distribution: PND - 2.6%. Typical oak-hornbeam woodland of Silesia and adjoining part of Moravia, northwestern outposts of Moravian Carpathians (Podbeskydská pahorkatina Hills) and Moravská brána Gate. Westwards it penetrates into the Hornomoravský úval Valley (Fig.15/11).

Land use: At present, near or near-natural stands cover c. 5% of the area of this unit. They are restricted to levels less suitable for agriculture and mostly managed as coppices. Coniferous plantations of *Picea abies*, *Pinus sylvestris*, *Larix decidua* cover large areas. Flat levels usually used as arable land (cereals, rarely sugarbeet, poppies, fodder crops, maize, rape). Of the meadows, mostly moist to wet types prevail in strongly waterlogged areas following deforestation. At present, many meadows drained, ploughed and replaced by arable land. A part of potential area covered by urban and industrial agglomerations (Ostrava area).

Coppices of a low productivity with a more or less natural species composition are able to regulate the water regime of the soil. High natural woodlands are very resistant against pollution.

(Near-)natural stands: Podbeskydská pahorkatina and Kelčská pahorkatina Hills.

Rare and endangered syntaxa: of non-forest vegetation *Scabioso-Phleetum*.

Rare and endangered taxa: *Abies alba*, *Daphne mezereum*, *Primula elatior*.

References: Kincl (1990a, 1992 ms.), Neuhäusl in Moravec *et al.* (1982), Neuhäuslová-Novotná et Neuhäusl (1971).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1972), Tab. 3, rel. 63 (Nízký Jeseník Mts.), 360 m, NW, 100, E3 - 90%, E2 - 40%, E1 - 70%, E0 - 3%.

E3 - 4: *Tilia cordata*, 1: *Carpinus betulus*, *Picea abies*, *Quercus petraea*, +: *Q. robur*,

E2 - 3: *Tilia cordata*, 2: *Corylus avellana*, 1: *Sambucus nigra*, *Grossularia uva-crispa*, +: *Acer pseudoplatanus*, *Lonicera xylosteum*, r: *Picea abies*,

E1 - 3: *Asarum europaeum*, *Oxalis acetosella*, 2: *Anemone nemorosa*, *Convallaria majalis*, *Melica uniflora*, *Senecio fuchsii*, 1: *Dryopteris filix-mas*, *Ficaria bulbifera*, *Impatiens noli-tangere*, *Galeobdolon luteum*, *Poa nemoralis*, *Rubus fruticosus* agg., *Sanicula europaea*, *Stachys sylvatica*, *Symphytum tuberosum*, *Viola reichenbachiana*, +: *Ajuga reptans*, *Campanula persicifolia*, *Corylus avellana*, *Dactylis polygama*, *Fragaria vesca*, *Geranium robertianum*, *Geum urbanum*, *Maianthemum bifolium*, *Moehringia trinervia*, *Mycelis muralis*, *Polygonatum multiflorum*, *Primula elatior*, *Scrophularia nodosa*, *Sorbus aucuparia*, *Tilia cordata*, *Viburnum opulus*, r: *Acer pseudoplatanus*, *Cerasus avium*, *Daphne mezereum*, *Epilobium montanum*, *Euonymus europaea*, *Festuca gigantea*, *Lonicera xylosteum*, *Luzula pilosa*, *Roegneria canina*,

E0 - 1: *Atrichum undulatum*.

Invas. expans.: *Carex brizoides*, *Sambucus nigra*, *Impatiens parviflora*, *Rubus fruticosus* agg., *Solidago canadensis*.

12. Lime-oak woodland (*Stellario-Tilietum* Moravec 1964), Fig. 19.

Structure: Mostly two-layered, rarely three-layered, stands dominated by *Tilia cordata* or *Quercus robur*, or by the same portion of both woody species. Absence of *Carpinus betulus* and *Quercus petraea* as result of cessation of migration from Central Bohemia. Frequently, *Sorbus aucuparia* and *Acer platanoides* admixed with low dominance. In the shrub layer, if developed, *Corylus avellana* prevails. Field layer dominated by (hygro)mesophilous forest species (*Stellaria holostea*, *Galeobdolon luteum*, *Poa nemoralis* or *Aegopodium podagraria*, *Oxalis acetosella* and *Milium effusum* abundant, *Carex brizoides* and *Luzula luzuloides* frequent).

Diagn.: Dif.: E1 - *Carex brizoides*, *Hepatica nobilis*.

Species with high constancy: E3 - *Tilia cordata*, *Quercus robur*, E1 - *Aegopodium podagraria*, *Anemone nemorosa*, *Campanula trachelium*, *Carex brizoides*, *Galeobdolon luteum*, *Galeopsis bifida*, *Hepatica nobilis*, *Luzula luzuloides*, *Maianthemum bifolium*, *Melica nutans*, *Milium effusum*, *Poa nemoralis*, *Pulmonaria obscura*, *Stellaria holostea*, *Veronica chamaedrys*, *Viola reichenbachiana*.

Differences: From the *Melampyro-Carpinetum*, absence of *Carpinus betulus*, *Quercus petraea* or *Melittis melissophyllum*, and frequent occurrence of *Carex brizoides* and higher proportion of *Tilia cordata* and *Quercus robur* in the canopy.

Habitat: MW. At colline levels (380-470 m). Various relief forms (moderate to relatively steep slopes, plains). (Pseudogleyed) cambisols developed on very different geological substrates: gneiss, granite, migmatites,

Fig. 19 — Stellario-Tilietum Moravec 1964.

Miocene loams, frequently covered by younger sediments.

Distribution: PND - 0.1%. Local association of S and W Bohemia, on sites where the migration of hornbeam and sessile oak did not penetrate. Valley of middle reaches of the Otava river, lower reaches of the Blanice river, valleys of the upper reaches of the Vltava river and its tributaries (Fig.15/12).

Land use: Near-natural stands very rare, partly replaced by coniferous plantations (*Picea abies*, *Pinus sylvestris*), partly arable land or meadows. Some more or less natural stands in plains used as pheasantries.

On slopes, very small areas of near-natural stands serve as protection woodland (regulation of runoff, protection against erosion).

Rare and endangered syntaxa: *Stellario-Tilietum*.

Rare and endangered taxa: *Lilium martagon*.

References: Moravec (1964), Neuhäusl in Moravec *et al.* (1982).

Typical relevé: Moravec J. (1964): Tab. 1, rel. 12 (middle reach of the Otava river), 400 m, S, 240. E3 - 80%, E2 - 10%, E1 - 50%.

E3 - 3: *Quercus robur*, *Tilia cordata*, +: *Sorbus aucuparia*, E2 - 2: *Corylus avellana*,

E1 - 2: *Carex brizoides*, *Galeobdolon luteum*, *Luzula luzuloides*, *Poa nemoralis*, 1: *Adoxa moschatellina*, *Aegopodium podagraria*, *Anemone nemorosa*, *Astragalus glycyphyllos*, *Calamintha clinopodium*, *Carex muricata*, *Convallaria majalis*, *Euphorbia dulcis*, *Geum urbanum*, *Hepatica nobilis*, *Lathyrus vernus*, *Lilium martagon*, *Lonicera xylosteum*, *Maianthemum bifolium*, *Melica nutans*, *Mercurialis perennis*, *Pulmonaria obscura*, *Stellaria holostea*, *Viola reichenbachiana*, +: *Dryopteris filix-mas*, *Epilobium montanum*, *Fragaria moschata*, *Galium aparine*, *Geranium robertianum*, *Hieracium murorum*, *Polygonatum multiflorum*, *Rosa canina*, *Rubus* sp., *Senecio nemorensis*.

Invas., expans.: *Carex brizoides*.

Scree and ravine woodland (*Tilio-Acerion* Klika 1955 em. Husová 1982)

Permanent communities of broadleaved, rarely mixed, stands with *Taxus baccata* or *Abies alba* on scree and weathered blocks with immature soils.

13. Scree and ravine woodlands of colline to montane sites (*Aceri-Carpinetum* Klika 1941, *Lunario-Aceretum* Schlüter in Grüneberg et Schlüter 1957, *Mercuriali-Fraxinetum* [Klika 1942] Husová 1982, *Scolopendrio-Fraxinetum* Schwickerath 1938), Fig. 20.

Synonyms: *Acerenion* (*Acerion*) Oberdorfer 1957 p.p., *Tilio-Acerenion* (*Tilio-Acerion*) Oberdorfer *et al.* 1967 p.p. as suball. of the *Fagion*, *Tilio-Acerenion* Neuhäusl et Neuhäuslová 1968 p.p. as suball. of the *Carpinion*.

Structure: This mapping unit includes four associations (see above). Their stands are mostly three-layered and consist of the canopy, field and ground layers (last unit developed mostly only on limestone scree). Cover and diversity of the canopy and field layer depend on the degree of succession and soil development. The young stages have an open canopy. Hook-like form of the stems, as result of scree movement in the early successional stages, are typical. Broadleaved woody species associated with scree and weathered blocks prevail (*Acer pseudoplatanus*, *A. platanoides*, *Ulmus glabra*, *Fraxinus excelsior*), accompanied by *Tilia cordata* on sunny sites, or *Tilia platyphyllos* on shady sites. Canopy of better developed stands relatively dense. The above mentioned woody species are accompanied by climax species - at lower levels *Carpinus betulus*, at higher levels, in shady sites and in bottoms of inversion valleys *Fagus sylvatica* and *Abies alba*. On soils with higher Ca^{++} content *Taxus baccata* occurs, sporadically, on the warmest sites, *Acer campestre*, too. In stands on limestone rocks, *Cornus mas* occurs, in the Carpathian area, rarely also *Staphylea pinnata*. In the field layer of pioneer stages on scree rankers

Fig. 20 — Scree and ravine woodlands of submontane sites (*Mercuriali-Fraxinetum* [Klika 1942] Husová 1982).

with small proportion of fine loam, nitrophilous species and ferns in groups. In better developed stands, dense field layer with many nutrient-demanding *Fagetalia* species.

Diagn.: Dif.: E3 - *Abies alba*, *Acer platanoides*, *A. pseudoplatanus*, *Carpinus betulus*, *Fagus sylvatica*, *Fraxinus excelsior*, *Tilia platyphyllos*, *T. cordata*, *Ulmus glabra*.

Species with high constancy: *Actaea spicata*, *Aegopodium podagraria*, *Alliaria petiolata*, *Asarum europaeum*, *Campanula trachelium*, *Dryopteris filix-mas*, *Galeobdolon luteum*, *G. montanum*, *Galium odoratum*, *Geranium robertianum*, *Impatiens noli-tangere*, *Lamium maculatum*, *Lathyrus vernus*, *Melica nutans*, *Mercurialis perennis*, *Oxalis acetosella*, *Pulmonaria officinalis*, *Urtica dioica*,

Assoc. diff. species: *Aceri-Carpinetum - Campanula rapunculoides*, *Galium sylvaticum*, *Hepatica nobilis*, *Stellaria holostea*; *Mercuriali-Fraxinetum - Fagus sylvatica*, *Hordelymus europaeus*; *Lunario-Aceretum*: *Lunaria rediviva*; *Scolopendrio-Fraxinetum - Polystichum aculeatum*, *Phyllitis scolopendrium*.

Differences: From the climax vegetation, dominance of woody scree species and, in contrast, very rare admixture of climax woody species. Abundance of nitrophilous species in the field layer also characteristic.

Adjoining PNV: Oak-hornbeam woodland (*Melampyro nemorosi-Carpinetum*), herb-rich beech woodlands (*Tilio cordatae-Fagetum*, *Dentario enneaphylli-Fagetum*, *Dentario glandulosae-Fagetum*, *Festuco altissimae-Fagetum*), thermophilous oak woodlands (*Sorbo torminalis-Quercetum*, *Corno-Quercetum*).

Habitat: Mostly MW (colder subunits), less frequently C. Permanent communities of scree and weathered blocks with immature soils (scree ranker, ranker cambisols, scree rendzina), prefering moister sites in areas of strong relief (principally inversion valleys). At lower levels *Aceri-Carpinetum*, associated mostly with deep river valleys. The *Mercuriali-Fraxinetum* includes scree slope woodland at submontane and montane beech woodland levels, on screes and summits with weathered blocks on siliceous, mostly mineral-rich rocks between 500-800 m. The *Lunario-Aceretum* is a slope-scree or ravine woodland dominated by *Lunaria rediviva* in the field layer at colline to montane levels. The *Scolopendrio-Fraxinetum* is a typical calcicolous ravine woodland on specific sites in deep karstic valleys.

Distribution: All these communities cover small areas (Fig.15/13). Deep river valleys (e.g. middle reaches of the Vltava, Berounka, Svratka, Jihlava, Dyje rivers), karstic areas (Český and Moravský kras), areas formed by Tertiary eruptives (České středohoří Uplands, Lužické hory Mts.) and mineral-rich rocks of the Proterozoicum (between the towns of Kladno and Klatovy).

The *Scolopendrio-Fraxinetum* rarely in the PLA Moravský kras and on one site only in the Moravskoslezské Beskydy Mts.

Land use: All these woodlands play an important role in stabilizing soils of steep slopes. Regeneration is mostly natural and management aims to encourage native trees. Exceptionally, temporary coppicing has resulted in abundant regeneration of lime from stumps. Rapid spread of graphiose in the last decades has caused the death of *Ulmus glabra*. At present, tracheomycosis endangers maple, ash and oak.

These communities have water and soil retension- and -protective functions, many stands are protected in nature reserves or other protected areas.

(Near-)natural stands: *Mercuriali-Fraxinetum*: Český les Mts. -

NR Starý Herštejn; PLA Lužické hory Mts. - NNR Růžový vrch Hill; Ralská pahorkatina Hills; Všerubská vrchovina Uplands, *Aceri-Carpinetum*: Křivoklátská vrchovina Uplands - BR and PLA Křivoklátsko - many locations, PLA Český kras - valley of the Loděnice river, *Scolopendrio-Fraxinetum*: PLA Moravský kras - Pustý žleb, *Lunario-Aceretum*: PLA Lužické hory Mts. - Studený vrch Hill; Ralská pahorkatina Hills etc.

Rare and endangered syntaxa: *Scolopendrio-Fraxinetum*.

Rare and endangered taxa: *Abies alba*, *Aconitum lycoctomum*, *A. variegatum*, *Aruncus vulgaris*, *Asplenium viride*, *Cimicifuga foetida*, *Cyclamen purpurascens*, *Lunaria rediviva*, *Phyllitis scolopendrium*, *Salvia glutinosa*, *Sesleria albicans*, *Taxus baccata*.

References: Husová (1982), Husová in Moravec *et al.* (1982).

Synthetical tables:

Aceri-Carpinetum Husová (1982 in Moravec *et al.* 1982: 18-33, Tab. 1, col. 1, synthesis of 256 rel. from the Czech Republic), species with constancy less than 10% not mentioned.

E3 - 65: *Carpinus betulus*, 53: *Acer pseudoplatanus*, 45: *Tilia platyphyllos*, 34: *Acer platanoides*, *Fraxinus excelsior*, 30: *Ulmus glabra*, 29: *Abies alba*, 28: *Tilia cordata*, 26: *Fagus sylvatica*, 19: *Quercus petraea*, 14: *Q. robur*, 11: *Picea abies*;

E2 - 49: *Corylus avellana*, 25: *Lonicera xylosteum*, 20: *Fraxinus excelsior*, 18: *Ulmus glabra*, 16: *Acer pseudoplatanus*, *Ribes alpinum*, 14: *Crataegus oxyacantha*, *Cornus sanguinea*, *Tilia cordata*, 13: *Acer campestre*, *A. platanoides*, 12: *Euonymus europaea*, *Ribes uva-crispa*, *Sambucus nigra*;

E1 - 69: *Hepatica nobilis*, 68: *Geranium robertianum*, 65: *Poa nemoralis*, 62: *Stellaria holostea*, 63: *Lamium galeobdolon*, *Mercurialis perennis*, 58: *Galium sylvaticum*, *Lathyrus vernus*, 56: *Galium odoratum*, 54: *Pulmonaria officinalis*, 52: *Dryopteris filix-mas*, 49: *Asarum europaeum*, *Campanula trachelium*, *Melica nutans*, 43: *Mycelis muralis*, 42: *Campanula rapunculoides*, 41: *Lamium maculatum*, *Urtica dioica*, 38: *Alliaria petiolata*, 37: *Aegopodium podagraria*, 36: *Oxalis acetosella*, 35: *Impatiens noli-tangere*, 29: *Geum urbanum*, *Viola reichenbachiana*, 28: *Epilobium montanum*, 25: *Actaea spicata*, 24: *Chelidonium majus*, 23: *Fragaria moschata*, 21: *Campanula persicifolia*, 20: *Bromus benekenii*, 19: *Cardamine impatiens*, 19: *Hieracium sylvaticum*, 18: *Roegneria canina*, *Pyrethrum corymbosum*, *Dactylis glomerata*, *Hieracium lachenalii*, *Senecio fuchsii*, *Viola mirabilis*, 17: *Convallaria majalis*, *Lapsana communis*, 15: *Galium aparine*, *Moehringia trinervia*, *Phyteuma spicatum*, *Ranunculus lanuginosus*, *Rubus idaeus*, 14: *Impatiens parviflora*, 13: *Galeopsis tetrahit*, *Milium effusum*, *Polygonatum multiflorum*, *Scrophularia nodosa*, 12: *Clinopodium vulgare*, *Veronica chamaedrys*, 11: *Prenanthes purpurea*, 10: *Anemone nemorosa*, *Cystopteris fragilis*, *Galeopsis speciosa*, *Ranunculus auricomus*, *Viola hirta*.

Mercuriali-Fraxinetum

Husová (1982 in Moravec *et al.* 1982: 18-33, Tab. 1, col. 5, synthesis of 68 rel. from the Czech Republic), species with constancy less than 10% not mentioned.

E3 - 84: *Fagus sylvatica*, 82: *Acer pseudoplatanus*, 51: *Fraxinus excelsior*, 41: *Ulmus glabra*, 26: *Acer platanoides*, 23: *Picea abies*, 21: *Salix caprea*, 13: *Abies alba*, 12: *Carpinus betulus*;

E2 - 38: *Fagus sylvatica*, 32: *Acer pseudoplatanus*, 25: *Ulmus glabra*, 24: *Fraxinus excelsior*, 20: *Sambucus racemosa*, 17: *Acer platanoides*, 16: *Corylus avellana*, *Daphne mezereum*, 15: *Sorbus aucuparia*;

E1 - 96: *Dryopteris filix-mas*, 85: *Galium odoratum*, 79: *Mercurialis perennis*, 72: *Oxalis acetosella*, 71: *Athyrium filix-femina*, 65: *Senecio fuchsii*, *Urtica dioica*, 62: *Lamium galeobdolon* agg., 56: *Geranium robertianum*, *Impatiens noli-tangere*, 51: *Actaea spicata*, 49: *Milium effusum*, 37: *Poa nemoralis*, 35: *Prenanthes purpurea*, 34: *Pulmonaria officinalis*, 32: *Stachys sylvatica*, *Viola reichenbachiana*, 30: *Dryopteris dilatata*, *Rubus idaeus*, 29: *Bromus benekenii*, *Polystichum aculeatum*, *Stellaria nemorum*, 28: *Paris quadrifolia*, 26: *Dentaria enneaphyllos*, 25: *Epilobium montanum*, *Petasites albus*, 24: *Stachys sylvatica*, 22: *Aegopodium podagraria*, *Arum maculatum*, *Epilobium montanum*, 21: *Lysimachia nemorum*, *Melica uniflora*, *Veronica montana*, 20: *Dentaria bulbifera*, 19: *Festuca altissima*, *F. gigantea*, *Gymnocarpium dryopteris*, *Mycelis muralis*, 18: *Hordelymus europaeus*, *Rubus hirtus*, 17: *Circaea lutetiana*, 16: *Corydalis cava*, *Cystopteris fragilis*, *Polygonatum multiflorum*, 15: *Ajuga reptans*, *Campanula trachelium*, *Dryopteris carthusiana*, *Senecio nemorensis*, *Vaccinium myrtillus*, 14: *Polygonatum verticillatum*, 13: *Calamagrostis villosa*, 12: *Melica nutans*, 10: *Anemone nemorosa*, *Carex muricata*, *Lathyrus vernus*, *Sanicula europaea*, *Scrophularia nodosa*.

Lunario-Aceretum Husová (1982 in Moravec *et al.* 1982: 18-33, Tab. 1, col. 3, synthesis of 80 rel. from the Czech Republic), species with constancy less than 10% not mentioned.

E3 - 87: *Acer pseudoplatanus*, 64: *Fagus sylvatica*, *Ulmus glabra*, 49: *Fraxinus excelsior*, 36: *Acer platanoides*, 29: *Quercus robur*, 21: *Tilia platyphyllos*, 14: *Abies alba*, 10: *Tilia cordata*;

E2 - 28: *Fagus sylvatica*, 25: *Ulmus glabra*, 21: *Corylus avellana*, *Fraxinus excelsior*, 20: *Sambucus racemosa*, 19: *Acer pseudoplatanus*, 11: *Acer platanoides*, *Ribes uva-crispa*, *Sambucus nigra*;

E1 - 94: *Lunaria rediviva*, 84: *Mercurialis perennis*, 81: *Dryopteris filix-mas*, 72: *Lamium galeobdolon*, 66: *Impatiens noli-tangere*, *Urtica dioica*, 63: *Actaea spicata*, 64: *Oxalis acetosella*, 61: *Senecio fuchsii*, 60: *Galium odoratum*, 55: *Geranium robertianum*, *Pulmonaria officinalis*, 49: *Athyrium filix-femina*, 39: *Epilobium montanum*, 36: *Milium effusum*, 33: *Stachys sylvatica*, 29: *Mycelis muralis*, 28: *Aegopodium podagraria*, *Dentaria bulbifera*, 27: *Petasites albus*, 25: *Asarum europaeum*, *Poa nemoralis*, 24: *Dentaria enneaphyllos*, 23: *Lamium maculatum*, 22: *Bromus benekenii*, *Viola reichenbachiana*, 21: *Festuca altissima*, 20: *Arum maculatum*, 19: *Dryopteris carthusiana*, *Scrophularia nodosa*, *Stellaria holostea*, *S. nemorum*, 18: *Chrysosplenium alternifolium*, 17: *Rubus idaeus*, 15: *Alliaria petiolata*, *Campanula trachelium*, *Galium sylvaticum*, *Hepatica nobilis*, *Lathyrus vernus*, *Ranunculus lanuginosus*, 14: *Galeopsis speciosa*, *Polygonatum verticillatum*, 13: *Calamagrostis arundinacea*, *Melica nutans*, *Senecio fuchsii*, 11: *Ajuga reptans*, *Cardamine impatiens*, *Carex digitata*, *Fragaria vesca*, *Polystichum aculeatum*, *Thalictrum aquilegiifolium*, 10: *Carex sylvatica*, *Corydalis cava*, *Lilium martagon*, *Lysimachia nemorum*, *Polygonatum multiflorum*.

Scolopendrio-Fraxinetum Husová (1982 in Moravec *et al.* 1982: 18-33, Tab. 1, col. 2, synthesis from the Czech Republic), species with constancy less than 10% not mentioned.

E3 - 92: *Acer pseudoplatanus*, 62: *Fagus sylvatica*, 54: *Fraxinus excelsior*, 38: *Picea abies*, 31: *Ulmus glabra*, 23: *Abies alba*, *Acer platanoides*, *Tilia cordata*, 15: *Tilia platyphyllos*;

E2 - 69: *Ribes uva-crispa*, 62: *Fagus sylvatica*, 54: *Acer pseudoplatanus*, *Corylus avellana*, 46: *Rubus idaeus*, 38: *Ulmus glabra*, 31: *Lonicera xylo-*

steum, 23: *Acer platanoides*, *Carpinus betulus*, *Daphne mezereum*, *Fraxinus excelsior*, *Sambucus racemosa*, *Sorbus aucuparia*, *Staphylea pinnata*, 15: *Abies alba*, *Acer campestre*, *Sambucus nigra*;

E1 - 100: *Lunaria rediviva*, *Urtica dioica*, 85: *Phyllitis scolopendrium*, *Epilobium montanum*, 82: *Lamium galeobdolon*, 77: *Geranium robertianum*, 69: *Poa nemoralis*, 62: *Actaea spicata*, *Chrysosplenium alternifolium*, *Impatiens noli-tangere*, *Pulmonaria officinalis*, 54: *Campanula trachelium*, *Cystopteris fragilis*, *Hordelymus europaeus*, *Mercurialis perennis*, *Lamium maculatum*, *Oxalis acetosella*, *Polystichum aculeatum*, *Cardamine impatiens*, 46: *Galium odoratum*, *Mycelis muralis*, *Rubus idaeus*, *Senecio nemorensis*, 38: *Arabis turrita*, *Dentaria bulbifera*, *Heracleum sphondylium*, *Senecio fuchsii*, 32: *Dryopteris filix-mas*, 31: *Adoxa moschatellina*, *Ajuga reptans*, *Alliaria petiolata*, *Aruncus vulgaris*, *Asarum europaeum*, *Lathyrus vernus*, *Melica nutans*, *Myosotis sylvatica*, *Polygonatum verticillatum*, 23: *Aegopodium podagraria*, *Athyrium filix-femina*, *Bromus benekenii*, *Chelidonium majus*, *Circaea alpina*, *Dentaria bulbifera*, *D. enneaphyllos*, *Festuca altissima*, *Hieracium murorum*, *Milium effusum*, *Paris quadrifolia*, *Ranunculus lanuginosus*, *Stellaria nemorum*, 15: *Anemone ranunculoides*, *Anthriscus nitida*, *Campanula rapunculoides*, *Carex digitata*, *Chaerophyllum hirsutum*, *Circaea lutetiana*, *Corydalis cava*, *Equisetum sylvaticum*, *Epipactis helleborine*, *Filipendula ulmaria*, *Fragaria moschata*, *Galium aparine*, *Glechoma hederacea*, *Prenanthes purpurea*, *Solidago virgaurea*.

Invas.,expans.: *Alliaria petiolata*, *Galium aparine*, *Impatiens parviflora*, *I. glandulifera* (at levels of the *Aceri-Carpinetum* in the Elbe valley near the village of Hřensko).

Herb-rich beech woodland (*Eu-Fagenion* Oberdorfer 1957 em. Tüxen in Oberdorfer et Tüxen 1958)

Herb- or grass-rich beech, silver fir-beech and lime-beech woodlands on siliceous soils at submontane and montane levels. PND - 16.2% of the total area of the Republic.

14. Lime-beech woodland with *Tilia platyphyllos* (*Tilio platyphylli-Fagetum* Klika 1939)

Structure: Three-layered stands with well-developed canopy and field layer and with open shrub layer. Mosses rare, with a low dominance only. Canopy dominated by *Fagus sylvatica* with frequent *Tilia platyphyllos*. Less frequently, *Quercus petraea* and *Tilia cordata* admixed. In the shrub layer *Lonicera xylosteum* frequent, *Daphne mezereum* and *Grossularia uva-crispa* rarely. In the field layer *Fagetalia* species prevail. *Fagion* species *Actaea spicata*, *Hordelymus europaeus* frequent, *Prenanthes purpurea* and *Polygonatum verticillatum* less abundant. Occurrence of these species together with the *Carpinion* elements (principally *Stellaria holostea*, *Galium sylvaticum*) is typical.

Diagn.: Dif.: E3 - *Tilia platyphyllos*, E2 - *Grossularia uva-crispa*, *Lonicera xylosteum*, E1 - *Convallaria majalis*, *Galium sylvaticum*, *Stellaria holostea*.

Species with high constancy: E3 - *Fagus sylvatica*, *Tilia platyphyllos*; E1 - *Actaea spicata*, *Anemone nemorosa*, *Bromus benekenii*, *Calamagrostis arundinacea*, *Convallaria majalis*, *Galium odoratum*, *G. sylvaticum*, *Geranium robertianum*, *Hepatica nobilis*, *Hieracium murorum*, *Hordelymus europaeus*, *Galeobdolon luteum*, *Lamium maculatum*, *Lathyrus vernus*, *Luzula luzuloides*, *Melica nutans*, *Mercurialis perennis*, *Mycelis muralis*, *Poa nemoralis*, *Pulmonaria officinalis*, *Senecio fuchsii*, *Stellaria holostea*, *Viola reichenbachiana*, *Urtica dioica*, *Veronica chamaedrys*.

Differences: From the *Tilio cordatae-Fagetum*, high constancy of *Carpinion* diagnostic species (*Galium sylvaticum*, *Stellaria holostea*), high constancy of *Hordelymus europaeus* and absence of *Dentaria* species.

Adjoining PNV: Mostly climatic oak-hornbeam woodland (*Melampyro-Carpinetum*).

Habitat: Mostly MT4, C7. Mostly northern slopes at an altitude of 450-650 m, on weathered Tertiary eruptives (phonolites and basalts) with abundant screes on phonolites. The soils are mesotrophic to eutrophic cambisols.

Distribution: PND - 0.1%. Small areas in the western part of the České středohoří Uplands, locally conditioned and locally distributed association (Fig.15/14).

Land use: High or medium-high woodland of relatively low economic value.

Natural and near-natural stands used as protection woodland (stabilising slopes, soil protection).

(Near-)natural stands: PLA České středohoří Uplands - Ostrý Hill.

Rare and endangered syntaxa: *Tilio platyphylli-Fagetum*.

Rare and endangered taxa: *Bupleurum longifolium*, *Vicia dumetorum*.

References: Klika (1939, 1952), Moravec (1977), Moravec *et al.* (1982).

Typical relevé: Moravec (1977): tab.2, suppl.2, rel.51 (České středohoří Uplands), 450 m, NE, 170, E3 - 90%, E2 - 1%, E1 - 70%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, 1: *Tilia platyphyllos*, *T. cordata*, +: *Acer pseudoplatanus*,

E2 - +: *Daphne mezereum*, *Grossularia uva-crispa*,

E1 - 3: *Galium odoratum*, *Galeobdolon luteum*, 2: *Mercurialis perennis*, 1: *Acer pseudoplatanus* (juv.), *Hepatica nobilis*, *Lathyrus vernus*, +: *Aegopodium podagraria*, *Acer platanoides* (juv.), *A. campestre* (juv.), *Anemone nemorosa*, *Calamagrostis arundinacea*, *Convallaria majalis*, *Hordelymus europaeus*, *Chelidonium majus*, *Melica nutans*, *Mycelis muralis*, *Pulmonaria officinalis*, *Sanicula europaea*, *Senecio fuchsii*, *Stellaria holostea*, *Vicia sylvatica*, r: *Dryopteris dilatata*, *Epilobium montanum*, *Fraxinus excelsior* (juv.), *Galium sylvaticum*, *Geranium robertianum*, *Hedera helix*, *Lathyrus niger*, *Phyteuma spicatum*, *Ranunculus lanuginosus*, *Scrophularia nodosa*, *Urtica dioica*, *Viola reichenbachiana*.

15. Lime-beech woodland with *Tilia cordata* (*Tilio cordatae-Fagetum* Mráz 1960 em. Moravec 1977)

Synonyms: *Abieto-Fagetum* Klika 1941 (*Querco-carpinetosum bohemicum*), *Abieto-Fagetum submontanum medioeuropaeum* Klika 1959, *Carpino-Fagetum* Samek 1960 p.p., *Dentario-Fagetum* Mráz 1960 p.p. incl., *Impatiento-Fagetum* (resp. *Impatiento-Abieto-Fagetum*) Mráz 1960 p.p. incl., *Bromo benekenii-Fagetum* Moravcová-Husová 1966.

Structure: Mostly two-layered stands with well-developed canopy and field layer. Shrub and ground layers fragmentary, occurring only incidentally. Canopy dominated by *Fagus sylvatica* with an admixture of *Carpinus betulus*, *Tilia cordata* and *Quercus petraea*, rarely *Abies alba* (which has mostly died out in the second half of this century). In the field layer species of the *Fagetalia* frequent, of the species of the *Fagion - Dentaria bulbifera*, *Prenanthes purpurea*, rarely *Actaea spicata* and (locally) *Hordelymus europaeus* occur.

Diagn.: Diff.: E1 - *Bromus benekenii*, *Campanula trachelium*, *Cardamine impatiens*, *Vicia sylvatica*.

Species with high constancy:

Athyrium filix-femina, *Brachypodium sylvaticum*, *Cardamine impatiens*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Galeobdolon luteum*, *Galium odoratum*, *Geranium robertianum*, *Hepatica nobilis*, *Hieracium murorum*, *Lathyrus vernus*, *Luzula luzuloides*, *Maianthemum bifolium*, *Melica nutans*, *Mercurialis perennis*, *Milium effusum*, *Moehringia trinervia*, *Mycelis muralis*, *Oxalis acetosella*, *Poa nemoralis*, *Prenanthes purpurea*, *Sanicula europaea*, *Scrophularia nodosa*, *Senecio fuchsii*, *Urtica dioica*, *Veronica chamaedrys*, *Viola reichenbachiana*.

Differences: From the *Tilio platyphylli-Fagetum*, high constancy of *Dentaria bulbifera* and the occurrence of the diagnostic species mentioned above.

Adjoining PNV: Supracolline and submontane woodlands (*Luzulo-Fagetum*, *Luzulo pilosae-Abietetum*, *Melampyro-Carpinetum*, *Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*, *Violo reichenbachianae-Fagetum*).

Habitat: MT11-7. Submontane levels (mostly 400-600 m), as climax woodland, and as mesoclimatically conditioned communities at lower levels on shady northern slopes or in deep valleys with frequent inversions.

The soils correspond to mesotrophic to eutrophic cambisols, developed mostly on siliceous rocks of different mineral content, rarely decalcified, sometimes polygenetic soils with complicated profiles and genesis. On mature soils this unit corresponds to the climax vegetation; on stony slopes or stabilized screes a subclimax on ranker cambisols.

Distribution: PND - 0.4%. Mostly in lower uplands of S and Central Bohemia, less frequently in W Bohemia. Recently found in the Dyje- and Oslava-valleys in Moravia (Fig.15/15).

Land use: Older, well-developed stands represent high beech woodland with admixed *Carpinus betulus*, *Quercus petraea*, rarely *Abies alba*, occurring at present on undulating relief or deep valleys. As a result of forest management, poor beech plantations can also be found. The natural stands produce high, straight stems of a high quality.

At present, the *Tilio cordatae-Fagetum* occurs as small, mostly isolated stands. Some of them are protected in nature reserves. They protect the soil against erosion and stabilise steep slopes. On higher sites they play an important hydrological role and they contribute to the recycling of mineral nutrients in the ecosystem. They are endangered principally by replacement with coniferous plantations (mostly *Picea abies*, rarely *Larix decidua* or *Pinus sylvestris*), which negatively influence soils and nutrient cycling.

(Near-)natural stands: BR and PLA Křivoklátsko - NNP Kohoutov; Sázava valley - Dobříšská pahorkatina Hills.

Rare and endangered taxa: *Abies alba* (locally).

References: Klika (1941, 1943), Kučera T. (1993), Mikyška (1943), Moravcová-Husová (1963, 1964, 1966), Moravec (1960, 1977), Moravec *et al.* (1982), Mráz (1960), Samek (1957a, 1960), Sofron et Vondráček (1975).

Typical relevé: Moravec (1977): tab. 2, suppl. 2, rel. 20 (Křivoklátská vrchovina Uplands), 460 m, NE, 60, E3 - 80%, E2 - 1%, E1 - 60%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, +: *Tilia cordata*, *Quercus petraea*,

E2 - +: *Grossularia uva-crispa*,

E1 - 2: *Brachypodium sylvaticum*, *Dentaria bulbifera*, *Galium odoratum*, *Hordelymus europaeus*, *Oxalis acetosella*, 1: *Bromus benekenii*, *Fagus sylvatica* (juv.), *Melica nutans*, *Ulmus glabra* (juv.), *Urtica dioica*, *Vicia sylvatica*, *Viola reichenbachiana*, +: *Alliaria petiolata*, *Cardamine impatiens*, *Calamagrostis arundinacea*, *Festuca gigantea*, *Fragaria vesca*, *Fraxinus excelsior* (juv.), *Geranium robertianum*, *Lathyrus vernus*, *Mercurialis perennis*, *Mycelis muralis*, *Poa nemoralis*, *Rubus idaeus*, *Quercus petraea* (juv.), *Tilia cordata* (juv.), r: *Athyrium filix-femina*, *Carex pairae*, *C. remota*, *Dryopteris filix-mas*, *Epilobium montanum*, *Galeopsis tetrahit*, *Moehringia trinervia*, *Vicia sepium*, *Veronica officinalis*.

Invas., expans.: *Impatiens parviflora*.

16. Beech woodland with *Melica uniflora* (*Melico-Fagetum* Seibert 1954)

Synonyms: *Abieto-Fagetum* Oberdorfer 1950 p.p. (*melicetosum uniflorae* Oberdorfer et Platte in Oberdorfer 1950), *Dentario bulbiferae-Fagetum* Hartmann 1953 p.p. (*melicetosum uniflorae*).

Structure: Two-layered stands, formed by the tree and field layers, other layers more or less absent. Canopy dominated by *Fagus sylvatica* with a weak admixture of *Acer pseudoplatanus*, *Carpinus betulus*, rarely *Abies alba* and *Ulmus glabra*. In the field layer species of the *Fagetalia* prevail, those of the *Fagion* less abundant (*Dentaria bulbifera*, *Festuca altissima*, *Hordelymus europaeus*). Dominance of *Melica uniflora* and relatively low number of species in the field layer.

Diagn.: Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Athyrium filix-femina*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Festuca altissima*, *Galeobdolon montanum*, *Galium odoratum*, *Hordelymus europaeus*, *Maianthemum bifolium*, *Melica uniflora* (dominant), *Mercurialis perennis*, *Milium effusum*, *Mycelis muralis*, *Oxalis acetosella*, *Poa nemoralis*, *Paris quadrifolia*, *Rubus hirtus*, *R. idaeus*, *Scrophularia nodosa*, *Senecio fuchsii*, *Urtica dioica*, *Viola reichenbachiana*.

Differences: From the *Tilio platyphylli-Fagetum* and *Tilio cordatae-Fagetum*, prevalence of *Melica uniflora*.

Adjoining PNV: Submontane and montane beech woodlands (*Luzulo-Fagetum*, *Festuco-Fagetum*, *Dentario enneaphylli-Fagetum*), acidophilous oak woodland (*Luzulo albidae-Quercetum petraeae*).

Habitat: Colder MT3, C7. Mostly at altitudes of 400-600 m, less frequently up to 720 m or below 300 m. With the exception of steep vulcanite slopes in N Bohemia mostly moderate slopes or plains. On moderately undulating plateaus of the Nízký Jeseník Mts., Oderské vrchy Hills and Drahanská vrchovina Uplands the *Melico-Fagetum* probably represents climax vegetation on mature mesotrophic to oligotrophic cambisols. On strongly weathered vulcanites the soils are mesotrophic to eutrophic cambisols, rarely ranker cambisols.

It probably occurred formerly also directly on Cretaceous sediments.

Distribution: PND - 0.5%. In Bohemia at submontane levels of the Lužické hory Mts. and on scattered volcanic hills in the adjoining part of the Česká tabule Plain (Ralská pahorkatina Hills), further on terrace elevations in the Orlická tabule Plain (at colline levels). In Moravia, on montane plateaus in the Nízký Jeseník Mts., Oderské vrchy Hills and Drahanská vrchovina Uplands. Recently found in the NP Podyjí (Fig.15/16).

Land use: As the *Melico-Fagetum* covered mostly moderately undulating relief, natural stands, producing tall straight stems, are very rare. As a result of forest management, practically pure beech stands can be found. Many natural woodlands replaced by coniferous plantations, especially *Picea abies*, rarely *Larix decidua*, *Pinus sylvestris*. In deforested areas, meadows and pastures (*Arrhenatherion*, *Polygono-Trisetion*) cover small areas only; more frequently used as arable land (potatoes, rye,

fodder, occasionally flax). Natural stands protect the soil against erosion and at higher levels they reduce runoff and contribute to nutrient recycling in the ecosystem. In contrast, substitute spruce plantations negatively influence the soil and nutrient recycling.

(Near-)natural stands: Oderské vrchy Hills; PLA Labské pískovce.

References: Moravec (1977), Moravec *et al.* (1982).

Typical relevé: Moravec (1977): tab. 3, suppl. 3, rel.9 (Oderské vrchy Hills), 460 m, W, 100, E3 - 80%, E2 - 1%, E1 - 90%, E0 - 0%.

E3 - 5: *Fagus sylvatica*,

E2 - +: *Fagus sylvatica*,

E1 - 5: *Melica uniflora*, 2: *Dentaria bulbifera*, *Oxalis acetosella*, 1: *Dryopteris filix-mas*, *Fagus sylvatica* (juv.), *Galium odoratum*, *Gymnocarpium dryopteris*, *Viola reichenbachiana*, +: *Acer pseudoplatanus* (juv.), *Anemone nemorosa*, *Athyrium filix-femina*, *Carex sylvatica*, *Dryopteris carthusiana*, *Festuca altissima*, *Hordelymus europaeus*, *Isopyrum thalictroides*, *Mercurialis perennis*, *Moehringia trinervia*, *Mycelis muralis*, *Paris quadrifolia*, *Urtica dioica*, r: *Deschampsia cespitosa*, *Galium rotundifolium*, *Hieracium murorum*.

17. Beech woodland with *Carex pilosa* (*Carici pilosae-Fagetum* Oberdorfer 1957), Fig. 21.

Synonyms: *Dentario-Fagetum* Neuhäuslová-Novotná 1970 p.p. (*caricetosum pilosae*).

Structure: Mostly two-layered, with tree and field layers. Ground layer mostly missing, shrub layer occurs only rarely and fragmentarily. Canopy formed almost exclusively by broadleaved woody species, principally by *Fagus sylvatica* with a relatively frequent admixture of *Quercus petraea*. On average, 20 species, mostly hygromesophilous elements of the *Fagetalia* (see below) in the field layer.

Diagn.: Dif.: E1 - *Carex pilosa* (dominant), *Cephalanthera longifolia*, *Euphorbia amygdaloides*.

Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Ajuga reptans*, *Athyrium filix-femina*, *Carex pilosa*, *C. sylvatica*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Epilobium montanum*, *Galium odoratum*, *Lathyrus vernus*, *Luzula luzuloides*, *Melica uniflora*, *Mycelis muralis*, *Oxalis acetosella*, *Poa nemoralis*, *Polygonatum multiflorum*, *Scrophularia nodosa*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: From the foregoing units (Nr. 14-16), prevalence of *Carex pilosa* in the field layer, and occurrence of *Cephalanthera longifolia* and *Euphorbia amygdaloides*. These species differentiate facies with a higher dominance of *Melica uniflora* from the *Melico-Fagetum*.

Fig. 21 — Carici pilosae-Fagetum Oberdorfer 1957.

Adjoining PNV: Climatic colline to montane broadleaved woodlands (*Carici pilosae-Carpinetum*, *Dentario enneaphylli-Fagetum*, on poorer soils *Luzulo-Fagetum*).

Habitat: Mostly MT9-5, at altitudes of 400-600 m on flat ridges and moderate slopes of different aspect. At higher levels on sunny slopes and at lower levels on northern slopes or in deep valleys. Relatively deep, mature cambisols (mesotrophic, rarely oligotrophic), developed mostly on flysh sandstones or claystones in the Carpathians; in the Česká vysočina Uplands on Culm sandstones.

Distribution: PND - 0.7%. Mostly at submontane levels of the Moravian Carpathians, continuing into the Carpathian system further east. (In spite of this, the *Carici pilosae-Fagetum* does not represent a Carpathian association, as it has been described from NW Germany). In flysh mountains, sometimes as continuous vegetation belt (e.g. in Maleník and the Chřiby Mts., which do not reach montane levels). In higher areas with strong relief (e.g. in the Bílé Karpaty Mts.) on southern slopes up to montane levels covered by the *Dentario enneaphylli-Fagetum*. In contrast, on northern slopes, at colline levels. From the Carpathians this unit extends to the eastern border of the Drahanská vrchovina Uplands on rocks of the Bohemian Massif (Fig.15/17). Also known from the NP Podyjí.

Land use: Well-developed, more or less natural stands mostly in the

fodder, occasionally flax). Natural stands protect the soil against erosion and at higher levels they reduce runoff and contribute to nutrient recycling in the ecosystem. In contrast, substitute spruce plantations negatively influence the soil and nutrient recycling.

(Near-)natural stands: Oderské vrchy Hills; PLA Labské pískovce.

References: Moravec (1977), Moravec *et al.* (1982).

Typical relevé: Moravec (1977): tab. 3, suppl. 3, rel.9 (Oderské vrchy Hills), 460 m, W, 100, E3 - 80%, E2 - 1%, E1 - 90%, E0 - 0%.

E3 - 5: *Fagus sylvatica*,

E2 - +: *Fagus sylvatica*,

E1 - 5: *Melica uniflora*, 2: *Dentaria bulbifera*, *Oxalis acetosella*, 1: *Dryopteris filix-mas*, *Fagus sylvatica* (juv.), *Galium odoratum*, *Gymnocarpium dryopteris*, *Viola reichenbachiana*, +: *Acer pseudoplatanus* (juv.), *Anemone nemorosa*, *Athyrium filix-femina*, *Carex sylvatica*, *Dryopteris carthusiana*, *Festuca altissima*, *Hordelymus europaeus*, *Isopyrum thalictroides*, *Mercurialis perennis*, *Moehringia trinervia*, *Mycelis muralis*, *Paris quadrifolia*, *Urtica dioica*, r: *Deschampsia cespitosa*, *Galium rotundifolium*, *Hieracium murorum*.

17. Beech woodland with *Carex pilosa* (*Carici pilosae-Fagetum* Oberdorfer 1957), Fig. 21.

Synonyms: *Dentario-Fagetum* Neuhäuslová-Novotná 1970 p.p. (*caricetosum pilosae*).

Structure: Mostly two-layered, with tree and field layers. Ground layer mostly missing, shrub layer occurs only rarely and fragmentarily. Canopy formed almost exclusively by broadleaved woody species, principally by *Fagus sylvatica* with a relatively frequent admixture of *Quercus petraea*. On average, 20 species, mostly hygromesophilous elements of the *Fagetalia* (see below) in the field layer.

Diagn.: Dif.: E1 - *Carex pilosa* (dominant), *Cephalanthera longifolia*, *Euphorbia amygdaloides*.

Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Ajuga reptans*, *Athyrium filix-femina*, *Carex pilosa*, *C. sylvatica*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Epilobium montanum*, *Galium odoratum*, *Lathyrus vernus*, *Luzula luzuloides*, *Melica uniflora*, *Mycelis muralis*, *Oxalis acetosella*, *Poa nemoralis*, *Polygonatum multiflorum*, *Scrophularia nodosa*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: From the foregoing units (Nr. 14-16), prevalence of *Carex pilosa* in the field layer, and occurrence of *Cephalanthera longifolia* and *Euphorbia amygdaloides*. These species differentiate facies with a higher dominance of *Melica uniflora* from the *Melico-Fagetum*.

Fig. 21 — Carici pilosae-Fagetum Oberdorfer 1957.

Adjoining PNV: Climatic colline to montane broadleaved woodlands (*Carici pilosae-Carpinetum*, *Dentario enneaphylli-Fagetum*, on poorer soils *Luzulo-Fagetum*).

Habitat: Mostly MT9-5, at altitudes of 400-600 m on flat ridges and moderate slopes of different aspect. At higher levels on sunny slopes and at lower levels on northern slopes or in deep valleys. Relatively deep, mature cambisols (mesotrophic, rarely oligotrophic), developed mostly on flysh sandstones or claystones in the Carpathians; in the Česká vysočina Uplands on Culm sandstones.

Distribution: PND - 0.7%. Mostly at submontane levels of the Moravian Carpathians, continuing into the Carpathian system further east. (In spite of this, the *Carici pilosae-Fagetum* does not represent a Carpathian association, as it has been described from NW Germany). In flysh mountains, sometimes as continuous vegetation belt (e.g. in Maleník and the Chřiby Mts., which do not reach montane levels). In higher areas with strong relief (e.g. in the Bílé Karpaty Mts.) on southern slopes up to montane levels covered by the *Dentario enneaphylli-Fagetum*. In contrast, on northern slopes, at colline levels. From the Carpathians this unit extends to the eastern border of the Drahanská vrchovina Uplands on rocks of the Bohemian Massif (Fig.15/17). Also known from the NP Podyjí.

Land use: Well-developed, more or less natural stands mostly in the

fodder, occasionally flax). Natural stands protect the soil against erosion and at higher levels they reduce runoff and contribute to nutrient recycling in the ecosystem. In contrast, substitute spruce plantations negatively influence the soil and nutrient recycling.

(Near-)natural stands: Oderské vrchy Hills; PLA Labské pískovce.

References: Moravec (1977), Moravec *et al.* (1982).

Typical relevé: Moravec (1977): tab. 3, suppl. 3, rel.9 (Oderské vrchy Hills), 460 m, W, 100, E3 - 80%, E2 - 1%, E1 - 90%, E0 - 0%.

E3 - 5: *Fagus sylvatica*,

E2 - +: *Fagus sylvatica*,

E1 - 5: *Melica uniflora*, 2: *Dentaria bulbifera*, *Oxalis acetosella*, 1: *Dryopteris filix-mas*, *Fagus sylvatica* (juv.), *Galium odoratum*, *Gymnocarpium dryopteris*, *Viola reichenbachiana*, +: *Acer pseudoplatanus* (juv.), *Anemone nemorosa*, *Athyrium filix-femina*, *Carex sylvatica*, *Dryopteris carthusiana*, *Festuca altissima*, *Hordelymus europaeus*, *Isopyrum thalictroides*, *Mercurialis perennis*, *Moehringia trinervia*, *Mycelis muralis*, *Paris quadrifolia*, *Urtica dioica*, r: *Deschampsia cespitosa*, *Galium rotundifolium*, *Hieracium murorum*.

17. Beech woodland with *Carex pilosa* (*Carici pilosae-Fagetum* Oberdorfer 1957), Fig. 21.

Synonyms: *Dentario-Fagetum* Neuhäuslová-Novotná 1970 p.p. (*caricetosum pilosae*).

Structure: Mostly two-layered, with tree and field layers. Ground layer mostly missing, shrub layer occurs only rarely and fragmentarily. Canopy formed almost exclusively by broadleaved woody species, principally by *Fagus sylvatica* with a relatively frequent admixture of *Quercus petraea*. On average, 20 species, mostly hygromesophilous elements of the *Fagetalia* (see below) in the field layer.

Diagn.: Dif.: E1 - *Carex pilosa* (dominant), *Cephalanthera longifolia*, *Euphorbia amygdaloides*.

Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Ajuga reptans*, *Athyrium filix-femina*, *Carex pilosa*, *C. sylvatica*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Epilobium montanum*, *Galium odoratum*, *Lathyrus vernus*, *Luzula luzuloides*, *Melica uniflora*, *Mycelis muralis*, *Oxalis acetosella*, *Poa nemoralis*, *Polygonatum multiflorum*, *Scrophularia nodosa*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: From the foregoing units (Nr. 14-16), prevalence of *Carex pilosa* in the field layer, and occurrence of *Cephalanthera longifolia* and *Euphorbia amygdaloides*. These species differentiate facies with a higher dominance of *Melica uniflora* from the *Melico-Fagetum*.

Fig. 21 — Carici pilosae-Fagetum Oberdorfer 1957.

Adjoining PNV: Climatic colline to montane broadleaved woodlands (*Carici pilosae-Carpinetum*, *Dentario enneaphylli-Fagetum*, on poorer soils *Luzulo-Fagetum*).

Habitat: Mostly MT9-5, at altitudes of 400-600 m on flat ridges and moderate slopes of different aspect. At higher levels on sunny slopes and at lower levels on northern slopes or in deep valleys. Relatively deep, mature cambisols (mesotrophic, rarely oligotrophic), developed mostly on flysh sandstones or claystones in the Carpathians; in the Česká vysočina Uplands on Culm sandstones.

Distribution: PND - 0.7%. Mostly at submontane levels of the Moravian Carpathians, continuing into the Carpathian system further east. (In spite of this, the *Carici pilosae-Fagetum* does not represent a Carpathian association, as it has been described from NW Germany). In flysh mountains, sometimes as continuous vegetation belt (e.g. in Maleník and the Chřiby Mts., which do not reach montane levels). In higher areas with strong relief (e.g. in the Bílé Karpaty Mts.) on southern slopes up to montane levels covered by the *Dentario enneaphylli-Fagetum*. In contrast, on northern slopes, at colline levels. From the Carpathians this unit extends to the eastern border of the Drahanská vrchovina Uplands on rocks of the Bohemian Massif (Fig.15/17). Also known from the NP Podyjí.

Land use: Well-developed, more or less natural stands mostly in the

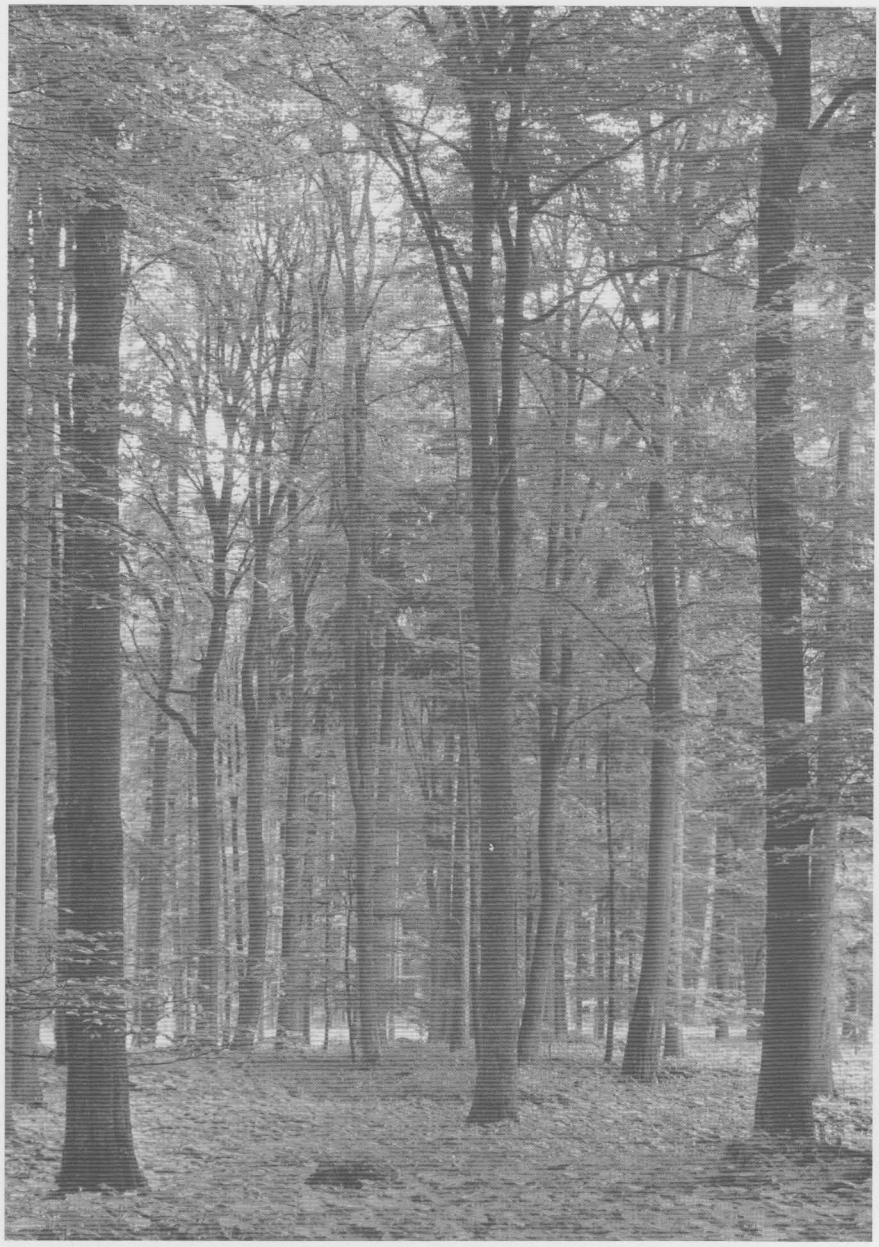

Fig. 22 — Dentario enneaphylli-Fagetum Oberdorfer ex W. et A. Matuszkiewicz 1960.

Carpathians. They produce high, straight stands of a high quality, currently damaged by replacement with coniferous species. As a result of forest management, almost pure high beech stands can be found.

On the slopes they protect the soil against erosion and reduce run-off, mostly at higher levels. They also contribute to nutrient recycling in the ecosystem.

(Near-)natural stands: Chřiby Mts. - Pěkná hora Hill; PLA Bílé Karpaty; Maleník.

Rare and endangered taxa: *Cephalanthera longifolia*, in deforested area *Melampyrum nemorosum* subsp. *moravicum*, *Traunsteinera globosa*, *Aremonia agrimonioides*.

References: Moravec (1977), Moravec *et al.* (1982).

Typical relevé: Moravec (1977): tab. 3, suppl. 3, rel. 25 (Chřiby Mts.), 825 m, W, 90, E3 - 90%, E2 - 3%, E1 - 75%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, +: *Quercus petraea*,

E2 - 1: *Fagus sylvatica*,

E1 - 4: *Carex pilosa*, 2: *Fagus sylvatica* (juv.), 1: *Galium odoratum*, *Viola reichenbachiana*, +: *Acer pseudoplatanus* (juv.), *Carex sylvatica*, *Euphorbia amygdaloides*, *Hordelymus europaeus*, *Mycelis muralis*, r: *Athyrium filix-femina*, *Cephalanthera longifolia*, *Epilobium montanum*, *Fragaria vesca*, *Galium rotundifolium*, *Neottia nidus-avis*, *Quercus petraea* (juv.), *Sanicula europaea*.

18. Beech woodland with *Dentaria enneaphyllos* (*Dentario enneaphylli-Fagetum* Oberdorfer ex W. et A. Matuszkiewicz 1960), Fig. 22.

Synonyms: *Fagetum sudeticum* Preis 1938, *Fagetum abietosum hercynicum* Klika et Šmarda 1940, *Abieto-Fagetum sudeticum* Neuhäusl 1959, *Dentario enneaphyllidis-(Abieti)-Fagetum* Hartmann et Jahn 1967, *Abieti-Fagetum hercynicum* Mikyška 1972.

Structure: Two-layered stands formed by tree and field layers. Shrub and ground layers developed fragmentarily only or missing. Canopy dominated by *Fagus sylvatica* with an admixture of *Acer pseudoplatanus*, *Abies alba* and *Picea abies* (at higher levels probably natural). Field layer mostly closed, its cover changing in relation to the canopy cover. Species of the *Fagetalia* prevail and most species of the *Fagion* are present.

Diagn.: Dif.: E1 - *Dentaria enneaphyllos*.

Species with high constancy: E3 - *Fagus sylvatica*, E1 - *Actaea spicata*, *Athyrium filix-femina*, *Dentaria bulbifera*, *Dryopteris filix-mas*, *Galeobdolon montanum*, *Galium odoratum*, *Mercurialis perennis*, *Mycelis muralis*, *Oxalis acetosella*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: From the montane (*Dentario glandulosae-Fagetum*, *Violo reichenbachianae-Fagetum*) and submontane beech woodlands (*Tilio platyphylli-Fagetum*, *Tilio cordatae-Fagetum*, *Melico-Fagetum*, *Carici pilosae-Fagetum*) - the presence of *Dentaria enneaphyllos* and frequent admixture of *Festuca altissima*. In smaller, isolated stands the species composition of the *Dentario enneaphylli-Fagetum* is incomplete.

Adjoining PNV: Climax submontane and montane broadleaved or mixed woodlands (*Luzulo-Fagetum*, in the Carpathians *Carici pilosae-Fagetum*, at montane levels of the Moravskoslezské Beskydy Mts. the vicariant *Dentario glandulosae-Fagetum*, in the Nízký Jeseník Mts. *Festuco altissimae-Fagetum*, at montane levels in the Doupovské hory Mts. and in the eastern part of the Krušné hory Mts. *Violo reichenbachianae-Fagetum*, at higher levels of the Česká vysočina Uplands acidophilous *Calamagrostio villosae-Fagetum*), at lower levels *Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*.

Habitat: Colder MW (MW4-2), C7. Mostly montane levels (600-1000 m, in the Šumava Mts. up to 1100 m).

On slopes of different aspects, frequent. On sites conditioned by mesoclimate (e.g. northern to northeastern or valley slopes, inversion levels) at altitudes below 400 m.

Weathered substrates from crystalline to sedimentary, relatively mineral-poor rocks. Exceptionally, decalcified slope loams on Cretaceous sediments. The soils belong to more or less stony cambisols (mesotrophic to eutrophic variants). The soils on Cretaceous sediments correspond to mull para-rendzina.

Distribution: PND - 12.1%. All higher mountains of the Česká vysočina Uplands (with exception of the Krušné hory Mts.) and the Western Carpathians. In the Carpathians it also forms a continuous cover in the Moravskoslezské Beskydy Mts. (with the exception of the catchments of the Olše and Kysuca rivers), the Javorníky, Hostýnské and Vsetínské vrchy Hills and in the Bílé Karpaty Mts. In the Doupovské hory Mts. only on the summits, in the Krušné hory Mts. only in the eastern-most part (elsewhere in these mountains replaced by the vicariant *Violo reichenbachianae-Fagetum*). In lower uplands it is associated with summit areas, northern and eastern slopes or deep valleys. Exceptionally, isolated stands at relatively low levels (390-510 m).

In the Moravskoslezské Beskydy and Javorníky Mts. the border with the vicariant Carpathian *Dentario glandulosae-Fagetum* runs approximately along the watershed of the Olše and Kysuca rivers (see Fig. 15/18).

Land use: The *Dentario enneaphylli-Fagetum* is preserved in many natural and near-natural stands, some of which are protected in nature reserves. The beech can reach 30 m in height and *Abies alba* up to 40 m high. In primeval stands of the *Dentario enneaphylli-Fagetum impatientetosum* high-quality spruce stems may reach more than 50 m. In managed woodlands the spruce can cover 50% of the area without damaging the equilibrium between the vegetation and soil and without a degradation of the ecosystem. However, the repeated planting of pure spruce stands causes soil degradation (mostly that of the humus horizons) and a decline of stand quality. Part of the mapped area used as meadows and pastures (*Arrhenatherion*, *Polygono-Trisetion*, poor communities of the *Nardetalia*).

Apart from the nature reserves, the stands are damaged by replacement with coniferous plantations (mostly spruce) which are less stable and have a negative influence on the soil and nutrient recycling. Besides their economic value, these phytocoenoses play an important regulatory role in the hydrology (they occur on watersheds and in spring areas) and in the ecological stability of the landscape (soil protection against erosion).

(Near-)natural stands: NP Šumava - NNR Boubínský prales and Stožec; Novohradské hory Mts. - NNR Žofínský prales; PLA Železné hory Mts. - NR Polom; Českomoravská vrchovina Uplands - NNR Žákova hora Mt.; Hostýnsko-vsetínská hornatina Uplands - primeval forests in the NR Čerňava and Cáb Hills; Moravskoslezské Beskydy Mts. - primeval forest Bumbálka.

Rare and endangered taxa: *Abies alba*, *Cardamine trifolia*, *Polystichum braunii*.

References: Klika et Šmarda (1940), Mikyška (1972), Moravec (1974, 1977), Moravec *et al.* (1982), Neuhäusl (1959), Neuhäusl et Neuhäuslová-Novotná (1979), Pohl (1943), Sedláčková (1978), Šmarda (1950).

Typical relevé: Moravec (1974): tab. 2, suppl. 5, rel. 4 (Šumava Mts.), 910 m, W, 80, E3 - 85%, E2 - 0%, E1 - 60%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, 2: *Abies alba*, +: *Picea abies*, r: (*Larix decidua*),

E1 - 3: *Impatiens noli-tangere*, *Oxalis acetosella*, 2: *Galium odoratum*, *Mercurialis perennis*, 1: *Dentaria enneaphyllos*, *Festuca altissima*, *Galeobdolon montanum*, *Geranium robertianum*, *Hordelymus europaeus*, *Milium effusum*, *Viola reichenbachiana*, +: *Actaea spicata*, *Fagus sylvatica* (juv.), *Galium rotundifolium*, *Moehringia trinervia*, *Mycelis muralis*, *Symphytum tuberosum*, *Urtica dioica*, *Veronica officinalis*, r: *Acer pseudoplatanus* (juv.), *Bromus benekenii*, *Carex pairae*, *Dentaria bulbifera*, *Festuca gigantea*, *Galeopsis tetrahit*, *Luzula luzuloides*, *Paris quadrifolia*, *Rubus hirtus*, *Sambucus racemosa* (juv.), *Senecio fuchsii*, *Sorbus aucuparia* (juv.), *Stachys sylvatica*.

Invas., expans.: *Reynoutria japonica* (e.g. Lužické hory Mts.).

19. Carpathian beech woodland with *Dentaria glandulosa* (*Dentario glandulosae-Fagetum* Matuszkiewicz ex Guzikowa et Kornaś 1969), Fig. 24.

Synonyms: *Dentario-Fagetum carpaticum-beschidicum* Samek et Javůrek 1964b, as. *Fagus sylvatica-Abies alba-Dentaria glandulosa* Švendová 1975, as. *Fagus sylvatica-Dentaria glandulosa-Oxalis acetosella* Švendová 1975, *Fagetum carpaticum* auct. polon. non Klika 1927.

Structure: As only the western-most part of this unit penetrates into the Czech Republic, differences from other units are not fully representative. They can be judged only according to phytosociological data from other countries where it is more extensive (e.g. Poland).

Mostly two-layered stands formed by tree and field layers only. Canopy, dominated by *Fagus sylvatica*, very poor in species (mostly only *Acer pseudoplatanus* and *Abies alba* admixed). Only at higher levels does *Picea abies* occur as a natural element. Species of the *Fagetalia* more abundant and dominant in the field layer (see below). Diagnostic species of the *Fagion* relatively abundant, but not always constant (e.g. *Dentaria bulbifera*, *Veronica montana*, *Polygonatum verticillatum*, *Prenanthes purpurea*). In the E Carpathians, *Symphytum cordatum* plays a differential role.

Diagn.: Dif.: E1 - *Dentaria glandulosa*, *Salvia glutinosa*.

Species with high constancy: E3 - *Acer pseudoplatanus*, *Fagus sylvatica*, E1 - *Athyrium filix-femina*, *Circaea intermedia*, *Dentaria bulbifera*, *Dryopteris carthusiana*, *D. filix-mas*, *Galium odoratum*, *Geranium robertianum*, *Impatiens noli-tangere*, *Mercurialis perennis*, *Oxalis acetosella*, *Senecio fuchsii*, *Sanicula europaea*, *Veronica montana*.

Differences: Besides *Dentaria glandulosa*, the *Dentario glandulosae-Fagetum* differs negatively from the *Dentario enneaphylli-Fagetum* (absence of *Festuca altissima*, low constancy of *Milium effusum*, and decline in importance of *Hordelymus europaeus* compared with the stands in Slovakia). Nevertheless, there is a floristic gradient between typical stands of the *Dentario glandulosae-Fagetum* in the Eastern Carpathians and those of the *Dentario enneaphylli-Fagetum* in the mountains of the Česká vysočina Uplands, characterized by a gradual increase of diagnostic species of the first association and by a decline of diagnostic species of the second association.

Adjoining PNV: Climax submontane and montane broadleaved and mixed woodlands (*Luzulo-Fagetum*, *Carici pilosae-Fagetum*), at montane levels of the Moravskoslezské Beskydy Mts. the vicariant *Dentario enneaphylli-Fagetum*, on mountain ridges *Calamagrostio villosae-Fagetum*.

Habitat: Colder MT2, C7. As a climatic climax, the *Dentario glandulosae-*

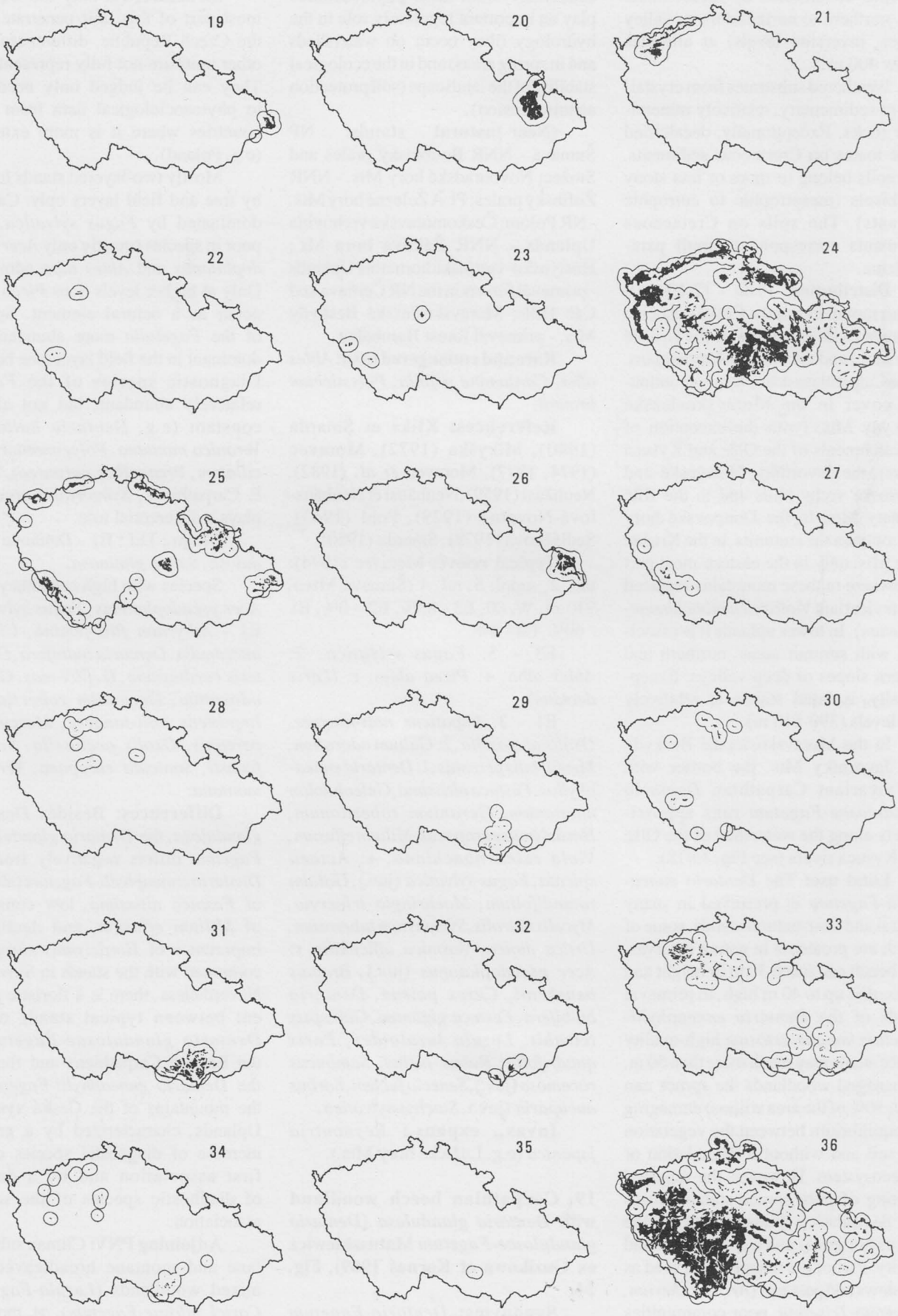

Fig. 23 — Potential natural distribution of mapping units 19-36. The lines surrounding the potential natural distribution of the individual mapping units represent buffer zones of a width of 10 km.

Fig. 24 — Dentario glandulosae-Fagetum Matuszkiewicz ex Guzikowa et Kornaś 1969.

Fagetum occupies analogous habitats to its vicariant *Dentario enneaphylli-Fagetum*, between 500-900 m (mostly 700-900m). Shady slopes in the catchment of the Olše river and northern to eastern slopes of the Moravskoslezské Beskydy Mts. The soils correspond mostly to mesotrophic or eutrophic cambisols.

Distribution: PND - 0.2%. Part of the Moravskoslezské Beskydy (catchment of the Olše river) and Javorník Mts. (catchment of the Kysuca river). It penetrates into the headwaters of the Vsetínská Bečva river (Fig. 23/19).

Centre of distribution: Slovakian and Polonian Carpathians and mountains of the Transcarpathians.

Land use: The *Dentario glandulosae-Fagetum* is preserved in some natural and near-natural stands, some of them protected in nature reserves. The beech reaches 30 m in height, *Abies alba* up to 40 m. Some stands replaced by spruce plantations which are less stable and have a negative influence on soil and nutrient cycling. About one third of area used for agriculture - mostly meadows and pastures (*Arrhenatherion*, *Polygono-Trisetion*, poor communities of the *Nardetalia*), less frequently arable land (potatoes, rye).

Besides their economic value they play an important role in the hydrology (occurrence on watersheads and in spring areas) and in the ecological stability of the landscape (protection against soil erosion).

Natural stands: Moravskoslezské Beskydy Mts. - NNR "Mionší"; Javorníky Mts. - NNR "Razula".

Rare and endangered taxa: *Abies alba*, *Cardamine trifolia*, *Polystichum braunii* (both only sporadically distributed).

References: Moravec *et al.* (1982), Samek et Javůrek (1964), Sedláčková (1980), Švendová (1975).

Typical relevé: Samek et Javůrek (1964): Tab. 1 ad p. 16, rel. 19 (Moravskoslezské Beskydy Mts.), E, 80, E3 - not mentioned, E2 - 5%, E1 - 80%, E0 - 0

E3 - 5: *Fagus sylvatica*,

E2 - +: *Fagus sylvatica*,

E1 - 2: *Galium odoratum*, *Impatiens noli-tangere*, *Oxalis acetosella*, 1: *Dentaria glandulosa*, *Dryopteris filix-mas*, *Galeobdolon luteum*, *Athyrium filix-femina*, *Geranium robertianum*, *Salvia glutinosa*, +: *Ajuga reptans*, *Asarum europaeum*, *Dentaria bulbifera*, *D. enneaphyllos*, *Dryopteris carthusiana*, *Euphorbia amygdaloides*, *Fragaria vesca*, *Gymnocarpium dryopteris*, *Hordelymus europaeus*, *Mercurialis perennis*, *Senecio fuchsii*, *Sanicula europaea*, *Veronica montana*, *Viola reichenbachiana*, r: *Circaea intermedia*, *Paris quadrifolia*, *Polystichum aculeatum*, *Rubus idaeus*.

20. Beech woodland with *Festuca altissima* (*Festuco altissimae-Fagetum* Schlüter in Grüneberg et Schlüter 1957)

Synonyms: *Dentario enneaphyllidis* (*Abieti-*) *Fagetum* Hartmann et Jahn 1967 p.p. [*festucetosum*]; non *Festuca sylvatica-Fagetum* Kuhn 1937.

Structure: Two-layered stands formed by tree and field layers. Shrub layer absent, ground layer developed only fragmentarily and very rarely. Canopy dominated by *Fagus sylvatica* with a regular admixture of *Acer pseudoplatanus*, less frequently *Abies alba*. The admixture of *Picea abies* is probably a result of human activity. Field layer dominated by *Festuca altissima* (cover 30-70%), species-poor (< 20 species). Species of the *Fagetalia* frequent, those of the *Fagion* sporadic (*Festuca altissima*, *Prenanthes purpurea*).

Diagn.: Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Dryopteris filix-mas*, *Festuca altissima* (dominant), *Oxalis acetosella*, *Senecio fuchsii*.

Differences: Dominance of *Festuca altissima*, even if this species is sometimes also admixed in other units (e.g. *Dentario enneaphylli-Fagetum*).

Adjoining PNV: Climax submontane and montane broadleaved or mixed woodlands (*Luzulo-Fagetum*, *Abieti-Quercetum*, partly *Dentario enneaphylli-Fagetum*), edaphic climax *Luzulo albidae-Quercetum petraeae*.

Habitat: Colder MW3, C7. Slopes of different aspects (mostly 450-900 m). The soils are mostly shallow, formed on rocky summits and on rocky edges of slopes. They correspond to stony cambisols (mesotrophic brown earths) with a relatively deep moder horizon, rarely ranker cambisols on stabilized screes. The geological substrates are mostly poor, siliceous rocks (graywackes of Culm and sandstones), or siliceous sediments (conglomerates, hard Pre-Tertiary sandstones).

Distribution: PND - 1.5%. Mostly small areas within other more extensive beech woodlands (*Dentario enneaphylli-Fagetum* and *Melico-Fagetum*, *Violo reichenbachianae-Fagetum*) in the mountains. Probably on large areas in the Nízký Jeseník Mts. and Oderské vrchy Hills, although natural stands have not been found (Fig.23/20). Natural stands recorded in the Rychlebské hory and Hrubý Jeseník Mts.

Land use: In natural, well-developed, mature stands well-growing beech with stems up to 30 m high. Pure high beech stands are result of forest management.

Besides the economic value of the timber, the *Festuco altissimae-Fagetum* plays an important role in the hydrology and ecological stability of the landscape (protection against soil erosion).

(Near-)natural stands: Hrubý Jeseník Mts., northern part.

References: Moravec *et al.* (1982).

Typical relevé: Moravec in Moravec *et al.* (1982): 220, tab. 29, rel. 3 (Brdská vrchovina Highland), 710 m, NE, 170, E3 - 80%, E1 - 35%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, 1: *Picea abies*, +: *Acer pseudoplatanus*,

E1 - 3: *Festuca altissima*, 1: *Acer pseudoplatanus* (juv.), *Fagus sylvatica* (juv.), *Oxalis acetosella*, *Sorbus aucuparia* (juv.), +: *Athyrium filix-femina*, *Deschampsia flexuosa*, *Dryopteris filix-mas*, *D. carthusiana*, *Mercurialis perennis*, *Paris quadrifolia*, *Vaccinium myrtillus*, r: *Dryopteris dilatata*, *Galeopsis tetrahit*.

Invas.,expans.: In large deforested area of Libavá, N Moravia, *Anthriscus sylvestris* and *Lupinus polyphyllus* very frequent.

21. Beech woodland with *Viola reichenbachiana* (*Violo reichenbachianae-Fagetum* Moravec 1979), Fig. 25.

Synonyms: *Dentario-Fagetum* sensu Samek et Krátký 1960, non Zlatník 1938, nec Hartmann 1953, nec Mráz 1960, *Impatiento-Fagetum* Samek et Krátký 1960, non Mráz 1960.

Structure: Mostly two-layered stands formed by tree and field layers. Open shrub layer present relatively frequently, although with a low dominance. Canopy dominated by *Fagus sylvatica* with an admixture of *Acer pseudoplatanus* (relatively frequent) and *Ulmus glabra* and *Fraxinus excelsior* (less frequent). In the past, *Abies alba* also occurred in the canopy. In the shrub layer, *Sambucus racemosa* frequent (probably as result of eutrophication from emissions).

Cover of the field layer between 20 and 90% related to the inclination of the slope and cover of the canopy. On average 23 species occur in the field layer (mostly *Fagetalia* species, from *Fagion* only *Hordelymus europaeus*, *Prenanthes purpurea*, *Actaea spicata*, *Rubus hirtus*). In the Czech Republic, *Hordelymus europaeus* is most constant species even in this association, with a tendency to prevail principally in mature stands on deep soils of moderate slopes and plateaus. *Galium odoratum*, *Galeobdolon luteum* and *Oxalis acetosella*, rarely *Impatiens noli-tangere*, *Senecio fuchsii* or *Mercurialis perennis* are dominant or codominant.

Diagn.: Species with high constancy: E3 - *Fagus sylvatica*; E1 - *Athyrium filix-femina*, *Dryopteris filix-mas*, *Galeobdolon luteum*, *Galium odoratum*, *Hordelymus europaeus*, *Mercurialis perennis*, *Oxalis acetosella*, *Prenanthes purpurea*, *Rubus idaeus*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: The *Violo-Fagetum* is characterized rather negatively by absence of *Dentaria* species. Mature stands are dominated by *Hordelymus europaeus*.

Adjoining PNV: Climax submontane to montane deciduous woodlands *Luzulo-Fagetum*, at lower levels on relatively rich soils *Melampyro nemorosi-Carpinetum*, on poorer soils *Luzulo albidae-Quercetum petraeae*, in the eastern part of the Krušné hory Mts. *Dentario enneaphylli-Fagetum*, on montane ridges and plateaus *Calamagrostio villosae-Fagetum*.

Habitat: Colder MW subunits, C6. (Sub)montane levels (mostly 500-700 m, in shady valleys down to 450 m). Mostly on slopes, without a marked preference for any particular aspect. Mature soils on weathered material of very different mineral content, from mineral-rich basalts to poor crystalline slates. The soils correspond to more or less stony cambisols, rarely ranker cambisols, from eutrophic to oligotrophic varieties.

Distribution: PND - 0.7%. In the Krušné hory Mts. only (with exception of the easternmost part) and the Doupovské hory Mts. (with exception of the summits) as vicariant of the *Dentario enneaphylli-Fagetum*. As a climatic climax these stands form a continuous belt at montane to submontane levels on upper slopes of the Krušné hory Mts. and at middle levels of the Doupovské hory Mts. (Fig. 23/21, 25).

Land use: The *Violo reichenbachianae-Fagetum* has been preserved in natural or near-natural stands on northern slopes of the Doupovské hory Mts. and here and there also in the Krušné hory Mts. In well-developed mature natural stands beech stems up to 30 m high. Very frequently, plantations of *Picea abies*. Of substitute communities, meadows and pastures - *Arrhenatherion* (*Poo-Trisetetum*), *Polygono-Trisetion* - and poor communities of the *Nardetalia*, are frequent.

The *Violo-Fagetum* represents the most resistant ecosystem against emissions. Besides its economic value it plays an important role in water management (occurrence on watersheds and in spring areas) and as protection against soil erosion.

(Near-)natural stands: Doupovské hory Mts. - between the Stoličná and Hora Hills; Krušné hory Mts. - northern slope of Špičák Hill.

References: Moravec (1979), Moravec *et al.* (1982).

Typical relevé: Moravec (1979): 498-500, tab. 2, rel. 18 (Krušné hory Mts.), 620 m, SW, 240, E3 - 85%, E2 - 0%, E1 - 35%, E0 - 0%.

E3 - 5: *Fagus sylvatica*, 1: *Acer pseudoplatanus*,

E1 - 2: *Galium odoratum*, *Hordelymus europaeus*, *Oxalis acetosella*, 1: *Acer pseudoplatanus* (juv.), *A. platanoides*, *Athyrium filix-femina*, *Galeobdolon luteum*, *Viola reichenbachiana*, +: *Carex sylvatica*, *Dryopteris filix-mas*, *Fagus sylvatica* (juv.), *Impatiens noli-tangere*, *Mercurialis perennis*, *Melica nutans*, *Milium effusum*, *Senecio fuchsii*, *Stachys sylvatica*, *Ulmus glabra* (juv.), *Urtica dioica*, r: *Galeopsis tetrahit*, *Geranium robertianum*, *Mycelis*

muralis, *Sanicula europaea*, *Veronica montana*.

Calciphilous beech woodland (*Cephalanthero-Fagenion* Tüxen in Tüxen in Oberdorfer 1957)

Herb-rich, mostly sub-montane, beech woodland on rendzina soils on substrates rich in, or with an admixture of, carbonates.

22. Beech woodland with *Cephalanthera* species (*Cephalanthero-Fagetum* Oberdorfer 1957)

Synonyms: *Carici-Fagetum* sensu Lohmeyer 1953 et auct. germ. non Moor 1952, *Carici montanae-Fagetum* Oberdorfer in Oberdorfer *et al.* 1992.

Structure: Mostly two- or three-layered stands formed by the tree and herb layers. The prevailing *Fagus sylvatica* accompanied by *Acer pseudoplatanus*, *A. platanoides*, *Tilia cordata*, *Quercus petraea*, and *Carpinus betulus*, here and there also by *Abies alba*. Shrub layer frequently present, consisting only of isolated shrubs (*Daphne mezereum*, *Swida sanguinea*, *Viburnum opulus*). Field layer rich in *Orchidaceae*, species of the *Cephalanthero-Fagenion*, *Fagetalia* and *Querco-Fagetea* frequent. *Fagion* elements *Prenanthes purpurea* and *Actaea spicata* also occur here, as well as some species of the *Carpinion* (e.g. *Galium sylvaticum*) and some thermophilous species (e.g. *Pyrethrum corymbosum*).

Diagn.: Dif.: E2 - *Swida sanguinea*, E1 - *Campanula rapunculoides*, *Cephalanthera damasonium*, *C. rubra*, *Corallorhiza trifida*, *Epipactis helleborine*, *Neottia nidus-avis*, *Orthilia secunda*, *Pyrethrum corymbosum*.

Species with high constancy: E3 - *Fagus sylvatica*, E2 - *Daphne mezereum*, E1 - *Actaea spicata*, *Carex digitata*, *Galium odoratum*, *Hedera helix*, *Hepatica nobilis*, *Hieracium murorum*, *Lathyrus vernus*, *Melica nutans*, *Mercurialis perennis*, *Mycelis muralis*, *Poa nemoralis*, *Viola reichenbachiana*.

Differences: From other beech woodlands, presence of *Cephalanthera damasonium* and *C. rubra*.

Adjoining PNV: *Melampyro nemorosi-Carpinetum*, *Brachypodio pinnati-Quercetum*, *Luzulo albidae-Quercetum petraeae*, *Luzulo-Fagetum*.

Habitat: Warmest units of MW. Mostly in the submontane belt, less frequently at colline levels (between 275-620 m). At lower levels on northern slopes. Humus-carbonate soils (moder and mull rendzina, pararendzina, terra fusca) on calcium carbonate-rich substrate formed by palaeozoic sedimentary limestones (Český kras, Moravský kras), small islands of crystalline limestones (Šumava Foothill, Ještědsko-kozákovský hřbet Ridge) and dolomites, but also mesozoic marlite or loess. Sorption complex of soils saturated by calcium or magnesium ions (high buffer capacity, pH around 7.0).

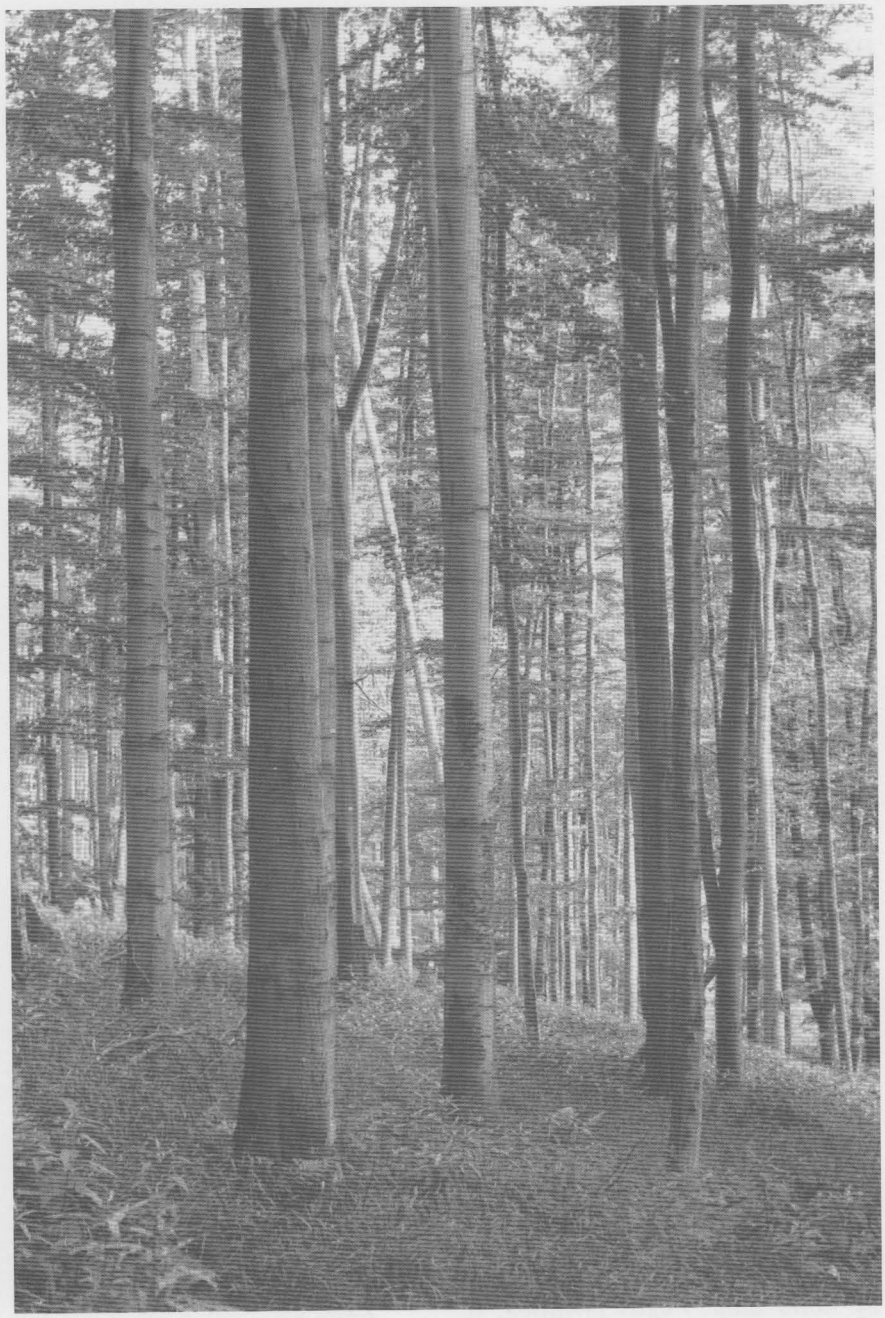

Fig. 25 — Violo reichenbachianae-Fagetum Moravec 1979.

Distribution: Besides the distribution mentioned above, also the Džbán Uplands and the Česká tabule Plain (Fig. 23/22).

Land use: The community forms tall stands in which beech, admixed with other tree species, produces timber of high quality. Deforested sites covered by meadows (*Arrhenatherion*, *Bromion erecti*). The stands are also important for water management and soil protection (control of runoff, prevention of soil erosion), and for the maintainance of nutrient recycling, especially calcium, in the ecosystem.

(Near-)natural stands: Karlštejnská vrchovina Uplands - PLA Český kras; Džbán Uplands; Hořaďovická pahorkatina and Sušická vrchovina Uplands - areas of crystalline limestones, PLA Moravský kras - NR Josefovské údolí.

Rare and endangered syntaxa: *Cephalanthero-Fagetum*.

Rare and endangered taxa: *Cephalanthera damasonium*, *C. rubra*, *Corallorhiza trifida*, *Cypripedium calceolus*, *Daphne mezereum*, *Lilium martagon*.

References: Mikyška (1972), Moravec in Moravec *et al.* (1982), Sýkora (1967b).

Typical relevé: Moravec in Moravec *et al.* (1982): 236-237, tab. 32,

rel. 1 (Džbán Uplands), 465 m, S, 220, E3 - 90%, E1 - 5%, E0 - 1%.

E3 - 5: *Fagus sylvatica*, +: *Acer pseudoplatanus*,

E1 - 1: *Galium odoratum*, *Hieracium lachenalii*, +: *Actaea spicata*, *Anemone nemorosa*, *Campanula rapunculoides*, *Cephalanthera damasonium*, *C. rubra*, *Corallorhiza trifida*, *Galeobdolon luteum*, *Hepatica nobilis*, *Hieracium murorum*, *Lathyrus vernus*, *Luzula luzuloides*, *Maianthemum bifolium*, *Melica nutans*, *Mercurialis perennis*, *Mycelis muralis*, *Neottia nidus-avis*, *Polygonatum multiflorum*, *Prenanthes purpurea*, *Sorbus aucuparia* (juv.), r: *Deschampsia flexuosa*, *Epipactis helleborine*, *Fragaria vesca*, *Lonicera xylosteum* (juv.), *Poa nemoralis*, *Quercus petraea* (juv.), *Rubus idaeus*, *Sanicula europaea*, *Scrophularia nodosa*, *Solidago virgaurea*, *Vicia sylvatica*,

E0 - +: *Brachythecium velutinum*, *Plagiothecium denticulatum*, *P. laetum*, r: *Tortula subulata*.

Herb-rich silver fir woodland (*Galio-Abietenion* Oberdorfer 1962)

Species-rich fir woodland on heavy, alternately moist, poorly permeable pseudogley soils in depressions and concave parts of moderate slopes, mainly at submontane levels.

23. Silver fir woodland with *Sanicula europaea* (*Saniculo europaeae-Abietetum* Husová 1998)

Synonyms: *Abietetum hercynicum* Husová 1968a provis.

Structure: Mostly three-layered stands with well-developed canopy, field and ground layers. Canopy dominated by *Abies alba*. *Fagus sylvatica*, if present, is rare in natural stands and an admixture of *Picea abies* is mostly of anthropogenic origin. Shrub layer, consisting of sparse individuals of young fir and *Sambucus racemosa*, present only in part of the stands. Field layer composed mainly of *Fagetalia* species (*Viola reichenbachiana*, *Mycelis muralis*, *Epilobium montanum*, *Galium odoratum*, *Carex digitata*, *Campanula trachelium*, *Impatiens noli-tangere*, and sparse *Actaea spicata*) and its physiognomy is determined by *Oxalis acetosella*. Ground layer often well-developed, consisting of shade-demanding hygrophilous mosses. Presence of *Mnium hornum* typical.

Diagn.: Dif.: E3, E2- *Abies alba*, E2 - *Sambucus racemosa*, E1 - *Galium rotundifolium*, *Luzula pilosa*, *Sanicula europaea*.

Species with high constancy: *Adoxa moschatellina*, *Athyrium filix-femina*, *Campanula trachelium*, *Carex digitata*, *Epilobium montanum*, *Festuca gigantea*, *Galium odoratum*, *Impatiens noli-tangere*, *Mycelis muralis*, *Oxalis acetosella*, *Senecio fuchsii*, *Viola reichenbachiana*.

Differences: Natural stands of the community occur in areas where fir thrives whereas beech is rare for mesoclimatic, biogeographic or edaphic reasons. Field layer of similar composition to herb-rich beech woodland of submontane levels (although *Hordelymus europaeus* and *Festuca altissima* mostly absent). Species of nutrient-poor sites (*Deschampsia flexuosa*, *Vaccinium myrtillus*) only sporadic here in contrast to their frequent occurrence in the acidophilous *Deschampsio-Abietetum*.

Adjoining PNV: *Melampyro-Carpinetum*, *Abieti-Quercetum* at lower levels, beech woodlands in uplands (*Tilio cordatae-Fagetum*, *Dentario enneaphylli-Fagetum*).

Habitat: MW, mostly submontane levels (550-700 m). Poorly permeable loamy cambisols or pseudogley soils, acidic to weakly acidic and periodically or permanently waterlogged. The upper horizons have a moderate biological activity and a prevalence of ammonium nitrogen. A high saturation of the sorption complex only in the humus layer near the soil surface. The stands form patches on the margins of springs, in depressions and on concave parts of moderate slopes with saturated soils.

Distribution: PND - 0.1%. Small areas in the Strážovská and Prachatická hornatina Uplands (Šumava Foothills), Železné hory Mts. and Benešovská pahorkatina Hills (Fig. 23/23).

Land use: Most areas of this unit suitable only for woodland. Prevailing spruce plantations of relatively good quality at higher altitudes but endangered by wind throw in some places. The habitats are not suitable for growing beech.

Surviving fragments of the fir stands serve as reservoirs of natural gene-pool of fir.

(Near-)natural stands: Šumava Foothills - Strážovská vrchovina Uplands; Benešovská pahorkatina Uplands.

Rare and endangered syntaxa: *Saniculo-Abietetum*.

Rare and endangered taxa: *Abies alba*.

References: Husová (1968a, 1998), Mráz (1959), Neuhäusl et Neuhäuslová-Novotná (1979, 1987), Sofron (1979).

Typical relevé: Husová (1968a): Tab. 35, rel. 20 (Šumava Foothills - Strážovská vrchovina Upland), 780 m, SW, 150, E3 - 70%, E1 - 75%, E0 - 80% (not determined).

E3 - 7: *Abies alba*, 2: *Picea abies*, +: *Fagus sylvatica*,

E1 - 5: *Oxalis acetosella*, *Senecio fuchsii*, 4: *Galium rotundifolium*, *Sanicula europaea*, *Viola reichenbachiana*, 2: *Carex digitata*, *Galium odoratum*, *Luzula pilosa*, *Mycelis muralis*, 1: *Abies alba*, *Carex pilulifera*, *Deschampsia flexuosa*, *Fragaria vesca*, *Hieracium murorum*, *Rubus idaeus*, *Ulmus glabra*, +: *Agrostis capillaris*, *Athyrium filix-femina*, *Dactylis glomerata*, *Dryopteris filix-mas*, *Epilobium montanum*, *Fraxinus excelsior*, *Galeopsis pubescens*, *Impatiens noli-tangere*, *Melandrium rubrum*, *Picea abies*, *Rubus hirtus*, *Salix caprea*, *Sorbus aucuparia*, *Veronica officinalis*, (+): *Sambucus racemosa*, *Scrophularia nodosa*.

Acidophilous beech and silver fir woodland (*Luzulo-Fagion* Lohmeyer et Tüxen in Tüxen 1954)

Species-poor beech and fir woodlands on nutrient-poor soils, mostly at submontane to supramontane levels, and waterlogged oak-beech woodland on pseudogley soils at lower altitudes of NE Moravia. PND - 19,1% of the total area of the Republic.

24. Woodrush-beech woodland (*Luzulo-Fagetum* Meusel 1937), Fig. 26.

Synonyms: *Fagetum boreoatlanticum* Tüxen 1937 p.p. (*luzuletosum*), *Fago-Abietetum* Oberdorfer 1938 p.p. (*luzuletosum albidae*), incl. *Calamagrostio arundinaceae-Fagetum* (Hartmann et Jahn 1967) Sýkora 1972.

Structure: Simple vertical structure, only tree and field layers. Shrub layer formed by rejuvenated beech. Ground layer supressed by a dense layer of slowly decomposing beech litter and therefore it occurs only in wind-exposed sites.

Tree layer often only of *Fagus sylvatica*. An admixture of *Quercus petraea* and, rarely, *Q. robur* or *Tilia cordata* at lower altitudes. *Abies alba* formerly also present, now mostly extinct. Field layer dominated by *Luzula luzuloides*, *Deschampsia flexuosa*, rarely *Calamagrostis arundinacea*, *Vaccinium myrtillus*, *Poa nemoralis*.

Diagn.: Dif.: E1 - *Luzula luzuloides*.

Species with high constancy: E3 - *Fagus sylvatica*, E1 - *Calamagrostis arundinacea*, *Deschampsia flexuosa*, *Hieracium murorum*, *Maianthemum bifolium*, *Oxalis acetosella*, *Poa nemora-*

lis, *Prenanthes purpurea*, *Vaccinium myrtillus*, *Veronica officinalis*.

Differences: From the *Calamagrostio villosae-Fagetum*, occurrence of *Luzula luzuloides* and absence of mountain species.

Adjoining PNV: Climax (sub)montane broadleaved woodland (*Dentario enneaphylli-Fagetum*, *Calamagrostio villosae-Fagetum*), at lower levels *Luzulo albidae-Quercetum petraeae*, on nutrient-rich soils *Melampyro nemorosi-Carpinetum*.

Habitat: Colder units of MW, mostly MW5-2, edaphic climax of submontane to montane levels (450-850 m). Mineral-poor oligotrophic acidic cambisols with a shallow humus horizon, that, though shallow (c. 5 cm) is a reserve of bases and nutrients. Substrates - acidic, silicate crystalline rocks (granitoids, gneiss, phyllites), volcanics (palaeorhyolites, phonolites), Proterozoic and Palaeozoic sediments (schists, quartzites, conglomerates), and nutrient-poor mesozoic sediments (especially sandstones). On substrates richer in mineral nutrients, the community colonizes windward slopes and ridges impoverished of nutrients as a result of the litter being blown away.

Distribution: PND - 16.5%. Uplands (Středočeská pahorkatina, Vrchovina Berounky, Všerubské mezihoří, Ještědsko-kozákovský hřbet, České středohoří, Brněnská vrchovina and, rarely, Jevišovická pahorkatina) and foothills and lower parts of mountains (Šumava, Český les, Krušné hory, Lužické hory, Jizerské hory, Krkonoše, Orlické hory, Moravskoslezské Beskydy Mts., see Fig.23/24, 26).

Land use: Beech, the most important component of mature stands, forms tall and upright stems up to 30m. The regular admixture of *Acer pseudoplanatus* is often restricted by forestry. Natural stands frequently replaced by plantations of spruce or, rarely, larch. Some sites used as meadows and pastures (poor communities of the *Arrhenatherion*, *Polygono-Trisetion*, *Lolio-Cynosurion* and *Nardetalia*) and as arable land (potatoes, rye, oats).

The community survives only in small and isolated stands. Because of its floristic poverty and absence of rare taxa, it has often been neglected for nature conservation purposes. Therefore, most protected stands occur in complexes with species-rich communities situated in, for example, protected landscape areas. The community plays an important role in the production of timber and in the ecological stability of the landscape (management of water supplies, retention and neutralisation of sulphur oxides by the beech canopy, protection of soils against erosion).

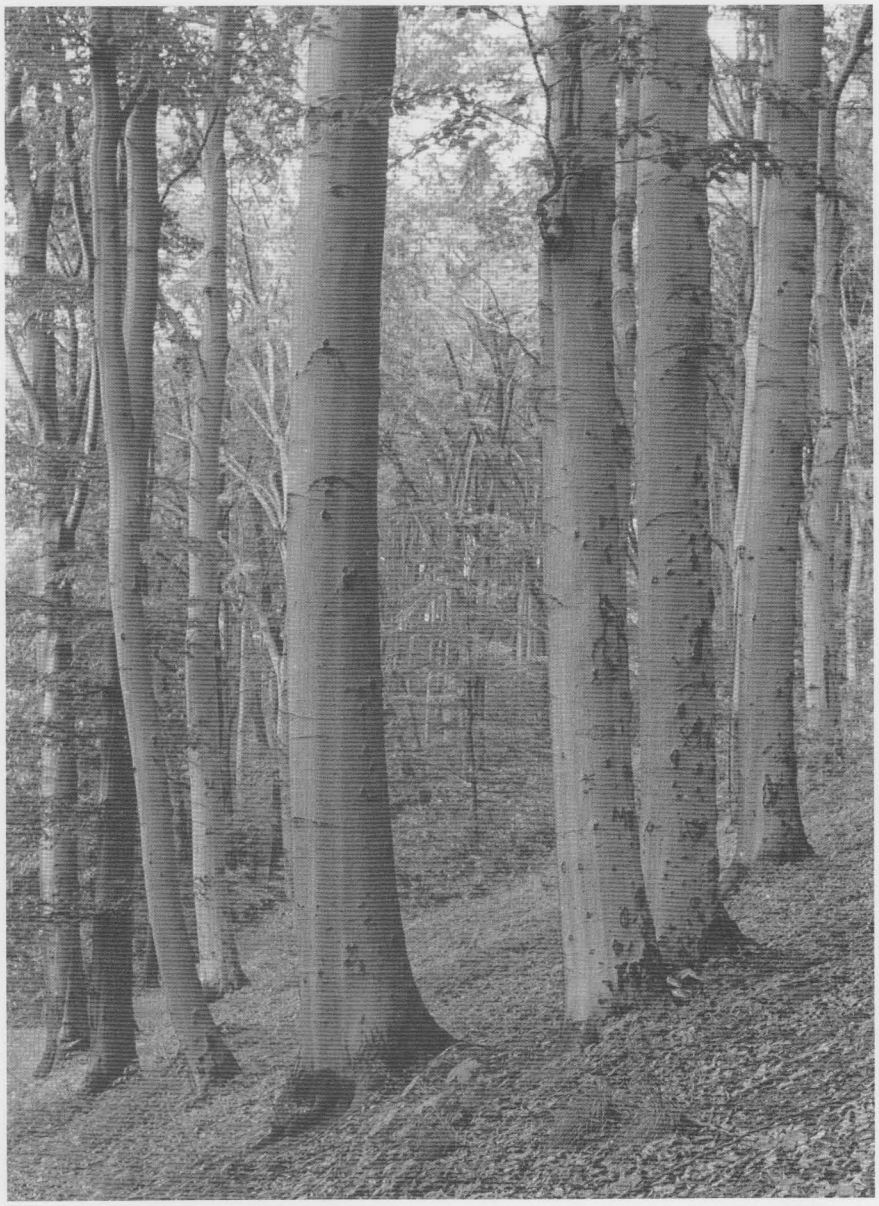

Fig. 26 — Luzulo-Fagetum Meusel 1937.

(Near-)natural stands: BR and PLA Křivoklátsko - NR Týřov and Vůznice; Benešovská pahorkatina Upland - NR Voděradské bučiny; Jizerské hory Mts. - woodland complex south-west of Raspenava village.

References: Hartmann et Jahn (1967), Klika (1943, 1952), Kopecký (1958), Mikyška (1956, 1968, 1972), Moravec in Moravec *et al.* (1982), Moravcová-Husová (1963, 1964, 1966), Mráz (1960), Neuhäusl (1960), Samek (1957b), Sýkora (1971).

Typical relevé: Moravec (1989 ms.), rel. 8904 (PLA Křivoklátsko), 470 m, WNW, 130, E3 - 85%, E2 - 0%, E1 - 30%, E0 - 1%.

E3 - 5: *Fagus sylvatica*,

E1 - 3: *Luzula luzuloides*, 1: *Deschampsia flexuosa*, *Fagus sylvatica* (juv.), +: *Calamagrostis arundinacea*, *Festuca ovina*, *Hieracium murorum*, *H. sabaudum*, *Poa nemoralis*, r: *Veronica officinalis*,

E0 - +: *Dicranella heteromalla*.

Invas., expans.: Weak invasion of *Reynoutria japonica*, *Impatiens parviflora*, *Calamagrostis villosa*, on deforested sites in W Bohemia *Rubus idaeus*, *Chamerion angustifolium*. In some localities *Heracleum mantegazzianum* is frequent.

25. Spruce-beech woodland (*Calamagrostio villosae-Fagetum* Mikyška 1972)

Synonyms: *Fagetum calamagrostidosum villosae* Zlatník 1928, *Fagetum myrtillosum* cum *Calamagrostis villosa* Zlatník 1928, *Fago-Piceetum Hercyniae* Reinhold 1939, *Fago-Piceetum* sensu Mikyška 1947 non Oberdorfer 1938, *Piceo-Fagetum* Samek 1961 p.p. (*oxalidetosum*), *Verticillato-Fagetum* sensu Sýkora 1967 non Oberdorfer 1957.

Structure: Three-layered stands with well-developed canopy, field and ground layers. Both broadleaved and coniferous species form the tree layer, which has a dense canopy dominated by *Fagus sylvatica* with frequent *Picea abies* and an admixture of *Acer pseudoplatanus* and *Abies alba*. Shrub layer formed only from rejuvenating trees. Species-poor field layer mostly dominated by *Calamagrostis villosa* and, in some places, *Vaccinium myrtillus*. Ground layer regularly present but its cover fluctuates.

Diagn.: Dif.: E1 - *Blechnum spicant*, *Calamagrostis villosa*, *Homogyne alpina*, *Huperzia selago*, *Luzula sylvatica*, *Lycopodium annotinum*, *Polygonatum verticillatum*.

Species with high constancy: E3 - *Fagus sylvatica*, *Picea abies*, E1 - *Deschampsia flexuosa*, *Maianthemum bifolium*, *Oxalis acetosella*, *Prenanthes purpurea*, *Vaccinium myrtillus*, E0 - *Dicranum scoparium*, *Polytrichum formosum*, *P. commune*, *P. juniperinum*.

Differences: From the *Luzulo-Fagetum*, the differential montane species mentioned above.

Adjoining PNV: Climax woodland of submontane (*Luzulo-Fagetum*) and montane belts (*Calamagrostio villosae-Piceetum*).

Habitat: Cold, mostly C7-6. Mostly on mountain watersheds, montane and supramontane belts (800-1200 m), rarely at lower altitudes. This climax vegetation represents an intermediate stage between the beech belt and the spruce belt, being associated with semi-podsolised soils of montane plateaus and flat ridges, less frequently on steep slopes with oligotrophic cambisol.

Distribution: PND - 2%. Higher mountains of the Česká vysočina Uplands (Šumava, Krušné hory, Krkonoše, Orlické hory, Rychlebské hory, Hrubý Jeseník and Králický Sněžník Mts., Ještědsko-Kozákovský hřbet ridge, and the Českomoravská vrchovina Uplands). Small patches also in the Český les and Novohradské hory Mts.; of the Carpathians, in the Moravskoslezské Beskydy Mts. (Fig.23/25).

Land use: Beech, spruce and less constant fir and sycamore are the most significant components of the stands. The timber produced is of dense structure and high-quality. However, natural stands mostly replaced by spruce plantations and, in some cases, also by meadows (*Polygono-Trisetion*) and pastures (*Nardetalia*). The community contributes to the ecological stability of the landscape (protection against erosion, water management). It is fairly common but is endangered by air pollution and by replacement with coniferous plantations.

(Near-)natural stands: Český les Mts. - NR Zvon and Čerchov; Šumava Mts. - NNR Boubínský prales (upper part) and NR Ždánidla near Prášily village.

References: Hartmann et Jahn (1967), Mikyška (1972), Moravec in Moravec *et al.* (1982), Samek (1961), Sýkora (1967a,b, 1971), Zlatník (1928).

Typical relevé: Moravec in Moravec *et al.* (1982): 247-278, Tab. 34, rel. 5 (Šumava Mts.), 1130 m, E, 180, E3 - 80%, E2 - 0%, E1 - 40%, E0 - 2%.

E3 - 4: *Fagus sylvatica*, 2: *Picea abies*, +: *Abies alba*,

E1 - 3: *Oxalis acetosella*, 2: *Calamagrostis villosa*, *Gymnocarpium dryopteris*, 1: *Fagus sylvatica* (juv.), *Lycopodium annotinum*, *Luzula sylvatica*, *Prenanthes purpurea* +: *Homogyne alpina*, *Hieracium murorum*, *Maianthemum bifolium*, (*Huperzia selago*), *Polygonatum verticillatum*, *Picea abies* (juv.), *Senecio nemorensis*, *Sorbus aucuparia* (juv.), r: *Deschampsia flexuosa*, *D. cespitosa*, *Dryopteris carthusiana*, *Vaccinium myrtillus*,

E0 - +: *Polytrichum formosum*, r: *Polytrichum juniperinum*.

Invas., expans.: In some sites *Calamagrostis villosa* forms degradation phases.

26. Waterlogged pedunculate oak-beech woodland with *Carex brizoides* (*Carici brizoidis-Quercetum* Neuhäusl in Mikyška *et al.* 1968)

Structure: Three-layered community dominated by *Quercus robur* (with *Alnus glutinosa* in wet sites and *Fagus sylvatica* in moderately dry sites), with a weak admixture of *Betula pubescens*, *B. pendula*, *Populus tremula*, and also nutrient-demanding species (*Carpinus betulus*, *Tilia cordata*, less frequently *Fraxinus excelsior*, probably also *Abies alba*). Shrub layer formed by *Rubus caesius*, *R. hirtus*, *R. idaeus*, *R. fruticosus* agg., *Frangula alnus*, *Sambucus nigra* and *S. racemosa*. Field layer of species of nutrient-poor habitats (*Vaccinium myrtillus*, *Carex brizoides*, *Maianthemum bifolium*) and some species of hygrophilous and mesophilous broadleaved woodland (*Impatiens noli-tangere*, *Galeobdolon montanum*, *Festuca gigantea*). The unit represents a transition between alluvial (*Alnenion glutinoso-incanae*) and beech woodlands (*Luzulo-Fagion*).

Diagn.: Dif. - E3: *Fagus sylvatica*, *Populus tremula*, *Quercus robur*, E2 - *Rubus hirtus*, E1 - *Carex brizoides*, *Dryopteris carthusiana*, *Holcus mollis*, *Oreopteris limbosperma*, *Maianthemum bifolium*, *Vaccinium myrtillus*.

Species with high constancy: E3 - *Fagus sylvatica*, *Quercus robur*, E2 - *Frangula alnus*, *Rubus caesius*, E1 - *Athyrium filix-femina*, *Carex brizoides*, *Dryopteris carthusiana*, *Festuca gigantea*, *Impatiens noli-tangere*, *Maianthemum bifolium*, *Oxalis acetosella*, *Vaccinium myrtillus*.

Differences: From the *Alnion incanae* comm., presence of beech in the canopy and acidophilous herbs in the field layer; from other communities of the *Luzulo-Fagion*, presence of *Carpinus betulus*, *Tilia cordata* and *Populus tremula* in the tree layer and species of alluvial woodland (*Carex remota*, *Festuca gigantea*, *Circaea lutetiana*) in the field layer.

Adjoining PNV: *Querco-Ulmetum*, *Pruno-Fraxinetum*, *Tilio-Carpinetum*, *Carici pilosae-Carpinetum*, *Dentario glandulosae-Fagetum*, *Luzulo-Fagetum*, rarely *Molinio arundinaceae-Quercetum*.

Habitat: Mostly MW10, relatively warm subcontinentally influenced climate with high precipitation (700-900 mm, see also climadiagram of Ostrava city), mostly at lower levels (190-300 m). Wet to waterlogged pseudogleys and luvisols occurring on Miocene clay, loess loam and loamy glacial deposits. Soils poorly permeable, acidic to very strongly acidic.

Distribution: PND - 0.7%. Ostravská pánev Basin, floodplain of the Odra river and Pobeskydská pahorkatina Hills (Fig.23/26).

Land use: Much of the area of the unit covered by plantations of unsuitable conifers and broadleaved woody species, extensive areas used as arable land (wheat, rye, sugarbeet, maize, fodder crops, potatoes, rape, vegetables), partly as orchards (*Prunus domestica*).

Near-natural stands rather rare. The

area of distribution of the community heavily stressed by industry. While coniferous plantations are damaged by air pollution, natural stands are tolerant: thus the natural composition of the woodland must be restored.

(Near-)natural stands: Ostravská pánev Basin - between Šilhéřovice and Petřkovice villages, near Oprechtice village near Frýdek-Místek; Pobeskydská pahorkatina Uplands.

Rare and endangered taxa: *Abies alba*, *Primula elatior*, *Rubus sprengeli*.

References: Neuhäusl (1963), Neuhäuslová-Novotná in Moravec *et al.* (1982).

Typical relevé: Neuhäusl (1963): Tab.1 - relevé 1 (Ostravská pánev Basin), 260 m, plain, E3 - 90%.

E3 - 3: *Carpinus betulus*, *Fagus sylvatica*, 2: *Betula pubescens*, *Quercus robur*, +: *Pinus sylvestris*,

E2 - 2: *Rubus hirtus*, 1: *Rubus caesius*, *Sambucus nigra*, +: *Frangula alnus*, *Sambucus racemosa*,

E1 - 2: *Carex brizoides*, *Impatiens noli-tangere*, *Oxalis acetosella*, *Urtica dioica*, 1: *Athyrium filix-femina*, *Dryopteris carthusiana*, *Festuca gigantea*, *Lamium galeobdolon* agg., *Mycelis muralis*, +: *Calamagrostis epigejos*, *Carex remota*, *C. sylvatica*, *Circaea lutetiana*, *Galeopsis speciosa*, *Luzula pilosa*, *Maianthemum bifolium*, r: *Vaccinium myrtillus*.

Invas., expans.: *Calamagrostis epigejos*, *Carex brizoides*, *Impatiens parviflora*, *I. glandulifera* (Hlučín town area), *Reynoutria japonica*, *R. sachalinensis* (Ostrava area), *Rubus fruticosus* agg. (especially in pine plantations), *R. idaeus*, *Solidago canadensis*.

27. Silver fir woodland with *Deschampsia flexuosa* (*Deschampsio-Abietetum* Husová 1968)

Structure: Mostly well-developed tree, field and ground layers. The canopy of the tree layer is rather low and it often forms small and irregular groups of trees. It is dominated by *Abies alba*, with an admixture of *Pinus sylvestris*, on steep slopes formed by Proterozoic slates (Křivoklátsko area). Natural admixtures of *Picea abies* on cool sites at high altitudes. Shrub layer of young fir and *Sambucus racemosa* (rarely also *Lonicera xylosteum*, *Corylus avellana*), mainly in nutrient-rich stands dominated by *Calamagrostis arundinacea*. Field layer formed by light-demanding species tolerant of acidic soils and dominated by *Calamagrostis arundinacea* and/or *Deschampsia flexuosa*. Presence of *Querco-Fagetea* and *Fagetalia* species negligible. Stands on rocky slopes characterized by *Polypodium vulgare*. The mosses are mostly species of nutrient-poor habitats (*Polytrichum formosum*, *Dicranum scoparium*, *Hypnum cupressiforme*, *Leucobryum glaucum*). Wet habitats on slopes exposed to rain colonized also by *Polytrichum commune*, *Bazzania trilobata* and *Sphagnum* spec. div.

Diagn.: Dif.: E3, E2 - *Abies alba*, E2 - *Sambucus racemosa*.

Species with high constancy: E1 - *Calamagrostis arundinacea*, *Dryopteris filix-mas*, *D. carthusiana*, *Deschampsia flexuosa*, *Hieracium murorum*, *Luzula luzuloides*, *Melica nutans*, *Moehringia trinervia*, *Mycelis muralis*, *Oxalis acetosella*, *Polypodium vulgare*, *Senecio fuchsii*, *Solidago virgaurea*, *Vaccinium myrtillus*.

Differences: Field layer of this fir woodland similar to that of acidophilous beech or oak woodland. *Luzula luzuloides* is of low constancy and cover. From acidophilous oak woodland, absence of *Genista* sp. div. and *Lembotropis nigricans*.

Adjoining PNV: *Abieti-Quercetum* or, rarely, *Luzulo-Quercetum* at lower levels on plateaus, *Luzulo-Fagetum* at higher altitudes, and *Melampyro-Carpinetum luzuletosum* or, rarely, *Dentario enneaphylli-Fagetum* and *Saniculo europaeae-Abietetum* bordering nutrient-rich ground.

Habitat: Mostly MW5-3, less frequently C7-4. Steep, NW-facing slopes mostly exposed to rain, deeply incised valleys with an apparent climatic inversion, at elevations between 400-500 m (very rarely 600 m) in areas where beech is rare or absent for ecological or historical reasons. Relief characterised by many knolls, small depressions, scattered small rock outcrops and protruding ledges.

The soils belong to oligotrophic acidic cambisols with low saturation of the sorption complex and low biological activity. The superficial humus is raw moder. Small peat pockets occur in the rain-exposed uppermost parts of slopes where valley fog condenses.

Distribution: PND - 0.1%. Scattered in small patches, mostly in valleys (upper reaches of the Vltava river, lower reaches of the Otava and Mže rivers, Berounka and Moravice rivers). Larger areas in the Plaská pahorkatina Uplands and the Šumava Foothills (Svatoborská vrchovina and Bavorovská vrchovina Uplands, see Fig.23/27).

Land use: The steep slopes colonized by this unit can be used only for woodland, mostly as coniferous plantations (*Pinus sylvestris*, *Picea abies*, *Larix decidua*). However, these coniferous species form a shallow rooting system and are subject to wind throw. Fir is the only native species of conifer whose roots are able to penetrate the rocky ground and to form stable stands. The community protects slopes from erosion.

(Near-)natural stands: Prachatická hornatina Uplands; Středočeská pahorkatina Hills; Křivoklátská vrchovina Uplands, Kralovická pahorkatina Hills.

Rare and endangered syntaxa: *Deschampsio flexuosae-Abietetum*.

Rare and endangered taxa: *Abies alba*.

References: Husová (1968b, 1983, 1984-1989 ms.), Nesvadbová, Sofron et Vondráček (1977), Neuhäusl et Neuhäuslová-Novotná (1972, 1979), Sofron (1979, 1988).

Typical relevé: Husová (1968a): Tab. 3, rel. 31 (Prachatická hornatina Uplands), 400 m, NW, 320, E3 - 60%, E2- 30%, E1- 60%, E0- 40%.

E3 - 4: *Abies alba*, +: *Picea abies*, *Pinus sylvestris*,

E2 - 3: *Abies alba*, 1: *Corylus avellana*,

E1 - 3: *Calamagrostis arundinacea*, *Deschampsia flexuosa*, 2: *Vaccinium myrtillus*, 1: *Luzula luzuloides*, *Prenanthes purpurea*, +: *Campanula rotundifolia*, *Oxalis acetosella*, *Polypodium vulgare*, *Senecio nemorensis*, *Solidago virgaurea*, r: *Campanula persicifolia*, *Dryopteris filix-mas*, *Hieracium murorum*, *Sambucus racemosa*,

E0 - 2: *Bazzania trilobata*, *Dicranum scoparium*, *Polytrichum formosum*, 1: *Sphagnum girgensohnii*, +: *Eurhynchium magnusii*, *Hylocomium splendens*, *Plagiochila asplenioides*, *Pohlia nutans*, r: *Hypnum cupressiforme*.

Expans.: *Calamagrostis arundinacea*.

Perialpidic basiphilous thermophilous oak woodland (*Quercion pubescenti-petraeae* Braun-Blanquet 1932)

Sub-climax thermophilous basiphilous woodland dominated by *Quercus pubescens* and/or *Q. petraea* on very- or medium-rich substrates, containing $CaCO_3$, at lower levels of warm and dry areas. PND - 0.2% of the total area of the Republic.

28. Oak woodland with *Lathyrus pannonicus* and *Buglossoides purpurocaerulea* (*Lathyro versicoloris-Quercetum pubescentis* Klika [1928] 1932, *Corno-Quercetum euonymetosum europaeae* Chytrý 1997[1])

Synonyms: *Quercetum lanuginosae* Klika 1928, *Quercetum lanuginosae bohemicum* Klika 1933, *Quercetum pubescentis* auct. bohem. p.p., *Lithospermo-Quercetum* auct. medioeurop., as. *Quercus pubescens-Lathyrus versicolor* subas. *lithospermetosum* Klika 1957, *Querco-Lithospermetum purpureo-coeruleae* Klika 1953.

Structure: Pubescent oak- and subxerophilous thermophilous oak woodlands with similar species composition and analogous site conditions.

Lathyro versicoloris-Quercetum dominated by *Quercus pubescens*, less frequently by *Quercus petraea*. Weak admixture of *Sorbus torminalis*, *S. aria*, *Carpinus betulus*, *Cornus mas*, *Acer campestre*, less frequently *Fraxinus excelsior*. The shrub layer consists of the oak species, *Cornus mas* and *Sorbus torminalis*, also with *Ligustrum vulgare*, *Sorbus aria*, *Crataegus laevigata*, less frequently *Acer campestre*, *Cotoneaster integerrimus*, *Carpinus betulus* and *Corylus avellana*.

Species-rich field layer dominated by thermophilous and subthermophilous forest species (*Pyrethrum corymbosum*, *Lathyrus pannonicus*, *Primula veris*, *Anthericum ramosum* etc.), thermophilous saum species (*Dictamnus albus*, *Helianthemum nummularium*, *Trifolium alpestre*, *Fragaria viridis*, *Centaurea triumfetti*, less frequently *Anemone sylvestris* and *Melica picta*), species of mesophilous woodlands (*Hepatica nobilis*, *Campanula persicifolia*, *C. rapunculoides*, *Poa nemoralis*, *Lathyrus vernus*, *Melica nutans* etc.) and species extending from thermophilous grassland communities (*Galium glaucum*, *Brachypodium pinnatum*, *Carex humilis*, *Sesleria albicans* etc. Ground layer very weakly developed, without any diagnostic significance.

Corno-Quercetum euonymetosum europaeae, dominated by *Quercus petraea* and *Fraxinus excelsior*, with an admixture of *Pyrus pyraster* and *Acer campestre*. In the shrub layer the thermophilous *Cornus mas* is replaced by *Swida sanguinea*, sometimes by *Rhamnus catharticus* with *Prunus spinosa* and *Rosa canina* agg. In the field layer the species of thermophilous grasslands decline markedly, while *Buglossoides purpurocaerulea* becomes dominant. Some mesophilous (*Campanula trachelium*, *C. persicifolia*) and nitrophilous species (*Alliaria petiolata*, *Torilis japonica*, *Geum urbanum*, *Impatiens parviflora*, *Chaerophyllum temulum*, *Galium aparine*) frequently present.

Diagn.: Dif.: E3 - *Quercus pubescens*, *Cornus mas*, E2 - *Cornus mas*, E1 - *Lathyrus pannonicus*, *Adonis vernalis*, *Silene nemoralis*, *Primula veris*, *Aster amellus*.

Species with high constancy: E3, E2 - *Quercus pubescens*, *Sorbus torminalis*, *Quercus petraea*, E1 - *Pyrethrum corymbosum*, *Trifolium alpestre*, *Dictamnus albus*, *Fragaria viridis*, *Hepatica nobilis*, *Campanula trachelium*, *Primula veris* agg., *Galium glaucum*, *Brachypodium pinnatum*, *Buglossoides purpurocaerulea*, *Sesleria albicans*, *Polygonatum odoratum*, *Lathyrus vernus*, *Torilis japonica*, *Impatiens parviflora*, *Alliaria petiolata*, *Galium aparine*.

Differences: From the oak-hornbeam woodlands (*Melampyro nemorosi-Carpinetum*) and the Bohemian subthermophilous oak woodlands (*Potentillo albae-Quercetum*, *Viscario-Quercetum*, *Sorbo torminalis-Quercetum*), high presence of thermophilous saum species of the *Trifolio-Geranietea*, species of thermophilous grasslands of the *Festucion valesiacae*, and thermophilous forest species (*Lathyrus pannonicus*, *Arabis pauciflora*).

The *Corno-Quercetum euonymetosum europaeae* differs mainly by the almost total dominance of *Buglossoides purpurocaerulea*, the presence of nitrophilous species and paucity of acidophytes and species of alternately moist soils.

Adjoining PNV: Subxerophilous oak and oak-hornbeam woodlands (*Potentillo albae-Quercetum*, *Melampyro nemorosi-Carpinetum*), acidophilous or degraded oak woodlands on slope loams of oligotrophic substrates (*Luzulo albidae-Quercetum petraeae*) and scree woods (*Aceri-Carpinetum*) on screes.

Habitat: W2. Both units are edaphic climaxes on very- or moderately-nutrient rich substrates (limestones, Tertiary vulcanites, calcareous marls, less frequently palaeoandesites) at planar and colline levels, in the warmer areas up to submontane levels. The *Lathyro-Quercetum* in particular associated with markedly warm sites, where it can ascend above 400 m. Both units colonize (steep) slopes with a thin soil layer or even stabilized screes (*Corno-Quercetum euonymetosum europaeae*). The soils contain much gravel and their physical properties are good. They correspond to rendzinas, scree rendzinas and pararendzinas, or to ranker and ranker-brown earths, to humus-carbonate soils with a thin humus layer, in deeper profiles to eutrophic brown earths. They can contain carbonates, pH ca 5.5-7.6 (acidity fluctuates depending on the substrate), a high content of leaf litter, a favourable humus form and balanced water regime (*Corno-Quercetum euonymetosum europaeae*). The soils of the *Lathyro versicoloris-Quercetum pubescentis* incline to desiccation and in the summer become dry.

Distribution: *Lathyro versicoloris-Quercetum* relatively rare. In the Czech Republic there are three centres of distribution, viz the Český kras, the warmest part of the České středohoří Uplands and the Cretaceous formations of the Elbe Basin. Its natural distribution nowhere extensive and frequently it forms mosaics with other more thermophilous communities.

The distribution of the *Corno-Quercetum euonymetosum europaeae* extends from warm region into some subthermophilous areas (e.g. BR Křivoklátsko). However, the areas of these stands are usually very small (Fig. 23/28).

Land use: The economic use is very low. In most cases the stands of both communities form protection woodlands and only the stems at the base of Tertiary vulcanite slopes produce good-quality timber. Consequently these stands have mostly been felled, probably as early as the Middle Ages. In contrast, stands resembling krummholz on shallow soils, at the top of slopes have persisted. Old documents show that many potential sites of these stands have been grazed by sheep since the Middle Ages and this has had a profound effect on their survival and present-day distribution. Natural stands show a high species diversity not only in terms of the flora, but also, e.g., in the entomofauna. A number of plant communities representing rare vegetation types occur. Their conversion to commercial forests or the clearance of stands usually results in irreversible changes, and the substitute communities are neither so rich nor so varied.

(Near-)natural stands: *Lathyro versicoloris-Quercetum*: PLA České středohoří; PLA Český kras - Velká hora, NNR Karlštejn, NNR Koda. *Corno-Quercetum euonymetosum europaeae*: PLA České středohoří, NNR Lovoš; PLA Český kras - Velká hora; Polabí - Kozí hůra near Žehuň; PLA Křivoklátsko - NNR Týřov.

Rare and endangered syntaxa: *Erysimo crepidifolii-Festucetum valesiacae*, *Koelerio macranthae-Stipetum joannis*, *Cirsio pannonici-Seslerietum calcariae*, *Adonido-Brachypodietum pinnati*, *Geranio-Anemonetum sylvestris*, *Geranio sanguinei-Dictamnetum*, *Geranio-Trifolietum alpestris*.

Rare and endangered taxa: *Adonis vernalis*, *Anacamptis pyramidalis*, *Anemone sylvestris*, *Anthericum liliago*, *A. ramosum*, *Arabis pauciflora*, *Aster amellus*, *Aster linosyris*, *Campanula glomerata*, *C. bononiensis*, *Cornus mas*, *Clematis recta*, *Daphne mezereum*, *Dictamnus albus*, *Epipactis atrorubens*, *Lathyrus pannonicus*, *Lilium martagon*, *Melampyrum cristatum*, *Melittis melissophyllum*, *Muscari tenuiflorum*, *Primula veris*, *Pulsatilla pratensis*, *Rosa gallica*, *Scorzonera purpurea*, *Silene nemoralis*, *Stipa joannis*, *Thalictrum minus*, *Veronica austriaca*.

References: Klika 1928, Blažková 1997, Chytrý 1997.

Typical relevé: *Lathyro versicoloris-Quercetum pubescentis* Klika (1932): PLA Český kras, Velká hora. W, 40°, E3 and E2 - not mentioned, E1 - 80%.

E3 - 1: *Quercus pubescens*, *Cornus mas*, +: *Sorbus torminalis*, *Acer campestre*,

E2 - 1: *Ligustrum vulgare*, *Cornus mas*, *Quercus pubescens*, +: *Sorbus aria*, *Carpinus betulus*,

E1 - 3: *Teucrium chamaedrys*, 2: *Trifolium alpestre*, *Sesleria albicans*, *Origanum vulgare*, 1: *Pyrethrum corymbosum*, *Anthericum ramosum*, *Dictamnus albus*, *Polygonatum odoratum*, *Quercus pubescens*, *Aster amellus*, *Cornus mas*, *Cotoneaster integerrimus*, *Lathyrus pannonicus*, *Festuca heterophylla*, *Betonica officinalis*, *Hepatica nobilis*, *Carex montana*, *Melica nutans*, *Primula veris*, *Galium glaucum*, *Coronilla varia*, *Brachypodium pinnatum*, *Bupleurum falcatum*, *Carex humilis*, *Viola hirta*, *Thlaspi caerulescens*, +: *Melampyrum cristatum*, *Rosa gallica*, *Silene nemoralis*, *Hypericum montanum*, *Verbascum lychnitis*, *Hieracium cymosum*, *Dactylis glomerata*, r: *Chenopodium vulgare*, *Festuca rupicola*, *Stellaria holostea*, *Genista tinctoria*, *Potentilla heptaphylla*, *P. argentea*, *Viola mirabilis*, *Linum catharticum*, *Thalictrum minus*, *Avenula pubescens*, *Melampyrum pratense*.

Corno-Quercetum euonymetosum europaeae: Kolbek (1983): PLA České středohoří, Svinky. SW, 25°, E3 - 70%, E2 - 10%, E1 - 80%, E0 - 0%.

E3 - 3: *Quercus petraea*, 2: *Acer campestre*,

E2 - 1: *Crataegus laevigata*, *Grossularia uva-crispa*, *Ligustrum vulgare*, *Rosa canina*,

E1 - 4: *Buglossoides purpurocaerulea*, 2: *Mercurialis perennis*, 1: *Stellaria holostea*, *Viola collina*, *V. odorata*, +: *Pyrethrum corymbosum*, *Galium aparine*, *Viola hirta*, *Brachypodium sylvaticum*, *Clinopodium vulgare*, *Sorbus torminalis*, *Urtica dioica*, *Acer campestre*, *Cirsium vulgare* subsp. *sylvaticum*, r: *Lathyrus niger*, *L. vernus*, *Campanula rapunculoides*.

Invas., expans.: *Calamagrostis arundinacea*, *C. epigejos*, *Impatiens parviflora*, *Alliaria petiolata*, *Anthriscus sylvestris*, *Torilis japonica*, *Chaerophyllum temulum*, *Geum urbanum*, *Arrhenatherum elatius*, *Galium aparine*.

29. Oak woodland with *Prunus mahaleb* and/or *Cornus mas* (*Pruno mahaleb-Quercetum pubescentis* Jakucs et Fekete 1957, *Corno-Quercetum* Máthé et Kovács 1962 *euonymetosum verrucosae* Chytrý 1987)

Synonyms: *Quercetum pubescentis* auct.

Structure: Open woodlands dominated by *Quercus pubescens* or *Q. petraea*. The *Pruno mahaleb-Quercetum*, confined to extremely dry habitats, may have the appearance of open shrubby woodland in which the tree and shrub layers grade continuously into one another, whereas the *Corno-Quercetum euonymetosum verrucosae* is a more closed four-layered woodland. In some places an admixture of other tree species occurs (*Fraxinus excelsior*, *Carpinus betulus*). Shrub layer luxuriant, with oak saplings, and *Cornus mas*, *Viburnum lantana*, *Euonymus verrucosa*, *Ligustrum vulgare*, and *Crataegus monogyna*. Dominants of the field layer: *Brachypodium pinnatum*, *Vincetoxicum hirundinaria*, *Carex humilis* and *Melica uniflora*, accompanied by *Buglossoides purpurocaerulea*, *Dictamnus albus*, *Pyrethrum corymbosum*, *Teucrium chamaedrys*, *Viola hirta*, *Bupleurum falcatum*, *Carex michelii*, *Euphorbia cyparissias* and many others. The poorly developed ground layer concentrated on rock outcrops and tree bases.

Diagn.: Dif.: E2: *Euonymus verrucosa*, *Viburnum lantana*, E1: *Festuca rupicola*, *Euphorbia polychroma*, *Medicago falcata*, *Melica ciliata*.

Species with high constancy: E3: *Quercus pubescens*, E2: *Cornus mas*, E1: *Pyrethrum corymbosum*, *Vincetoxicum hirundinaria*, *Teucrium chamaedrys*.

Differences: From the *Lathyro versicoloris-Quercetum* and *Corno-Quercetum euonymetosum europaeae*, absence of some sub-Mediterranean and sub-continental species (*Euonymus verrucosa*, *Euphorbia polychroma*, *Inula ensifolia* and *Melica ciliata*). The *Quercetum pubescenti-roboris* on loess has a higher proportion of species confined to deep soils (*Quercus robur*, *Calamagrostis arundinacea*, *Carex montana*, *Convallaria majalis*, *Lathyrus niger*, *Poa nemoralis*, *Veronica officinalis*).

Adjoining PNV: *Primulo veris-Carpinetum*, *Melampyro nemorosi-Carpinetum*, *Quercetum pubescenti-roboris*, *Berberidion*, *Prunion spinosae*, *Geranion sanguinei*.

Habitat: W, less frequently MW (warm slopes), lower altitudinal limit of the potential distribution about 250 m; the *Pruno mahaleb-Quercetum* occurs up to c. 350 m and the *Corno-Quercetum* up to 480 m. Only on the limestone of the Pálava Hills are both communities potentially distributed up to the summit (550 m). In the dry area of southern Moravia, the *Pruno mahaleb-Quercetum* confined to steep, sunny slopes and the *Corno-Quercetum* found on gentle slopes. On the wetter fringes of the Bohemian Massif the *Pruno mahaleb-Quercetum* almost absent, and steep slopes are mainly occupied by the *Corno-Quercetum*. The soils are shallow rendzinas on Devonian, Jurassic or Neogene limestones, or calcareous luvisols (= pararendzina) on calcareous Palaeogenic sandstones or Permo-Carboniferous conglomerates.

Distribution: Only in S and Central Moravia. Extensive stands rare; mostly rather small patches surrounded by mesic woodlands (Fig. 23/29). Most localities in the Pálava Hills and the flysh zone of S Moravia where some residual forest tracts are still preserved in the middle of the otherwise deforested landscape. In the cooler and wetter fringes of the Bohemian Massif (e.g. Moravský kras), this unit is represented almost exclusively by the *Corno-Quercetum*.

Land use: In the past the *Pruno mahaleb-Quercetum* and *Corno-Quercetum euonymetosum verrucosae* were coppiced and used for grazing by domestic animals. This management led to an opening of the canopy and immigration of species from adjacent dry grasslands. After the abandonment of traditional coppice management, some stands changed into tall, closed forests, while others were felled and replaced by plantations of *Pinus sylvestris*, *P. nigra*

or *Robinia pseudacacia*. Dry grasslands in some deforested sites grazed or more rarely mown.

Oak forests on steep slopes prevent soil erosion and are a habitat of high conservation value containing many threatened species.

Rare and endangered syntaxa on non-forest soil: *Poo badensis-Festucetum pallentis*, *Medicagini prostratae-Festucetum pallentis*, *Ranunculo illyrici-Festucetum valesiacae*, *Astragalo austriaci-Stipetum capillatae*, *Astragalo austriaci-Brachypodietum pinnati*, *Corothamno-Brachypodietum pinnati*, perhaps also some other *Festuco-Brometea* communities, *Prunetum fruticosae*, *Geranion sanguinei*, *Caucalido daucoidis-Conringietum orientalis* (the latter rarely on arable land).

Rare and endangered taxa: *Aconitum anthora*, *Adonis vernalis*, *Allium flavum*, *Anemone sylvestris*, *Arabis pauciflora*, *A. sagittata*, *Asperula tinctoria*, *Aster amellus*, *Buglossoides purpurocaerulea*, *Buphthalmum salicifolium*, *Campanula bononiensis*, *Carex michelii*, *Centaurea triumfettii*, *Cephalanthera damasonium*, *Cerasus mahaleb*, *Clematis recta*, *Crepis praemorsa*, *Dictamnus albus*, *Dorycnium germanicum*, *Erysimum odoratum*, *Euphorbia polychroma*, *Ficaria calthifolia*, *Glechoma hirsuta*, *Hesperis sylvestris*, *Inula ensifolia*, *I. hirta*, *I. oculus-christi*, *Iris pumila*, *I. variegata*, *Lactuca quercina*, *Laser trilobum*, *Laserpitium latifolium*, *Lathyrus pannonicus* subsp. *collinus*, *Limodorum abortivum*, *Linaria genistifolia*, *Lonicera caprifolium* (? native), *Malus sylvestris*, *Melampyrum cristatum*, *Melica ciliata*, *Mercurialis ovata*, *Orchis militaris*, *O. purpurea*, *Phlomis tuberosa*, *Potentilla patula*, *Pulmonaria mollis*, *Quercus cerris* (? native), *Staphyllea pinnata*, *Stipa joannis*, *Thesium linophyllon*, *Vicia pisiformis*. In replacement communities critically threatened species include *Dracocephalum austriacum*, *Cleistogenes serotina*, *Conringia orientalis*, *Echium russicum*, *Euphorbia salicifolia*, *E. seguieriana* subsp. *minor*, *Linum hirsutum*, *Reseda phyteuma*, *Salvia aethiopis*, *Trinia glauca*, *Viola kitaibeliana* and many other rare or threatened species.

References: Chytrý (1997), Chytrý et Horák (1997), Chytrý et Vicherek (1995, 1996), Horák (1969, 1979).

Typical relevé: *Pruno mahaleb-Quercetum pubescentis* Chytrý et Horák (1997): Tab. 1, rel. 1 (Ždánický les Hills, S Moravia), 300 m, S, 100, E3 - 40%, E2 - 30 %, E1 - 50 %, E0 - 1 %.

E3 - 3: *Quercus pubescens*, 2: *Quercus petraea*, +: *Sorbus torminalis*,

E2 - 3: *Crataegus monogyna*, 2: *Cornus mas*, 1: *Ligustrum vulgare*, +: *Acer campestre*, *Euonymus europaea*, *Prunus spinosa*, *Quercus petraea*, *Q. pubescens*, *Rosa canina* s.l.,

E1 - 2: *Brachypodium pinnatum*, *Carex humilis*, 1: *Aster amellus*, *Buglossoides purpurocaerulea*, *Bupleurum falcatum*, *Dictamnus albus*, *Euphorbia polychroma*, *Fragaria viridis*, *Inula ensifolia*, *I. hirta*, *I. salicina*, *Melampyrum nemorosum*, *Melica nutans*, *Melittis melissophyllum*, *Pulmonaria officinalis* s.l., *Pyrethrum corymbosum*, *Teucrium chamaedrys*, *Viola hirta*, *V. mirabilis*, +: *Acer campestre* juv., *Adonis vernalis*, *Anthericum ramosum*, *Asarum europaeum*, *Campanula bononiensis*, *Chamaecytisus* cf. *virescens*, *Cirsium pannonicum*, *Clinopodium vulgare*, *Coronilla varia*, *Crepis praemorsa*, *Dorycnium germanicum*, *Euphorbia amygdaloides*, *E. cyparissias*, *Fragaria moschata*, *Galium mollugo* s.l., *Helianthemum nummularium* subsp. *obscurum*, *Melica uniflora*, *Peucedanum cervaria*, *Pimpinella saxifraga* s.l., *Quercus pubescens* juv., *Salvia verticillata*, *Solidago virgaurea*, *Taraxacum officinale*, *Vincetoxicum hirundinaria*, *Viola rupestris*, r: *Convallaria majalis*,

E0 - +: *Plagiomnium affine*.

Corno-Quercetum euonymetosum verrucosae Chytrý et Horák (1997): Tab. 1, rel. 24 (Moravský kras, Central Moravia), 400 m. SW, 200, E3 - 90%, E2 - 20 %, E1 - 60 %, E0 - 10 %.

E3 - 3: *Quercus petraea*, *Carpinus betulus*,

E2 - 2: *Cornus mas*, *Crataegus monogyna*, 1: *Corylus avellana*,

Euonymus verrucosa, *Ligustrum vulgare*,

E1 - 2: *Glechoma hederacea* s.l., *Melica uniflora*, *Vincetoxicum hirundinaria*, 1: *Bromus benekenii*, *Buglossoides purpurocaerulea*, *Crataegus monogyna* juv., *Dactylis polygama*, *Fragaria moschata*, *Galium album*, *Ligustrum vulgare* juv., +: *Acer campestre* juv., *A. platanoides* juv., *Brachypodium sylvaticum*, *Bupleurum falcatum*, *Carex michelii*, *Carpinus betulus* juv., *Clinopodium vulgare*, *Convallaria majalis*, *Epipactis helleborine*, *Euphorbia cyparissias*, *Festuca rupicola*, *Fraxinus excelsior* juv., *Geum urbanum*, *Origanum vulgare*, *Peucedanum cervaria*, *Polygonatum odoratum*, *Pulmonaria mollis*, *Pyrethrum corymbosum*, *Sedum maximum*, *Stellaria holostea*, *Teucrium chamaedrys*, *Veronica vindobonensis*, r: *Anthericum ramosum*, *Fagus sylvatica* juv.,

E0 - 1: *Homalothecium sericeum*, *Porella platyphylla*, +: *Amblystegium serpens*.

Invas., expans.: *Galium aparine*, *Impatiens parviflora*, *Robinia pseudacacia*.

30. Undetermined basiphilous thermophilous oak woodland (*Brachypodio pinnati-Quercetum* sensu Klika 1952 and other undetermined woodland)

Synonyms: *Querceto-Brachypodietum pinnati* sensu Klika 1952, cf. *Querceto-Caricetum humilis* sensu Klika 1952.

Structure: Subxerothermic oak woodlands on eutrophic, possibly also on mesotrophic, soils. They are formed by the dominant *Quercus petraea* or (in S Bohemia) *Quercus robur*. However, in most existing stands they have been replaced by *Pinus sylvestris* or *P. nigra*, locally with an admixture of *Betula pendula*. The shrub layer is either absent or relatively poorly developed (*Rosa canina* spec. agg., *Betula pendula*, *Crataegus* sp. div., *Juniperus communis*, *Ligustrum vulgare*, *Pyrus pyraster*). Field layer determined by *Brachypodium pinnatum* with an admixture of subxerothermic forest species (*Astragalus glycyphyllos*, *Agrimonia eupatoria*, *Carex humilis*, *Anthericum liliago*, *A. ramosum*, *Teucrium chamaedrys*). Ground layer absent or less than 10% (*Hypnum cupressiforme*, *Plagiomnium affine*, *Lophocolea heterophylla*, *Dicranum scoparium*).

Diagn.: Dif.: E1 - *Carex humilis*, *Astragalus cicer*, *Stipa joannis*, *Anemone sylvestris*.

Species with high constancy: E3, E2 - *Quercus petraea*, *Pinus sylvestris*, *Viscum laxum*, E1 - *Brachypodium pinnatum*, *Poa angustifolia*, *Fragaria viridis*, *Helianthemum nummularium*, *Euphorbia cyparissias*, *Pimpinella saxifraga*, *Galium glaucum*, *Agrimonia eupatoria*, *Astragalus glycyphyllos*, *Pyrethrum corymbosum*, *Festuca rupicola*, *Carex humilis*, *Trifolium alpestre*, *Bupleurum falcatum*, *Ajuga genevensis*, *Anthericum ramosum*, *Centaurea scabiosa*, *Scabiosa ochroleuca*, *Anthyllis vulneraria*.

Differences: From the *Melampyro-Carpinetum*, paucity of its diagnostic species (*Stellaria holostea*, *Hepatica nobilis*, *Galium sylvaticum*, *G. odoratum*); from the *Potentillo albae-Quercetum*, absence of species of alternately moist soils and acidophytes; from the *Corno-Quercetum euonymetosum europaeae*, low occurrence of nitrophilous species and, in contrast, dominance of *Brachypodium pinnatum*;

from the *Lathyro-Quercetum*, absence of forest thermophytes and species of the class *Festuco-Brometea*.

Adjoining PNV: *Potentillo albae-Quercetum* at the base of slopes and *Melampyro-Carpinetum* on hydrologically more favourable substrates, less frequently *Tilio-Betuletum* and acidophilous *Luzulo albidae-Quercetum petraeae*.

Habitat: W2. Colline and supracolline levels, individual stands over 400 m. Southern slopes up to 360 on moderately- to very rich substrates (basalts, spilites, loess loams). The soils are eutrophic brown earths with a deep profile and with a frequent admixture of loess or dust loam. In summer they dry out.

Distribution: PND - 0.1%. Xerothermic and subxerothermic areas of Bohemia: Doupovské hory Mts., Rakovnická pahorkatina Hills, Dolnooharská tabule Plain, České středohoří Uplands, and the Strakonice limestone area (Fig. 23/30).

Land use: Most sites of these woodlands deforested and used as pastures and meadows, rarely as arable land (maize, wheat, rape). Some areas planted with *Pinus sylvestris* which gives timber of good quality, and it seems that thanks to the good properties of the bedrock, there is no threat of soil degradation. However, it is recommended to plant *Q. petraea* (or in S Bohemia, *Q. robur*) as an understorey. The old pine trees are often densely overgrown with mistletoe, which is gathered along with the branches, thus opening up the stand. The substitute meadows are mown once or twice a year. Brickyards and clay pits frequent.

Even the stands of substitute woody species are very valuable because of the species richness of the field layer. These woodlands provide cover for game and on sloping sites protect the soils against erosion. In the cultural landscape they represent important refuges for forest vegetation.

(Near-)natural stands: Rakovnická pahorkatina Hills, Doupovské hory Mts., Jizerská tabule Plain near Bělá pod Bezdězem.

Rare and endangered syntaxa: *Cirsio pannonici-Seslerietum*, *Adonido-Brachypodietum pinnati*, *Lino tenuifolii-Ononidetum spinosae*, *Pulsatillo-Globularietum*, *Brachypodio-Seslerietum*, *Geranio-Anemonetum sylvestris*.

Rare and endangered taxa: *Anemone sylvestris*, *Anthericum liliago*, *A. ramosum*, *Aster linosyris*, *A. amellus*, *Astragalus cicer*, *Campanula glomerata*, *Carex ornithopoda*, *C. pallens*, *Coronilla vaginalis*, *Cypripedium calceolus*, *Epipactis atrorubens*, *Globularia elongata*, *Goodyera repens*, *Gymnadenia conopsea*, *Gypsophila arenaria*, *Helichrysum arenarium*, *Chamaebuxus alpestris*, *Juniperus communis*, *Linum flavum*, *L. tenuifolium*, *Listera ovata*, *Ophrys insectifera*, *Orchis militaris*, *Platanthera bifolia*, *Prunella grandiflora*, *Pulsatilla pratensis*, *Scabiosa canescens*, *Stipa joannis*.

References: Klika (1952), Chytrý (1997).

Typical relevé: *Brachypodium pinnatum-Quercus robur* comm. Chytrý et Mandák (1996 ms.), rel. 400 799, Strakonice, S slope of the Kuřidlo Hill, 400 m², 530 m, S, 25°, E3 - 70%, E2 - 30%, E1 - 70 %, E0 - 2 %, 1.7. 1996.

E3 - 4: *Quercus robur*, 1: *Betula pendula*,

E2 - 3: *Swida sanguinea*, 1: *Corylus avellana*, *Crataegus monogyna*, +: *Ligustrum vulgare*,

E1 - 3: *Brachypodium pinnatum*, 2: *Campanula rapunculoides*, *Inula salicina*, *Mercurialis perennis*, *Swida sanguinea*, 1: *Betonica officinalis*, *Calamagrostis arundinacea*, *Fragaria vesca*, *Poa pratensis* agg., *Pyrethrum corymbosum*, +: *Achillea millefolium*, *Astragalus glycyphyllos*, *Campanula persicifolia*, *Carex chabertii*, *Carex montana*, *Cephalanthera damasonium*, *Clinopodium vulgare*, *Coronilla varia*, *Crataegus monogyna*, *Epipactis helleborine*, *Festuca ovina*, *Fragaria moschata*, *Galium album*, *G. aparine*, *G. verum*, *Genista tinctoria*, *Hepatica nobilis*, *Hieracium murorum*, *Hypericum perforatum*, *Melampyrum nemorosum*, *Melica nutans*, *Myosotis sylvatica*, *Poa nemoralis*, *Polygonatum odoratum*, *Quercus robur*, *Ranunculus nemorosus*, *Rhamnus catharticus*, *Rosa* sp., *Rubus fruticosus* agg., *Sanicula europaea*, *Silene nutans*, *Tilia cordata*, *Thymus pulegioides*, *Trifolium medium*, *Verbascum lychnitis*, *Veronica chamaedrys*, *Veronica teucrium*, *Viola collina*,

E0 - +: *Hypnum cupressiforme*, *Plagiomnium vulgare*, *Tortula ruralis*.

Invas., expans.: *Arrhenatherum elatius*, *Calamagrostis epigejos*, *Carduus nutans*, *Chaerophyllum temulum*, *Cirsium arvense*, *Convolvulus arvensis*, *Cynoglossum officinale*, *Echinops sphaerocephalus*, *Elytrigia repens*, *E. intermedia*, *Galium aparine*, *Geum urbanum*, *Rubus fruticosus* spec. agg.

Remarks: Within this unit the calciphilous pine forests of the class *Pulsatillo-Pinetea sylvestris* (E. Schmid 1936) Oberdorfer in Oberdorfer *et al.* 1967 in the surroundings of Mělník and Úštěk and on the Jizerská tabule Plateau have also been included. *Pinus sylvestris* dominant, other woody species rare. Shrub layer very rich in species (*Swida sanguinea*, *Ligustrum vulgare*, *Pyrus pyraster*, *Viburnum opulus* and many others). Field layer very rich, dominated by *Brachypodium pinnatum*, *Teucrium chamaedrys*, *Centaurea scabiosa*, *Cirsium acaule*, or *Sesleria albicans* and *Geranium sanguineum*. Presence of rare calciphilous species (see below), the concentration of which has no counterpart in other forest communities in the Republic. Some forest acidophytes are also present.

The calciphilous pine forests are differentiated by the following species: E2 - *Viburnum opulus*, E1 - *Gymnadenia conopsea*, *Ophrys insectifera*, *Globularia elongata*, *Epipactis atrorubens*, *Linum flavum*, *Carex flacca*, *Pulsatilla pratensis*.

They occur on clay slates and calcium-rich sandstones up to c. 400 m, on slopes or plains. The soils are shallow rendzinas, pararendzinas and humus-carbonate soils with poor aeration and inclined to alternate moistening and desiccation.

Distribution: Úštěcká pahorkatina Hills, the Jizerská tabule Plateau (near Bělá p.B.).

They are used for the production of rather second-rate pine wood and firewood from scrub. Probably, stands were also used as pasture in the past. Occurrence of a number of very rare species.

Subcontinental thermophilous oak woodland (*Aceri tatarici-Quercion*)

Oak woodlands (*Quercus petraea*, *Q. pubescens*, *Q. robur*) on chernozems (over loess) or cambisols (over sands), mostly in plains at lower levels of the S Moravian Pannonian area. PND - c. 1.2% of the total area of the Republic.

31. Oak woodland on loess with *Quercus petraea*, *Q. pubescens* and *Q. robur* (*Quercetum pubescenti-roboris* [Zólyomi 1957] Michalko et Džatko 1965)

Synonyms: *Aceri tatarici-Quercetum pubescenti-roboris* Zólyomi 1957

Structure: Open oak woodlands with *Quercus petraea*, *Q. pubescens* and *Q. robur*. Shrub layer usually well-developed in undisturbed stands (most frequently *Ligustrum vulgare*, *Acer campestre*, *Crataegus monogyna*). Field layer dominated by *Melica uniflora*, *Convallaria majalis*, *Poa nemoralis* or *Brachypodium pinnatum*. Thermophil-

ous oak-forest species (*Buglossoides purpurocaerulea*, *Carex michelii*, *Dictamnus albus*, *Iris graminea*, *I. variegata*, *Lathyrus niger*) occur together with species of mesic oak-hornbeam woodlands (*Asarum europaeum*, *Campanula rapunculoides*, *Dactylis polygama*, *Galium odoratum*, *G. sylvaticum*, *Mercurialis perennis*, *Polygonatum multiflorum*, *Pulmonaria officinalis* agg.). Ground layer sparse or absent.

Diagn.: Dif.: E1 - *Galium odoratum*, *G. sylvaticum*, *Melica picta*, *M. uniflora*, *Polygonatum multiflorum*, *Pulmonaria officinalis* agg., *Viola mirabilis*.

Species with high constancy: E3 - *Quercus petraea*, E2 - *Ligustrum vulgare*, *Quercus petraea*, E1 - *Dactylis polygama*, *Dictamnus albus*, *Lathyrus niger*, *Poa nemoralis*.

Differences: *Potentillo albae-Quercetum* and *Carici fritschii-Quercetum* are differentiated by species of alternately wet soils and lack *Quercus pubescens* and *Dictamnus albus*. In addition, acidophilous species (*Deschampsia flexuosa*, *Luzula luzuloides*, *Vaccinium myrtillus*) occur in the *Potentillo-Quercetum*. The *Corno-Quercetum* and *Pruno mahaleb-Quercetum* are characterized by species of dry grasslands (*Aster amellus*, *Inula hirta*, *Salvia pratensis*, *Stachys recta*) and lack species confined to deeper soils (*Quercus robur*, *Carex montana*, *Convallaria majalis*).

Adjoining PNV: *Primulo veris-Carpinetum*, *Pruno mahaleb-Quercetum pubescentis*, *Corno-Quercetum*.

Habitat: W4. Zonal community of warm and dry areas of S Moravia (between 200-300 [-350] m), on flat land or gentle slopes of southern aspect. The soils are haplic or luvic chernozems, in some places degraded into luvisols, developed over loess. As potential vegetation, it is also mapped on calcareous Miocene sediments.

Distribution: PND - 1%. The *Quercetum pubescenti-roboris* is confined to S Moravia where it was widespread in the pre-cultural landscape. Today, however, stands are only rarely found in residual forest tracts of the Ždánický les Hills, Kyjovská and Milovická pahorkatina Hills and in the plain between the lower reaches of the Svratka and Jihlava rivers (Fig.23/31).

Land use: The soils supporting the *Quercetum pubescenti-roboris* are very suitable for agricultural exploitation; consequently their conversion into arable land began as early as the Neolithic period. Nowadays this land used for vineyards, maize, wheat, barley, fruit trees and some other thermophilous crops. The remnant woodlands were traditionally managed by coppicing.

The stands of the *Quercetum pubescenti-roboris* are rather restricted in area. Some are protected in nature reserves, others are threatened by planting with *Pinus sylvestris* and *Robinia pseudacacia* or by high stocking rates of wild ungulates in game preserves. All conserved stands deserve legal protection as local centres of biodiversity.

Rare and endangered syntaxa: On non-forest soils *Astragalo austriaci-Brachypodietum pinnati*; on arable land *Lathyro-Adonidetum aestivalis*, *Euphorbio-Melandrietum noctiflori*.

Rare and endangered taxa: *Buglossoides purpurocaerulea*, *Campanula bononiensis*, *Carex michelii*, *Centaurea triumfettii*, *Cephalanthera damasonium*, *Crepis praemorsa*, *Cypripedium calceolus*, *Dictamnus albus*, *Euphorbia polychroma*, *Iris graminea*, *I. variegata*, *Malus sylvestris*, *Melampyrum cristatum*, *Melica picta*, *Orchis militaris*, *O. purpurea*, *Phlomis tuberosa*, *Platanthera bifolia*, *Pulmonaria mollis*, *Vicia pisiformis*, *Viola alba*; in substitute communities *Amygdalus nana*, *Artemisia pancicii*, *Conringia orientalis*, *Crepis pannonica*, *Galium exoletum*, *Klasea lycopifolia*, *Linum hirsutum*, to name only the critically endangered species.

References: Chytrý (1997), Chytrý et Horák (1997), Horák (1980, 1983).

Typical relevé: Chytrý et Horák (1997): Tab. 2, rel. 32 (Milovický les Forest, S Moravia), 280 m, SSE, 15°, E3 - 90%, E2 - 20%, E1 - 80%, E0 - 0%.

E3 - 5: *Quercus petraea*,

E2 - 2: *Cornus mas*, 1: *Crataegus monogyna*, *Sorbus torminalis*, +: *Acer campestre*, *Carpinus betulus*, *Ligustrum vulgare*, *Lonicera xylosteum*, *Pyrus pyraster*, *Quercus petraea*,

E1 - 2: *Convallaria majalis*, *Melica uniflora*, *Poa nemoralis*, 1: *Calamagrostis arundinacea*, *Dictamnus albus*, *Festuca heterophylla*, *Galium odoratum*, *Lathyrus niger*, *Pulmonaria officinalis* s.l., +: *Acer campestre* juv., *Asarum europaeum*, *Berberis vulgaris* juv., *Buglossoides purpurocaerulea*, *Campanula persicifolia*, *C. rapunculoides*, *Carex montana*, *Cornus mas* juv., *Dactylis polygama*, *Fragaria vesca*, *Fraxinus excelsior* juv., *Galium sylvaticum*, *Geum urbanum*, *Hieracium lachenalii*, *H. maculatum*, *H. sabaudum*, *Melica picta*, *Melittis melissophyllum*, *Peucedanum alsaticum*, *Polygonatum multiflorum*, *Quercus petraea* juv., *Sedum maximum*, *Tilia cordata* juv., *Verbascum austriacum*, *Veronica vindobonensis*, *Viola mirabilis*.

Invas., expans.: *Galium aparine*, *Impatiens parviflora*, *Robinia pseudacacia*.

32. *Carici fritschii-Quercetum roboris* Chytrý et Horák 1997

Synonyms: *Quercetum roboris stepposum* Soó 1937 *caricetosum fritschii* Šmarda 1961

Structure: Canopy formed of open monospecific stands of *Quercus robur*. Shrub layer sparsely developed in existing stands, with *Frangula alnus*, *Tilia cordata* and saplings of *Quercus robur*. Field layer extremely rich in species, mostly without dominants, except locally for *Molinia caerulea* agg. and *Convallaria majalis*. A constant species is *Carex fritschii*, accompanied by thermophilous oak-forest species (*Geranium sanguineum*, *Trifolium alpestre*, *Iris variegata*, *Vincetoxicum hirundinaria*), species of mesic oak-hornbeam woodlands (*Dactylis polygama*), those of oligotrophic soils (*Festuca ovina*, *Anthoxanthum odoratum*), and species of alternately wet soils (*Potentilla alba*, *Serratula tinctoria*, *Galium boreale*, *Succisa pratensis*).

Diagn.: Dif.: E3 - *Quercus robur*, E2 - *Betula pendula*, *Frangula alnus*, *Quercus robur*, *Tilia cordata*; E1 - *Ajuga reptans*, *Anthoxanthum odoratum*, *Asperula tinctoria*, *Avenula pubescens*, *Briza media*, *Carex curvata*, *C. fritschii*, *C. pallescens*, *Cerastium arvense*, *Dianthus superbus*, *Euphorbia villosa*, *Festuca amethystina*, *Filipendula vulgaris*, *Galium boreale*, *G. palustre*, *Geranium sanguineum*, *Iris sibirica*, *I. variegata*, *Laserpitium prutenicum*, *Lathyrus pratensis*, *Linaria vulgaris*, *Lysimachia vulgaris*, *Melampyrum pratense*, *Molinia caerulea* agg., *Ornithogalum kochii*, *Peucedanum oreoselinum*, *Polygonum bistorta*, *Potentilla erecta*, *Pulmonaria angustifolia*, *Quercus robur* juv., *Ranunculus acris*, *Rumex acetosa*, *Sanguisorba officinalis*, *Scrophularia nodosa*, *Selinum carvifolia*, *Serratula tinctoria*, *Stachys sylvatica*, *Stellaria graminea*, *Succisa pratensis*, *Valeriana wallrothii*, *Vicia cassubica*, *V. sepium*, *Viola reichenbachiana*.

Species with high constancy: E3 - *Quercus robur*; E1 - *Achillea millefolium* agg., *Ajuga reptans*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Asperula tinctoria*, *Betonica officinalis*, *Carex fritschii*, *Clinopodium vulgare*, *Convallaria majalis*, *Dactylis polygama*,

Euphorbia cyparissias, *Festuca ovina*, *Galium boreale*, *Geranium sanguineum*, *Hypericum perforatum*, *Iris variegata*, *Laserpitium prutenicum*, *Luzula campestris* agg., *Melampyrum pratense*, *Molinia caerulea* agg., *Polygonatum odoratum*, *Potentilla alba*, *Serratula tinctoria*, *Silene vulgaris*, *Succisa pratensis*, *Trifolium alpestre*, *Veronica chamaedrys*, *Vicia sepium*, *Vincetoxicum hirundinaria*, *Viola reichenbachiana*.

Differences: The *Potentillo albae-Quercetum* is positively differentiated by *Quercus petraea*, acidophilous oak-forest species (*Luzula luzuloides*, *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Hieracium murorum*), and species of oak-hornbeam woodlands (*Galium sylvaticum*, *Stellaria holostea*). On the other hand, it lacks some thermophilous species of peri-alpine and sub-Mediterranean or Pontic distribution (*Carex fritschii*, *Iris variegata*, *Festuca amethystina*, *Valeriana wallrothii*).

Adjoining PNV: *Carici elongatae-Alnetum*, *Salici-Franguletum*, *Pruno-Fraxinetum*, *Fraxino pannonicae-Ulmetum*, *Primulo veris-Carpinetum*, *Festuco ovinae-Quercetum roboris*, *Quercetum pubescenti-roboris*.

Habitat: W4. Lowlands (160-220 m). Cambisols enriched in basic cations from the groundwater and developed over siliceous sand of Pleistocene age, in some places slightly influenced by podsolization or gleying. It is assumed that its potential distribution would include sandy-gravelly river terraces.

Distribution: PND - 0.1%. Near-natural stands in the SW part of the Doubrava Forest near the town of Hodonín (S Moravia). Altered stands can also be encountered in Boží les Forest in the extreme south of Moravia and in a few other rather restricted areas in S Moravia (Fig.23/32).

Land use: In the past the stands of the *Carici fritschii-Quercetum* were mostly coppiced. After cessation of this management, succession lead to the formation of tall forests with a relatively dense canopy. Plantations of *Pinus sylvestris*, *Robinia pseudacacia* and *Quercus cerris* have replaced the natural stands in some places after clear-cutting. Deforested sites support poor sandy grasslands.

Residual woodlands on sandy plains and river terraces are remarkable centres of biodiversity and habitats of many endangered species in an otherwise deforested landscape. Forest cover also significantly contributes to protection against aeolian erosion.

Rare and endangered syntaxa: *Carici fritschii-Quercetum roboris*, *Thymo angustifolii-Corynephoretum canescentis*, *Diantho serotini-Festucetum vaginatae*, *Erysimo diffusi-Agrostietum capillaris*.

Rare and endangered taxa: *Asperula tinctoria*, *Aster linosyris*, *Astragalus danicus*, *Biscutella laevigata*, *Campanula cervicaria*, *Carex ericetorum*, *C. fritschii*, *C. michelii*, *Centaurea triumfetti*, *Daphne cneorum*, *Dianthus superbus*, *Euphorbia villosa*, *Festuca amethystina*, *Gladiolus palustris*, *Hieracium hoppeanum*, *Iris variegata*, *Laserpitium prutenicum*, *Melampyrum cristatum*, *Orobanche alsatica*, *Platanthera chlorantha*, *Pulmonaria mollis*, *Scorzonera purpurea*, *Thalictrum simplex* subsp. *galiodes*; in the substitute communities the following critically threatened species are found: *Gypsophila paniculata*, *Hierochloe repens*, *Melandrium viscosum*, *Spergula pentandra*, *Stipa borysthenica*, *Viola saxatilis* subsp. *curtisii*.

References: Chytrý (1997), Chytrý et Horák (1997), Šmarda F. (1961).

Typical relevé: Chytrý et Horák (1997): Tab. 2, rel. 49 (Doubrava Forest, S Moravia), 170 m, plain, E3 - 70%, E2 - 5% E1 - 90%, E0 - 30%.

E3 - 4: *Quercus robur*,

E2 - 1: *Crataegus laevigata*, +: *Frangula alnus*, *Ligustrum vulgare*,

E1 - 3: *Convallaria majalis*, 2: *Carex fritschii*, 1: *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Betonica officinalis*, *Brachypodium pinnatum*, *Dactylis polygama*, *Festuca ovina*, *Fragaria moschata*, *Genista tinctoria*, *Geranium sanguineum*, *Heracleum sphondylium*, *Potentilla alba*, *Silene vulgaris*, +: *Asperula tinctoria*, *Astragalus glycyphyllos*, *Bupleurum falcatum*, *Carex curvata*, *Clinopodium vulgare*, *Corylus avellana* juv., *Crataegus* cf. *laevigata* juv., *Galium boreale*, *Laserpitium prutenicum*, *Leontodon hispidus*, *Luzula campestris* s.l., *Lysimachia vulgaris*, *Melampyrum pratense*, *Pimpinella saxifraga* s.l., *Platanthera chlorantha*, *Poa pratensis* s.l., *Polygonatum odoratum*, *Pulmonaria mollis*, *Quercus robur* juv., *Ranunculus polyanthemos*, *Rosa* sp. juv., *Rumex acetosa*, *Selinum carvifolia*, *Solidago virgaurea*, *Stellaria graminea*, *Succisa pratensis*, *Symphytum officinale*, *Trifolium alpestre*, *Valeriana wallrothii*, *Veronica vindobonensis*, *Vicia cassubica*, *V. sepium*, *Vincetoxicum hirundinaria*, *Viola reichenbachiana*, r: *Serratula tinctoria*,

E0 - 1 *Hypnum cupressiforme*, +: *Brachythecium velutinum*, *Bryum* sp.

Invas., expans.: *Calamagrostis epigejos*, *Robinia pseudacacia*.

Subacidophilous Central European thermophilous oak woodland (*Quercion petraeae* Zólyomi et Jakucs ex Jakucs 1960)

Thermophilous oak woodland (*Quercus petraea*, *Q. robur*) on poor soils of siliceous substrates of relatively cold and moist levels of the planar and (supra)colline belts. PND - 0.8% of the total area of the Republic.

33. Oak woodland with Potentilla alba (*Potentillo albae-Quercetum* Libbert 1933)

Structure: Species-rich oak forests with *Quercus petraea* and *Q. robur*, in some stands with a subcanopy admixture of *Carpinus betulus* and *Tilia cordata*, rarely *Fagus sylvatica*, *Sorbus torminalis* and *S. aria*. *Frangula alnus* is diagnostically important in the shrub layer; frequent species include *Corylus avellana*, *Rosa* sp. div. and some others. Field layer dominated by *Poa nemoralis*, *Carex montana*, *Brachypodium pinnatum* and *Convallaria majalis*, *in* some places also *Calamagrostis arundinacea*, composed of thermophilous oak-forest species (*Anthericum ramosum*, *Polygonatum odoratum*, *Pyrethrum corymbosum*, *Trifolium alpestre*), species of alternately wet soils (*Betonica officinalis*, *Frangula alnus*, *Galium boreale*, *Potentilla alba*, *Serratula tinctoria*), those of mesic deciduous woodlands (*Anemone nemorosa*, *Campanula persicifolia*, *Carpinus betulus*, *Convallaria majalis*, *Galium sylvaticum*, *Lathyrus vernus*, *Melica nutans*), and acidophilous oak-forest species (*Hieracium lachenalii*, *H. murorum*, *H. sabaudum*, *Luzula luzuloides*, *Melampyrum pratense*, *Vaccinium myrtillus*). Ground layer poorly developed and represented by *Polytrichum formosum* and *Hypnum cupressiforme*.

Diagn.: Dif.: E1 - *Anemone nemorosa*, *Betonica officinalis*, *Carex montana*, *Frangula alnus* juv., *Galium boreale*, *Hepatica nobilis*, *Melampyrum pratense*, *Melica nutans*, *Potentilla alba*, *Serratula tinctoria*, *Vaccinium myrtillus*, *Viola riviniana*.

Species with high constancy: E3 - *Quercus petraea*, E1 - *Carex montana*, *Hieracium murorum*, *Lathyrus niger*, *Melampyrum pratense*, *Poa nemoralis*, *Pyrethrum corymbosum*.

Differences: *Carpinion* communities and the *Luzulo albidae-Quercetum* lack the species of intermittently wet soils and thermophilous oak-forest species. *Sorbo torminalis-Quercetum* lacks the constant presence of *Convallaria majalis* and species of intermittently

wet soils. *Carici fritschii-Quercetum* lacks acidophilous oak-forest species, *Quercus petraea*, and some species of mesic deciduous woodlands; on the other hand, some peri-alpine and SE European species are present. *Quercetum pubescenti-roboris* possesses some sub-Mediterranean thermophilous species, whereas many acidophilous species are absent.

Adjoining PNV: *Melampyro nemorosi-Carpinetum* (rarely also *Carici pilosae-Carpinetum* and *Primulo veris-Carpinetum*), *Pruno-Fraxinetum*, *Carici acutiformis-Alnetum*, *Quercetum pubescenti-roboris*, *Luzulo albidae-Quercetum petraeae*, *Molinio arundinaceae-Quercetum*.

Habitat: W2. Lowlands and upland fringes at 200-400 m, on gentle south-facing slopes, plains or shallow depressions. The soils have a clay-loam texture which impairs drainage; seasonal surface-water gleying occurs, although in summer the soils dry out considerably. It occurs over various bedrocks, most frequently marls, clays and loess loams. The base-status of these soils is superficially low, but base-rich conditions are maintained below.

Distribution: PND - c. 0.7%. All low-lying areas of the Czech Republic, except for southernmost Moravia, Silesia and the elongated depression of the Moravská brána Gate. The centres of potential distribution are the Mostecká pánev Basin, SW fringes of the České středohoří Uplands, plains of N and E Bohemia, and the western surroundings of Prague (including Křivoklátsko area). Less frequently, surroundings of Plzeň and in Moravia, where the localities are concentrated in the surroundings of Brno, Znojmo and in the SW part of the Bílé Karpaty Mts (Fig.23/33).

Land use: In the past these forests were used for timber extraction for house-building, charcoal production and fuel, for grazing and animal bedding. Most of the stands were formerly coppiced. Under proper management the timber is of medium to high quality. At present many of the potential areas of distribution have been converted into plantations (*Pinus sylvestris*, *Picea abies*, *Larix decidua*, *Robinia pseudacacia* and exotic oak species), meadows, pastures, orchards or arable land (maize, wheat, barley, hops, fruit trees, sunflower, sugarbeet, rape).

The *Potentillo albae-Quercetum* is a community with a high biodiversity and the habitat of many threatened species. Many of the fragmented stands surrounded by arable land are endangered by the input of artificial fertilizers and pesticides.

Rare and endangered syntaxa: *Scabioso ochroleucae-Brachypodietum pinnati*, *Brachypodio-Molinietum* and some other *Bromion erecti* associations, *Potentillo albae-Festucetum rubrae*, *Agrimonio eupatoriae-Festucetum valesiacae*, *Peucedanetum cervariae*, rarely *Koelerio-Phleion phleoidis*; on arable land: *Caucalido daucoidis-Conringietum orientalis*, *Lathyro-Adonidetum aestivalis*.

Rare and endangered taxa: *Campanula bononiensis*, *Centaurea triumfetti*, *Cephalanthera damasonium*, *Clematis recta*, *Cornus mas*, *Dianthus seguieri*, *D. superbus*, *Dictamnus albus*, *Euphorbia angulata*, *E. polychroma*, *Hierochloe australis*, *Laserpitium prutenicum*, *Malus sylvestris*, *Melampyrum cristatum*, *Melica picta*, *Melittis melissophyllum*, *Platanthera bifolia*, *P. chlorantha*, *Potentilla rupestris*, *Pulmonaria angustifolia*, *P. mollis*, *Rosa gallica*, *Vicia cassubica*, *V. pisiformis*. In the areas of potential distribution in the Bílé Karpaty Mts., several critically threatened plant species occur in substitute communities: *Anacamptis pyramidalis*, *Conringia orientalis*, *Danthonia alpina*, *Galium tricornutum*, *Klasea lycopifolia*, *Lathyrus aphaca*, *Ophrys apifera*, *O. holosericea*, *Ornithogalum pyrenaicum*, *Orchis ustulata*, *Pseudolysimachion spurium*, *Senecio ovirensis*.

References: Blažková (1962), Chytrý (1997), Chytrý et Horák (1997), Klika (1952, 1957, 1959), Mikyška (1943), Mráz (1958a,b), Neuhäusl et Neuhäuslová-Novotná (1968), Novotný et Petříček (1980).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1968): Tab. 17, rel. 48 (Lower Ohře area, N Bohemia), 265 m, N, 30°, E3 - 80 %, E2 - 20 %, E1 - 90 %, E0 - 1 %.

E3 - 4: *Quercus petraea*, +: *Q. robur*,

E2 - 2: *Frangula alnus*, 1: *Corylus avellana*, *Quercus petraea*,

E1 - 3: *Carex montana*, 2: *Agrostis capillaris*, *Brachypodium pinnatum*, *Festuca ovina*, *Melampyrum pratense*, *Potentilla alba*, 1: *Betonica officinalis*, *Fragaria vesca*, *Frangula alnus* juv., *Hieracium lachenalii*, *Lathyrus niger*, *Quercus petraea* juv., +: *Acer platanoides* juv., *Calamagrostis arundinacea*, *Clinopodium vulgare*, *Convallaria majalis*, *Deschampsia cespitosa*, *Galium boreale*, *Hieracium murorum*, *H. sabaudum*, *Melica nutans*, *Poa nemoralis*, *Prunus spinosa* juv., *Quercus robur* juv., *Rubus fruticosus* agg., *Serratula tinctoria*, *Sorbus aucuparia* juv., *Veronica chamaedrys*, *Viola riviniana*, r: *Anthericum ramosum*, *Carex pairae*, *Crataegus monogyna* juv., *Festuca heterophylla*, *Molinia arundinacea*, *Mycelis muralis*, *Scrophularia nodosa*, *Polygonatum odoratum*,

E0 - +: *Atrichum undulatum*.

Invas., expans.: *Calamagrostis arundinacea*, *Arrhenatherum elatius*, *Impatiens parviflora*, *Rubus fruticosus* agg., *Robinia pseudacacia*.

34. Oak woodland with *Sorbus torminalis* and *Vincetoxicum hirundinaria* (*Sorbo torminalis-Quercetum* Svoboda ex Blažková 1962), Fig. 27.

Synonyms: *Cynancho-Quercetum* auct. bohem.

Structure: Open woodlands dominated by *Quercus petraea*; in extremely dry places individual trees stunted and the canopy cover is less than 50 %. The appearance of trunks in most of the existing stands indicates coppice management in the past. Some stands have an admixture of *Carpinus betulus*, *Sorbus aria* agg., *S. torminalis*, *Pinus sylvestris* and *Acer campestre*. Often the shrub layer is rather restricted, being formed by *Quercus petraea* saplings. Field layer with species of thermophilous oak woodlands (*Vincetoxicum hirundinaria*, *Euphorbia cyparissias*, *Anthericum ramosum*, *Polygonatum odoratum*, *Carex humilis*, *Pyrethrum corymbosum*), acidophilous species (*Deschampsia flexuosa*, *Hieracium lachenalii*, *H. murorum*, *H. sabaudum*, *Luzula luzuloides*, *Veronica officinalis*) and some species of mesic deciduous woodlands (*Poa nemoralis*, *Stellaria holostea*, *Melica nutans*). Luxuriant carpets of mosses are mainly found in types in drier habitats (*Ceratodon purpureus*, *Dicranum scoparium*, *Hypnum cupressiforme*, *Polytrichum juniperinum*).

Diagn.: Dif.: E1 - *Agrostis vinealis*, *Cardaminopsis arenosa*, *Genista pilosa* (reg., SW Moravia), *Jasione montana*, *Linaria genistifolia* (reg., SW Moravia), *Pinus sylvestris* juv., *Polypodium vulgare*, *Rumex acetosella*, *Sedum maximum*, *S. reflexum*, *Thymus praecox*.

Species with high constancy: E3 - *Quercus petraea*, E1 - *Poa nemoralis*, *Festuca ovina*, *Vincetoxicum hirundinaria*, *Euphorbia cyparissias*, *Quercus petraea* juv.

Differences: From the *Melampyro nemorosi-Carpinetum*, lower presence of *Carpinus betulus* and species of mesic woodlands, thermo- and xerophilous species frequent. From the *Luzulo albidae-Quercetum petraeae*, occurrence of thermophilous species.

Adjoining PNV: *Melampyro nemorosi-Carpinetum*, *Aceri-Carpi-*

netum, *Luzulo albidae-Quercetum petraeae*, *Viscario-Quercetum*.

Habitat: Warm to moderately warm areas (W2, MT11). Mostly colline levels (250-450 m), rarely, in suitable habitats, up to about 550 m. In warm and dry areas, such as SW Moravia, it was probably widespread on plateaus and gentle slopes over gneiss and granite. In slightly cooler or wetter areas confined to steep south-facing slopes (river valleys of Central Bohemia and SW Moravia). The soils are shallow rankers or cambisols, poor in nutrients, developed over granitoids, gneiss, granulite and Proterozoic or Palaeozoic sediments, particularly shales.

Distribution: PND - c. 0.1%. Upland fringes of the Bohemian Massif in SW and Central Moravia, particularly in the surroundings of the towns of Znojmo, Moravský Krumlov and Brno. Central Bohemia, in particular the Berounka and Vltava river valleys, although some less remarkable localities recorded in N and E Bohemia. Potential distribution also presumed on the fringes of the Doupovské hory Mts., NW Bohemia (Fig. 23/34, 27).

Land use: Traditional management included coppicing to obtain fuel wood. Clear-felled areas partly converted into acidophilous dry grasslands and used for grazing, partly into arable land (wheat, barley, rape, maize, sunflower). In some places with apple- and pear-orchards.

Near-natural stands of the *Sorbo torminalis-Quercetum* are largely absent from gently sloping landscapes where they have been either converted into pine and *Robinia* plantations or clear-felled. Some steep slopes in river valleys, however, still support well-preserved stands which are remarkable for their species richness. These stands have a protective function against soil erosion.

Rare and endangered syntaxa on non-forest soil: *Pulsatillo pratensis-Avenochloetum pratensis*, *Diantho deltoidis-Festucetum rupicolae*, *Potentillo arenariae-Agrostietum vinealis*, *Avenulo pratensis-Festucetum valesiacae*, *Carici humilis-Festucetum sulcatae*, *Carici humilis-Callunetum*, *Agrostio vinealis-Genistetum pilosae*, *Festuco pallentis-Alyssetum saxatilis*, *Asperulo glaucae-Festucetum pallentis*, *Potentillo arenariae-Festucetum pallentis*, *Ononido spinosae-Cirsietum acaulis*, *Gageo bohemicae-Veronicetum dillenii*, *Geranio-Trifolietum alpestris*, *Geranio-Dictamnetum*, *Vincetoxico hirundinariae-Origanetum vulgaris*, *Cynancho-Calamagrostietum arundinaceae*, *Agrostio vinealis-Genistetum pilosae*.

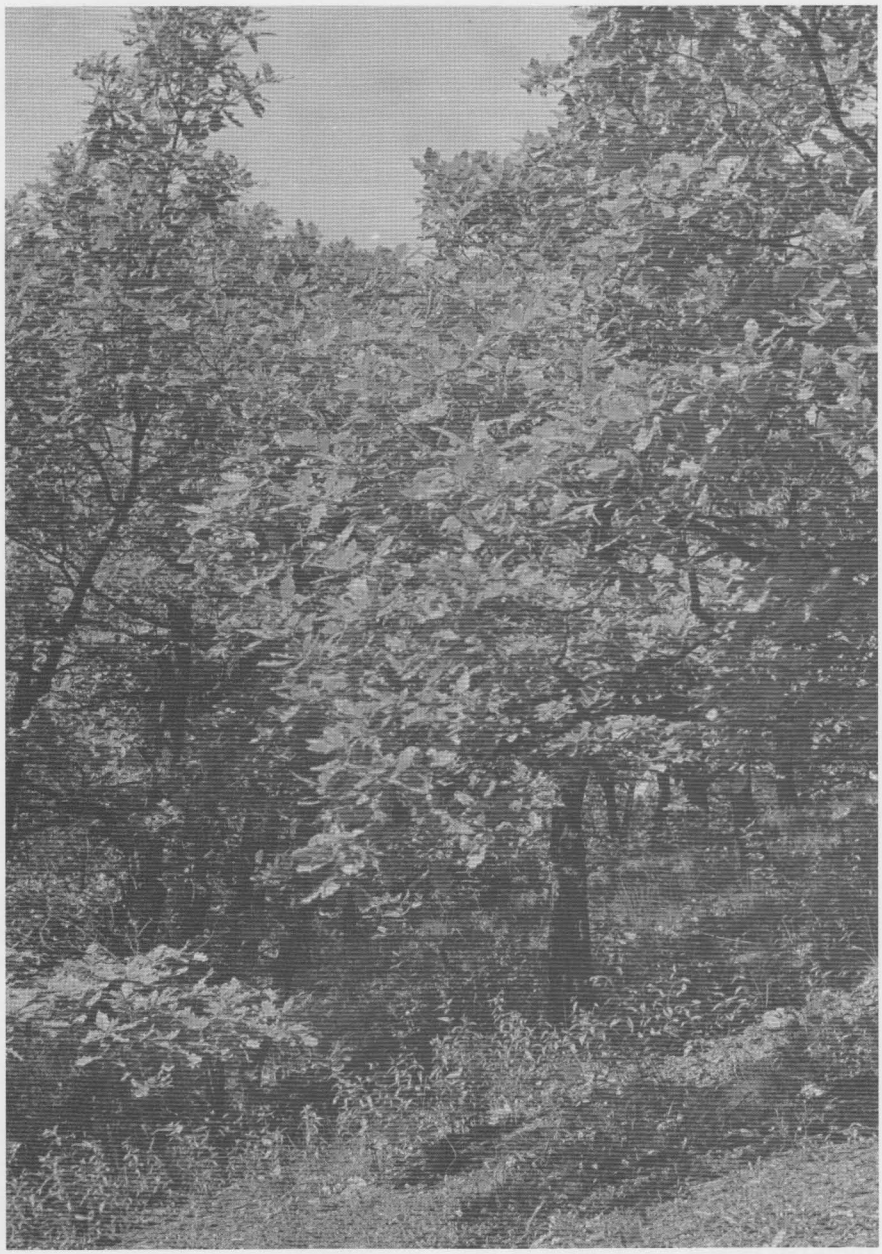

Fig. 27 — Oak woodland with *Sorbus torminalis* and *Vincetoxicum hirundinaria* (*Sorbo torminalis-Quercetum* Svoboda ex Blažková 1962).

Rare and endangered taxa: *Achillea nobilis*, *Aconitum anthora*, *Allium flavum*, *Arabis pauciflora*, *Asperula tinctoria*, *Aurinia saxatilis*, *Bupleurum longifolium*, *Carex michelii*, *Centaurea triumfetti*, *Clematis recta*, *Dactylorhiza sambucina*, *Daphne cneorum*, *Dictamnus albus*, *Erysimum crepidifolium*, *Euphorbia polychroma*, *Gagea bohemica*, *Hesperis sylvestris*, *Inula hirta*, *Lactuca quercina*, *Lonicera caprifolium* (? native), *Malus sylvestris*, *Melampyrum cristatum*, *Mercurialis ovata*, *Platanthera bifolia*, *P. chlorantha*, *Potentilla rupestris*, *Pulmonaria mollis*, *Pulsatilla pratensis*, *Vicia pisiformis*, *Viola saxatilis* subsp. *saxatilis*; the following critically threatened plants in substitute communities: *Bromus squarrosus*, *Bupleurum affine*, *Genistella sagittalis*, *Verbascum speciosum*.

References: Blažková (1962), Chytrý (1997), Chytrý et Horák (1997), Chytrý et Vicherek (1995), Horák (1981), Moravec, Neuhäusl *et al.* (1992), Mráz (1963), Neuhäusl et Neuhäuslová-Novotná (1977), Samek (1962).

Typical relevé: Chytrý et Vicherek (1995): Tab. 6, rel. 23 (NP Podyjí, SW Moravia), 340 m, SW, 30°, E3 - 70 %, E2 - 0 %, E1 - 80 %, E0 - 30 %.

E3 - 4: *Quercus petraea*,

E1 - 3: *Carex humilis*, 2: *Anthericum ramosum*, *Festuca ovina*, 1: *Deschampsia flexuosa*, *Genista pilosa*, *Hieracium pilosella*, *Pyrethrum corymbosum*, +: *Achillea millefolium* agg., *A. nobilis*, *Anthemis tinctoria*, *Asperula cynanchica*, *Bupleurum falcatum*,

Calamagrostis arundinacea, *Campanula persicifolia*, *Carpinus betulus* juv., *Dianthus carthusianorum* agg., *Hieracium murorum*, *H. sabaudum*, *Hypericum perforatum*, *Jasione montana*, *Luzula divulgata*, *L. luzuloides*, *Poa angustifolia*, *P. nemoralis*, *Polygonatum odoratum*, *Quercus petraea* juv., *Rumex acetosella*, *Sedum sexangulare*, *S. reflexum*, *Solidago virgaurea*, *Sorbus aucuparia* juv., *Steris viscaria*, *Teucrium chamaedrys*, *Thesium linophyllon*, *Thymus praecox*, *Tilia cordata* juv., *Trifolium alpestre*, *Verbascum austriacum*, *Veronica officinalis*, *Vincetoxicum hirundinaria*, r: *Cardaminopsis arenosa*, *Euphorbia cyparissias*, *Fallopia convolvulus*, *Linaria genistifolia*, *Scleranthus perennis*,

E0 - 2: *Ceratodon purpureus*, *Polytrichum juniperinum*, +: *Cladonia coniocraea*, *C. fimbriata*, *C. pyxidata*, *C. rangiferina*, *C. rangiformis*, *Hypnum cupressiforme*, *Hypogymnia physodes*, *Parmelia caperata*.

Invas., expans.: *Impatiens parviflora*, *Rubus fruticosus* agg., *Robinia pseudacacia*, *Galium aparine*, *Calamagrostis epigejos*, *C. arundinacea*.

35. Oak woodland with *Asplenium cuneifolium* on serpentine substrate (*Asplenio cuneifolii-Quercetum petraeae* Chytrý et Horák 1997)

Structure: Open woodlands of *Quercus petraea* with a natural admixture of *Pinus sylvestris*. This species predominates in existing stands that have developed as a result of secondary succession on abandoned pastures. However, natural regeneration of oak can be seen in the undergrowth. Shrub layer dominated by *Cerasus mahaleb*, *Berberis vulgaris*, *Frangula alnus* and *Quercus petraea*. Typical of the field layer is the high constancy of species of dry grasslands (*Carex humilis*, *Potentilla arenaria*, *Dorycnium germanicum*, *Achillea collina*, *Genista pilosa*, *Koeleria macrantha*) and the occurrence of the serpentinicolous fern *Asplenium cuneifolium*. Ground layer constantly present, with *Hypnum cupressiforme* being the commonest species.

Diagn.: Dif.: E3 - *Pinus sylvestris* (partly planted), epiphytes: *Viscum laxum*; E2 - *Berberis vulgaris*, *Cerasus mahaleb*, *Frangula alnus*, *Juniperus communis*, E1 - *Alyssum montanum*, *Asplenium cuneifolium*, *Avenula pubescens*, *Berberis vulgaris* juv., *Biscutella laevigata*, *Bothriochloa ischaemum*, *Carlina vulgaris*, *Centaura scabiosa*, *C. rhenana*, *Cerasus mahaleb* juv., *Dorycnium germanicum*, *Euphorbia seguieriana* subsp. *minor*, *Koeleria macrantha*, *Lepidium campestre*, *Melica transsilvanica*, *Potentilla arenaria*, *Scorzonera austriaca*, *Seseli hippomarathrum*, *Stipa joannis*.

Species with high constancy: E3 - *Pinus sylvestris* (partly planted), E2 - *Quercus petraea*, E1 - *Achillea collina*, *Bupleurum falcatum*, *Carex humilis*, *Dorycnium germanicum*, *Euphorbia cyparissias*, *Festuca ovina*, *Galium verum*, *Genista pilosa*, *Pimpinella saxifraga* agg., *Potentilla arenaria*, *Quercus petraea*, *Vincetoxicum hirundinaria*, E0 - *Hypnum cupressiforme*.

Differences: *Sorbo torminalis-Quercetum* lacks *Pinus sylvestris*, *Cerasus mahaleb*, *Berberis vulgaris*, *Juniperus communis*, *Frangula alnus*, *Potentilla arenaria*, *Dorycnium germanicum*, *Pimpinella saxifraga* agg. and several other species. *Thlaspio montani-Pinetum sylvestris* lacks high presence of *Quercus petraea*, and many thermophilous species are absent (e.g. *Cerasus mahaleb*, *Koeleria macrantha*, *Verbascum austriacum*, *Vincetoxicum hirundinaria*); on the other hand, it is positively differentiated by *Asplenium cuneifolium*, peri-alpine and dealpine species (*Sesleria albicans*, *Biscutella laevigata*, *Galium valdepilosum*, *Thlaspi montanum*) and by mesophilous mosses (*Pleurozium schreberi*, *Hylocomium splendens*).

Habitat: MW11. Steep rocky slopes of southern and western aspects, with an inclination of 15-40°, altitudes between 300-350 m. The bedrock is serpentine; the soils are shallow, Mg-rich rankers.

Distribution: The community is endemic to the middle Jihlava valley in SW Moravia (Fig. 23/35).

Land use: The stands of the *Asplenio cuneifolii-Quercetum* used to be coppiced and grazed by domestic animals. Substantial part deforested and used as common pasture land.

Serpentine localities in SW Moravia support unique communities of short dry grasslands, traditionally grazed.

After the grazing had been abandoned, spontaneous secondary succession lead to the establishment of pine forest in many sites during the second half of 20th century. Some stands are protected in nature reserves.

Rare and endangered syntaxa: endemic *Asplenio cuneifolii-Quercetum petraeae*, *Sedo albi-Cheilanthetum*, *Euphorbio-Festucetum pallentis*, *Dorycnio sericei-Caricetum humilis*.

Rare and endangered taxa: *Armeria vulgaris* subsp. *serpentini*, *Biscutella laevigata*, *Carex michelii*, *Centaurea triumfetti*, *Cerasus mahaleb*, *Euphorbia polychroma*, *E. seguieriana* subsp. *minor*, *Linaria genistifolia*, *Notholaena marantae*, *Senecio erucifolius*, *Stipa dasyphylla*, *S. joannis*, *S. pulcherrima*.

References: Chytrý (1997), Chytrý et Horák (1997), Chytrý et Vicherek (1996), Horák (1981).

Typical relevé: Chytrý et Horák (1996): Tab. 3, rel. 83 (Jihlava river valley, SW Moravia), 330 m, S, 40°, E3 - 60 %, E2 - 50 %, E1 - 50 %, E0 - 5 %.

E3 - 3: *Pinus sylvestris*, 2: *Quercus petraea*, epiphytes - +: *Viscum laxum*,

E2 - 2: *Berberis vulgaris*, *Cerasus mahaleb*, 1: *Ligustrum vulgare*, +: *Frangula alnus*,

E1 - 2: *Carex humilis*, *Genista pilosa*, *Thymus glabrescens*, 1: *Centaurea triumfetti*, *Fragaria viridis*, *Galium valdepilosum*, *Hieracium pilosella*, *Potentilla arenaria*, +: *Achillea collina*, *Ajuga genevensis*, *Alyssum montanum*, *Arrhenatherum elatius*, *Astragalus glycyphyllos*, *Avenula pratensis*, *Berberis vulgaris* juv., *Carlina vulgaris* agg., *Centaurea rhenana*, *Euphorbia cyparissias*, *Festuca ovina*, *F. pallens*, *Hypericum perforatum*, *Inula conyza*, *Lepidium campestre*, *Melica ciliata*, *Pimpinella saxifraga* agg., *Quercus petraea* juv., *Salvia pratensis*, *Scabiosa ochroleuca*, *Teucrium chamaedrys*, *Verbascum lychnitis*, *Viola collina*, r: *Asplenium cuneifolium*, *Koeleria macrantha*, *Scorzonera austriaca*,

E0 - 1: *Rhytidium rugosum*, +: *Hypnum cupressiforme*, *Tortella inclinata*.

Invas., expans.: *Calamagrostis epigejos*, *Rubus fruticosus* agg.

Acidophilous woodrush, silver fir, birch and pine woodlands (*Genisto germanicae-Quercion* Neuhäusl et Neuhäuslová-Novotná 1967)

Species-poor, broadleaved (*Quercus robur*, *Q. petraea*) or mixed oak woodlands *Abies alba* or *Pinus sylvestris*, with prevailing grasses, *Juncaceae* or dwarf shrubs, on nutrient-poor substrates at planar and colline levels, partly at submontane levels. PND - 25%.

36. Woodrush and/or silver fir-oak woodland (*Luzulo albidae-Quercetum petraeae* Hilitzer 1932, *Abieti-Quercetum* Mráz 1959), Fig. 28.

Synonyms: *Quercus sessiliflora-Deschampsia flexuosa*-Ass. Firbas 1928, *Quercus sessilis-Genista tinctoria* Ass. Klika 1932, *Querco-Fagetum* sensu Samek 1957 p.p., *Festuco ovinae-*

Quercetum Mráz 1963, *Quercetum medioeuropaeum* auct. bohem.

Structure: Acidophilous woodrush- and silver fir-oak woodlands of similar species composition and analogous habitats.

Luzulo albidae-Quercetum dominated by *Quercus petraea* with a weak admixture or absence of more or less nutrient-demanding broad-leaved woody species - *Betula pendula*, *Carpinus betulus*, *Fagus sylvatica*, *Sorbus aucuparia*, *Tilia cordata*, on drier habitats with natural *Pinus sylvestris*. On relatively moist sites *Quercus robur*, especially in the southern half of Bohemia. Regenerating woody species of the canopy occur in the weakly developed shrub layer, with *Frangula alnus* and *Juniperus communis*. Field layer dominated by (sub)acidophilous and mesophilous woodland species (*Poa nemoralis*, *Luzula luzuloides*, *Vaccinium myrtillus*, *Convallaria majalis*, *Festuca ovina*, *Deschampsia flexuosa*, *Calamagrostis arundinacea*, *Melampyrum pratense* etc.). Ground layer species-rich, with frequent *Polytrichum formosum*, *Pleurozium schreberi*, *Dicranum scoparium*, *Leucobryum glaucum*, *Pohlia nutans* etc.

Similar species composition is typical for silver fir-oak woodland with, besides *Quercus robur* and *Q. petraea*, *Abies alba* in the canopy, and in the shrub layer with frequent *Sambucus racemosa*, and *Galium rotundifolium*, *Luzula pilosa*, *Carex digitata*, *Epipactis helleborine*, *Oxalis acetosella*, *Senecio fuchsii* and saplings of silver fir in the field layer.

Diagn.: *Luzulo albidae-Quercetum petraeae*: Dif.: E1 - *Luzula luzuloides*, *Genista tinctoria*, *G. germanica*, *Viola riviniana*, E0 - *Atrichum undulatum*.

Species with high constancy: E3, E2 - *Quercus petraea*, *Q. robur*, *Betula pendula*, E1 - *Luzula luzuloides*, *Calamagrostis arundinacea*, *Deschampsia flexuosa*, *Festuca ovina*, *Hieracium lachenalii*, *H. murorum*, *Melampyrum pratense*, *Rubus fruticosus* agg., *Sorbus aucuparia*, *Vaccinium myrtillus*, *Veronica officinalis*, E0 - *Polytrichum formosum*, *Dicranum scoparium*.

Abieti-Quercetum: Dif.: E3 - *Abies alba*, E2 - *Sambucus racemosa*, E1 - *Luzula pilosa*, *Epipactis helleborine*, *Galium rotundifolium*.

Species with high constancy: E3, E2 - *Betula pendula*, *Quercus petraea*, *Q. robur*, E1 - *Galium rotundifolium*, *Luzula pilosa*, *Calamagrostis arundinacea*, *Deschampsia flexuosa*, *Hieracium murorum*, *Melampyrum pratense*, *Rubus fruticosus* agg., *Sorbus aucuparia*, *Vaccinium myrtillus*, E0 - *Polytrichum formosum*, *Dicranum scoparium*, *Pleurozium schreberi*.

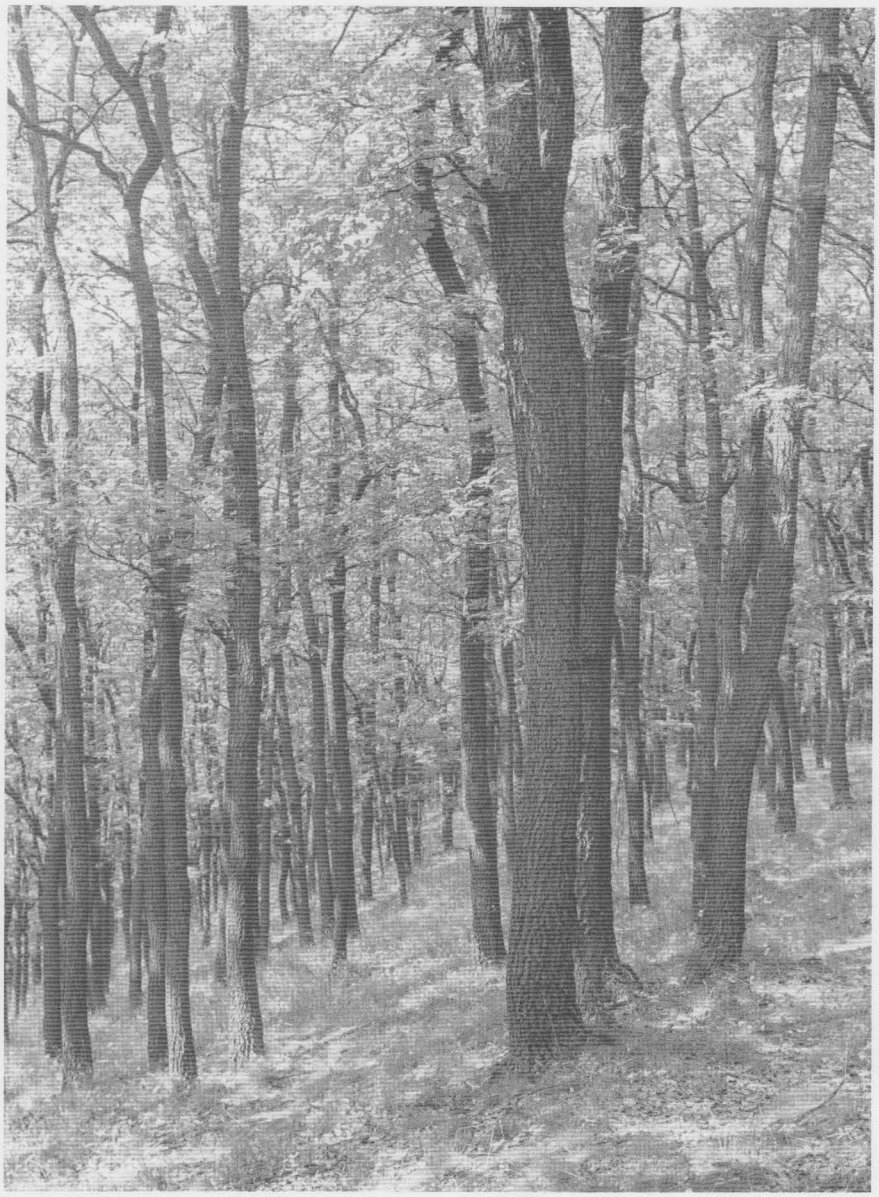

Fig. 28 – Luzulo albidae-Quercetum petraeae Hilitzer 1932.

Differences: From the *Melampyro nemorosi-Carpinetum* and *Tilio-Carpinetum*, lower occurrence or absence of nutrient-demanding species of the *Fagetalia*, from the *Molinio arundinaceae-Quercetum*, absence of its diagnostic species *Molinia arundinacea*, *Lysimachia vulgaris*, *Betula pubescens*.

Adjoining PNV: Alluvial woodlands (*Querco-Ulmetum*, *Alnenion glutinoso-incanae*), oak-hornbeam and lime-oak woodlands (*Carpinion*), acidophilous oak woodlands of mineral-weak substrates (*Molinio arundinaceae-Quercetum*, *Festuco ovinae-Quercetum*, *Vaccinio vitis-idaeae-Quercetum*), acidophilous and herb-rich beech and silver fir woodlands (*Luzulo-Fagetum*, *Carici-Quercetum*, *Deschampsio flexuosae-Abietetum*, *Luzulo pilosae-Abietetum*, *Saniculo-Abietetum*, *Eu-Fagenion*), subxerophilous thermophilous oak woodlands (*Quercion petraeae*).

Habitat: Mostly MW11-7, less frequently MW5-3 (*Abieti-Quercetum*). Edaphic climax on nutrient-poor substrates (gneiss, granite, acidic slates etc.) at lowland and especially colline levels with subcontinental climate. The *Abieti-Quercetum* frequently also at higher levels. It is particularly linked with relatively colder and moister levels than the *Luzulo-Quercetum*. In SW Bohemia, up to 700 m. Various relief forms - hills, flat or moderately undulating plains, rarely steep slopes of river canyons. Prevailing soil types - meso-oligotrophic to oligotrophic, acidic to very strongly acidic, typical cambisols or luvisols, under silver fir-oak woodlands frequently pseudogleyed. In the *Luzulo albidae-Quercetum* the soils sometimes dry out; the *Abieti-Quercetum* covers moist or fresh soils.

Distribution: PND - 21.2%. Western part of the Republic, especially S and W Bohemia. In Moravia large complexes concentrated on the border of crystallinicum.

On the basis of archival studies, palynological analyses and present-day more or less natural stands, it can be assumed that the *Abieti-Quercetum* prevailed on relatively moister and colder sites, while on the Česká tabule Plateau, the *Luzulo-Quercetum* predominated. The area of both these units in Moravia and Silesia is relatively small, but there the *Abieti-Quercetum* is also associated with moister and colder sites on the border with (sub)montane beech woodlands, where (principally in Silesia) *Abies alba* is still relatively frequent (Fig. 23/36, 28).

Land use: At present many natural stands replaced by plantations of *Picea abies*, *Larix decidua*, *Pinus sylvestris* (the last principally at levels of the *Luzulo-Quercetum*), *Quercus rubra*, *Robinia pseudacacia*, woodlands with *Betula pendula*, most frequent in W Bohemia. Most areas deforested and used as arable land, less frequently acidophilous pastures or meadows (*Potentillo arenariae-Agrostietum vinealis*, *Genisto pilosae-Callunetum*, *Carici humilis-Callunetum*, *Agrostio vinealis-Genistetum pilosae*, *Calamagrostio arundinaceae-Vaccinietum*, *Violion caninae*, *Arrhenatherion*, *Sanguisorbo-Festucetum commutatae*). Near-natural woodlands of middle or low yield class, mostly managed as coppices, cover < 1 % of the area, mostly as small areas inside larger forest complexes or on sites unsuitable for agriculture. *Pinus sylvestris* achieves a high yield class especially in the 1st generation but in plantations on sandy siliceous substrates degradation of upper soil layers as a result of humus accumulation can be observed. The dense cover of chamaephytes restricts the natural regeneration of woody species. A 50 % admixture of pine is economically viable when ameliorating woody species are admixed. Spruce is not viable, its growth is good on moist sites, but it is attacked by fungi. Arable land is used for potatoes, wheat, oat, rye, rape, beans or alfalfa. Frequently, meadows are managed as "Mähäcker" - ploughed and resown by grass mixtures dominated by *Dactylis glomerata*, *Festuca pratensis*, *F. rubra*, *Phleum pratense*, or *Lolium multiflorum*. A part of the forest area is built up.

Besides the timber reserves, use as protection woodlands (soil and water retention), for recreational activities, aesthetic importance, biodiversity and protection of deer in the mostly agricultural landscape.

(Near)-natural stands of the *Luzulo albidae-Quercetum* rare. The *Abieti-Quercetum* is a very rare community in imminent danger of extinction.

(Near-)natural stands: *Luzulo albidae-Quercetum petraeae*: Křivoklátská vrchovina Uplands, PLA Křivoklátsko; Jizerská tabule Plateau; PLA Železné hory.

Abieti-Quercetum: PLA Železné hory - NNR "Jedlová doubrava"; Nízký Jeseník Mts.

Rare and endangered syntaxa: *Abieti-Quercetum*.

Rare and endangered taxa: *Abies alba*, *Epipactis helleborine*, *Platanthera bifolia*.

References: Hilitzer (1932), Chytrý et Vicherek (1995), Mráz (1959), Neuhäusl et Neuhäuslová-Novotná (1967, 1979, 1989).

Typical relevé: *Luzulo albidae-Quercetum petraeae* Neuhäuslová (1991 ms.): Křivoklátská vrchovina Uplands - PLA Křivoklátsko, Ohrádka ESE from the village of Žloukovice, plain. E3 - 70%, E2 - 0%, E1 - 75%, E0 - 3%.

E3 - 4: *Quercus petraea*, r: *Carpinus betulus*, *Fagus sylvatica*,

E1 - 3: *Calamagrostis arundinacea*, 2: *Anemone nemorosa*, *Convallaria majalis*, *Quercus petraea*, 1: *Anthoxanthum odoratum*, *Deschampsia flexuosa*, *Festuca ovina*, *Luzula luzuloides*, *Melampyrum pratense*, *Vaccinium myrtillus*, +: *Carpinus betulus*, *Galium boreale*, *G. sylvaticum*, *Luzula pilosa*, *Hieracium murorum*, *Oxalis acetosella*, *Polygonatum odoratum*, *Sorbus torminalis*, r: *Achillea millefolium*, *Carex digitata*, *C. montana*, *Lembotropis nigricans*, *Luzula campestris*, *L. divulgata*, *Melica nutans*, *Stellaria holostea*, *Veronica chamaedrys*, *Viola riviniana*,

E0 - 1: *Polytrichum formosum*, +: *Hypnum cupressiforme*, *Leucobryum glaucum*, *Plagiomnium affine*.

Abieti-Quercetum Neuhäusl et Neuhäuslová-Novotná (1979): tab. 28, rel. 62 (Železné hory Mts.), 310 m, SW, 2°, E3 - 90%, E2 - 2%, E1 - 60%, E0 - 1%.

E3 - 5: *Quercus patraea*, +: *Carpinus betulus*, *Picea abies*,

E2 - 1: *Picea abies*,

E1 - 2: *Calamagrostis arundinacea*, *Vaccinium myrtillus*, 1: *Galium rotundifolium*, *Luzula pilosa*, *Melampyrum pratense*, *Poa nemoralis*, *Quercus petraea*, +: *Carex digitata*, *Festuca ovina*, *Galeopsis tetrahit*, *Hieracium murorum*, *Poa angustifolia*, *Pteridium aquilinum*, *Rubus fruticosus* agg., *Sorbus aucuparia*, *Viola riviniana*, r: *Carex brizoides*, *Carpinus betulus*, *Frangula alnus*, *Melica nutans*, *Picea abies*, *Scrophularia nodosa*,

E0 - +: *Plagiomnium affine*.

Invas., expans.: *Heracleum mantegazzianum* and *Chamerion angustifolium* (W Bohemia), *Calamagrostis epigejos*, *Impatiens parviflora*, *Rubus fruticosus* agg., *R. idaeus*, *Reynoutria japonica*, *Arrhenatherum elatius*, *Robinia pseudacacia*, *Sambucus racemosa*, or *Galium aparine*.

37. Oak woodland with *Molinia arundinacea* (*Molinio arundinaceae-Quercetum* Samek 1962)

Synonyms: *Querco-Betuletum* auct. bohem. et morav., *Querco-Betuletum bohemicum* Mikyška 1956.

Structure: Four-layered birch-oak stands dominated by *Quercus robur* with a frequent admixture of *Betula pendula*, or *B. pubescens*. From the subatlantic *Betulo-Quercetum*, *Fagus sylvatica* is missing and *Quercus petraea*, *Populus tremula*, *Sorbus aucuparia* are typical. *Pinus sylvestris* and *Picea abies* also admixed. Only rarely, *Alnus glutinosa* occurs in a moist variant. *Frangula alnus* dominates the shrub layer, accompanied by regeneration of the canopy species. Field layer dominated by acidophytes (*Carex brizoides* or *Molinia arundinacea*). Frequently, *Deschampsia flexuosa*, *D. cespitosa*, *Vaccinium myrtillus*, *Melampyrum pratense*, or *Festuca ovina*, *Pteridium aquilinum*, rarely *Convallaria majalis* occur. Acidophytes also dominate the ground layer (*Leucobryum glaucum*, *Pleurozium schreberi*, *Polytrichum commune*, *P. formosum*, *Dicranum scoparium*). *Sphagna* sect. *Acutifolia*, *Squarrosa*, *Subsecunda* occur here also.

Diagn.: Dif.: E3-E1 - *Betula pubescens*, *Populus tremula*, E2 - *Frangula alnus*, E1 - *Carex brizoides*, *Dryopteris carthusiana*, *Lysimachia vulgaris*, *Molinia arundinacea*, *Hieracium laevigatum*, *Potentilla erecta*.

Species with high constancy: E3 - *Quercus robur*, *Betula pendula*, E2 - *Frangula alnus*, E1 - *Molinia arundinacea*, *Carex brizoides*, *Deschampsia flexuosa*, *Lysimachia vulgaris*, *Melampyrum pratense*, *Potentilla erecta*, *Sorbus aucuparia*, *Vaccinium myrtillus*.

Differences: This unit differs from other acidophilous oak woodlands by its diagnostic species.

Adjoining PNV: Alluvial woodlands (*Carici remotae-Fraxinetum*, *Pruno-Fraxinetum*), oak-hornbeam and lime-oak woodlands (*Melampyro-Carpinetum*, *Tilio-Betuletum*, *Tilio-*

Carpinetum), acidophilous *Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*, thermophilous *Potentillo albae-Quercetum*, beech woodlands (*Tilio cordatae-Fagetum*, *Luzulo-Fagetum*).

Habitat: W2 in Bohemia, MW10 in NE Moravia and Silesia. Edaphically conditioned permanent community of colline levels (mostly 200-450 m), on very strongly acidic, heavy loamy to clay-loamy, nutrient-poor pseudogleys or pseudogleyed cambisols, waterlogged by stagnant precipitation water in shallow depressions and enclosed hollows, with temporarily very unfavourable physical properties of soils. In enclosed hollows acidic raw humus accummulates as a result of waterlogging and surface anmoor formation can be observed. However, in dry periods, these soils dry out.

Distribution: PND - 0.3%. The *Molinio-Quercetum* represents a vicariant of (sub)Atlantic birch-oak woodlands in subcontinental parts of Central Europe. Small areas in Central and E Bohemia (namely the Česká tabule Plain), frequent in the Opavská pahorkatina hills, Silesia. Sporadically in SW Bohemia (Český les Mts.) (Fig.29/37).

Land use: Areas of this unit partly used for forestry, partly (after drainage) as arable land (rye, oats, potatoes) or meadows (*Molinion*). Broadleaved woodland managed mostly as coppices, partly converted to mixed oak-pine stands or spruce plantations of low yield class. The *Molinio-Quercetum* represents rare and endangered vegetation, important for water retention in landscape. Deforestation is accompanied by pronounced waterlogging. Repeated pine plantations cause accummulation of raw humus and soil and stand degradation.

(Near-)natural stands: Středolabská tabule Plain - woodlands near the village of Býchory; Opavská pahorkatina Hills - Městský les near Osoblaha.

Rare and endangered taxa: *Iris sibirica*, *Scorzonera humilis*, on non-forest soil *Dianthus superbus*.

References: Mikyška in Mikyška *et al.* (1968), Neuhäusl et Neuhäuslová-Novotná (1967), Moravec, Neuhäusl *et al.* (1992), Vicherek (1962).

Typical relevé: Vicherek (1962): tab. p. 283-284, rel. 8 (Opavská pahorkatina hills), 320 m, plain. E3 - 90%, E2 - 20%, E1 - 70%, E0 - 25%.

E3 - 3: *Quercus robur*, 2: *Betula pubescens*, 1: *Pinus sylvestris*, +: *Betula pendula*, *Populus tremula*,

E2 - 2: *Frangula alnus*,

E1 - 3: *Molinia arundinacea*, 1: *Convallaria majalis*, *Galium vernum*, *Hieracium laevigatum*, *H. murorum*, *H. sabaudum*, *Lysimachia vulgaris*, *Luzula campestris*, *Maianthemum bifolium*, *Poa nemoralis*, *Potentilla erecta*, *Vaccinium myrtillus*, +: *Corylus avellana*, *Festuca rubra*, *Fragaria vesca*, *Genista germanica*, *Listera ovata*, *Serratula tinctoria*, *Veronica chamaedrys*,

E0 - 2: *Polytrichum commune*, +: *Atrichum undulatum*, *Dicranum scoparium*.

Invas., expans.: *Carex brizoides*, *Holcus mollis*, *Molinia arundinacea*, rarely *Impatiens parviflora*.

38. Pine-oak woodland with *Vaccinium vitis-idaea* (*Vaccinio vitis-idaeae-Quercetum* Oberdorfer 1957)

Synonyms: *Pino-Quercetum* Reinhold sec. auct.

Structure: Open natural and near-natural species-poor stands dominated by *Quercus petraea* and *Pinus sylvestris*, less frequently also by *Q. robur*. Other frequent trees are *Betula pendula* and *Sorbus aucuparia*. Sparse shrub layer formed by saplings of the canopy or also by some shrubs of nutrient-poor habitats (*Frangula alnus*, *Salix aurita*). Acidophilous species prevail also in the field layer formed by chamaephytes (*Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*), grasses (*Deschampsia flexuosa*) or ferns (*Pteridium aquilinum*). Typical for Dokeská pahorkatina Uplands is *Trientalis europaea* (also in the Chebská pánev Basin) and in some sandy localities also *Corynephorus canescens*, *Spergula morisonii*, *Pulsatilla vernalis*. The occurrence of *Picea abies*, *Chamaebuxus alpestris*, *Abies alba*, *Dianthus seguieri* subsp. *glaber* characterize stands in W and S Bohemia, and *Erica carnea* and *Galium saxatile* are common in the Chebská pánev Basin (W Bohemia). Ground layer mostly well-developed consisting both of mosses (*Pleurozium schreberi*, *Dicranum scoparium*, *Hylocomium splendens*, *Hypnum cupressiforme*, *Leucobryum glaucum*, *Dicranum polysetum*) and lichens (*Cladonia rangiferina*, *C. arbuscula*, *Cetraria islandica*).

Diagn.: Diff.: E1 - *Vaccinium vitis-idaea*, *V. myrtillus*, E0 - *Cladonia rangiferina*, *C. arbuscula*, *Cetraria islandica*, *Dicranum polysetum*.

Species with high constancy: E3, E2 - *Pinus sylvestris*, E1 - *Calluna vulgaris*, *Deschampsia flexuosa*, *Melampyrum pratense*, *Vaccinium myrtillus*, *V. vitis-idaea*, E0 - *Dicranum scoparium*, *D. polysetum*, *Pleurozium schreberi*.

Differences: From *Festuco-Quercetum*, common occurrence of *Vaccinium vitis-idaea* and *V. myrtillus*, presence of *Sarothamnus scoparius* and *Trientalis europaea*, abundant rejuvenation of *Picea abies* and absence of nutrient-demanding species of warm habitats.

Adjoining PNV: Alder carrs (*Carici elongatae-Alnetum*), oak-hornbeam woodland (*Melampyro-Carpinetum*), acidophilous *Luzulo-Quercetum*, beech or fir woodlands (*Luzulo-Fagetum*, *Luzulo-Abietetum*, *Dentario enneaphylli-Fagetum*).

Habitat: MW with annual mean temperature 7-8°C (in sandstone areas of Central Bohemia considerably above 8°C) and with annual mean precipitation mostly between 550-650 mm. Higher parts of the oak woodland belt, between 400-500 m in W and S Bohemia, and 260-300 m in Central and E Bohemia.

The *Vaccinio-Quercetum* is the edaphic climax in nutrient-poor, strongly acidic soils (typical or arenic types of oligotrophic cambisols). These light soils are a product of weathering of mineral-poor substrates (acid sandstones, arcosas, conglomerates, and Tertiary or Quaternary sands and sand-gravels).

Distribution: PND - 3.3%. Large areas in Plzeňská pahorkatina and Ralská pahorkatina Hills. Small areas also in the Chebská pánev and Třeboňská pánev Basins and in the Třebechovická tabule Plain. Also assumed to occur in the Šumava Foothills, in lower parts of the Český les Mts. and in some other areas influenced by the subcontinental climate (Fig.29/38).

Land use: Plantations of *Pinus sylvestris* prevail and natural pine-oak stands survive only as remnants. *Picea abies*, if cultivated in pure stands, is of only low quality, apart from moist habitats. Much of the area deforested and used for agriculture, mostly rye, potatoes and oats, sometimes rape and alfalfa. The cultivation of maize is unprofitable. Part of the area covered by pastures.

The *Vaccinio-Quercetum* was formerly a widespread unit now largerly replaced by pure pine stands of low productivity. Oaks often regenerate in these stands (especially in the Třeboňská pánev Basin) and sometimes they are also planted. Natural stands protect the soil from erosion.

Rare and endangered syntaxa: *Vaccinio vitis-idaeae-Quercetum*, on arable land *Scleranthion annui*.

Rare and endangered taxa: *Arnica montana*, *Trientalis europaea*, on arable land *Arnoseris minima*, *Teesdalia nudicaulis*, in sandy habitats *Pulsatilla vernalis*, *Spergula morisonii*.

References: Neuhäusl et Neuhäuslová-Novotná (1967).

Typical relevé: Neuhäusl et Neuhäuslová-Novotná (1967): Tab. 3, rel. 8 (= Mikyška 1965 ms., rel. 131), Východočeská tabule Plain. Dominance E3-E0 not mentioned.

E3 - 3: *Pinus sylvestris*, *Quercus petraea*,

E2 - 2: *Quercus petraea*, 1: *Frangula alnus*, +: *Fagus sylvatica*, *Picea abies*, *Pinus sylvestris*, *Sorbus aucuparia*,

E1 - 4: *Vaccinium myrtillus*, 2: *Melampyrum pratense*, *Vaccinium vitis-idaea*, 1: *Convallaria majalis*, *Festuca ovina*, *Luzula pilosa*, *Deschampsia flexuosa*, r: *Calamagrostis epigejos*,

E0 - 3: *Pleurozium schreberi*, 2: *Dicranum polysetum*, 1: *D. scoparium*, +: *Leucobryum glaucum*.

Invas., expans.: In W Bohemia in clearings *Holcus mollis*, *Rubus idaeus*, and in woodland *Deschampsia flexuosa*, or *Vaccinium myrtillus*.

39. Pine-oak woodland with *Festuca ovina* (*Festuco ovinae-Quercetum roboris* F. Šmarda 1961)

Synonyms: *Quercetum roboris-Festucetum ovinae* F. Šmarda 1961, non Mráz 1963, *Pino-Quercetum* auct. bohem. p.p.

Structure: Open pine-oak woodland on blown sands and sandy terraces of rivers in warm regions of Bohemia and Moravia. *Pinus sylvestris* and *Quercus robur* are characteristic in the tree layer in which *Quercus petraea* and isolated trees of *Betula pendula* also occur. The shrub layer consists of canopy saplings and has a high cover e.g. in pine plantations. Field layer dominated by non-nutrient-demanding species (*Festuca ovina*, *Hypericum perforatum*, *Agrostis vinealis*, *A. capillaris*, *Anthoxanthum odoratum*, *Cerastium arvense*, *Deschampsia flexuosa*, *Carex pilulifera*, *Rumex acetosella*). *Vaccinium* species, *Luzula luzuloides*, *Convallaria majalis*, *Pteridium aquilinum*, *Nardus stricta*, common in other acidophilous oak woods, are rare. Presence of species of open sandy habitats (*Festuca psammophila*, *F. vaginata*, *Corynephorus canescens*, *Armeria vulgaris*) and species of the *Festuco-Brometea* (*Teucrium chamaedrys*, *Anthericum ramosum*, *Carex humilis*, *Euphorbia cyparissias*). Grasses, e.g. *Festuca ovina* and, less frequently, *Poa angustifolia* prevails in the field layer. Dense ground layer (*Pleurozium schreberi*, *Ceratodon purpureus*, *Cladonia* sp. div., *Dicranum polysetum*, *Leucobryum glaucum* etc.) developed in many stands.

Diagn.: Diff.: E2 - *Pinus sylvestris*, E1 - *Corynephorus canescens*, *Agrostis vinealis*, *Thymus serpyllum*, *Anthericum ramosum*, *Trifolium alpestre*, *Pseudolysimachion spicatum*, *Armeria vulgaris*, in Moravia also *Dianthus pontederae* and *Achillea collina*.

Species with high constancy: E3 - *Pinus sylvestris*, *Quercus robur*, *Q. petraea*, E1 - *Agrostis vinealis*, *A. capillaris*, *Anthoxanthum odoratum*, *Calamagrostis epigejos*, *Euphorbia cyparissias*, *Festuca ovina*, *F. rubra*, *Hieracium pilosella*, *Hypericum perforatum*, *Rumex acetosella*, *Poa angustifolia*, *Veronica officinalis*, in Bohemia also *Deschampsia flexuosa*, in Moravia *Achillea collina*, *Carex montana*.

Differences: From the *Luzulo-Quercetum*, occurrence of species of sandy biotopes and more or less absence of *Luzula luzuloides*, *Calamagrostis arundinacea*, *Anemone nemorosa*, shrubs of *Sorbus aucuparia* and species of the *Fagetalia* and *Querco-Fagetea*. From the *Vaccinio-Quercetum*, absence or very low presence of *Vaccinium vitis-idaea*, *V. myrtillus* and *Trientalis europaea* and the low regeneration of spruce.

Adjoining PNV: Fen peats (*Caricion davallianae*), alluvial woodlands of lower levels (*Querco-Ulmetum*, *Prunо-Fraxinetum*, *Fraxino pannonicae-Ulmetum*), hornbeam-oak and lime-oak woodland (*Tilio-Betuletum*, *Melampyro nemorosi-Carpinetum*, *Primulo veris-Carpinetum*), thermophilous oak woodland (*Carici fritschii-Quercetum*).

Habitat: W4. Lowlands (180-230 m) in the warm climatic region with mean annual temperature >8°C and total annual rainfall between 500-600 mm. Most common on the edge of river terraces on accumulations of blown sand over sand-gravel deposits. Nutrient-poor, acidic to very acidic arenic cambisols, sometimes moderately lime-rich.

Distribution: PND - 0.4%. Lower parts of the Česká tabule Plain (Elbe Valley) from Pardubice to Terezín and in the Dolnomoravský úval Valley in the Doubrava wood near Hodonín (Fig. 29/39).

Land use: Mostly plantations of *Pinus sylvestris*, *P. strobus*, *Quercus rubra*, *Robinia pseudacacia* but oak also grows well in these habitats, even as an admixture in pine cultures. Its former abundance can be deduced from rare natural stands and historical data. Deforested plots mostly used as arable land (early potatoes). Extreme habitats colonized by surviving remnants of open sandy grassland.

Natural or near-natural stands of the *Festuco-Quercetum* sparse and fragmentary. Community endangered by human impact (replacement by coniferous plantations) and faces imminent extinction. The productivity of the natural stands is low. Their importance consists in their value as a refuge for many taxa and communities associated with sandy habitats which have a high value for nature conservation. The sand communities survive in ecotones such as forest margins, open patches and glades along forest ways, whereas they disappear rapidly in the open agricultural landscape. Many of these taxa can be used for the colonization and stabilization of sandy sites. The *Festuco-Quercetum* also stabilizes sandy soils. The stands contribute to the amelioration of the dry climate, especially in deforested parts of S Moravia.

(Near-)natural stands: Středolabská tabule Plain - Southern margin of wooded area North of Stará Boleslav town, Dolnomoravský úval Valley - Doubrava wood near Hodonín.

Rare and endangered syntaxa: *Festuco ovinae-Quercetum roboris*, on blown sands *Thymo angustifolii-Corynephoretum canescentis*, *Erysimo diffusi-Festucetum ovinae*, *Jurineo cyanoidis-Koelerietum glaucae*, *Airetum praecocis*.

Rare and endangered taxa: *Agrostis vinealis*, *Aira caryophyllea*, *A. praecox*, *Alyssum montanum* subsp. *gmelinii*, *Androsace septentrionalis*, *Armeria vulgaris*, *Astragalus arenarius*, *Carex pseudobrizoides*, *C. stenophylla*, *C. praecox* subsp. *velenovskyi*, *Corynephorus canescens*, *Equisetum ramosissimum*, *E. variegatum*, *E.* x *moorei*, *E.* x *meridionalis*, *Euphorbia seguieriana*, *Hierochloe odorata*, *Chondrilla juncea*, *Koeleria glauca*, *K. macrantha* subsp. *jiraseki*, *Logfia minima*, *Scirpoides holoschoenus*, *Silene otites*, *Spergula morisonii*, *Thymus serpyllum*, *Vulpia myuros*, *Verbascum phoeniceum*, in Moravia also *Carex supina*, *C. ericetorum*, *Dianthus pontederae*, *Helichrysum arenarium*, *Iris variegata*, *Stipa borysthenica*, *S. pulcherrima*, in Bohemia *Gypsophila fastigiata*, *Teesdalia nudicaulis*, in deforested areas *Jurinea cyanoides* and Czech endemic *Dianthus arenarius* subsp. *bohemicus*.

References: Šmarda F. (1961).

Typical relevé and synthetic table: Sádlo (1996 ms.): Středočeská tabule Plain - near railway bridge on the road between Stará Boleslav town and Otradovice village, 400 m², plain. E3 -

65%, E2 - 5%, E1 - 55%, E0 - 1%.

E3 - 3: *Quercus robur*, *Pinus sylvestris*, 1: *Quercus petraea*, E2 - 1: *Quercus robur*, +: *Q. petraea*, *Pinus sylvestris*,

E1 - 3: *Festuca ovina*, 1: *Anthoxanthum odoratum*, *Carex humilis*, *Festuca rubra*, +: *Agrostis capillaris*, *A. vinealis*, *Deschampsia flexuosa*, *Festuca psammophila*, *Fragaria vesca*, *Hieracium pilosella*, *Poa angustifolia*, *Pseudolysimachion spicatum*, *Sieglingia decumbens*, *Quercus* sp., *Veronica officinalis*, r: *Campanula rotundifolia*, *Carex caryophyllea*, *Dactylis glomerata*, *Galium verum*, *Hieracium murorum*, *H. umbellatum*, *Hypericum perforatum*, *Impatiens parviflora*, *Moehringia trinervia*, *Rosa canina*, *Rumex acetosella*, *Sorbus aucuparia* juv., *Viola canina*,

E0 - +: *Pleurozium schreberi*, *Polytrichum formosum*.

Šmarda F. (1961): 29-30, synthesis of 6 rel. in % (Dolnomoravský úval Valley - Doubrava wood near Hodonín).

E3 - 100: *Quercus robur*,

E1 - 100: *Anthoxanthum odoratum*, *Festuca ovina*, *Hypericum perforatum*, 83: *Luzula campestris*, *Veronica officinalis*, 66: *Achillea collina*, *Arrhenatherum elatius*, *Anthericum ramosum*, *Carex montana*, *C. pallescens*, *Calamagrostis epigejos*, *Hieracium pilosella*, *Rumex acetosella*, 50: *Ajuga reptans*, *Campanula patula*, *Carex pilulifera*, *Dianthus pontederae*, *Silene vulgaris*, *Teucrium chamaedrys*, *Trifolium alpestre*, 33: *Antennaria dioica*, *Astragalus glycyphyllos*, *Calluna vulgaris*, *Dactylis glomerata*, *Fragaria vesca*, *Galium verum*, *Genista germanica*, *Iris variegata*, *Lembotropis nigricans*, *Plantago lanceolata*, *Poa angustifolia*, *Scirpoides holoschoenus*, *Thymus serpyllum*, *Verbascum phoeniceum*, *Vicia cassubica*, *Vincetoxicum hirundinaria*, 17: *Carex hirta*, *Corynephorus canescens*, *Pteridium aquilinum*, *Viola reichenbachiana*,

E0 - 33: *Ceratodon purpureus*, *Pleurozium schreberi*.

Invas., expans.: *Arrhenatherum elatius*, *Calamagrostis epigejos*, *Padus serotina*, *Pinus strobus*, *Robinia pseudacacia*.

Basiphilous perialpine pine woodland (*Erico-Pinion* Braun-Blanquet in Braun-Blanquet, Sissingh et Vlieger 1937)

Open pine woodland (*Pinus sylvestris*) with perialpine species (*Biscutella laevigata*, *Myosotis stenophylla*, *Thesium alpinum*, *Thlaspi montanum*) and species of serpentine substrates (*Asplenium cuneifolium*, *Armeria vulgaris* subsp. *serpentini*) on magnesium-rich rankers of steep slopes at colline levels.

40. Pine woodland with *Thlaspi montanum* on serpentine substrate (*Thlaspio montani-Pinetum sylvestris* Chytrý in Chytrý et Vicherek 1996)

Structure: Open forest of *Pinus sylvestris*, in some places with artificial admixture of alien *Pinus nigra*. Shrub layer characterized by *Berberis vulgaris* and *Frangula alnus*. Field layer in some stands dominated by *Sesleria albicans*. Relict perialpine species frequent in the field layer (see above). The locality near Želivka reservoir (Central Bohemia) is famous for its local endemic *Minuartia smejkalii* and relict occurrence of arcto-alpine *Potentilla crantzii*. These relict species are accompanied by serpentinophytes *Asplenium cuneifolium* and *Armeria vulgaris* subsp. *serpentini* and species of dry grasslands (*Carex humilis*, *Dianthus carthusianorum* agg., *Dorycnium germanicum*, *Pimpinella saxifraga* agg., *Thymus praecox*).

Diagn.: Dif.: E1 - *Armeria vulgaris* subsp. *serpentini*, *Asplenium cuneifolium*, *Biscutella laevigata* (reg., Jihlava Valley), *Dorycnium germanicum* (reg., Jihlava Valley), *Genista pilosa* (reg., Jihlava Valley), *Potentilla crantzii* (reg., near the Želivka reservoir), *Senecio erucifolius* (reg., Jihlava Valley), *Sesleria albicans*, *Silene vulgaris*, *Thlaspi montanum*.

Species with high constancy: E3 - *Pinus sylvestris*, E1 - *Asplenium cuneifolium*, *Festuca ovina* agg., *Galium verum*, *Pimpinella saxifraga* agg., *Thlaspi montanum*, E0 - *Hylocomium splendens*, *Pleurozium schreberi*.

Differences: From the *Asplenio cuneifolii-Quercetum*, occurrence of less thermophilous or less xerophilous species (*Sesleria albicans*, *Biscutella laevigata*, *Galium valdepilosum*, *Thlaspi montanum*), including the mosses *Pleurozium schreberi* and *Hylocomium splendens*; on the other hand, the *Asplenio-Quercetum* is positively differentiated by the occurrence of *Quercus petraea* and some thermophilous species (*Cerasus mahaleb*, *Koeleria macrantha*, *Verbascum austriacum*, *Vincetoxicum hirundinaria*).

Adjoining PNV: *Melampyro nemorosi-Carpinetum*, *Asplenio cuneifolii-Quercetum petraeae*, *Luzulo albidae-Quercetum petraeae*.

Habitat: MW10. Colline levels (280-400 m), as a rule on steep slopes of 25-450. In warmer areas of the Jihlava Valley it is confined to north-facing slopes, whereas in the cooler area of the Želivka reservoir it is found on slopes of all aspects. The bedrock is serpentine; soils are shallow to medium-deep, magnesium-rich rankers.

Distribution: Middle Jihlava Valley, SW Moravia, and near the Želivka reservoir, Central Bohemia (Fig. 29/40).

Land use: This unit represents a protective woodland, most stands of which have been preserved. Some are casually grazed, on deforested areas covered with poor pastures. Biotope of many endangered, mostly relict, species incl. endemic *Minuartia smejkalii*.

(Near-)natural stands: Jevišovická pahorkatina Hills - NR Dukovanský mlýn; Křemešnická vrchovina Uplands.

Rare and endangered syntaxa: *Thlaspio montani-Pinetum sylvestris*, from non-forest vegetation *Asplenion serpentini* communities, *Asplenio cuneifolii-Seslerietum calcariae*.

Rare and endangered taxa: *Armeria vulgaris* subsp. *serpentini*, *Asplenium viride*, *Biscutella laevigata*, *Minuartia smejkalii*, *Myosotis stenophylla*, *Potentilla crantzii*, *Thesium alpinum*, *Thlaspi montanum*.

References: Chytrý et Vicherek (1996).

Typical relevé: Chytrý et Vicherek (1996): Tab. 19, rel. 5 (Jevišovická pahorkatina Hills), 300 m, NNE, 45°, E3 - 60%, E2 - 5%, E1 - 90%, E0 - 50%.

E3 - 4: *Pinus sylvestris*, epiphyte - +: *Viscum laxum*,

E2 - 1: *Frangula alnus*, +: *Berberis vulgaris*,

E1 - 5: *Sesleria albicans*, 1: *Biscutella laevigata*, *Thlaspi montanum*, +: *Allium senescens* subsp. *montanum*, *Anthericum ramosum*, *Armeria vulgaris* subsp. *serpentini*, *Asperula cynanchica*, *Asplenium cuneifolium*, *Avenula pratensis*, *Carex humilis*, *Dianthus carthusianorum* agg., *Dorycnium germanicum*, *Festuca ovina* agg., *Galium valdepilosum*, *Genista pilosa*, *Hieracium murorum*, *Hypericum montanum*, *Melica nutans*, *Pimpinella saxifraga* agg., *Potentilla arenaria*, *Rubus idaeus* juv., *Senecio viscosus*, *Silene vulgaris*, *Sorbus aucuparia* juv., *Teucrium chamaedrys*, *Thymus praecox*, *Viola hirta*, r: *Carduus nutans*, *Polygonatum odoratum*, *Senecio erucifolius*,

E0 - 2: *Hylocomium splendens*, *Pleurozium schreberi*, 1: *Dicranum polysetum*, *Hypnum cupressiforme*, *Polytrichum juniperinum*, +: *Dicranum scoparium*.

Invas., expans.: *Impatiens parviflora* (rarely).

Acidophilous pine woodland (*Dicrano-Pinion* [Libbert 1933] Matuszkiewicz 1962)

Relict rocky pine woodlands (*Pinus sylvestris*) on dystrophic rankers or humus-podsols, and pine woodlands on oligotrophic soils of sands and sandy terraces.

41. (Sub)montane spruce-pine and spruce woodland on stony substrates (*Betulo carpaticae-Pinetum* Mikyška 1970, *Anastrepto-Piceetum* Stöcker 1967)

Synonyms: *Pinetum hercynicum* Mikyška 1964 p.p., *Vaccinio myrtilli-Piceetum* (Szafer, Pawlowski et Kulczynski 1923) Sofron 1981 p.p., *Anastrepto-Piceetum* Stöcker 1967 incl. *Betulo carpaticae-Piceetum* Stöcker 1967 p.p.

Structure: Three-layered communities of (sub)montane spruce-pine woodland (*Betulo carpaticae-Pinetum sylvestris*) and boulder-spruce woodland (*Anastrepto-Piceetum*), in mosaics in "rock cities" in areas of sandstone pillars. The canopy of the first association very open, in the *Anastrepto-Piceetum* relatively dense. Boulder-spruce woodland dominated by *Picea abies*, *Sorbus aucuparia* very weakly admixed. In open, frequently old spruce-pine stands of bent growth form, the canopy is formed by *Pinus sylvestris* with a weak admixture of *Betula carpatica*, *Picea abies* and *Abies alba*. Dwarf shrubs (*Vaccinium myrtillus*, *V. vitis-idaea*) prevail in the field layer of both units. In boulder-spruce stands *Lycopodium annotinum* weakly admixed, in the well-developed ground layer acidophilous and hygrophilous mosses and montane *Hepaticae* are typical. In younger stages of relict pine woods on stony blocks lichens of the genus *Cladonia* frequent.

Diagn.: Dif.: E3, E2 - *Abies alba*, *Betula carpatica*, *Picea abies*, *Pinus sylvestris*, E1 - *Lycopodium annotinum*, *Trientalis europaea*, E0 - *Anastrepta orcadensis* (in the Krkonoše Mts. only), *Cetraria islandica*, *Cladonia alpestris*, *C. rangiferina*, *Mylia taylorii*, *Ptilidium ciliare*.

Species with high constancy: E3 - *Pinus sylvestris*, *Picea abies*, E1 - *Calamagrostis villosa*, *Calluna vulgaris*, *Deschampsia flexuosa*, *Vaccinium myrtillus*, *V. vitis-idaea*.

Differences: From the climax *Calamagrostio villosae-Piceetum*, absence of *Homogyne alpina*, *Luzula sylvatica*, *Streptopus amplexifolius* (*Anastrepto-Piceetum*); from relict pine woodlands at lower levels (unit 42) occurrence of *Picea abies* and *Betula carpatica* in the canopy and many hygrophilous mosses and *Hepaticae* in the ground layer.

Adjoining PNV: In montane valley inversion sites montane pine woods adjoin the *Deschampsio flexuosae-Abietetum*, boulder-spruce woods at higher levels - *Calamagrostio villosae-Piceetum*, in the Broumov area - *Luzulo-Fagetum*, *Dentario enneaphylli-Fagetum*.

Habitat: C7, C2. Both associations (*Betulo carpaticae-Pinetum*, *Anastrepto-Piceetum*) are permanent communities on stony blocks or screes in valleys influenced by climatic inversions, at levels of natural occurrence of spruce. In the so-called "rock cities" relict spruce-pine stands associated with the upper parts of slopes or the summits of rock pillars, while spruce stands cover disintegrating blocks at the bases of the pillars. The soils are mostly dystrophic rankers, more developed soils form transitions to humic or (in wetter facies) gleyic podsols.

Distribution: Sandstone area of "rock cities" in NE Bohemia (Broumovská vrchovina Uplands - NNR Broumovské stěny and NNR Adršpašsko-Teplické skály). The *Anastrepto-Piceetum* occurs also in the Krkonoše Mts. (Fig. 29/41).

Land use: The areas not used economically, economic value being slight. Only local penetration of *Pinus sylvestris* and *Picea abies* of unsuitable provenance.

These communities play an important role in protection against erosion. Natural and near-natural stands in "rock cities" are protected in national nature reserves (very rare and specific vegetation).

(Near-)natural stands: NNR Broumovské stěny, NNR Adršpašsko-Teplické skály.

Rare and endangered syntaxa: *Betulo carpaticae-Pinetum*, *Anastrepto-Piceetum*.

Rare and endangered taxa: *Betula carpatica*, *Anastrepta orcadensis*, *Cladonia alpestris*.

References: Hilitzer (1932), Jirásek (1996a), Mikyška (1964, 1970), Sýkora et Hadač (1984), Vacek et Podrázský (1996).

Typical relevés: *Betulo carpaticae-Pinetum* var. *Vaccinium myrtillus*

Mikyška (1970): Tab. 1, p. 132-133, rel. 4 (Broumovská vrchovina Uplands - Töpferberg), 520 m, SW, 3°.

E3 - 3: *Pinus sylvestris*, 2: *Betula carpatica*,

E2 - 2: *Pinus sylvestris*, 1: *Betula carpatica*, *B. pendula*, *Quercus petraea*,

E1 - 4: *Vaccinium myrtillus*, 3: *V. vitis-idaea*, 2: *Calluna vulgaris*, 1: *Deschampsia flexuosa*, +: *Betula pendula*,

E0 - 2: *Cladonia rangiferina*, *Leucobryum glaucum*, 1: *Dicranella heteromalla*, *Dicranum polysetum*, *D. scoparium*, *Pleurozium schreberi*, +: *Pohlia nutans*, *Scleroderma aurantium*.

Anastrepto-Piceetum

Jirásek (1996a): Tab. 2, p. 237-238, rel. 6 (= Stöcker 1968, Tab. 1, rel. 23 - Krkonoše Mts.), 1060 m, ENE, 33°, E3 - E0 - dominance not mentioned.

E3 - 5: *Picea abies*, E1 - 3: *Vaccinium myrtillus*, 2: *Vaccinium vitis-idaea*, 1: *Deschampsia flexuosa*, *Dryopteris dilatata*, *Lycopodium annotinum*, +: *Homogyne alpina*, *Picea abies*, *Sorbus aucuparia*,

E0 - 2: *Dicranum scoparium*, *Pleurozium schreberi*, *Ptilidium ciliare*, *Polytrichum formosum*, *Sphagnum nemoreum*, 1: *Anastrepta orcadensis*, *Barbilophozia lycopodiodes*, *Bazzania trilobata*, *Dicranodontium denudatum*, *Hylocomium splendens*, *Lophozia ventricosa*, *Sphagnum girgensohnii*, *S. robustum*, +: *Barbilophozia gracilis*, *Blepharostoma trichophyllum*, *Brachythecium starkei*, *Calypogeia neesiana*, *Cephalozia bicuspidata*, *Cladonia bacillaris*, *C. digitata*, *C. furcata*, *Dicranum fuscescens*, *Mylia taylorii*, *Plagiothecium denticulatum*, *Rhytidiadelphus triquetrus*.

Invas., expans.: *Pinus strobus* (strong invasion).

42. Other acidophilous pine woodlands (*Dicrano-Pinion* [Libbert] Matuszkiewicz 1962 excl. *Betulo carpaticae-Pinetum* Mikyška 1970, *Vaccinio uliginosi-Pinetum sylvestris* Kleist 1929)

Synonyms: *Pinion medioeuropaeum* Libbert 1933 p.p., *Pleurozio-Pinion* Passarge et Hofmann 1968 p.p., *Eu-Cladonio-Pinion* Passarge in Passarge et Hofmann 1968 p.p., *Vaccinio-Pinion* Passarge in Passarge et Hofmann 1968 p.p.

Structure: This unit includes other relict pine woodlands on siliceous rocks (excl. associations mentioned above) and those of oligotrophic sands and sand terraces.

Dwarf shrub-rich pine stands with well-developed field and ground layers on poor siliceous rocks are represented by *Dicrano-Pinetum* Passarge 1956, with a specific variant with *Erica herbacea*, relict lichen-rich pine stands by *Cladonio rangiferinae-Pinetum*

sylvestris Kobendza 1930 em. Passarge 1956. The *Hieracio pallidi-Pinetum* Stöcker 1965 and *Cardaminopsio petraeae-Pinetum* Hübl et Holzner 1977 represent a xerophilous variant, *Asplenio cuneifolii-Pinetum sylvestris* Pišta 1982 is a pine woodland on serpentine substrate.

Natural pine stands on blown sands have been destroyed and replaced by plantations, with psammophilous species *Corynephorus canescens*, *Spergula morisonii*, *Festuca psammophila*, *Teesdalia nudicaulis*, *Jurinea cyanoides*.

Canopy of open natural pine woodlands dominated by *Pinus sylvestris*. Stands on shallow rankers on rocks are low, krummholz-like. On sandy terraces in warmer sites *Quercus petraea* very rarely admixed. In colder and moister sites in areas of sandstone "rock cities" *Fagus sylvatica* rare. In mesoclimatically suitable habitats *Abies alba* admixed. Shrub layer only weakly developed, dominated by regenerating pine, with a rare admixture of *Betula pendula* and *Frangula alnus*.

In the field layer dwarf shrubs frequently prevail (*Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, in W Bohemia also *Erica herbacea*). In lichen-rich pine stands field layer very reduced, species-rich ground layer with *Cladonia* species well-developed. Pine woodlands on serpentine substrate characterized by *Asplenium cuneifolium*, *A. adulterinum*, *Cerastium alsinifolium*. For subxerophilous pine stands on rocks of moderately mineral-rich siliceous substrates (*Hieracio pallidi-Pinetum*, *Cardaminopsio petraeae-Pinetum*) thermophilous species of rock communities (*Hieracium pallidum*, *Festuca pallens*, *Anthericum ramosum*, *Aurinia saxatilis*, *Galium pumilum*, *Genista pilosa*) are typical.

Ground layer of acidophilous pine stands formed by non nutrient-demanding species *Dicranum scoparium*, *D. polysetum*, *Leucobryum glaucum*, *Pleurozium schreberi*, *Hypnum cupressiforme*. *Dicranum spurium* differentiates pine stands in areas more or less influenced by subatlantic climate. In the lichen-rich pine stands *Cladonia* species frequent, on rocks also *Parmelia* species.

Diagn.: Diff.: E1 - *Anthericum ramosum*, loc. *Arctostaphylos uva-ursi*, *Asplenium cuneifolium*, *A. adulterinum*, *Aurinia saxatilis*, *Calluna vulgaris*, *Cerastium alsinifolium*, *Dianthus carthusianorum*, *Erica herbacea*, *Festuca pallens*, *Genista pilosa*, *Hieracium pallidum*, *H. cymosum*, *Trientalis europaea*, *Vaccinium myrtillus*, *V. vitis-idaea*, E0 - *Cladonia rangiferina*, *C. portentosa*, *C. arbuscula*, *Dicranum polysetum*, *D. spurium*, *Polytrichum commune*, *Ptilidium ciliare*.

Species with high constancy: E3, E2 - *Pinus sylvestris*, E1 - *Deschampsia flexuosa*, *Festuca ovina*, *Hieracium murorum*, *H. pilosella*, *Rumex acetosella*, E0 - *Cladonia furcata*, *C. chlorophaea*, *C. gracilis*, *Coelocaulon aculeatum*, *Dicranum scoparium*, *Leucobryum glaucum*, *Parmelia conspersa*, *P. taractica*, *P. saxatilis*, *Pleurozium schreberi*, *Polytrichum piliferum*.

Differences: From the *Calamagrostio-Piceetum*, absence of *Homogyne alpina*, *Luzula sylvatica*, *Streptopus amplexifolius*; from the foregoing montane pine woods, absence of *Picea abies* and *Betula carpatica* in the canopy. Many hygrophilous mosses and liverworts also missing.

Adjoining PNV: *Sorbo torminalis-Quercetum*, *Luzulo albidae-Quercetum petraeae*, *Abieti-Quercetum*, *Deschampsio flexuosae-Abietetum*, *Luzulo-Fagetum*.

Habitat: MW5. Communities covering small areas in extreme habitats, forming blocked successional stages on rocks with shallow ranker soils, and paraclimax on sand dunes and terraces.

Natural stands of the *Dicrano-Pinetum* associated with shallow, poor cambisols (cambisols arenic, cambisols dystric) on siliceous substrates, formed mostly on sandy sediments and gravel terraces, or with oligotrophic to dystrophic rankers on granite substrates or sandstone pillars. The lichen-rich *Cladonio-Pinetum* is a permanent, orographically and edaphically conditioned community on specific habitats in the area of broadleaved woodlands. Its occurrence is concentrated on outcrops of disintegrating mineral-poor substrates on upper parts of slopes in inversion valleys, between 300-500 m. The *Asplenio cuneifolii-Pinetum* is a community of serpentine substrates with a high Magnesium content. The sub-xerophilous *Hieracio pallidi-Pinetum* is linked with rock substrates of dysgeogenous, moderately mineral-rich eruptive or metamorphic rocks (basalts, spilites, palaeorhyolites), rarely with rocks of the Central Bohemian granite massif. Soils are shallow grey rankers. The *Cardaminopsio petraeae-Pinetum* covers summits of granulite or gneiss rocks with shallow rankers in some deeply cut valleys in SW Moravia.

Distribution: In Bohemia, rarely on rocks in some river valleys (Central Vltava, lower reaches of the Otava, Mže, Berounka rivers and their tributories), in sandstone areas of "rock cities" (NNP Broumovské stěny, Hradčanské stěny, Maštale near Proseč), on sand terraces in the Elbe and Orlice valleys, on serpentines of the Slavkovský les Mts. In Moravia, subxerophilous relict pine woodlands occur in river valleys on the SE border of the Bohemian Massif (Fig. 29/42).

Land use: Some habitats of natural pine woodlands planted with *Pinus sylvestris* (sand terraces or borders of drained mires).

Pine woodlands of this unit serve as protection woodlands. They help to stabilize habitats exposed to erosion. Most pine stands on serpentine (*Asplenio cuneifolii-Pinetum*) are protected in nature reserves or landscape protected areas.

(Near-)natural stands: *Dicrano-Pinetum*: Česká tabule Plain - NR Maštale near Proseč, *Cladonio rangiferinae-Pinetum*: Kralovická pahorkatina Hills, Křivoklátská vrchovina Uplands, *Hieracio pallidi-Pinetum*: in the same place, *Cardaminopsio petraeae-Pinetum*: Jevišovická pahorkatina Hills.

References: Hejtmánek (1954), Hilitzer (1932b), Holovský et Holubičková (1957), Husová et Andresová (1992), Chytrý et Vicherek (1995, 1996), Knapp et Böhnert (1978), Kolbek et Petříček (1985), Mikyška (1968, 1972), Neuhäusl et Neuhäuslová-Novotná (1972b), Nevečeřal (1995), Pišta (1982).

Typical relevés:

Dicrano-Pinetum Mikyška (1968 sub *Leucobryo-Pinetum vaccinietosum vitis-idaeae*): Tab. XII, p. 107, rel. 141 (Orlická tabule Plain), 300 m, SW, 1-2°.

E3 - 3: *Pinus sylvestris*, E2 - 1: *Pinus sylvestris*,

E1 - 3: *Vaccinium vitis-idaea*, 1: *Vaccinium myrtillus*,

E0 - 3: *Pleurozium schreberi*, 2: *Dicranum polysetum*, 1: *Leucobryum glaucum*, *Dicranum scoparium*, *D. spurium*, *Pseudoscleropodium purum*.

Asplenio cuneifolii-Pinetum

Pišta (1982): Tab. 14, rel. 157 (Šumava Foothills - Křemžská kotlina Basin), 720 m, N, 10°, E3 - 60%, E2 - 50%, E1 - 60%, E0 - 40%.

E3 - 50%: *Pinus sylvestris*,

E2 - 50%: *Juniperus communis*,

E1 - 2: *Calluna vulgaris*, *Festuca ovina*, *Vaccinium myrtillus*, *V. vitis-idaea*, 1: *Silene vulgaris*, +: *Agrostis*

capillaris, *Asplenium cuneifolium*, *Deschampsia flexuosa*, *Molinia caerulea*, r: *Orthilia secunda*,

E0 - 3: *Cladonia rangiferina*, 1: *Cetraria islandica*, *Cladonia arbuscula*, *Dicranum polysetum*, +: *Hylocomium splendens*, *Leucobryum glaucum*, *Rhytidiadelphus triquetrus*.

Climatic and waterlogged spruce woodland (*Piceion excelsae* Pawłowski in Pawłowski, Sokolowski et Wallisch 1928)

Natural spruce woodland with a predominance of dwarf shrubs or grasses and with a species-rich ground layer dominated by mosses on podsols and podsol cambisols of siliceous substrates at supramontane levels, and edaphically determined moss- and *Sphagnum*-rich spruce forests on stagnogleys, gley podsols and peaty gleys in waterlogged depressions, mostly at submontane to montane levels. PND - 1.2%.

43. Spruce woodland with *Calamagrostis villosa* (*Calamagrostio villosae-Piceetum* Hartmann in Hartmann et Jahn 1967)

Synonyms: *Piceetum excelsae* Pawłowski in Pawłowski, Sokolowski et Wallisch 1928, *Lophozio-Piceetum* Volk 1939, *Vaccinio myrtilli-Piceetum* (Szafer, Pawłowski et Kulczynski 1923) Sofron 1981.

Structure: Three-layered stands with pronounced predominance of *Picea abies* in the canopy, frequent admixture of *Sorbus aucuparia*, at lower levels also with *Fagus sylvatica* and *Abies alba*. Adjacent to the subalpine belt the spruce woodland is open and low or spruce forms single groups only. Shrub layer poorly developed, formed by regenerating species of the canopy. Species-poor field layer dominated by *Calamagrostis villosa*, on shallow stony soils *Vaccinium myrtillus*, in the lower sub-layer *Deschampsia flexuosa* with *Homogyne alpina* and *Trientalis europaea*. Sometimes *Luzula sylvatica*, *Dryopteris dilatata*, *Oxalis acetosella* or *Galium saxatile* occur as subdominants. Species-rich ground layer with prevailing *Polytrichum formosum* or *Dicranum scoparium*, abundant *Sphagnum girgensohnii*, *Plagiothecium undulatum*, *Barbilophozia* sp. div., *Rhytidiadelphus triquetrus*.

Diagn.: Dif.: E3 - *Picea abies*, E1 - *Calamagrostis villosa*, *Homogyne alpina*, *Luzula sylvatica*.

Species with high constancy: E3 - *Picea abies*, E1 - *Sorbus aucuparia*, *Deschampsia flexuosa*, *Dryopteris dilatata*, *Oxalis acetosella*, *Trientalis europaea*, *Vaccinium myrtillus*, E0 - *Dicranum scoparium*, *Polytrichum formosum*, *Sphagnum girgensohnii*.

Differences: From *Calamagrostio villosae-Fagetum*, low proportion of beech and silver fir in the canopy and occurrence of spruce-accompanying species *Homogyne alpina*, *Trientalis europaea*, *Luzula sylvatica* and *Sphagnum girgensohnii*. In the *Mastigobryo-Piceetum* retreat of *Calamagrostis villosa*, *Oxalis acetosella*, *Dryopteris dilatata* and, in contrast, a dense ground layer with frequent *Sphagna* and a regular occurrence of *Bazzania trilobata*.

Adjoining PNV: Waterlogged and fern-rich spruce woodlands (*Mastigobryo-Piceetum*, *Sphagno-Piceetum*, *Athyrio alpestris-Piceetum*), montane acidophilous woodlands (*Calamagrostio villosae-Fagetum*, *Aceri-Fagetum*, *Dentario enneaphylli-Fagetum*), further *Myrtillo-Pinetum mughi*, subalpine grassland (*Calamagrostion villosae*).

Habitat: C4, C6. Climatic spruce woodland of (supra)montane levels (between 950 m in the Krušné hory Mts., mostly 1100-1350 m in the Krkonoše Mts.) on summits and moderate, convex slopes (up to 25°) of various aspect. These spruce forests frequently form the upper timberline.

The soils are montane humus-rich (typical) and cambisol podsols on siliceous substrates, frequently rich in gravel or stones, on exposed habitats - rankers.

Distribution: PND - 0.4%. Higher, principally border mountains of the Republic (Šumava, Krušné and Jizerské hory, Krkonoše, Orlické hory, Králický Sněžník, Rychlebské hory, Hrubý Jeseník, Moravskoslezské Beskydy Mts. (Fig. 29/43).

Land use: Near-natural spruce forests used as economic forests, frequently replaced by pure spruce plantations. Near the timberline of no economic value. Sometimes stands cut and the deforested areas used as meadows or pastures (*Nardion*), sometimes for recreational purposes (ski pistes).

Strongly endangered, principally by immissions and insect attacts. Over large areas of our border mountains (principally in the E part of the Krušné hory, Krkonoše, Jizerské, Lužické and Orlické hory, at present also in the Šumava Mts.) totally destroyed.

(Near-)natural stands: Šumava and Krkonoše National Parks, PLA Jeseníky and Beskydy, NNR Králický Sněžník.

Rare and endangered syntaxa: *Calamagrostio villosae-Piceetum* (in areas damaged by immissions), *Dryopterido dilatatae-Piceetum*, *Anastrepto-Piceetum*.

Rare and endangered taxa: *Blechnum spicant*, *Gentiana asclepiadea*, *Huperzia selago*, *Lycopodium annotinum*, rarely *Listera cordata*, *Veratrum lobelianum*.

References: Bednář et Pěnčíková (1985), Hartmann et Jahn (1967), Jirásek (1995, 1996a), Krahulec (1979), Pišta (1975), Sofron (1981), Sýkora (1971), Vacek (1984).

Typical relevé: Jirásek (1996a): Tab.1, rel. 1 (NNR Králický Sněžník), 1335 m, S, 5°, 100 m², E3- 40%, E1- 60%, E0- 35%.

E3 - 3: *Picea abies*,

E1 - 3: *Deschampsia flexuosa*, 2: *Calamagrostis villosa*, *Vaccinium myrtillus*, 1: *Trientalis europaea*, +: *Athyrium distentifolium*, *Dryopteris dilatata*, r: *Homogyne alpina*, *Vaccinium vitis-idaea*,

E0 - 3: *Polytrichum formosum*, 1: *Dicranum scoparium*.

Invas., expans.: *Calamagrostis villosa* and *C. arundinacea* in stands damaged by immissions.

44. Waterlogged spruce woodland with *Bazzania trilobata* (*Mastigobryo-Piceetum* Br.-Bl. et Sissingh in Braun-Blanquet, Sissingh et Vlieger 1939), partly in complex with *Sphagnum*-rich spruce woodland (*Sphagno-Piceetum* [Tüxen 1937] Hartmann 1953)

Synonyms: *Soldanello-Piceetum* Volk 1939 p.p, *Calamagrostio villosae-Piceetum sphagnetosum* Hartmann et Jahn 1967 p.p., *Molinio-Piceetum* Sýkora 1971.

Structure: In the *Mastigobryo-Piceetum*, canopy formed by *Picea abies* with high, straight stems, only locally (in contact with *Sphagno-Piceetum*) of lower growth. The extreme concentration of spruce roots in the upper soil layers causes frequent wind throw. *Sorbus aucuparia* admixed rarely at lower levels, sometimes also with *Pinus sylvestris*, *Abies alba* and *Betula pubescens*. Shrub layer formed from regenerating spruce.

Field layer open and species-poor (dominance around 50%, but frequently < 10%). *Vaccinium myrtillus* is constant and dominant. *Deschampsia flexuosa* and *Vaccinium vitis-idaea* are constant, *Calamagrostis villosa* less frequent. Species of montane spruce forest (*Trientalis europaea*, *Homogyne alpina*, *Lycopodium annotinum*, *Soldanella montana*, *Listera cordata*) occur sporadically.

Ground layer very well-developed with a constant occurrence of *Bazzania trilobata*, mostly covering the above-ground part of tree roots and rotting stumps. Frequently *Sphagnum* species prevail (mostly *Sphagnum girgensohnii*) and *Polytrichum commune*, *P. formosum*, *Dicranum scoparium* and the liverworts *Lepidozia reptans*, *Calypogeia* sp. div., are also frequent.

Sphagnum-rich spruce forests are mostly open, formed by low trees of *Picea abies*, concentrated in small groups. Dead (spruce) trees are frequent. *Pinus rotundata* or *Betula carpatica* admixed in the canopy. *Pinus mugo* forms the shrub layer.

Open- to moderately dense field layer dominated by *Vaccinium myrtillus*, or *V. vitis-idaea*, *Deschampsia flexuosa*, *Calamagrostis villosa*, *Trientalis europaea*. Rarely, *Homogyne alpina*, *Lycopodium annotinum*, concentrated around the tree bases, occur. Peat-bog species (*Eriophorum vaginatum*, *Vaccinium uliginosum*, *Oxycoccus palustris*, less frequently *Melampyrum pratense* subsp. *paludosum*, *Drosera rotundifolia*, *Carex nigra*), in depressions *Carex rostrata*, and on relatively dry sites *Molinia caerulea*, are typical.

The ground layer exceeds 75%, dominated by *Sphagnum* species, mostly *Sphagnum fallax*, *Polytrichum commune* as subdominant.

Diagn.: *Mastigobryo-Piceetum*: E3 - *Picea abies*, E1 - *Calamagrostis villosa*, *Deschampsia flexuosa*, *Vaccinium myrtillus*, *V. vitis-idaea*, E0 - *Bazzania trilobata*, *Dicranum scoparium*, *Polytrichum commune*, *P. formosum*, *Sphagnum girgensohnii*, *Sphagnum* sp. div.

Sphagno-Piceetum: E3 - *Picea abies*, E1 - *Calamagrostis villosa*, *Carex nigra*, *Deschampsia flexuosa*, *Eriophorum vaginatum*, *Oxycoccus palustris*, *Trientalis europaea*, *Vaccinium myrtillus*, *V. uliginosum*, *V. vitis-idaea*, E0 - *Dicranum scoparium*, *Polytrichum commune*, *Sphagnum magellanicum*, *S. fallax*.

Differences: Spruce plantations at levels of *Luzulo-Fagetum* or *Calamagrostio villosae-Fagetum* differ by absence of *Sphagnum* species and *Bazzania trilobata*; those at levels of *Piceo-Alnetum* or *Arunco-Alnetum* by presence of nutrient-demanding woodland species (*Impatiens noli-tangere*, *Senecio fuchsii* etc.). Species of raised bogs (*Eriophorum vaginatum*, *Vaccinium uliginosum*, *Oxycoccus palustris* etc.) in the *Sphagno-Piceetum* differentiate this unit from all other forest vegetation.

Adjoining PNV: Spruce-beech woodland (*Calamagrostio villosae-Fagetum*), woodrush-silver fir woodland (*Luzulo pilosae-Abietetum*), climatic spruce woodland (*Calamagrostio villosae-Piceetum*), spruce-alder woodland (*Piceo-Alnetum*), at lower levels *Carici remotae-Fraxinetum*, rarely *Molinio arundinaceae-Quercetum* and peaty-pine woods (*Vaccinio uliginosi-Pinetum*).

Habitat: Mostly C, rarely MW5. *Mastigobryo-Piceetum* - mostly submontane to montane levels (600-1000 m), in the Šumava Mts. to 1200 m, sporadically also at lower levels about 500 m. Flat basins, depressions or moderate slopes, cold inversions with high precipitation and humidity. Impeded drainage is the determining factor for the existence of this community. The soils are stagnogleys, pseudogleys, gleyic podsols and waterlogged peat gleys. A thick layer of raw humus or a relatively thin peat layer can be found on the soil surface.

Sphagno-Piceetum - submontane to montane, rarely subalpine levels of higher mountains (800-1200 m). Rarely, and in an impoverished form, at lower levels c. 500 m. Mostly plains or only slightly inclined relief on the margins of raised bogs. These stands represent the most extreme habitats for spruce with regards to the moisture of the rhizosphere. The soils are organosols (peats) of various depth. The surface is characterised by hummocks and hollows. Groundwater sometimes at the soil surface, and the root system very shallow.

Distribution: PND - 0.9%. *Mastigobryo-Piceetum* - mostly border mountains in the W part of the Republic, relatively large areas in the Šumava and Krušné hory Mts., further in the Český les, Novohradské hory, Slavkovský les and Jizerské hory Mts. Sporadically in uplands and foothills of the Česká vysočina Uplands, very rarely in the Krkonoše, Hrubý Jeseník, Moravskoslezské Beskydy, Lužické and Javoří hory Mts. (Fig. 29/44).

Sphagno-Piceetum - most frequently in the Šumava and the Krušné hory Mts., further in other border mountains, very rarely in the Ždárské vrchy Hills and in the Třeboňská pánev Basin.

Land use: The levels of the *Mastigobryo-Piceetum* usually covered by spruce plantations and, especially at lower altitudes, intensively used. The stands form mostly straight stems of a high quality; at higher levels without any important economic value. Less frequently, waterlogged meadows with *Juncus effusus*, *Carex brizoides* and *Deschampsia cespitosa* can be found here. However, the agricultural use of these sites is not profitable.

Areas of the *Sphagno-Piceetum* partly covered by open spruce stands without any economic value. After cutting or dying raised bogs (*Sphagnetalia medii*) develop and (after drainage) stands with *Molinia caerulea*.

Both communities used mostly as protection forests regulating run-off. They are endangered by human activity (drainage, immissions and unsuitable forest management), as well as by wind and insect attact, and are in imminent danger of extinction. The *Sphagno-Piceetum* also damaged by peat exploitation.

(Near-)natural stands: *Mastigobryo-Piceetum*: Český les Mts. - NNR Čerchov, NR Haltrava; NP Šumava; Krušné hory Mts. - NNR Božídarské peat bog; Hrubý Jeseník Mts. - NNR Rejvíz and Peat bog Skřítek; PLA Ždárské vrchy Hills - NNR Velké Dářko; Brdy Mts. - Padrťské rybníky; Moravskoslezské Beskydy Mts. - Podolánky.

Sphagno-Piceetum: PLA Slavkovský les Mts. - NNR Kladské rašeliny; Krušné hory Mts. - NNR Božídarské rašeliniště, NNR Velké jeřábí jezero; Krkonošský NP - Černohorská rašelina peat bog; Hrubý Jeseník Mts. - NNR Rejvíz and Praděd; NNR Králický Sněžník.

Rare and endangered syntaxa: *Mastigobryo-Piceetum*, *Equiseto-Piceetum*, *Scheuchzerio-Caricetea fuscae*, *Sphagno- Piceetum*, raised bogs (*Sphagnetalia medii*).

Rare and endangered taxa: in the *Mastigobryo-Piceetum* - *Abies alba*, *Blechnum spicant*, *Circaea alpina*, *Listera cordata*, *Lycopodium annotinum*, *Soldanella montana*, in the *Sphagno-Piceetum* - *Andromeda polifolia*, *Carex pauciflora*, *C. limosa*, *Drosera rotundifolia*, *Empetrum hermaphroditum*, *Eriophorum vaginatum*, *Dactylorhiza fuchsii*, *Lycopodium annotinum*, *Oxycoccus palustris*, in Novohradské hory Mts. also *Veratrum album* subsp. *album*.

References: Bednář et Pěnčíková (1985), Holubičková (1961b), Jirásek (1995, 1996a), Kučera S. (1966), Nesvadbová, Sofron et Vondráček (1994), Pišta (1975), Sofron (1981), Sýkora (1971).

Typical relevés: *Mastigobryo-Piceetum*: Sofron (1981): Tab. 5, rel. 76 (NP Šumava), 1100 m, S, 3°, 100 m², E3- 70%, E1- 10%, E0- 60%.

E3 - 4: *Picea abies*,

E1 - 1: *Vaccinium myrtillus*, +: *Calamagrostis villosa*, *Vaccinium vitis-idaea*, r: *Picea abies*,

E0 - 3: *Sphagnum girgensohnii*, 1: *Bazzania trilobata*, *Polytrichum commune*, +: *Dicranum scoparium*, r: *Calypogeia neesiana*, *Cephalozia lunulifolia*.

Sphagno-Piceetum: Sofron (1981): Tab. 6, rel. 89 (Slavkovský les Mts.), 845 m, W, 1°, 200 m², E3 - 50%, E2 - 10%, E1 - 40%, E0 - 100%,

E3 - 3: *Picea abies*,

E2 - 1: *Picea abies*,

E1 - 2: *Vaccinium myrtillus*, 1: *Calamagrostis villosa*, *Eriophorum vaginatum*, *Melampyrum pratense*, *Oxycoccus palustris*, *Picea abies*, *Vaccinium uliginosum*, +: *Betula carpatica*, *Carex rostrata*, *Dactylorhiza fuchsii*, r: *Vaccinium vitis-idaea*,

E0 - 5: *Sphagnum fallax*, 1: *Polytrichum commune*, *Sphagnum russowii*.

Invas., expans.: In the damaged and drained *Mastigobryo-Piceetum Carex brizoides*, *Urtica dioica*, *Equisetum arvense*, *Rubus fruticosus* agg., *Calamagrostis epigejos*, *Pteridium aquilinum*. After drainage of the *Sphagno-Piceetum Molinia caerulea* begins to spread.

Remarks to mapping: This mapping unit includes the *Equiseto-Piceetum* J. Šmarda 1950, a waterlogged spruce woodland with *Abies alba* in the canopy, and, in contrast to the *Mastigobryo-Piceetum*, with some more nutrient-demanding species in the field layer: *Dryopteris dilatata*, *Oxalis acetosella*, *Luzula pilosa*, with frequent *Maianthemum bifolium* and *Equisetum sylvaticum*; frequently, it is dominated by *Calamagrostis villosa*. In the ground layer, *Sphagnum* species typical, and, in contrast, *Bazzania trilobata* less frequent. Appropriate sites in the whole Republic with exception of highest levels and warmest lowlands.

Montane to supramontane fern-rich spruce woodland (*Athyrio alpestris-Piceion* Sýkora 1971)

Fern- and species-rich spruce woodland at montane and supramontane levels, with frequent species of high-montane tall-herb communities on moist oligotrophic soils of relatively steep slopes, permanently saturated by groundwater.

45. Spruce woodland with *Athyrium distentifolium* (*Athyrio alpestris-Piceetum* [Hartmann 1959] Hartmann et Jahn 1967)

Synonyms: *Piceetum hercynicum filicetosum* Matuszkiewicz W. et Matuszkiewicz A. 1960, *Piceetum altherbosum silicicolum*, typ *Athyrium distentifolium* Sillinger 1933, *Piceetum adenostyletosum* Samek *et al.* 1957 p.p.

Structure: Three- to four-layered stands dominated by *Picea abies*, with an admixture of *Sorbus aucuparia*, near the upper timberline open and relatively low, at lower levels with admixture of *Fagus sylvatica* and *Acer pseudoplatanus*. Shrub layer formed by regenerating canopy species.

Two-layered dense field layer mostly dominated by *Athyrium distentifolium*, especially frequent in shady sites. *Calamagrostis villosa*, *Vaccinium myrtillus*, *Oxalis acetosella*, *Adenostyles alliariae*, or *Dryopteris dilatata* occur as subdominants. Species of tall-herb communities typical here (*Veratrum lobelianum*, *Rumex alpestris*, *Stellaria nemorum*, *Senecio nemorensis*, *Cicerbita alpina*, *Melandrium rubrum*, *Doronicum austriacum* etc.), those of montane spruce woods (*Homogyne alpina*, *Trientalis europaea*, *Streptopus amplexifolius*) regularly present, frequently also *Luzula sylvatica*. Species of beech woodlands (*Prenanthes purpurea*, *Phegopteris connectilis*, in the E part of the Republic also *Calamagrostis arundinacea*) are characteristic.

Ground layer only poorly developed, mostly with a cover < 10%. Besides *Polytrichum formosum*, *Dicranum scoparium*, *Rhizomnium punctatum* and *Sphagnum* species also occur more frequently.

Diagn.: Dif.: E3 - *Sorbus aucuparia*, E1 - *Athyrium distentifolium*, *Cicerbita alpina*, *Homogyne alpina*, *Luzula sylvatica*, *Rumex alpestris*, *Senecio nemorensis*, *Stellaria nemorum*, *Streptopus amplexifolius*, *Veratrum lobelianum*.

Species with high constancy: E3 - *Picea abies*, E1 - *Athyrium distentifolium*, *Calamagrostis villosa*, *Dryopteris dilatata*, *Oxalis acetosella*, *Vaccinium myrtillus*, E0 - *Polytrichum formosum*.

Differences: From the foregoing acidophilous spruce forests, higher proportion of more nutrient-demanding species of tall-herb high-montane communities (*Athyrium distentifolium*, *Rumex alpestris*, *Senecio nemorensis*, *Veratrum lobelianum*) and species of mesophilous broadleaved woodlands (*Stellaria nemorum*, *Phegopteris connectilis*, *Polygonatum verticillatum* and others).

Adjoining PNV: Montane spruce woodlands (*Dryopterido dilatatae-Piceetum*, *Calamagrostio villosae-Piceetum*), subalpine *Myrtillo-Pinetum mughi*, high-montane tall-herb communities (*Adenostyletalia*), maple and spruce beech woodlands at lower levels (*Aceri-Fagetum*, *Calamagrostio villosae-Fagetum*).

Habitat: C4. Supramontane levels (mostly 1150-1250 m), on steep, concave slopes (mostly 25-350) of various aspect, with a cold climate, high humidity, frequent fogs and deep snow cover. Relatively deep, well-aerated stony moist soils permanently saturated by groundwater bringing nutrients from upper parts of slopes (humic typical cambisol or gley podsols, dystric cambisols, or rankers). Frequently on borders of slope-spring areas.

Distribution: Most frequently in the Krkonoše, Hrubý Jeseník, Králický Sněžník and Moravskoslezské Beskydy Mts., further in the Šumava and the Jizerské hory Mts. Isolated occurrence in the Orlické, Krušné and Rychlebské hory Mts. (Fig. 29/45).

Land use: Forests mostly without any economic importance. The non-forest tall-herb, tall-grass and fern-rich communities (*Adenostylion*, *Dryopterido-Athyrion*) cover small area only.

The *Athyrio-Piceetum* very strongly endangered and in danger of extinction. Although unimportant for timber production, its other functions (soil retention, hydrological role etc.) are valuable.

(Near-)natural stands: NP Šumava Mts. - Třístoličník Mt.; Krkonošský NP - Labský důl; Hrubý Jeseník Mts. - NNR Praděd; summit of the NNR Králický Sněžník; Moravskoslezské Beskydy Mts. - Lysá hora Mt.

Rare and endangered syntaxa: *Athyrio alpestris-Piceetum*, *Adenostyletalia*.

Rare and endangered taxa: *Adenostyles alliariae*, *Cicerbita alpina*, *Doronicum austriacum*, *Gentiana asclepiadea*, *Ranunculus platanifolius*, *Rosa pendulina*, *Veratrum lobelianum*.

References: Bednář et Pěnčiková (1985), Hartmann et Jahn (1967), Jirásek (1995, 1996a), Krahulec (1979), Sedláčková (1978), Sýkora (1971), Vacek (1984).

Typical relevé: Krahulec (1979 ms.): rel. 4 (NNR Králický Sněžník), 1220 m, S, 12°, 25 m², E3 - 75%, E1 - 95%, E0 - 4%

E3 - 4: *Picea abies*, 1: *Sorbus aucuparia*,

E1 - 5: *Athyrium distentifolium*, 2: *Calamagrostis villosa*, 1: *Dryopteris dilatata*, *Luzula sylvatica*, *Oxalis acetosella*, *Rumex alpestris*, *Streptopus amplexifolius*, *Vaccinium myrtillus*, +:

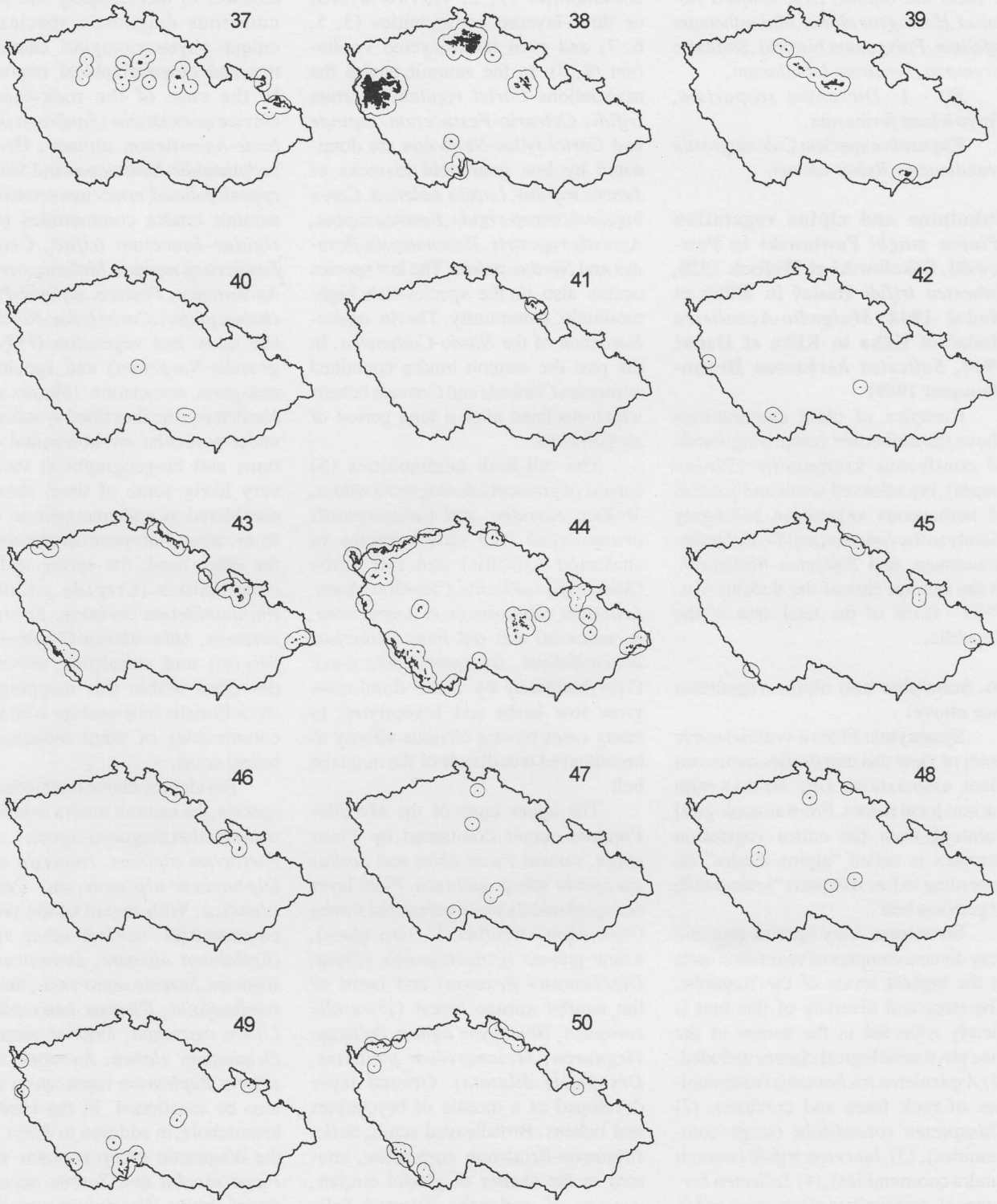

Fig. 29 — Potential natural distribution of mapping units 37-50.

Sorbus aucuparia, *Stellaria nemorum*, r: *Cicerbita alpina*, *Deschampsia flexuosa*, *Homogyne alpina*, *Maianthemum bifolium*, *Polygonum bistorta*, *Solidago virgaurea*, *Veratrum lobelianum*,

E0 - 1: *Dicranum scoparium*, *Polytrichum formosum*.

Expansive species: *Calamagrostis arundinacea*, *Rubus idaeus*.

Subalpine and alpine vegetation (*Pinion mughi* Pawlowski in Pawlowski, Sokolowski et Walisch 1928, *Juncetea trifidi* Hadač in Klika et Hadač 1944, *Mulgedio-Aconitetea* Hadač et Klika in Klika et Hadač 1944, *Salicetea herbaceae* Braun-Blanquet 1949)

Complex of plant communities above the timberline comprising stands of coniferous krummholz (*Pinion mughi*), broadleaved scrub and patches of herbaceous vegetation belonging mainly to the *Juncetea trifidi*, *Mulgedio-Aconitetea*, and *Salicetea herbaceae*, in the summit area of the Sudetes Mts. PND - 0.1% of the total area of the Republic.

46. Subalpine and alpine vegetation (see above)

Synonyms: From a syntaxonomic point of view this unit unifies numerous plant associations (see below) with various local names. From an ecological point of view the entire vegetation complex is called "alpine tundra" or, according to forest experts "krummholz vegetation belt".

Structure: Very species-rich and very diverse complex of vegetation units at the highest levels of the Republic. The structural diversity of this unit is clearly reflected in the names of the nine phytocenological classes included: (1) *Asplenietea trichomanis* (communities of rock faces and crevices), (2) *Thlaspietea rotundifolii* (scree communities), (3) *Juncetea trifidi* (summit tundra communities), (4) *Salicetea herbaceae* (communities of late snow beds), (5) *Mulgedio-Aconitetea* (tall-herb communities), (6) *Montio-Cardaminetea* (spring and flush communities), (7) *Nardo-Callunetea* (mat-grass communities), (8) *Betulo carpaticae-Alnetea viridis* (subalpine broadleaved scrub), and (9) *Vaccinio-Piceetea* (coniferous taiga and krummholz). The largest area is covered by summit tundra (*Juncion trifidi* and *Nardo-Caricion rigidae*) and coniferous krummholz (*Pinion mughi*); these syntaxa can tentatively be regarded as the "climatic climax" of the alpine and subalpine belts, respectively.

This complex contains discontinuous phytocenoses (1, 2), one-layered communities (1, 2, 4), two-layered or three-layered communities (3, 5, 6, 7) and even multi-layered vegetation (8, 9). In the summit tundra the associations *Carici rigidae-Juncetum trifidi*, *Cetrario-Festucetum supinae* and *Carici fyllae-Nardetum* are dominated by low graminoid tussocks of *Juncus trifidus*, *Luzula sudetica*, *Carex bigelowii* subsp. *rigida*, *Festuca supina*, *Agrostis rupestris*, *Deschampsia flexuosa* and *Nardus stricta*. The last species occurs also in the species-rich high-mountain community *Thesio alpini-Nardetum* of the *Nardo-Callunetea*. In the past the summit tundra contained numerous *Cladonia* and *Cetraria* lichens which declined after a long period of air pollution.

The tall-herb communities (5) consist of grasses *Calamagrostis villosa*, *Molinia caerulea*, and *Calamagrostis arundinacea* (the latter species in sheltered habitats) and tall herbs (*Adenostyles alliariae*, *Cicerbita alpina*, *Aconitum callibotryon*, *A. variegatum*, *A. vulparia*) and tall ferns (*Athyrium distentifolium*, *Dryopteris filix-mas*). Overshadowed by these dominants grow low herbs and bryophytes, in many cases having obvious affinity to broadleaved woodlands of the montane belt.

The upper layer of the *Myrtillo-Pinetum mughi* dominated by *Pinus mugo*, stunted *Picea abies* and *Sorbus aucuparia* subsp. *glabrata*. Field layer occupied mainly by dwarf ericoid shrubs (*Vaccinium myrtillus*, *V. vitis-idaea*), a few grasses (*Calamagrostis villosa*, *Deschampsia flexuosa*) and herbs of the nearby spruce forest (*Trientalis europaea*, *Homogyne alpina*, *Solidago virgaurea*, *Melampyrum pratense*, *Dryopteris dilatata*). Ground layer developed as a mosaic of bryophytes and lichens. Broadleaved scrub, *Salici silesiacae-Betuletum carpaticae*, situated in the shelter of glacial cirques, consists of avalanche-distorted *Salix carpatica*, *Acer pseudoplatanus* and *Salix silesiaca* occasionally accompanied by "relict" shrubs of *Salix lapponum*, *Padus avium* subsp. *borealis*, *Ribes petraeum*, and rarely even *Corylus avellana*; field layer is similar to that of the tall-herb communities.

Diagn.: This unit includes about 600 plant species, of which more than half are vascular plants. Within the above named nine phytocenological classes more than 60 associations have been described, belonging to 26 alliances and 18 orders. In the Czech mountains, particularly in the High Sudetes, many associations and alliances of this mapping unit possess numerous diagnostic species with unique phytocenological characteristics and biogeographical importance. In the case of the rock-face and crevice associations (*Saxifrago paniculatae-Agrostietum alpinae*, *Hedysaro hedysaroidis-Molinietum* and *Saxifrago oppositifoliae-Festucetum versicoloris*), summit tundra communities (*Carici rigidae-Juncetum trifidi*, *Cetrario-Festucetum supinae*, *Molinio coeruleae-Agrostietum*, *Festuco supinae-Polytrichetum piliferi*, *Caricifyllae-Nardetum*), late snow bed vegetation (*Polytricho gracilis-Nardetum*) and species-rich mat-grass association (*Thesio alpini-Nardetum*), the described syntaxa occur under particular environmental conditions and biogeographical isolation; very likely some of them should be considered as endemic syntaxa absent from other European mountains. On the other hand, the spring and flush communities (*Crepido paludosae-Philonotidetum seriatae*, *Swertietum perennis*, *Allio sibirici-Cratoneuretum filicini*) and subalpine mires (not described within this mapping unit) show floristic relationships with similar communities of other mountain and boreal areas.

Besides the above mentioned plant species, the summit tundra associations contain other diagnostic species, such as *Hieracium alpinum*, *Huperzia selago*, *Diphasium alpinum* and *Cetraria islandica*. With regard to the tall-herb communities, several other species (*Epilobium alpestre*, *Doronicum austriacum*, *Senecio nemorensis*, *Valeriana sambucifolia*, *Cirsium heterophyllum*, *Lilium martagon*, *Daphne mezereum*, *Delphinium elatum*, *Anemone narcissiflora*, *Bupleurum vapincense*) should also be mentioned. In the coniferous krummholz, in addition to *Pinus mugo*, the diagnostic group contains stunted *Picea excelsa* and *Sorbus aucuparia*, dwarf shrubs (*Vaccinium myrtillus*, *V. vitis-idaea*) and small forbs (*Trientalis europaea*, *Homogyne alpina*, etc.).

Associated natural vegetation: In addition to the above-mentioned continuous stands of grassy summit tundra and coniferous krummholz, the Czech mountains display a variety of small patches of communities belonging to the classes *Asplenietea trichomanis*, *Thlaspietea rotundifolii*, *Salicetea herbaceae*, *Montio-Cardaminetea* and *Betulo carpaticae-Alnetea viridis*. Specialised associations of these classes colonise the ecologically unique habitats on the summit cliffs (tors), screes, rock

walls and in the crevices of the glacial corries. These communities contain diagnostic species characterised by their affinity to arctic-alpine ecosystems, e.g., *Poa laxa*, *Festuca versicolor*, *Saxifraga oppositifolia*, *Hedysarum hedysaroides*, *Padus avium* subsp. *borealis*; some of these species are endemic taxa, e.g., *Campanula gelida*, *Knautia arvensis* subsp. *pseudolongifolia*, *Sorbus sudetica*, *Plantago atrata* subsp. *sudetica*, and *Dianthus carthusianorum* subsp. *sudeticus*.

Adjoining PNV: The mapping unit occupies the uppermost mountain area; its lower altitudinal boundary is marked by the "upper" or "alpine" timberline. Still lower down the slope occurs coniferous taiga, dominated by *Picea abies* (*Piceion excelsae*). In the sheltered habitats of glacial corries small patches of the *Acerenion*.

Habitat: C4. In the summit area of these mountains the average annual air temperature is estimated to be 0.2 to 20°C; a substantial portion of the high annual precipitation is snow and rime. Transported by prevailing winds the snow drifts to the leeward slopes and creates cornices on their upper edge which trigger avalanches in winter and spring. In the course of millenia, the moving snow and avalanches have prevented the establishment of a closed-canopy forest and thus facilitated the sustainable existence of treeless subalpine vegetation.

Mostly crystalline schists, gneisses and granites. The relief partly sculptured by glacial erosion (corries and nivation niches) and periglacial climate which have created patterned ground (frost polygons) and cryogenic landforms due to freeze-thaw effects (regelation), congelifraction and solifluction. The variety of soils encountered in these areas belongs to the groups of lithosols, podzols and organosols.

On scattered outcrops of mineral-rich rocks, periglacial scree, spring-sites and streams, highly specialised soils and associated "edaphic climaxes" in the vegetation.

In the Giant Mountains (Krkonoše/Karkonosze), the highest range of the Sudetes, the subalpine coniferous krummholz, ass. *Myrtillo-Pinetum mughi*, covers a nearly continuous belt betwen 1250 to 1450 m, but locally descends to the bottom of glacial cirques at 1 000 m. Acidic podzolic soils with a thick layer of raw humus and shallow rankers. In the Šumava Mts. there are only small patches of this krummholz on top of some rocky peaks, in contrast to large stands of *Pinus pseudopumilio*, a hybrid between *Pinus mugo* and *Pinus rotundata*, which dominate the peatlands.

Distribution: PND - 0.1% (Fig. 29/46). Extensive areas only in the High Sudetes, whose three ranges (Krkonoše, Králický Sněžník and Hrubý Jeseník Mts.) exceed the alpine timberline (1250 m). These ranges contain a number of syntaxon-rich localities, such as Kotelné jámy Cirques, Tpská jáma Cirque and Velká Kotlina Cirque. Continuous stands of the *Myrtillo-Pinetum mughi* only in the Krkonoše Mts., where *Pinus mugo* reaches its northernmost limit. Due to florogenetical factors, this species is missing in the Hrubý Jeseník Mts. and Králický Sněžník Mt., but locally established plantations threaten the development of indigenous plant communities. In the Šumava Mts., *Pinus mugo* grows only on rocky peaks (e.g., Luzný Mt. and Trojmezná Mt.) and on rocky headwalls of some glacial cirques, such as the Černé and Plešné jezero corries. Larger complexes of tundra vegetation restricted to Velký Javor Mt. (1456 m), the highest peak situated on the Bavarian side of the Šumava Mts.

Land use: The complex of subalpine and alpine ecosystems creates the core area of the Czech-Polish UNESCO Biosphere reserve in the Krkonoše Mts., an area covered also by the two national parks - Krkonošský NP and Karkonoski Park Narodowy, respectively. In the Hrubý Jeseník Mts., the area of this unit belongs to the National Nature Reserves incorporated in the PLA Jeseníky. The smaller area, on the Králický Sněžník Mt., is a National Nature Reserve, and the peaks and corries of the Šumava Mts. also have the status of National Nature Reserves. In the terminology of the Nature Conservancy, the subalpine and alpine vegetation belongs to Zone One of the large-scale protected regions, which is strictly protected against human interference.

According to the list of protected plant species (No. 395 Decree of the Ministry of Environment and the Red Data List of vascular plants of the Czech Republic, see Holub *et al.* 1979) this mapping unit contains more than 40 critically threatened species, e.g., *Sorbus sudetica*, *Salix lapponum*, *Luzula spicata*, *Gentiana verna*, *Pulsatilla vernalis*, *Dianthus carthusianorum* subsp. *sudeticus*, *Knautia arvensis* subsp. *pseudolongifolia*, a further 30 highly threatened species, e.g. *Anemone narcissiflora*, *Primula minima*, *Saxifraga oppositifolia*, *Selaginella selaginoides*, and 20 threatened species, e.g., *Campanula bohemica*, *Trollius altissimus*, *Huperzia selago*, *Doronicum austriacum*. These taxa are represented mostly by small biogeographically isolated populations, and endemic taxa evolved in the Czech mountains during the Holocene period, e.g., about 23 neo-endemic *Hieracium* species which grow in the sub-alpine and alpine ecosystems of the Krkonoše Mts. For about four centuries these rare populations have been the object of observations and taxonomic studies and thus a number of plant taxa have their "locus classicus" in these ecosystems; e.g. *Poa laxa*, a typical grass of the European and N American high-mountains, was first described by Haenke from the population on Sněžka peak in the Krkonoše Mts. The syntaxa newly described by Zlatník (1928), Jeník (1961) and Hadač et Váňa (1967) from the discrete habitats of the central Hercynian mountains are of similar importance.

Over the entire area these unique taxa and syntaxa are being affected by acid rain and general air pollution which are damaging even krummholz and tundra ecosystems, whose decline was temporarily delayed and less conspicuous than that of the coniferous taiga. Recent observations show a remarkable impoverishment of the subalpine and alpine communities exposed to the impact of sulphur dioxide, nitrogen oxides and heavy metals. Monitoring of earlier research plots indicated progressive invasion of clonal grasses, namely *Calamagrostis villosa* and *Deschampsia flexuosa* in the arctic-alpine tundra. Spontaneous dispersal of weeds and ruderal plants along tourist trails and tracks have changed the species composition of the indigenous communities, and in certain cases resulted in genetic erosion of local populations (e.g., introgression of *Viola sudetica* by *V. tricolor*).

Two kinds of substitute plant communities have been created by human activity:

a) pastures and meadows (*Nardion*), maintained by grazing of cattle or sheep,

b) ruderal vegetation (*Rumicion alpini*), created by the past enclosure of cattle and sheep.

In the past, stands of the *Myrtillo-Pinetum* were intentionally cut and burnt in the Krkonoše Mts., mostly in order to expand the pastures and gain fuel for mountain cottages; wood of *Pinus mugo* served also as a source of turpentine. At present, none of the subalpine and alpine plant communities are exploited by man in the areas of

strict nature reserves, but indirectly these ecosystems provide an important service to man by the prevention of soil erosion, controlling run-off in the watershed and particularly by their scenic and aesthetic values.

References: Bercíková (1976), Hadač et Štursa (1983), Jeník (1961, 1972, 1973), Jeník, Bureš et Burešová (1980), Jirásek (1996b), Kociánová et Štursová (1986), Krahulec (1990), Sofron et Štěpán (1971), Soukupová, Kociánová, Jeník et Sekyra (1995), Šmarda (1950), Štursa (1966), Štursová (1995), Štursová et Štursa (1982).

Synthesis and typical relevé: *Myrtillo-Pinetum mughi*, synthesis of 64 relevés by various authors from the Czech Republic (Jirásek 1996b):

E3 - I: *Picea abies*, *Sorbus aucuparia*,

E2 - *Picea abies*, *Pinus mugo*, IV: *Sorbus aucuparia*, I: *Betula carpatica*, *Salix grandifolia*, *S. silesiaca*,

E1 - V: *Deschampsia flexuosa*, *Vaccinium myrtillus*, *V. vitis-idaea*, IV: *Calamagrostis villosa*, *Homogyne alpina*, *Trientalis europaea*, III: *Dryopteris dilatata*, II: *Athyrium distentifolium*, *Calluna vulgaris*, *Huperzia selago*, *Melampyrum pratense*, *Polygonum bistorta*, *Solidago virgaurea*, I: *Adenostyles alliariae*, *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Deschampsia cespitosa*, *Empetrum hermaphroditum*, *Galium saxatile*, *Gentiana asclepiadea*, *Hieracium villosum*, *Hypericum maculatum*, *Luzula luzuloides*, *Lycopodium annotinum*, *Maianthemum bifolium*, *Melampyrum sylvaticum*, *Molinia caerulea*, *Nardus stricta*, *Oxalis acetosella*, *Polygonatum verticillatum*, *Rubus idaeus*, *Rumex alpestris*, *Silene vulgaris*, *Vaccinium uliginosum*, *Veratrum lobelianum*,

E0 - IV: *Cetraria islandica*, *Dicranum scoparium*, III: *Hylocomium splendens*, *Pleurozium schreberi*, *Polytrichum formosum*, III: *Cladonia bellidiflora*, *Dicranum fuscescens*, *Polytrichum commune*, *P. strictum*, *Ptilidium ciliare*, *Sphagnum capillifolium*, I: *Barbilophozia lycopodioides*, *Bazzania trilobata*, *Calypogeia muellerana*, *C. trichomanis*, *Cladonia gracilis*, *C. pyxidata*, *C. rangiferina*, *S. squamosa*, *C. arbuscula*, *Dicranodontium denudatum*, *Mylia taylorii*, *Plagiothecium curvifolium*, *P. laetum*, *P. undulatum*, *Pohlia nutans*, *Polytrichum juniperinum*, *Rhytidiadelphus loreus*, *Sphagnum girgensohnii*, *S. fallax*, *S. russowii*, *S. rubellum*.

Jeník (1961): Tab. 3, rel. 3 (Krkonoše Mts., Velký Šišák Mt.), 1410 m, S, 15°, E1 - 1%, E2 - 90%, E1 - 80%, E0 - 30%.

E3 - +: *Picea abies*,

E2 - 5: *Pinus mugo*, 2: *Picea abies*, +: *Sorbus aucuparia*,

E1 - 3: *Vaccinium myrtillus*, 2: *Deschampsia flexuosa*, 1: *Homogyne alpina*, +: *Calamagrostis villosa*, *Dryopteris dilatata*, *Trientalis europaea*, *Vaccinium vitis-idaea*,

E0 - 2: *Dicranum scoparium*, *Pleurozium schreberi*, 1: *Polytrichum formosum*, +: *Cetraria islandica*, *Polytrichum strictum*.

Mires (*Scheuchzerio-Caricetea fuscae* Tüxen 1937 and *Oxycocco-Sphagnetea* Braun-Blanquet et Tüxen ex Westhoff *et al.* 1946)

Complex of mire vegetation from sedge- and sedge-moss types at lower levels (planar to submontane belts) to mountain raised bogs (montane and supramontane levels). PND - c. 0.1%.

47. Complex of sedge and sedge-moss communities of minerotrophic mires (*Caricetalia fuscae* Koch 1926)

Synonyms: *Caricetalia davallianae* Braun-Blanquet 1949, *Tofieldietalia* Preising in Oberdorfer 1949, *Molinio-Caricetalia fuscae* Duvigneaud 1949 p.p., *Scorpidietalia* Du Rietz 1954.

Structure: Treeless stands with usually only field and ground layers; shrubs (mostly *Salix* spec. div. and shrubby forms of *Alnus glutinosa*, *Picea abies*, *Betula pubescens* agg.) occur in places where the habitat conditions do not allow further existence of open heliophilous communities. Upper field layer > 1m with, e.g., tall sedges, *Filipendula ulmaria*, *Cirsium* species, etc.; the lower sublayer with short sedges, grasses, some *Juncaceae*, etc. < 50 cm. Brown-mosses (*Amblystegiaceae*) prevail in the ground layer. *Sphagna*, if present, represented by a few calcitolerant species (*Sphagnum warnstorfii*, *S. contortum*, etc.).

Diagn.: *Eriophorum latifolium*, *Eleocharis quinqueflora*, *Baeothryon alpinum*, *Schoenus nigricans*, *S. ferrugineus*, *Carex flava* agg., *C. davalliana*, *C. panicea*, *C. lasiocarpa*, *C. diandra*, *C. rostrata*, *C. dioica*, *Epipactis palustris*, *Dactylorhiza majalis*, *Triglochin palustris*, *Tofieldia calyculata*, *Pedicularis palustris*, *Parnassia palustris*, *Pinguicula vulgaris*, *Galium uliginosum*, *Campylium stellatum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Fissidens adianthoides*, *Tomenthypnum nitens*, *Sphagnum contortum*, *S. warnstorfii*, *Aneura pinguis*.

Differences: From the following unit, absence or low representation of *Sphagnum* species.

Habitat: In general, these communities are independent of climatic conditions and elevation except at the highest altitudes, where they are missing. Shallow minerotrophic peat (up to about 2 m) of alkaline, neutral or slightly acidic reaction in sloping spring and valley mires. Groundwater table at, or close to, the surface in initial stages, decreasing to below the main rhizosphere layer in terminal stages.

Distribution: N Central Bohemia, small areas in the Českomoravská vrchovina Uplands, foothills of the Krkonoše and Šumava Mts., Nízký Jeseník and Oderské vrchy Mts., Bílé Karpaty Mts., Česká tabule Plain and fragmentarily over the whole country (Fig. 29/47).

Land use: Formerly used as hay-meadows or pasture. Following drainage they were converted into fields or forests. Peat was often exploited for soil improvement.

Most of the vegetation types are of a relict character having their origin in the late Glacial or early Holocene. Therefore, they belong to the globally endangered communities. Drainage, eutrophication and subsequent invasion of shrubs and trees are the most common reasons for their disappearance. The remaining sites, still retaining their ability to survive, remain very important refugia for several protected plant and even animal biota. Jestřebská blata (the Ralská pahorkatina Hills), Hrabanovská černava and Mělnická Vrutice (both in the central part of the Česká tabule Plain) are examples of the most valuable National Nature Reserves in the Czech Republic.

Rare and endangered syntaxa: Communities of the *Caricion davallianae*, *Caricion lasiocarpae*, *Caricion demissae* and *Sphagno-Tomenthypnion*.

Rare and endangered taxa: *Baeothryon alpinum*, *Eleocharis quinqueflora*, *Schoenus ferrugineus*, *S. nigricans*, *Carex davalliana*, *C. dioica*, *C. flava*, *C. lepidocarpa*, *C. diandra*, *C. lasiocarpa*, *Triglochin palustris*, *Tofieldia calyculata*, *Dactylorhiza majalis*, *D. traunsteineri*, *Epipactis palustris*, *Pinguicula bohemica*, *P. vulgaris*, *Scorpidium scorpioides*, *Calliergon trifarium*, *Drepanocladus lycopodioides*, *Paludella squarrosa* and others.

References: Husáková (1996), Klika (1935, 1947), Klika et Šmarda (1946), Kopecký (1960), Moravec

(1966), Moravec et Rybníčková (1960), Neuhäusl (1972), Rybníček (1964, 1970, 1974), Vicherek et Koráb (1969).

48. Complex of sedge-*Sphagnum* communities of minerotrophic mires (*Scheuchzerietalia palustris* Nordhagen 1936 excl. *Leuko-Scheuchzerion* Nordhagen 1943)

Synonyms: *Apiculetalia* Du Rietz 1954, *Scheuchzerietea* den Held *et al.* in Westhoff *et al.* 1969, *Sphagno-Caricetalia* Palczynski 1975.

Structure: Mostly treeless open communities with field and ground layers. Their height depends on the dominants or subdominants of the field layer and varies between c. 30 cm (*Rhynchospora alba*, *Carex chordorrhiza*, *etc.*) and 150-200 cm (*Carex lasiocarpa*, *Phragmites australis*, etc.). *Cyperaceae*, *Menyanthes trifoliata*, *Naumburgia thyrsiflora*, *Peucedanum palustre*, *Comarum palustre*, *Lysimachia vulgaris* are important. *Sphagna* Sect. *Subsecunda* and those of Sect. *Cuspidata* and Sect. *Palustria* prevail in the ground layer. A shrub layer occurs in successionally higher developmental stages (*Salix cinerea*, *S. aurita*, *S. rosmarinifolia*, *Betula pubescens* agg., *Picea abies*, *Alnus glutinosa*, *Frangula alnus*).

Diagn.: *Eriophorum angustifolium*, *E. gracile*, *Rhynchospora alba*, *R. fusca*, *Carex rostrata*, *C. lasiocarpa*, *C. chordorrhiza*, *C. diandra*, *C. limosa*, *C. nigra*, *C. canescens*, *Juncus filiformis*, *Drosera rotundifolia*, *D. anglica*, *D. intermedia*, *Viola palustris*, *Menyanthes trifoliata*, *Comarum palustre*, *Utricularia vulgaris*, *Peucedanum palustre*, *Naumburgia thyrsiflora*, *Oxycoccus palustris*, *Equisetum fluviatile*, *E. palustre*, *Lycopodiella inundata*; *Calliergon giganteum*, *C. stramineum*, *Drepanocladus exannulatus*, *Meesia triquetra*, *Sphagnum subsecundum*, *S. platyphyllum*, *S. lescurii*, *S. contortum*, *S. flexuosum*, *S. obtusum*, *S. teres*.

Differencies: From the foregoing unit, absence or weak occurrence of *Bryidae* among the dominant *Sphagnum* species.

Adjoining PNV: *Magnocaricetalia*, *Phragmitetalia*, *Mastigobryo-Piceetum*, *Sphagno-Piceetum*, *Alnenion glutinoso-incanae*, *Alnion glutinosae*, *Oxycocco-Sphagnetea*, *Betulion pubescentis*.

Habitat: MW3, MW9, at submontane and montane levels. Organogenic soils (peats) are the prevailing substrates, exceptionally humic non-calcareous sands or other minerogenic soils. Mires of this type indicate meso- and/or oligotrophic, slightly- to moderately acidic environments. The water table varies from being close to the surface in the case of relatively undisturbed sites, but under anthropogenic influence (drainage) it decreases and causes irreversible changes in the natural composition of the communities.

Distribution: Šumava Mts., Českomoravská vrchovina Uplands, Třeboňská pánev Basin, Ralská pahorkatina Hills, small sites in W Bohemia, the Krušné hory Mts., the Jizerské hory and Krkonoše Mts., the Hrubý and Nízký Jeseník Mts. incl. the Oderské vrchy Hills (Fig. 29/48).

Land use: The stands were used as hay meadows or pastures until about 1960. Drainage and subsequent use changed most of the sites into monospecific meadows, fields or tree plantations.

The maximum extent of these communities dates back to the middle Holocene and the remaining stabilized stands are relicts from that time. Being endangered at present, at least in Central Europe, they should be protected and restored using sophisticated management techniques in sites where a chance for further potential existence still remains. These sites are mapped, e.g. in the NNR Ruda (the Třeboň Basin) and NNM Swamp at Máchovo jezero Lake (the Ralská pahorkatina Hills).

Rare and endangered syntaxa: communities of the *Eriophorion gracilis*, *Rhynchosporion albae*, *Sphagno recurvi-Caricion canescentis*.

Red list taxa: *Eriophorum gracile*, *Rhynchospora alba*, *R. fusca*, *Carex lasiocarpa*, *C. chordorrhiza*, *C. limosa*, *C. diandra*, *Dactylorhiza majalis*, *Hammarbya paludosa*, *Menyanthes trifoliata*, *Comarum palustre*, *Drosera rotundifolia*, *D. anglica*, *D. intermedia*, *Hydrocotyle vulgaris*, *Utricularia vulgaris*, *U. intermedia*, *U. minor*, *Lycopodiella inundata*; *Meesia triquetra*, *Calliergon giganteum*, *Drepanocladus exannulatus*, *Sphagnum lescurii*, *S. subsecundum*, *S. platyphyllum*, *S. contortum*, *S. obtusum* and others.

References: Březina *et al.* (1963), Kästner et Flössner (1933), Klika (1935), Klika et Šmarda (1946), Neuhäusl (1972a), Rybníček (1970, 1974), Sofron (1980).

49. Complex of submontane *Pinus rotundata*- and *P. sylvestris*-mires (*Pino rotundatae-Sphagnetum* Kästner et Flössner 1933 corr. Neuhäusl 1969, *Eriophoro vaginati-Pinetum sylvestris* Hueck 1931 em. Neuhäusl 1984)

Synonyms: *Sphagno-Eriophoretum vaginati* Klika et Šmarda 1946 sensu Šmarda 1950, *Ledo-Pinetum sylvestris* subas. *pinetosum uliginosae* Březina *et al.* 1963, *Pinetum uncinatae ledetosum* Březina 1957.

Structure: Tree-rich or forest communities differentiated into 3 or 4 layers. *Pinus rotundata* (tree form), *P. sylvestris*, rarely *Betula pubescens* and *Picea abies* occur in the tree and shrub layers. Field layer differentiated into an upper sub-layer with dwarf shrubs and a lower one with *Eriophorum vaginatum*, *Andromeda polifolia*, *Melampyrum pratense* subsp. *paludosum* and other low herbs. In the ground layer *Sphagna* Sect. *Acutifolia*, *S.* Sect. *Cuspidata* and *S.* Sect. *Palustria* prevail in the initial and optimal developmental stages. *Dicranum* spec. div., *Pleurozium schreberi*, *Hylocomium splendens*, *Polytrichum* spec div., *Cladonia* spec. div. and other moss and lichen species are present in the terminal stages.

Diagn.: E3, E2 - *Pinus rotundata*, *P. sylvestris*, E1 - *Ledum palustre*, *Vaccinium myrtillus*, *V. vitis-idaea*, *V. uliginosum*, *Oxycoccus palustris*, *Calluna vulgaris*, *Eriophorum vaginatum*, *Melampyrum pratense* subsp. *paludosum*, E0 - *Dicranum affine*, *D. polysetum*, *Sphagnum fallax*, *S. magellanicum*, *S. girgensohnii*, *S. russowii*, *S. capillifolium*.

Differences: In contrast to mountain raised bogs, presence of *Ledum palustre*, absence of *Empetrum hermaphroditum* and *E. nigrum*. *Andromeda polifolia* occurs only sparsely.

Adjoining PNV: *Calamagrostio-Piceetum*, *Sphagno-Pinetum*, *Alnenion glutinoso-incanae*, *Betulion pubescentis*, *Luzulo-Fagion* and, locally, *Abieti-Quercetum*.

Habitat: Colder subunits of MW7-4, mean annual temperature between 5-8°C, mean precipitation 600-900 mm. Mostly submontane levels (rarely 270-420 m, frequently up to 760 m), with deep peat (over 2.5 m) of medium (H 4-6) to high (H 6-8) humification. The *Eriophoro vaginati-Pinetum* with *Vaccinium uliginosum* occurs sporadically on organomineral soils. The water table varies between about 10-40 cm at initial and optimal developmental stages and decreases to below 50 cm in the terminal stages. Acidity of the peat < pH 4, nutrient content very low.

Distribution: PND - 0.1%. *Pino rotundatae-Sphagnetum* occurs in the Třeboňská pánev Basin, the Slavkovský les Mts., Českomoravská vrchovina Uplands, northern foothills of the Hrubý Jeseník Mts. and fragmentarily in the Šumava Mts.

Fig. 30 — Complex of montane raised bogs (*Sphagnetalia medii* Kästner et Flössner 1933 with *Pinus mugo* in the Krkonoše Mts.

Eriophoro vaginati-Pinetum sylvestris occurs in the Ralská pahorkatina Hills, N Bohemia. In fragments in the NNR Padrtiny (the Ždárské vrchy Mts.) and in a bog at Hůrky (southern part of the Českomoravská vrchovina Uplands). (Fig. 29/49).

Land use: Peat extraction and secondary coniferous plantations of *Picea abies* or *Pinus rotundata*.

The global distribution of *Pinus rotundata* bogs is endemic to Switzerland, SW Germany, NE Austria, the Českomoravská vrchovina Uplands, the Hrubý Jeseník Mts., S Bohemia and, in fragments only, in the northern foothills of the High Tatra Mts. Consequently the remaining sites with these communities must be strictly protected and kept under permanent conservation management. They are a genetic resource of *Pinus rotundata*, which seems to be a very resistant tree of economic importance. Šumava Mts. - NNR Velká niva and part of the Mrtvý luh bogs; Třeboňská pánev Basin - NNR Červené blato bog; Českomoravská vrchovina Uplands - NNR Padrtiny; Hrubý Jeseník Mts. - NNR Rejvíz.

Rare and endangered syntaxa: *Pino rotundate-Sphagnetum*, *Eriophoro vaginati-Pinetum sylvestris*.

Rare and endangered taxa: *Pinus rotundata*, *Ledum palustre*, *Vaccinium uliginosum*, *Oxycoccus palustris*, *Dicranum affine*, and most of the *Sphagnum* species, mentioned above.

References: Březina (1957), Březina *et al.* (1963), Dohnal et Mejstřík (1963), Nesvadbová, Sofron et Vondráček (1994), Neuhäusl (1972a, 1972b, 1975), Šmarda (1950).

Typical relevé: Březina *et al.* (1963): 268, rel. 1 (Třeboňská pánev Basin, the Červené blato bog, 470 m).

50. Complex of montane raised bogs (*Sphagnetalia medii* Kästner et Flössner 1933 excl. *Pino rotundatae-Sphagnetum* Kästner et Flössner 1933 corr. Neuhäusl 1969, *Eriophoro vaginati-Pinetum sylvestris* Hueck 1931 em. Neuhäusl 1984 et *Vaccinio uliginosi-Pinetum sylvestris* Kleist 1929), partly with *Pinus mugo* agg. and/or *Sphagnum*-rich spruce woodland (*Sphagno-Piceetum* [Tüxen 1937] Hartmann 1953) (Fig. 30).

Synonyms: *Ombro-Sphagnetea* Du Rietz 1954 p.p., *Vaccinietea uliginosi* Lohmeyer et Tüxen in Tüxen 1955 p.p., *Vaginato-Sphagnetea* Malmer 1968 p.p.

Structure: Treeless communities with field and ground layers. Shrub layer, if present, is usually dense and formed by *Pinus mugo* agg., rarely with krummholz forms of *Picea abies*. Dwarf shrubs, plus *Eriophorum vaginatum*, *Baeothryon caespitosum*, *Carex pauciflora*, *Andromeda polifolia*, *Oxycoccus palustris* are the commonest species in the field layer. Ground layer always very well-developed with high cover values, formed by acidophilous *Sphagna*. Terrestrial forest mosses (*Dicranum* spec. div., *Pleurozium schreberi*, etc.) and lichens appear in *Pinus mugo* stands. Complex of mountain bogs includes small-sized bog pools and lakes of the *Leuko-Scheuchzerion* with *Carex limosa*, *Scheuchzeria palustris*, *Sphagnum cuspidatum*, *S. majus*, *Drepanocladus fluitans*, *Gymnocolea inflata* as dominants.

Diagn.: E2 - *Pinus mugo*, E1 - *Vaccinium uliginosum*, *Oxycoccus palustris*, *O. microcarpus*, *Andromeda polifolia*, *Empetrum hermaphroditum*, *E. nigrum*, *Eriophorum vaginatum*, *Baeothryon caespitosum*, *Carex pauciflora*, E0 - *Aulacomnium palustre*, *Sphagnum magellanicum*, *S. capillifolium*, *S. fuscum*, *S. rubellum*, *S. fallax*, *S. balticum*, *S. russowii*, *Gymnocolea inflata*, *Mylia anomala*.

Differences: From the foregoing unit, absence of tree forms of *Pinus rotundata* and *Ledum palustre* and presence of *Empetrum hermaphroditum* and/or *E. nigrum*.

Adjoining PNV: *Piceion excelsae*, *Pinion mughi*.

Habitat: Cold C4-6 with mean

annual temperature between 1-5°C, mean annual precipitation 900-1400 mm. Montane levels between (750)900-1000 (1300) m.

Oligo-dystrophic bog environments, usually with a deep peat profile (over 2 m); only sites at high altitudes have a comparatively shallow peat layer. Humification of the upper peat layer H 1-3 in initial and actively growing stands, to H 7-8 in terminal communities with *Pinus mugo* agg. and/or *Picea abies* cover. Similarly, the water table varies between 0-10 and 50-80 cm respectively. The acidity of the substrate is very low (pH between 3 and 4.5), nutrient supply very poor and Ca^{2+} and Mg^{2+} ions absent or nearly absent.

Distribution: Border mountain chains of Bohemia and Moravia (the Šumava Mts., Krušné and Jizerské hory, Krkonoše, Orlické hory and Hrubý Jeseník Mts.), the Slavkovský les Mts., fragments in the Českomoravská vrchovina Uplands and the Beskydy Mts. (Fig. 29/50, 30).

Land use: Easily accessible sites often drained and used for industrial peat extraction. Many of the bogs at upper elevations converted into spruce plantations.

Several actively growing and well preserved mountain bogs protected. No attempts to restore damaged and drained sites are currently in progress. Air pollution, incl. aerial drift of lime-fertilizers, general eutrophication and the increasing frequency of prolonged periods of drought are the most negative factors which endanger even protected areas.

Examples of protected sites: NP Šumava - NM Modravské slatě, Rybárenská slať, Jezerní slať, Mrtvý luh bogs; Krušné hory Mts. - NNR Božídarské rašeliniště, NNR Velké jeřábí jezero, NNR Novodomské rašeliniště bogs; Jizerské hory Mts. - Na Čihadle, NNR Rašeliniště Jizerky, NNR Rašeliniště Jizery, Klečové louky bogs; the Slavkovský les Mts. - NNR Kladské rašeliny; Krkonošský NP - NM Černohorské rašeliniště, Pančická louka, Tpská rašelina bogs; the Jeseníky Mts. - bogs between the Vozka and Keprník Mts.

Rare and endangered syntaxa: All communities of the *Oxycocco-Sphagnetea*. The endemic association *Chamaemoro-Pinetum mughi* deserves special attention.

Rare and endangered taxa: *Betula nana*, *Andromeda polifolia*, *Empetrum hermaphroditum*, *E. nigrum*, *Oxycoccus palustris*, *O. microcarpus*, *Baeothryon caespitosum*, *Carex pauciflora*, *C. limosa*, *C. paupercula* ssp. *irrigua*, *Scheuchzeria palustris*, *Rubus chamaemorus*, *Drosera rotundifolia*; *Drepanocladus fluitans*, *Sphagnum lindbergii*, *S. compactum*, *S. imbricatum*, *S. papillosum*, *S. magellanicum*, *S. cuspidatum*, *S. majus*, *S. balticum*, *S. tenellum*, *S. fuscum*, *Mylia anomala* and some rare liverworts.

References: Hadač et Váňa (1967, 1968), Houšková (1981), Kästner et Flössner (1933), Nesvadbová, Sofron et Vondráček (1996), Rudolph, Firbas et Sigmond (1928), Sofron (1980), Sofron et Šandová (1972), Šmarda (1950).

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Footnotes:

* Dominance in vernal aspect (See pages 19, 20, 21, 24, 27 and 29).

** In stands of the *Fraxino-Populetum* (See page 24).

1) Formerly called *Torilido-Quercetum* Blažková 1997 (See page 47).

Authors of the photos:

D. Blažková: Fig. 27
J. Moravec: Fig. 14, 17, 18, 19, 21, 22, 24, 25, 26
J. Sádlo: Fig. 11, 12, 13
J. Štursa: Fig. 30
J. Wild: Fig. 15, 23, 29
Z. Nehäuslová: Fig. 16, 28

Zdenka Nehäuslová
Institut of Botany of the Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic
e-mail: neuhauslova@ibot.cas.cz

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