

ASSOCIATION *FRAXINO ORNI-PINETUM NIGRAE* MARTIN-BOSSE
1967 IN THE SOUTH-EASTERN ALPINE REGION

ASOCIACIJA *FRAXINO ORNI-PINETUM NIGRAE* MARTIN-BOSSE
1967 V JUGOVZHODNOALPSKEM OBMOČJU

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ABSTRACT

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Association *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 in the south-eastern Alpine region

Comparison of phytocenoses of *Fraxino orni-Pinetum nigrae* in the south-eastern Alpine region showed that phytocenoses in individual regions differ, especially in the greater or lesser presence of characteristic and distinguishing species. We compared phytocenoses in the Karavanke, and the Gailtal, Carnic, Julian and Savinje Alps and along the Piave and Soča/Isonzo (Italy). We further compared these with Western Dinarid phytocenoses of Austrian pine in Slovenia.

Keywords: *Pinus nigra* Arnold, *P. sylvestris* L., phytocenology, Slovenia, eastern Alpine region.

IZVLEČEK

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Asociacija *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 v jugovzhodnoalpskem območju

Primerjava fitocenoze *Fraxino orni-Pinetum nigrae* v jugovzhodnoalpskem območju je pokazala, da se fitocenoze v posameznih območjih nekoliko razlikujejo, zlasti v večji ali manjši prisotnosti značilnic in razlikovalnic. Primerjali smo fitocenoze v Karavankah, Ziljskih, Karnijskih, Julijskih in Savinjskih Alpah ter ob Piavi in Soči (Italija). Le-te smo primerjali še z zahodnodinarskimi fitocenzami črnega bora v Sloveniji.

Ključne besede: *Pinus nigra* Arnold, *P. sylvestris* L., fitocenologija, Slovenija in vzhodnoalpsko območje.

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1 INTRODUCTION

In the south-eastern region, especially on the Balkan peninsular, Austrian pine *Pinus nigra* Arnold s. lat. is an interesting species and south-eastern European phytocenology more or less justifiably classifies it among south-eastern European-Illyrian geoelements. It appears in this space disjunctively as an autochthonous species on areas ranging from small, perhaps hectare size to very extensive areas, mainly in the central part of the Balkan peninsular. In Slovenia, it is only native in smaller areas. Austrian pine has planted on larger areas as a pioneer in the Karst world. The Karst is most forested with it where it constructs a secondary phytocenosis with an understory of autochthonous vegetation of downy oak (ZUPANČIČ & ŽAGAR 2008).

Only the classical subspecies of Austrian pine – *Pinus nigra* Arnold subsp. *nigra* (= *P. nigra* Arnold subsp. *austriaca* Aschers & Graebn.) is known in Slovenia.

The main area of distribution of Austrian pine *Pinus nigra* is in the montane zone of the submeridional, it partly also appears in the montane zone of meridional oceanic Europe and is a sub-mediterranean (disjunct mediterranean) floral element of the montane zone (MEUSEL et al. 1965). OBERDORFER (1979) considers it to be a south-eastern European species. POLDINI (1991) though classifies it among southern Illyrian species. The distribution of Austrian pine in its natural environment is in general disjunct, to wit from the northern edge of the Mediterranean, i.e., from Spain to Asia Minor, and in the northeast part of Africa (ACCETTO et al. 1986, MEUSEL et al. 1965 – Karte: 22).

ŠERCELJ (1996) states that pine – *Pinus* s. lat. is the most widespread Euro-Asian tree, which is enabled by its ecological breadth.

ACCETTO et al. (1986), summarised by Mirova, considers that Austrian pine already settled its area of dis-

tribution from the Pleistocene onwards. ŠERCELJ (1996), too, for the area of Slovenia repeats that pine – *Pinus* s. lat. was always present in all pollen sediments and had the largest share of territory in the glacial periods.

Austrian pine is a very variable species, with many morphological and physiological differences having been created, probably because of the discontinuity and wide distribution. Many sub-species, varieties and forms are known (VIDAKOVIĆ 1980, ACCETTO et al. 1986). In the central Balkan peninsular, the taxa *Pinus nigra* Arnold subsp. *nigra* var. *dalmatica* Visiani (Dalmatia and Herzegovina) and *Pinus nigra* Arnold subsp. *caramanica* Rehd. (= *Pinus nigra* Arnold subsp. *pallasiana* Aschers & Graebn. in Macedonia) appear, as well as many more or less recognised taxa (e.g., *Pinus nigra* Arnold subsp. *gocensis* Džordžević, *Pinus nigra* Arnold var. *sharganica* F. Novak).

Austrian pine is a photophyllic, xerophyllic and pioneer species, which occupies extreme habitats, mainly dry, rocky, shallow, nutrient poor soils on dolomite, limestone, periodite and serpentinite at altitudes from 250–1400 (1600) m. It withstands well climatic extremes and occupies nutrient poor habitats where other tree species are unable to grow (VIDAKOVIĆ 1980, ŠERCELJ 1996, ACCETTO et al. 1986).

Austrian pine is excellent for afforesting in arid and semi-arid (dry) climates on rocky soils. In Slovenia it has been used successfully for forestation of the Karst, where it is also spreading spontaneously. It grows quickly when young, in age more in girth, while the height increase is smaller (VIDAKOVIĆ 1980, ŠERCELJ 1996, ACCETTO et al. 1986).

Austrian pine is spontaneous in Slovenia – autochthonous - and it constructs a number of primary phytocenoses. I. HORVAT (1959, 1974) devoted particular at-

tention to Austrian pine and its phytocenoses and divided pine forests in the phytocenological sense into two sub-alliances, in which Austrian pine has an important role; namely, on dolomite *Helleboro nigri-Pinionion* (Ht. 1959) Zupančič 2007 nom. nov. (= *Orno-Ericion dolomiticum* Ht. 1959) and on serpentinitoids *Asplenio cuneifoliae-Pinionion* (Ht. 1959) Zupančič 2007 nom. nov. (= *Orno-Ericion serpentanicum* Ht. 1959). The sub-alliances are placed in the alliance *Fraxino orni-Pinion nigrae-sylvestris* (Ht. 1953) Zupančič 2007 nom. nov. This division applies for the Illyrian floral province, including the southeast Alpine region. In the Central European province, pine forests are included in the alliance *Erico-Pinion sylvestris* Br.-Bl. and Br.-Bl. et al. 1939 nom. inv.

To date, three areas of primary phytocenoses of Austrian pine *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 are known (described) in Slovenia (T. WRABER 1979, DAKSKOBLER 1998, ZUPANČIČ & ŽAGAR in situ). It is throughout more or less mixed with the species *Pinus sylvestris* L., only in the phytocenosis described by Zupančič & Žagar is there none of the species *Pinus nigra*. The phytocenoses *Carici sempervirentis-Pinetum*

nigrae Accetto 1999 and *Daphno alpinae-Pinetum nigrae* Accetto 2001 contain exclusively the species *Pinus nigra*. We must highlight, TOO, the phytocenosis *Genisto januensis-Pinetum sylvestris* Tomažič 1940, in which a phytocenosis with *Pinus nigra* appears as a sub-association *Genisto januensis-Pinetum* subass. *pinetosum nigrae* Tomažič 1940.

We have monitored the appearance of pine forests in Slovenia from the sixties of the twentieth century to today and occasionally recorded phytocenological relevés. Despite the exemplary presentation of the southeast Alpine phytocenosis *Fraxino orni-Pinetum nigrae* by our colleagues T. WRABER (1979) and DAKSKOBLER (1998), we have decided to publish a phytocenosis from the eastern edge of the southeast Alpine region, which the aforementioned authors did not include.

We researched according to the standard (Central European) phytocenological method. The floristic nomenclature used is according to Mala flora Slovenije (MARTINČIČ et al. 2007). We determined life forms according to Raunkier, on the basis of POLDINI'S (1991) monograph, as also the horological groups of geoelements.

2 PHYTOCENOSIS IN THE EASTERN EDGE OF SOUTHEAST ALPINE SLOVENIA

We inventoried the phytocenosis *Fraxino orni-Pinetum nigrae* in the area of the Savinja Alps in the north-western part of the Savinja Alps (Huda goša, Veža – Planica, Tolsta peč), in the eastern (Sedlec and Rogovilc pod Raduho) and central Karavanke (Tabre by Martuljek in Gorenjska) and in the northeast Julian Alps (Mala Pišnica by Kranjski Gori in Gorenjska). The altitudes were from 690 to 1315 m; the majority of the steep southern slopes have an inclination from 20 to 70°. The geological base is dolomite, dolomite limestone, limestone and dolomite moraine. The habitat of the phytocenosis is not for the most part rocky. The tree layer, which is constructed by the species *Pinus sylvestris*, *Larix decidua*, *Picea abies* and partially *Fagus sylvatica*, *Sorbus aria* and *Abies alba*, covers from 50 to 80 % of the studied surface. The shrub layer is relatively rich, with thermophilous and sciophilous shrubs and covers from 10 to 40 % of the studied surface. The herb layer is very rich, for the most part with 100% cover. Shade and cool loving plants predominate in the herb layer, with a two-thirds share. Slightly less than a third of them are fagetal, slightly less than a fifth piceetal and a good tenth pinetal species, the remainder are non-forest species. Moss species are poorly represented. There are a total of 196 species in the analytical Phytocenological Table 1.

Vascular flora have an absolute majority; there are 2% ferns and 6% mosses and lichens.

Characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae* are not convincingly represented. The level of presence of these is from 9 to 36 percent. Of the characteristic species, the species *Coronilla vaginalis* Lam. is missing, which we classify among characteristic species of the western European alliance *Erico-Pinion sylvestris* Br.-Bl. and Br.-Bl. et al. nom. nov. A particularity of our phytocenosis is also the absence of the leading tree species, *Pinus nigra*, which is completely replaced by the tree species *Pinus sylvestris*. This is similar to some described phytocenoses on the Austrian side of the Karavanke (AICHINGER 1933, BRAUN-BLANQUET et al. 1939). A comparison of our phytocenosis with other phytocenoses of *Fraxino orni-Pinetum nigrae* shows that ours can only be classified in the association *Fraxino orni-Pinetum nigrae*. This is also confirmed by Sørensen's index of similarity (σ) in a comparison between the original phytocenosis of Martin-Bosse and our phytocenosis, which is 67. The entire floristic composition of the phytocenosis, shown in Phytocenological Table 1, demonstrates relatedness to the association *Fraxino orni-Pinetum nigrae* and does not allow the possibility of defining a new association. No

species stands out that could be synsystematically and synecologically individually characterise a difference from described similar Austrian pine or Scots pine phytocenoses. The only difference of our phytocenosis is the absence of the species *Pinus nigra*. The authors have resolved the increased level of presence and medium cover value of the species *Pinus sylvestris* in the phytocenoses of T. WRABER (1979) and POLDINI (1999) by a division of the association into two sub-associations, »*pinetosum nigrae*« in »*pinetosum sylvestris*«. AICHINGER (1933) and BRAUN-BLANQUET et al. (1939) already indicated such a division. The aforementioned division causes certain quandaries because of the appearance of other phytocenoses in the synsystematic rank of sub-association, which are described and well documented on the basis of ecological, floristic, phytogeographic or other conditions, and one or other species of pine, *Pinus nigra* or *P. Sylvestris*, is represented in them to a greater extent.

Our phytocenosis is divided into two sub-associations.

The sub-association *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 *laricetosum* subass. nova is a newly described sub-association in the Savinja valley, where the Savinja Alps border on the Karavanke. It grows on higher lying, more acid habitats, for the most part south facing (but because of the altitude, in general in a cold climate) and steep slopes. It is distinguished by the species *Picea abies* (L.) Karsten, *Larix decidua* Miller, *Vaccinium myrtillus* L. and *Senecio abrotanifolius* L. All species are acidophilic, since they prefer fresh, nutrient and base poor soils with acidic raw humus. They are semi-shade species (larch is a light loving species) which grow well in a humid climate. They are classified among characteristic species of spruce forests. In four relevés (Phytocenological Table 1: columns 1–4 n), which represent the sub-association, a poor representation of characteristic and distinguishing species of the association is evident. We think that it is an extreme form of the phytocenosis in ecologically extreme conditions (steepness, shallow soil). The difference of the sub-association is also demonstrated by numerous species of the class *Vaccinio-Piceetea* s. lat., some with greater cover, e.g., *Valeriana tripteris*, *Rhodothamnus chamaecistus*, *Rhododendron hirsutum*, *Adenotyles glabra*, *Gentiana asclepiadea* etc. In terms of ecological conditions and, consequently,

floristically, the sub-association is relatively similar to the sub-association *Fraxino orni-Pinetum nigrae rhodothamnetosum* Dakskobler 1998 (DAKSKOBLER 1998: 261). The holotype of the sub-association is relevé 4 in Phytocenological Table 1.

The second sub-association, *Fraxino orni-Pinetum nigrae* Martin (1961) *caricetosum humilis* Martin-Bosse 1967 is described in detail in papers by MARTIN-BOSSE (1967: 21–27) and POLDINI (1967). The sub-association grows in warm, dry, more or less extreme habitats (MARTIN-BOSSE 1967), which is also characteristic of our phytocenosis. In addition to distinguishing species of the sub-association, in it predominate species of the classes *Trifolio-Geranietea sanguinei*, *Seslerietea*, *Festuco-Brometea*, *Molinio-Arrhenatheretea* and *Thlaspietea rotundifolii*. The enumerated classes of non-forest vegetation indicate the openness of the habitat, which is also confirmed by the poor cover of the tree layer (50–60 %). The majority of these non-forest species have a pioneer role.

Phytocenological Table 1 presents the association *Fraxino orni-Pinetum nigrae* with 11 phytocenological relevés in the Upper Sava and Upper Savinja valleys, which differ in some details from described phytocenoses in the region of the Upper Soča valley (T. WRABER 1979, DAKSKOBLER 1998). By comparison, we find in our phytocenosis an impoverishment of diagnostic species and complete absence of the species *Pinus nigra*. There is also a difference in the presence of the species *Polygala nicaeensis* subsp. *forojulensis* in the phytocenosis of Upper Soča, which DAKSKOBLER (1998) described as a local (phytogeographic) distinguishing species for this region. Among the aforementioned phytocenoses, there is a minor difference in the number of non-forest species, which are for the most part modestly represented in our phytocenosis. A more considerable difference is in the greater presence of fagetal species in our phytocenosis. Our phytocenosis was probably created after storms on beech habitat, where beech could no longer be established because of the extreme habitat conditions, and it is a development through associations of Scots pine. The idea of the secondary nature of the association, especially the sub-association *caricetosum humilis* in the described region is confirmed mainly by the numerical presence of species of the order *Fagetalia* and partially the previously mentioned non-forest species.

3 COMPARISON OF PHYTOCENOSES

3.1 Research to date

We focused mainly on the most significant research of the association *Fraxino orni-Pinetum nigrae* in the southeast Alpine region, i.e., in southern Austria, northeast Italy and northern Slovenia. This region belongs for the most part to the Illyrian floral province or, more exactly, to the western Illyrian province, which according to MEUSL et al. (1965) borders on the pre-Noric-Slovene province.

The first investigator of a phytocenosis of Scots and Austrian pine, which refers to research of the association recognised today as *Fraxino orni-Pinetum nigrae*, was AICHINGER (1933), when he studied the vegetation of the northern slopes of the Karavanke. He called the phytocenosis *Pinetum silvestris ericetosum*. He published two phytocenological tables, of which the second shows a sub-association with the species *Pinus nigra*. In 1936 (in POLDINI 1969), Schmid mentioned in his monograph on Alpine »relict« pine forests a Scots pine phytocenosis for the region under discussion, under the name *Pinetum silvestris subillyricum*, but he did not define it exactly.

In the 1930s, BRAUN-BLANQUET and colleagues SISSINGH & VIEGER (1939) collected material for a monograph on the class *Vaccinio-Piceetea* in Europe, in which he also included six phytocenological relevés from Aichinger's table of the association *Pinetum silvestris ericetosum* and with Sissingh renamed it *Pinetum austroalpinum* (Aichinger 1933) Br.-Bl. & Sissingh 1939. This name was used right up to 1967, or even longer, when H. MARTIN-BOSSE (1967) carried out a review of this phytocenosis. Braun-Blanquet's renaming of the association corresponded in both phytogeographic and floristic senses (Scots pine forests of the Southern Alps).

The most extensive and thorough research was performed by H. MARTIN-BOSSE (1967). She had already dealt with the problem of Austrian pine forests in the southeast limestone Alps, with particular regard to Austrian Carinthia (Schwarzförenwälder in den südöstlichen Kalkalpen mit besonderer Rücksicht auf Kärnten) in 1961 in his dissertation. This basic work of hers provided the foundation for further supplementary study of pine forests. She decided to rename the association *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967. The renaming of the association was perhaps too narrow and it would have been better also to include Scots pine in the name of the association, e.g., *Fraxino orni-Pinetum nigrae-silvestris*. It seemed that in some places in the southeast limestone Alps, more or less pure stands of Scots pine forest appeared, which do not construct an independent phytocenosis and in terms of floristic inventory and, consequently, according to phytocenologi-

cal principles, are placed in the association *Fraxino orni-Pinetum nigrae*.

In Italy, POLDINI (1967, 1969, POLDINI & VIDALI 1999) were committed to research of pine forests. The report of the first two discussions is based on Poldini's research in the Carnic Alps in northern Italy, which border on the Austrian and Slovene southeast Alpine region. In a paper from 1969, Poldini refers to a dissertation by H. MARTIN (1961) and designates the association by the earlier, invalid name *Orno-Pinetum nigrare* Martin 1961. In a third synthesis paper on Austrian and Scots pine and European hop hornbeam and flowering ash (POLDINI & VIDALI 1999) he called the phytocenosis with Austrian pine according to the valid codex *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967. In this paper, influenced by T. WRABER (1979), he also studied a phytocenosis with Scots pine without hop hornbeam, as an independent sub-association.

In Slovenia, T. WRABER (1979) first more thoroughly tackled the problem of the phytocenosis of Austrian and Scots pine. He defined the phytocenosis according to Braun-Blanquet as *Pinetum austroalpinum* (Aichinger 1933) Br.-Bl. & Sissingh 1939, with two sub-associations – *pinetosum nigrae* (Aichinger 1933) Br.-Bl. & Sissingh 1939 and – *pinetosum silvestris* (Aichinger 1933) Br.-Bl. & Sissingh 1939. This principle of designation was long used here, also because of the influence of M. WRABER (1960), who in his review of forest vegetation discussed the association *Pinetum austroalpinum*. T. Wraber studied Austrian pine forests in the valley of the Koritnica (Julian Alps).

DAKSKOBLER (1998), similarly to T. Wraber, studied Austrian pine forests in the western Julian Alps on the heights by Treska pri Srpenici above the valley of the Tolminka, not far as the crow flies from the object of research of T. Wraber. He correctly called the phytocenosis by the valid codex *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 with a new sub-association – *rhodothamnetosum* Dakskobler 1998 - and two variants with the species *Rhododendron hirsutum* and *Asperula purpurea*. He justifiably characterised the phytocenosis as a geographic variant, to wit *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 var. geogr. *Polygala nicaeensis* subsp. *forojulensis* Dakskobler 1998. The endemic *Polygala nicaeensis* subsp. *forojulensis* is an excellent phytogeographic distinguishing species for the narrower region of the southeast Alpine region and not just a local distinguishing species, as Dakskobler states for his phytocenosis.

A year later, DAKSKOBLER (1998a) reported on the association *Fraxino orni-Pinetum nigrae* in the Govci forest reserve (Trnovski gozd) and then published ana-

lytical tables (DAKSKOBLER 1999), in which he described a new geographic variant of the species *Primula carniolica*. At the same time, he compared the associations *Fraxino orni-Pinetum nigrae* and *Genisto januensis-Pinetum* (ibid.).

H. MAYER & HOFMANN 1969, H. MAYER 1974, WALLNÖFER 1993 and others also wrote about Austrian pine phytocenoses in the eastern Alps. We should perhaps draw attention to WALLNÖFER'S (1993) standpoint that only the species *Euphorbia triflora* subsp. *Kernerii* counts as a characteristic species of the association *Fraxino orni-Pinetum nigrae* for the region of Austria and the species *Laserpitium peucedanoides* as a distinguishing species, with additional dominant and constant accompanying species, which are generally distributed not only in pine forests but also elsewhere. The species *Euphorbia triflora* subsp. *kernerii* is certainly an excellent characteristic species for the association *Fraxino orni-Pinetum nigrae* in the southeast Alpine space, together with other species stated in the synthesis Phytocenological Table 2. The species *Laserpitium peucedanoides* is also a southeast Alpine species but numerically widespread in other phytocenoses (e.g., *Rhodothamno-Rhododendretum hirsuti* or *Rhododendro hirsuti-Pinetum mugo*, *Genisto januensis-Pinetum*, *Carici sempervirentis-Pinetum nigrae*).

3.2 Similarity of phytocenoses in the southeast region

We took the following analytical tables of authors for comparison: MARTIN-BOSSE (1967) 5 tables, POLDINI (1967, 19669, POLDINI & VIDALI 1999) 3 tables, T. WRABER (1979) 1 table, DAKSKOBLER (1998) 1 table, ZUPANČIČ & ŽAGAR (in situ) 1 table, AICHINGER (1933) 2 tables and BRAUN-BLANQUET et al. (1939) 1 table. We additionally compared Austrian pine and Scots pine forests in the near vicinity from the Dinarid or transitional Dinarid-southeast Alpine region. We compared them to two analytical tables, by ACCETTO (1993, 2001) and TOMAŽIČ (1940). The synthesis Phytocenological Table 2 summarises 18 analytical tables of the aforementioned authors. The comparisons showed us the floristic and vegetational (phytocenological) similarities and differences. On the basis of the comparison, we were able to establish the relatedness or differences of the phytocenoses. It was particularly important how many of the same or different species appear in the phytocenoses. The latter (different), we distinguished as possible diagnostically important species for one or another phytocenosis. We were able to define more exactly or more firmly the characteristic and distinguishing species of the phytocenosis *Fraxino orni-Pinetum nigrae* (Phytocenological Table 2).

3.2.1 Characteristic species of the association *Fraxino orni-Pinetum nigrae*

H. MARTIN-BOSSE (1967) distinguished 16 characteristic species for the association *Fraxino orni-Pinetum nigrae*, namely »... *Allium ochroleucum* (= *A. ericetorum*), *Asperula longiflora* (= *A. aristata* subsp. *longiflora*), *Bupleurum canalense*, *Centaurea scabiosa* subsp. *fritschii*, *Crepis froelichiana* subsp. *incarnata* (*C. slovenica*), *Cytisus purpureus* (= *Chamaecytisus purpureus*), *Daphne alpina* (poor!), *Laburnum alpinum* (poor!), *Ostrya carpinifolia*, *Peucedanum austriacum* subsp. *rablaense*, *Pinus nigra*, *Thymus longicaulis* ...«. The selected characteristic species, except for the species *Laburnum alpinum*, were taken into account in his tables, and the species *Coronilla emerus* var. *Emeroides* is added. Already during publication of the paper or vegetation tables, the author decided on the diagnostic unsuitability of the »characteristic species« *Laburnum alpinum* and, because of poor representation in the phytocenosis, had misgivings about the species *Daphne alpina* and *Galium purpureum*.

POLDINI (1969) for the most part accepted the characteristic species proposed by Martin-Bosse, but excluded the following: *Crepis froelichiana* subsp. *incarnata* (= *Crepis slovenica*), *Cytisus purpureus* (= *Chamaecytisus purpureus*) *Coronilla emerus*, *Fraxino ornus*, *Ostrya carpinifolia* and *Pinus nigra*; with this we join him in relation to our analysis of the frequency of appearance of the mentioned species, because they are also represented in other similar phytocenoses of Austrian pine (Phytocenological Table 2). His idea (finding) is that only the species *Euphorbia kernerii* and *Bupleurum canalense* are general (absolute) characteristic species for the association *Fraxino orni-Pinetum nigrae*. He classifies the species *Allium ochroleucum* (= *A. ericetorum*), *Asperula longiflora* (= *A. aristata* subsp. *longiflora*), *Centaurea scabiosa* subsp. *fritschii*, *Euphrasia cuspidata*, *Galium purpureum*, *Peucedanum austriacum* subsp. *rablaense* and *Thymus longicaulis* among regional (territorial) characteristic species, so of slightly lower diagnostic value. The species *Daphne alpina* and *Laburnum alpinum* are not represented in his phytocenosis.

DAKSKOBLER (1998) accepted Poldini's idea about the characteristic species of the association *Fraxino orni-Pinetum nigrae*. The absolute characteristic species are not present in his phytocenosis, only three territorial characteristic species, namely *Allium ochroleucum* (= *A. ericetorum*), *Asperula aristata* and *Euphrasia cuspidata*. He added the local distinguishing species *Polygala nicaeensis* subsp. *forojulensis*, which is an endemic and a good phytogeographic distinguishing species for the narrower region of the southeast Alpine space.

We return to the past, to AICHINGER's (1933) first description of a pine phytocenosis in the southeast Alpine space in the Karavanke. The original phytocenosis, the forerunner of the association *Fraxino orni-Pinetum nigrae*, was *Pinetum silvestris ericetosum* Aichinger 1933, for which Aichinger determined the following characteristic species: *Coronilla vaginalis*, *Cytisus purpureus* (= *Chamaecytisus purpureus*), *Daphne cneorum* and *Platanthera bifolia*. In 1939, Braun-Blanquet and Sissingh renamed the phytocenosis *Pinetum austroalpinum* (Aichinger 1933), Braun-Blanquet & Sissingh 1939 and, except for the species *Cytisus purpureus* (= *Chamaecytisus purpureus*), accepted all Aichinger's other characteristic species. Instead of the species *Cytisus purpureus* (= *Chamaecytisus purpureus*) they decided on the characteristic species *Epipactis atropurpurea* (= *E. atropurpurea*).

On the basis of the findings of the aforementioned authors, we compared the phytocenoses – association *Fraxino orni-Pinetum nigrae* (MARTIN-BOSSE 1967, POLDINI 1967, 1969, POLDINI & VIDALI 1999, T. WRABER 1979, DAKSKOBLER 1998, AICHINGER 1933, BRAUN-BLANQUET et al. 1939, ZUPANČIČ & ŽAGAR in situ) with the also close important (relevant) phytocenoses ACCETTO (1999, 2001) and TOMAŽIČ (1940) and concluded that the following species correspond to characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae*:

CHARACTERISTIC SPECIES

Allium ericetorum Thore (= *A. ochroleucum* Waldst. & Kit.)¹ (JVE)
Coronilla vaginalis Lam.² (JVE)
Daphne cneorum L.² (JVE)
Euphorbia triflora Schott, Nyman & Kotschy subsp. *kernerii* (Huter) Poldini¹ (JVA)
Euphrasia cuspidata Host¹ (JVA)
Galium purpureum L.¹ (JVA)
Petasites paradoxus (Retz.) Baumg.² (JVE)
Asperula aristata L. (& *A. aristata* subsp. *longiflora*)¹ (JVE)
Scleropodium purum (L. ap. Hedw.) Limpr.³

DISTINGUISHING SPECIES

Pinus mugo Turra subsp. *mugo*
Rhodothamnus chamaecistus (L.) Reichenb.
Salix glabra Scop.

It is clear from the previous content of this chapter that Martin-Bosse's very well identified five characteristic species (marked 1), two (marked 2), which excellently characterise the association *Fraxino orni-Pinetum nigrae*, are taken from Aichinger's phytocenosis, and two

are new, which supplement the ecological characteristics of the association. The majority of the characteristic species are southeast European (JVE) or southeast Alpine (JVA) species, the species *Asperula aristata* stands out, which POLDINI (1991) classifies among mediterranean-montane geoelements, but MEUSEL et al. (1992) among western Mediterranean-sub-Mediterranean species in the montane belt. The characteristic species *Euphrasia cuspidata* and *Euphorbia triflora* subsp. *kernerii* are relative endemics and stress in particular the phytogeographic position of the association *Fraxino orni-Pinetum nigrae*. The species *Allium ericetorum* is actually a southeast European-Illyrian species, its appearance is focused on the wider region of southeast Europe with transition into the Dinarid world, so it also appears in the phytocenoses of the associations *Genisto januensis-Pinetum* and *Daphno alpinae-Pinetum nigrae*. We could be sceptical of its classification among characteristic species but it gives the association *Fraxino orni-Pinetum nigrae* an ecological seal (sub-alpine rocky sunny habitat). The species *Petasites paradoxus* and *Scleropodium purum* (marked 3) are added to characteristic species. The mountain (altimontane) species *Petasites paradoxus* appears constantly, to a lesser or greater extent, exclusively in phytocenoses of *Fraxino orni-Pinetum nigrae*. Its presence indicates coarse, pioneer, rocky, scree, gravel or sandy, skeletal, humus poor, fresh, soil soaked during downpours. The moss *Scleropodium purum* prefers fresh, carbonate (dolomite) forest soils and is distributed to the tree line. In Slovenia, it achieves large cover value and permanence in phytocenoses of *Fraxino orni-Pinetum nigrae*. Because of its ecological indication, primarily pioneer character, it is classified among characteristic species, which corresponds to the general ecological conditions of the habitat of the phytocenosis *Fraxino orni-Pinetum nigrae*.

Comparative analysis (see Phytocenological Table 2) showed that the following proposed characteristic species of Martin-Bosse do not enter into consideration either because of poor or unilateral appearance (only in Martin-Bosse's phytocenoses): *Bupleurum canalense*, *Centaurea scabiosa* subsp. *fritschii*, *Coronilla emerus*, *C. emeroides* and *Daphne alpina*, or because of general distribution in other Austrian pine and Scots pine phytocenoses on carbonate bedrock: e.g., *Chamaecytisus purpureus*, *Crepis slovenica* (= *C. froelichiana* subsp. *incarnata*), *Epipactis atropurpurea* (proposed by Braun-Blanquet & Sissingh), *Fraxinus ornus*, *Laburnum alpinum* (also poorly represented), *Ostrya carpinifolia*, *Pinus nigra*, *Platanthera bifolia* (proposed by Aichinger) and *Thymus longicaulis*. The above findings for the mentioned species deprive them of the possibility of the position of good characteristic species. Some of the afore-

mentioned species also do not belong in the ranks of characteristic species of the phytocenosis *Fraxino orni-Pinetum nigrae* in terms of their ecological diagnosis. Perhaps because of the designation of the association, the species *Fraxinus ornus* could be ranked among relative characteristic species of the association. The diagnostic value of the species is limited because of its generally wide distribution in all pine forests on carbonate soils.

The distinguishing species of the association *Fraxino orni-Pinetum nigrae* show us its synhorological position. They are distributed in the eastern Alpine space, so they are good distinguishing species in comparison with pine forests of the Dinarid region. In addition to phytogeographic differentiation, they indicate ecological conditions in phytocenoses of *Fraxino orni-Pinetum nigrae*, where they thrive on dolomite/limestone fresh, base rich soils of the sub-alpine world or habitats adapted to it (steep, shallow, cold slopes of Alpine valleys).

In the central part of the eastern Alps (Gail and Carnic Alps) a specific phytogeographic form of the association *Fraxino orni-Pinetum nigrae* appears with the southeast European species *Peucedanum austriacum* (Jacq.) Koch subsp. *rablense* (Wulfen) Koch and the relative endemic of steno-Mediterranean origin *Polygala nicaeensis* Risso subsp. *forojulensis* (Kerner) Graebn.

3.2.2 Mutual similarity of phytocenoses

In identifying the characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae*, we were interested in the mutual similarity of phytocenoses from different regions of the southeast Alpine area, which is the area of their central distribution. We were primarily interested in similarities between the phytocenoses of MARTIN-BOSSE (1967) and ours (ZUPANČIČ & ŽAGAR in situ). Sørensen's index of similarity ($\sigma = 67$) indicates primary similarity, although characteristic and distinguishing species have poor values (are poorly represented) in our phytocenosis, as we already established in chapter 2.

We were also interested in the similarity between our phytocenosis and that of T. WRABER (1979) (Sørensen's index $\sigma = 42$) and ours and DAKSKOBLE's (1998) phytocenoses (index $\sigma = 51$) and among associated phytocenoses of the Upper Soča valley (T. WRABER 1979 and DAKSKOBLE 1998) and ours (index $\sigma = 54$). The mutual similarity of phytocenoses of the Upper Sava and Upper Savinja valleys and the Upper Soča valley is less than between the phytocenoses of Martin-Bosse and ours, although it is satisfactory. The lower index of similarity shows the correctness of distinguishing a geo-

graphic variant with the species *Polygala nicaeensis* subsp. *forojulensis*.

Together with these comparisons, the question occurs of how much is the similarity between the phytocenoses of T. Wraber or Dakskobler and the phytocenosis of Martin-Bosse. The similarity between the phytocenoses of T. Wraber and Martin-Bosse is $\sigma = 51$, and between Dakskobler's and Martin-Bosse's $\sigma = 56$, which is satisfactory. Much better, and in all cases of comparison higher, is the index between the combined phytocenoses of T. Wraber and Dakskobler (Upper Soča) and that of Martin-Bosse (Austrian Carinthia), in which $\sigma = 70$.

We were also interested in the similarity between the phytocenoses of T. Wraber and Dakskobler. This is considerable (index $\sigma = 63$), which we also expected because of the vicinity of the objects of research in the Upper Soča valley.

We find that Sørensen's indexes of similarity of phytocenoses show satisfactory to good similarity and mutual equilibrium. The characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae* are well chosen in terms of their distribution (synhorology) and adaptability to ecological conditions and demonstrate the phytogeographic position and living conditions of the association *Fraxino orni-Pinetum nigrae*. The floristic content of phytocenoses of *Fraxino orni-Pinetum nigrae* is fairly matched and the following species completely or for the most part predominate in them; they could be characterised as species of the »characteristic combination« (see Phytocenological Table 2):

It was expected that species of the class *Erico-Pinetea* s. lat. would be represented uniformly and to the greatest extent in all phytocenoses – there are 18 of these; the species *Fraxinus ornus*, *Ostrya carpinifolia*, *Salix glabra*, *Carex humilis*, *Asperula aristata* and *Euphrasia cuspidata* from other classes can also be classified with them, since they have specific diagnostic value in the phytocenoses of *Fraxino orni-Pinetum nigrae*. The surprisingly eloquent representation of 15 species of the class *Quercu-Fagetea* s. lat. is surprising but, of these, 6 species are ecologically (thermophilic and cryophilic species) and partially synsystematically (*Quercetalia pubescentis*, *Prunetalia spinosae*, *Festuco-Brometea*) close to the class *Erico-Pinetea*; these are *Sorbus aria*, *Peucedanum oreoselinum*, *Polygonatum odoratum*, *Berberis vulgaris* and *Viburnum lantana*, to which we can add the species *Helleborus niger* subsp. *niger* (*Aremonio-Fagion*), which is a distinguishing species for the sub-alliance *Helleboro nigri-Pinenion*. A review of Phytocenological Table 2 shows that species of the class *Quercu-Fagetea* s. lat. have an ecological role in phytocenoses of *Fraxino*

ERICO-PINETEA s. lat.

ABSOLUTE

Chamaecytisus purpureus
Helleborus niger subsp. *niger**
Amelanchier ovalis
Daphne cneorum
Erica carnea
Polygala chamaebuxus
Epipactis atrorubens
Carex alba
Pinus sylvestris
Calamagrostis varia
Buphthalmum salicifolium
Platanthera bifolia
 VACCINIO-PICEETEA s. lat.
Picea abies

PREDOMINANT

Crepis slovenica
Cotoneaster tomentosus
Pinus nigra
Rhamnus saxatilis
Gymnadenia odoratissima

QUERCO-FAGETEA s.lat.

Helleborus niger subsp. *niger*
Cyclamen purpurascens
Fraxinus ornus
Ostrya carpinifolia
Sorbus aria
Peucedanum oreoselinum
Berberis vulgaris

Hieracium sylvaticum
Rubus saxatilis
Rhododendron hirsutum
Solidago virgaurea

Anemone trifolia
Fagus sylvatica
Melica nutans
Polygonatum odoratum
Pteridium aquilinum
Frangula alnus
Juniperus communis
Viburnum lantana

BETULO-ADENOSTYLETEA s.lat.
 (MULGEDIO-ACONITETEA)

TRIFOLIO-GERANIETEA s.lat.
Vincetoxicum hirundinaria
 NARDO-CALLUNETEA s. lat.

Salix glabra

Anthericum ramosum

Potentilla erecta
Genista germanica

SESLERIETEA s.lat.
Globularia cordifolia

Sesleria albicans
Biscutella laevigata

FESTUCO-BROMETEA s.lat.
Teucrium montanum

Euphorbia cyparissias
Carlina acaulis
Carex humilis
Prunella grandiflora
Asperula aristata & *A. a.* subsp. *longiflora* (?)
Galium verum

MOLINIO-ARRHENATHERETEA s.lat.
Lotus corniculatus

Betonica alopecuroides
Lathyrus pratensis
Euphrasia cuspidata

THLASPIETEA ROTUNDIFOLII s. lat.

Campanula caespitosa

OTHER SPECIES

Sorbus aucuparia subsp. *aucuparia*

* Razlikovalnica za *Helleboro-nigri-Pinenion*

orni-Pinetum nigrae, since they indicate occasionally fresh habitats, which enables the growth and survival of fagetal species. Indicators of fresh habitats are also the rarely represented species of the classes *Betulo-Adenos-*

tyletea (= *Mulgedio-Aconitetea*), *Scheuchzerio-Caricetea fuscae* s. lat. and *Thlaspietea rotundifolii* s. lat., as well as species of the class *Vaccinio-Piceetea* s. lat., of which there are five in the »characteristic combination«.

Among faetal species, species of the Illyrian alliance *Aremonio-Fagion* are noticeable, in *Fraxino orni-Pinetum nigrae* phytocenoses. These and other southeast European-Illyrian species are diagnostic of the Illyrian floral province.

On the basis of Sørensen's indexes of similarity of phytocenoses ($\sigma = 42-70$; frequently 54-56) and frequency of appearance of species of the »characteristic combination«, we conclude that all phytocenoses in the synthesis Phytocenological Table 2 in columns 1-14 are ranked in a uniform phytocenosis *Fraxino orni-Pinetum nigrae*. For additional confirmation of the uniform association *Fraxino orni-Pinetum nigrae*, we additionally analysed horological and phytocenological groups and the biological spectrum of the phytocenoses.

3.3 Horological groups

A comparison among phytocenoses of *Fraxino orni-Pinetum nigrae* described by the authors Zupančič & Žagar (Upper Sava valley and Upper Savinja valley), T. Wraber & Dakskobler (Upper Soča valley) and Martin-Bosse (Austrian Carinthia) showed no essential differences among horological groups. In some places there are somewhat lower or higher percentages among individual horological groups, as is evident from Table 1. One or

other deviations are noticeable differences in the sum of thermophilic and cryophilic horological groups. There is considerably more difference in the phytocenosis of Martin-Bosse, in which there is an increased amount of thermophilic horological groups (43.6 %) from the other two (37.4 % and 36.3 %, respectively). In all three phytocenoses, cryophilic horological groups predominate, which confirms that the habitat of the phytocenosis *Fraxino orni-Pinetum nigrae* in the pre-Alpine/Alpine region is moderately fresh.

3.4 Phytocenological groups

The analysis of phytocenological groups (Table 2) is in accordance with the findings stated in chapter 2 and with the analysis of the horology of the phytocenoses and, above all, it confirms the establishment of beech on some phytocenoses of the Upper Sava and Upper Savinja regions (Zupančič & Žagar) or the variant of Martin-Bosse with the species *Fagus sylvatica* (Phytocenological Table 2, column 5). These phytocenoses have fewer species of the class *Erico-Pinetea*, which suggests their secondary nature. The most pinetal is the phytocenosis of the Upper Soča (T. Wraber & Dakskobler) with a lower percentage of species of the classes of grassland plants *Festuco-Brometea* s. lat. and *Molinio-Arrhenatheretea*, which ranks it

GEOELEMENTS	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse
	%	%	%	%	%	%
Euromediterranean	3.1	1.4	2.7			
Mediterranean-montane	19.9	20.5	21.3			
Mediterranean-Atlantic	0.5	0.7	0.5			
Mediterranean-Pontic	2.0	1.4	2.7			
Pontic	4.1	4.1	3.8			
Southeast European	1.6	0.7	3.3			
Southern Illyrian	3.6	3.4	3.3			
Northern Illyrian	2.6	2.7	4.9			
Sub-Atlantic		0.7	1.1			
Stenomediterranean		0.7		37.4	36.3	43.6
European	16.8	15.1	16.9			
Euroasian	13.2	8.9	12.5			
Eurosiberian	6.1	4.8	7.1			
Paleotemperate	5.1	3.4	2.7			
Circumboreal	7.6	7.5	3.1			
Alpine	2.6	4.1	3.3			
Alpine-Carpathian	0.5	0.7				
Eastern Alpine	1.6	3.4	2.7			
Southeast Alpine	0.5	0.7	1.1			
Arctic-Alpine	1.0	1.4	1.6			
Endemic	1.0	1.4	1.6			
Cosmopolitan	0.5	1.4	0.5			
Chance		0.7				
Undefined species	6.1	10.2	3.3	62.6	63.7	56.4
TOTAL	100.0	100.0	100.0			

Table 1: Horological groups in the association *Fraxino orni-Pinetum nigrae*

PHYTOCENOLOGICAL GROUPS	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse
	%	%	%
<i>Erico-Pinetea</i>	11.7	19.5	16.7
<i>Vaccinio-Piceetea</i>	16.3	10.0	10.4
<i>Quercio-Fagetea</i>	28.5	20.1	25.0
<i>Adenostylo-Betuletea (=Mulgedio-Aconitetea)</i>	3.1	2.5	1.5
<i>Epilobietea</i>	1.5	0.6	1.0
<i>Trifolio-Geranietea</i>	6.1	8.8	6.7
<i>Nardo-Callunetea</i>	2.1	1.3	1.0
<i>Seslerietea</i>	7.7	6.3	6.7
<i>Festuco-Brometea</i>	8.6	6.3	10.4
<i>Molinio-Arrhenatheretea</i>	6.7	4.4	5.7
<i>Scheuchzerio-Caricetea fuscae</i>	2.1	2.5	2.0
<i>Thlaspietea rotundifolii</i>	1.5	3.8	4.1
<i>Asplenietea trichomanis</i>	1.5	5.7	5.7
Undefined species	2.6	8.2	3.1
TOTAL	100.0	100.00	100.0

Table 2: Phytocenological groups in the association *Fraxino orni-Pinetum nigrae*

among more or less optimal phytocenoses of *Fraxino orni-Pinetum nigrae*. The most balanced, one could even say standard, is the phytocenosis of Martin-Bosse from Austrian Carinthia, which is shown by comparison with the previously mentioned phytocenoses. The standard nature or optimality of this phytocenosis is conditioned or confirmed by the number (67) and geographic breadth (on a large area) of the phytocenological relevés.

3.5 Biological spectrum

Deviations between individual phytocenoses are not great. There are slightly higher percentages of phanero-

phytes and chamaephytes and a lower percentage of chamaecryptophytes in the phytocenoses of T. Wraber and Dakskobler in the Upper Soča valley but these deviations are not essential. It can be said that the phytocenosis *Fraxino orni-Pinetum nigrae* in the Upper Soča valley grows in slightly more difficult living conditions. The biological spectrum of all three (four) phytocenoses indicates the living conditions that prevail between the temperate and mountain belt. It could be said that in some regions, living conditions are closer to those in the mountain belt, mainly because of the higher percentage of geophytes. The situation of the investigated areas fully corresponds to the analysis of the biological spectrum.

LIFE FORM	Zupančič & Žagar	T. Wraber & Dakskobler	Martin-Bosse
	%	%	%
PHANEROPHYTES PHANEROPHYTA	15.3	19.1	17.5
P. scap.	5.6	6.8	6.0
P. caesp.	5.6	6.8	6.0
NP	4.1	5.5	5.5
CHAMAEPHYTES – CHAMAEPHYTA	17.8	21.3	16.9
Ch. suffr.	8.7	10.3	9.3
Ch. rept.	1.5	2.1	2.7
Ch. frut	1.5	0.7	2.2
B. Ch.	5.6	7.5	2.7
L. Ch.	0.5	0.7	
HEMICRYPTOPHYTES – HEMICRYPTOPHYTA	47.9	41.8	48.9
H. scap.	34.2	27.4	32.8
H. ros.	7.1	8.2	9.3
H. caesp.	5.6	6.2	6.0
H. rept.	1.0		0.6
GEOPHYTES – GEOPHYTA	16.4	15.7	13.6
G. rhiz.	12.8	11.6	9.8
G. bulb.	3.6	3.4	2.7
G. rad.		0.7	1.1
THEROPHYTES – THEROPHYTA	2.6	2.1	3.3
T. scap.	2.6	2.1	3.3
TOTAL	100.0	100.	100.0

Table 3: Biological spectrum of the association *Fraxino orni-Pinetum nigrae*

4 DISCUSSION AND CONCLUSIONS

On the basis of floristic and vegetational analysis, we resolved the question of the classification of phytocenoses belonging to the association *Fraxino orni-Pinetum nigrae* in the area of the Upper Sava valley and Upper Savinja valley (Zupančič & Žagar) and those of Aichinger and Braun-Blanquet & Sissingh from the Austrian part of the Karavanke, and partially from the area of the Upper Soča valley (T. Wraber), where the leading tree species *Pinus nigra* is not present but only *P. sylvestris*. In addition, the question arose of whether it would not be better and more exact from synsystematic and ecological points of view for the author H. Martin-Bosse to have more clearly designated the association, namely *Fraxino orni-Pinetum sylvestris-nigrae*. Analysis of the phytocenosis of Scots pine on carbonate bedrock of the south-east Alpine region did not show any syntaxonomic, synecological or synhorological particularities that would allow it to be distinguished as an individual association.

Phytocenoses of *Fraxino orni-Pinetum nigrae* are in various states of development in different regions of the southeast Alpine space – from initial, pioneer or substitute to optimal. In view of the appearance of the association's characteristic and distinguishing species and also in view of the floristic content, the phytocenoses of Martin-Bosse and Poldini (Phytocenological Table 2, columns 1 and 7) are closest to the optimal state, the others are somewhere in the middle, and in them some phytocenological relevés even indicate a starting, initial state of the phytocenosis. Some forms of the phytocenosis have been created secondarily on primary habitats of other phytocenoses, e.g., on primary habitats of beech forest.

The phytogeographic position of the southeast Alpine space is somewhat complicated, because it is governed by both the Illyrian and Noric (pre-Noric-Slovene) floristic provinces. This appears in the intermixture of southeast European-Illyrian and southeast European, southeast Alpine and eastern Alpine species, which is clearly shown in the synthesis Phytocenological Table 2. On the basis of the floristic and vegetational (synsystematic) analysis, we decided in agreement with H. Martin-Bosse to classify the association *Fraxino orni-Pinetum nigrae* into the Illyrian alliance of pine *Fraxino orni-Pinetum nigrae-sylvestris* (Ht. 1958) Zupančič 2007 (= *Orneto-Ericetum* Ht. 1958) and in our opinion in the sub-alliance *Helleboro nigri-Pinion* (Ht. 1959) Zupančič 2007 (= *Orneto-Ericion dolomiticum* Ht. 1959).

The selection or decision on characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae* enabled us inter-comparison of phytocenoses of *Fraxino orni-Pinetum nigrae*, with supple-

mentary comparisons of pine phytocenoses of the Illyrian floral province from the Slovene Dinarids, i.e., TOMAŽIČ's (1940) association *Genisto januensis-Pinetum* and ACCETTO's (1999, 2001) associations *Daphno alpinae-Pinetum nigrae* and *Carici sempervirentis-Pinetum nigrae*. On the basis of comparison, we more or less objectively determined the characteristic and distinguishing species of the association *Fraxino orni-Pinetum nigrae*. The characteristic species were selected from the phytocenoses of Martin-Bosse, Aichinger and Braun-Blanquet & Sissingh. The distinguishing species are new and relate to differentiation between the association *Fraxino orni-Pinetum nigrae* and the associations *Genisto januensis-Pinetum*, *Daphne alpinae-Pinetum nigrae* and *Carici sempervirentis-Pinetum nigrae*. In the comparison, it appeared that we must partially change the characteristic species of the association *Genisto januensis-Pinetum*. The species *Chamaecytisus purpureus* and *Crepis slovenica* (= *C. incaranta*), because of their general distribution in associations of pine forests, cannot have the position of characteristic species for the association *Genisto januensis-Pinetum*. Only the species *Genista januensis*, *Potentilla carniolica* and *Daphne blagayana* therefore remain characteristic species for the association. A distinguishing species is added for the association *Genisto januensis-Pinetum*, namely the southeast European-Illyrian species *Hacquetia epipactis* (Scop.) DC., which very well distinguishes the phytocenosis from the previously mentioned associations *Fraxino orni-Pinetum nigrae*, *Daphno alpinae-Pinetum nigrae* and *Carici sempervirentis-Pinetum nigrae*.

The comparison of pine phytocenoses in the synthesis Phytocenological Table 2, between the association *Fraxino orni-Pinetum nigrae* and the aforementioned associations *Genisto-Pinetum*, *Daphno-Pinetum* and *Carici-Pinetum*, shows a different appearance of southeast European and eastern Alpine species. There are far fewer southeast European and eastern Alpine species in the associations *Genisto januensis-Pinetum*, *Daphno alpinae-Pinetum nigrae* and *Carici sempervirentis-Pinetum nigrae*, which is understandable given that they belong to the Dinarid or intermediate Dinarid-southeast Alpine region. However, there are considerably more southeast European and eastern Alpine species in the associations *Daphno alpinae-Pinetum nigrae* and *Carici sempervirentis-Pinetum nigrae*, which brings the phytocenosis *Fraxino orni-Pinetum nigrae* close to the association.

In the paper, a sub-association *Fraxino orni-Pinetum nigrae laricetosum* in the area of the Karavanke and Savinja Alps is newly described, in which the leading tree species *Pinus nigra* is lacking.

5 POVZETEK

5.1 Uvod

V jugovzhodnem območju, zlasti na Balkanskem polotoku, je črni bor *Pinus nigra* Arnold s. lat. zanimiva vrsta in jo jugovzhodnoevropski fitocenologi bolj ali manj upravičeno uvrščamo med jugovzhodnoevropsko-ilirske geoelemente. V tem prostoru se kot avtohtona vrsta pojavlja disjunktno od majhnih, morda hektar velikih, do zelo obsežnih površin, predvsem v osrednjem delu Balkanskega polotoka. V Sloveniji je domoroden le na manjših površinah. Na večjih površinah je črni bor sajen kot pionir na kraškem svetu, najbolj je z njim pogozden Kras, kjer gradi sekundarno fitocenozo s podstojno avtohtono vegetacijo puhastega hrasta (ZUPANČIČ & ŽAGAR 2008).

V Sloveniji poznamo le klasično podvrsto črnega bora – *Pinus nigra* Arnold subsp. *nigra* (= *P. nigra* Arnold subsp. *austriaca* Aschers & Graebn.).

Glavni areal črnega bora *Pinus nigra* je v montanskem pasu submeridionala, deloma se pojavlja tudi v montanskem pasu meridionala oceanske Evrope, in je submediteransko (disjunktno mediteranski) florni element montanskega pasu (MEUSEL et al. 1965). OBERDORFER (1979) ga šteje za jugovzhodnoevropsko vrsto. POLDINI (1991) pa ga uvršča med južnoilirske vrste. Razširjenost črnega bora v njegovem naravnem okolju je na splošno disjunktna, in sicer od severnega roba Sredozemlja, to je od Španije do Male Azije, ter v severovzhodnem delu Afrike (ACCETTO et al. 1986, MEUSEL et al. 1965 – Karte: 22).

ŠERCELJ (1996) navaja, da je bor – *Pinus* s. lat. najbolj razširjeno evroazijsko drevo, kar mu omogoča njegova ekološka širina.

ACCETTO s sodelavcema (1986) povzema po Mirovu, da črni bor svoj areal naseljuje že od pleistocena dalje. Tudi ŠERCELJ (1996) za območje Slovenije ponovi, da je bil bor – *Pinus* s. lat. vedno prisoten v vseh pelodnih sedimentih in je imel v glacialih največji delež ozemlja.

Črni bor je zelo variabilna vrsta, nastale so mnoge morfološke in fiziološke razlike, verjetno zaradi diskontinuiranosti in razširjenosti. Znane so mnoge podvrste, varietete in forme. (VIDAKOVIĆ 1980, ACCETTO et al. 1986). Na osrednjem Balkanskem polotoku se pojavljata taksona *Pinus nigra* Arnold subsp. *nigra* var. *dalmatica* Visiani (Dalmacija in Hercegovina), *Pinus nigra* Arnold subsp. *caramanica* Rehd. (= *Pinus nigra* Arnold subsp. *pallasiana* Aschers & Graebn. v Makedoniji) in še mnogi bolj ali manj priznani taksoni (npr. *Pinus nigra* Arnold subsp. *gocensis* Džordžević, *Pinus nigra* Arnold var. *sharganica* F. Novak).

Črni bor je fotofilna, kserofilna in pionirska vrsta, ki naseljuje ekstremna rastišča, predvsem suha, skalnata, plitva, s hranili revna tla na dolomitu, apnencu, peridotitu in serpentinitih v nadmorskih višinah od 250–1400 (1600) m. Dobro prenaša klimatske skrajnosti in naseljuje s hranili revna rastišča, kjer ne morejo uspevati druge drevesne vrste (VIDAKOVIĆ 1980, ŠERCELJ 1996, ACCETTO et al. 1986).

Črni bor je odličen za pogozdovanje v aridni in semiaridni (suhi) klimi na skalnatih tleh. V Sloveniji so z njim uspešno pogozdovovali Kras, kjer se tudi spontano razširja. V mladosti hitro raste, v starosti pa se bolj debeli in je višinski prirastek manjši (VIDAKOVIĆ 1980, ŠERCELJ 1996, ACCETTO et al. 1986).

Pri nas je črni bor spontan – avtohton in gradi več primarnih fitocenz. Posebno pozornost je črnemu boru in njegovim fitocenzam posvečal I. HORVAT (1959, 1974), ki je borove gozdove v fitocenološkem smislu razdelil v dve podzvezi, v katerih ima pomembno vlogo črni bor, in sicer na dolomitu *Helleboro nigri-Pinenion* (Ht. 1959) Zupančič 2007 nom. nov. (= *Orno-Ericion dolomiticum* Ht. 1959) in na serpentinoidih *Asplenio cuneifoliae-Pinenion* (Ht. 1959) Zupančič 2007 nom. nov. (= *Orno-Ericion serpentanicum* Ht. 1959). Podzvezi pa uvrščamo v zvezo *Fraxino orni-Pinion nigrae-sylvestris* (Ht. 1953) Zupančič 2007 nom. nov. Ta delitev velja za ilirsko florno provinco, vključno z jugovzhodnoalpskim območjem. V srednjeevropski provinci pa so borovi gozdovi vključeni v zvezo *Erico-Pinion sylvestris* Br.-Bl. in Br.-Bl. et al. 1939 nom. inv.

Do sedaj so znana (opisana) tri območja primarne fitocenoze črnega bora *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 v Sloveniji (T. WRABER 1979, DAKSKOBLER 1998, ZUPANČIČ & ŽAGAR in situ). Povsod je bolj ali manj primešana vrsta *Pinus sylvestris* L., le v fitocenozi, ki sta jo opisala Zupančič & Žagar, ni vrste *Pinus nigra*. Fitocenozi *Carici sempervirentis-Pinetum nigrae* Accetto 1999 in *Daphno alpinae-Pinetum nigrae* Accetto 2001 vsebujeta izključno le vrsto *Pinus nigra*. Opozoriti moramo še na fitocenozo *Genisto januensis-Pinetum sylvestris* Tomažič 1940, v kateri se pojavlja fitocenoza z vrsto *Pinus nigra* kot subasociacija *Genisto januensis-Pinetum* subsp. *pinetosum nigrae* Tomažič 1940.

Pojavljanje borovih gozdov v Sloveniji smo spremljali že od šestdesetih let dvajsetega stoletja do danes in občasno beležili fitocenološke popise. Kljub nazornima predstavama jugovzhodnoalpske fitocenoze *Fraxino orni-Pinetum nigrae* kolegov T. WRABERJA (1979) in DAKSKOBLERJA (1998) smo se odločili objaviti fitocenoze z vzhodnega obrobja jugovzhodnoalpskega območja, ki ga omenjena avtorja nista zajela.

Raziskovali smo po standardni (srednjeevropski) fitocenološki metodi. Floristična nomenklatura je uporabljena po Mali flori Slovenije (MARTINČIČ et al. 2007). Življenjske oblike po Raunkierju smo določili na osnovi POLDINIJEVE (1991) monografije, enako tudi horološke skupine geoelementov.

5.2 Fitocenoza na vzhodnem obrobju jugovzhodnoalpske Slovenije

Fitocenozo *Fraxino orni-Pinetum nigrae* smo popisovali na območju Savinjskih Alp v severozahodnem delu Savinjske doline (Huda goša, Veža – Planica, Tolsta peč), v vzhodnih (Sedlec in Rogovilc pod Raduho) in v osrednjih Karavankah (Tabre pri Martuljku na Gorenjskem) ter v severovzhodnih Julijskih Alpah (Mala Pišnica pri Kranjski Gori na Gorenjskem). Nadmorske višine so od 690 do 1315 m, večinoma strma južna pobočja imajo naklon od 20 do 70°. Geološka podlaga je dolomit, dolomiti apnenec, apnenec in dolomitna morena. Rastišče fitocenoze v glavnem ni kamnito. Drevesna plast, ki jo gradijo vrste *Pinus sylvestris*, *Larix decidua*, *Picea abies* in deloma *Fagus sylvatica*, *Sorbus aria* in *Abies alba*, pokriva od 50 do 80 % raziskovane površine. Grmovna plast je razmeroma bogata s termofilnimi in skiofilnimi grmišči in pokriva od 10 do 40 % raziskovane površine. Zelo bogata je zeliščna plast, večinoma s 100-odstotno pokrovnostjo. V zeliščni plasti prevladujejo z dvotretjinskim deležem sencoljubne in hladoljubne vrste. Med njimi je slaba tretjina fagetalnih, slaba petina piceetalnih in dobra desetina pinetalnih vrst, ostalo so negozdne vrste. Mahovne vrste so slabo zastopane. V analitični Fitocenološki tabeli 1 je skupno 196 vrst. Absolutno večino ima vaskularna flora, praprotnic je 2 % in mahov z lišajem 6 %.

V naši fitocenozi značilnice in razlikovalnice asociacije *Fraxino orni-Pinetum nigrae* niso prepričljivo zastopane. Stopnja navzočnosti le-teh je od 9 do 36-odstotna. Od značilnic manjka vrsta *Coronilla vaginalis* Lam., ki jo uvrščamo med značilnice zahodnoevropske zveze *Erico-Pinion sylvestris* Br.-Bl. in Br.-Bl. et al. nov. Posebnost naše fitocenoze je tudi odsotnost vodilne drevesne vrste *Pinus nigra*, ki jo v celoti zamenjuje drevesna vrsta *Pinus sylvestris*. Ta primer je podoben nekaterim opisanim fitocenzam na avstrijski strani Karavank (AICHINGER 1933, BRAUN-BLANQUET et al. 1939). Primerjava naše fitocenoze z drugimi fitocenzami *Fraxino orni-Pinetum nigrae* kaže, da je našo mogoče uvrstiti le v asociacijo *Fraxino orni-Pinetum nigrae*. To potrjuje tudi Sørensenov indeks podobnosti (σ) v primerjavi med izvorno fitocenozo Martin-Bossejeve in našo fitocenozo, ki je 67. Celotna floristična sestava fitocenoze, prika-

zana v Fitocenološki tabeli 1, kaže sorodnost z asociacijo *Fraxino orni-Pinetum nigrae* in ne daje možnosti za opredelitev nove asociacije. Nobena vrsta ne izstopa, da bi sinsistematsko in sinekološko posebej označevala razliknost od opisanih podobnih črnoborovih ali rdečebovovih fitocenzov. Razliknost naše fitocenoze je le v odsotnosti vrste *Pinus nigra*. Povečano stopnjo navzočnosti in srednje pokrovne vrednosti vrste *Pinus sylvestris* v fitocenzah T. WRABERJA (1979) in POLDINIJA (1999) sta avtorja reševala z delitvijo asociacije v dve subasociaciji, »*pinetosum nigrae*« in »*pinetosum sylvestris*«. Tako delitev sta nakazovala že AICHINGER (1933) in BRAUN-BLANQUET et al. (1939). Omenjena delitev povzroča določene zadrege zaradi pojavljanja drugih fitocenzov v sinsistematskem rangu subasociacij, ki so opisane in dobro dokumentirane na osnovi ekoloških, florističnih, fitogeografskih ali drugih razmer, v njih pa je v večji meri zastopana ena ali druga vrsta bora – *Pinus nigra* ali *P. sylvestris*.

Naša fitocenoza se deli na dve subasociaciji.

Subasociacija *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 *laricetosum* subass. nova je novo opisana subasociacija v Savinjski dolini, kjer Savinjske Alpe mejijo na Karavanke. Porašča višje ležeča bolj zakisana rastišča, večinoma južna (vendar zaradi nadmorske višine na splošno v hladnem podnebnju) in strma pobočja. Razlikujejo jo vrste *Picea abies* (L.) Karsten, *Larix decidua* Miller, *Vaccinium myrtillus* L. in *Senecio abrotanifolius* L. Vse vrste so kisloljubne, saj preferirajo sveža, s hranili in bazami revna tla s kislim surovim humusom. So polsenčne vrste (macesen je svetloljuben), ki dobro uspevajo v humidni klimi. Uvrščamo jih v značilnice smrekovih gozdov. V štirih popisih (Fitocenološka tabela 1: stolpci 1–4), ki predstavljajo subasociacijo, je razvidna slaba zastopanost značilnic in razlikovalnic asociacije. Mislimo, da gre za skrajno obliko fitocenoze v ekološko skrajnih razmerah (strmina, plitva tla). Razliknost subasociacije nakazujejo tudi številnejše vrste razreda *Vaccinio-Piceetea* s. lat., nekatere z večjo pokrovnostjo, npr. *Valeriana tripteris*, *Rhododendron chamaecistus*, *Rhododendron hirsutum*, *Adenotyles glabra*, *Gentiana asclepiadea* idr. Subasociacija je glede ekoloških razmer in posledično floristično razmeroma podobna subasociaciji *Fraxino orni-Pinetum nigrae rhododamnetosum* Dakskobler 1998 (DAKSKOBLER 1998: 261). Holotip subasociacije je popis 4 v Fitocenološki tabeli 1.

Druga subasociacija *Fraxino orni-Pinetum nigrae* Martin (1961) *caricetosum humilis* Martin-Bosse 1967 je podrobno opisana v razpravah MARTIN-BOSSEJEVE (1967: 21–27) in POLDINIJA (1967). Subasociacija porašča topla, suha, bolj ali manj ekstremna rastišča (MARTIN-BOSSE 1967), kar je značilno tudi za našo fitocenozo.

Poleg razlikovalnic subasociacije v njej prevladujejo vrste razredov *Trifolio-Geranietea sanguinei*, *Seslerietea*, *Festuco-Brometea*, *Molinio-Arrhenatheretea* in *Thlaspietea rotundifolii*. Našteti razredi negozdne vegetacije kažejo na odprtost rastišča, kar potrjuje tudi slaba zastrtost drevesne plasti (50–60 %). Večina teh negozdnih vrst ima pionirsko vlogo.

V Fitocenološki tabeli 1 je predstavljena asociacija *Fraxino orni-Pinetum nigrae* z 11 fitocenološkimi popisi v Zgornji Savski in Zgornji Savinjski dolini, ki se v nekaterih podrobnostih razlikuje od opisanih fitocenoza na območju Zgornjega Posočja (T. WRABER 1979, DAKSKOBLER 1998). Z medsebojno primerjavo v naši fitocenozi ugotavljamo obubožanost diagnostičnih vrst in popolno odsotnost vrste *Pinus nigra*. Razlika je tudi v prisotnosti vrste *Polygala nicaeensis* subsp. *forojulensis* v fitocenozah Zgornjega Posočja, ki jo DAKSKOBLER (1998) za to območje opredeljuje kot lokalno (fitogeografsko) razlikovalnico. Med omenjenimi fitocenozi je manjša razlika v številčnosti negozdnih vrst, ki so s skromno večino zastopane v naši fitocenozi. Precejšnja razlika je v večji prisotnosti fagetalnih vrst v naši fitocenozi. Verjetno je naša fitocenoza nastala po ujmi na bukovem rastišču, kjer se zaradi ekstremnih rastiščnih razmer ni mogla ponovno uveljavljati bukev, in gre razvoj prek združbe rdečega bora. Misel na sekundarnost asociacije, zlasti subasociacije – *caricetosum humilis*, v opisanem območju potrjuje predvsem številčna prisotnost vrst reda *Fagetalia* ter deloma prej omenjenih negozdnih vrst.

5.3 Primerjava fitocenz

5.3.1 Dosedanje raziskave

Osredotočili smo se predvsem na najbolj odmevne raziskave asociacije *Fraxino orni-Pinetum nigrae* v jugovzhodnoalpskem območju, to je v južni Avstriji, severovzhodni Italiji in severni Sloveniji. To območje v glavnem pripada ilirski florni provinci oziroma natančneje, zahodni ilirski provinci, ki po MEUSLU et al. (1965) meji na prenorjsko-slovensko provinco.

Prvi raziskovalec fitocenoze rdečega in črnega bora, ki se nanaša na raziskave danes priznane asociacije *Fraxino orni-Pinetum nigrae*, je bil AICHINGER (1933), ko je preučeval vegetacijo severnih pobočij Karavank. Fitocenozo je poimenoval *Pinetum silvestris ericetosum*. Objavil je dve fitocenološki tabeli, druga tabela prikazuje subasociacijo z vrsto *Pinus nigra*. Schmid je leta 1936 (v POLDINI 1969) v svoji monografiji o alpskih »reliktnih« borovih gozdovih omenil za obravnavano območje rdečeborovo fitocenozo pod imenom *Pinetum silvestris subillyricum*, ki pa je ni natančneje opredelil.

V tridesetih letih dvajsetega stoletja je BRAUN-BLANQUET s sodelavcema SISSINGHOM & VLIJERJEM (1939) zbiral gradivo za monografijo o razredu *Vaccinio-Piceetea* v Evropi, v katero je vključil tudi šest fitocenoloških popisov iz Aichingerjeve tabele asociacije *Pinetum silvestris ericetosum* in jo s Sissinghom preimenoval v *Pinetum austroalpinum* (Aichinger 1933) Br.-Bl. & Sissingh 1939. To ime asociacije smo uporabljali vse do leta 1967 oziroma še dlje, ko je H. MARTIN-BOSSE (1967) opravila revizijo te fitocenoze. Braun-Blanquetovo poimenovanje asociacije je ustrezalo tako v fitogeografskem kot v florističnem pomenu (rdečeborov gozd južnih Alp).

Najobširnejše in temeljite raziskave je opravila H. MARTIN-BOSSE (1967). O problemu črnboborovih gozdov v jugovzhodnih apnenčastih Alpah s posebnim oziranjem na avstrijsko Koroško (Schwarzförenwälder in den südostlichen Kalkalpen mit besonderer Rücksicht auf Kärnten) je obravnavala že leta 1961 v svoji disertaciji. To njeno temeljno delo je osnova za nadaljnja dopolnilna preučevanja borovih gozdov. Odločila se je za poimenovanje asociacije *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967. Morda je poimenovanje asociacije preozko in bi bilo bolje vključiti v ime asociacije tudi rdeči bor, npr. *Fraxino orni-Pinetum nigrae-silvestris*. Izkazalo se je, da se ponekod v jugovzhodnih apnenčastih Alpah pojavljajo bolj ali manj čisti sestoji rdečeborovih gozdov, ki ne gradijo samostojne fitocenoze in jih po florističnem inventarju in posledično po fitocenoloških principih uvrščamo v asociacijo *Fraxino orni-Pinetum nigrae*.

V Italiji je zavzeto raziskoval borove gozdove POLDINI (1967, 1969, POLDINI & VIDALI 1999). Sporočilo prvih dveh razprav temelji na Poldinijevih raziskavah v Karnijskih Alpah v severni Italiji, ki mejijo na avstrijsko in slovensko jugovzhodnoalpsko območje. V razpravi iz leta 1969 se Poldini sklicuje na disertacijo H. MARTINOVE (1961) in asociacijo poimenuje s starejšim invalidnim imenom *Orno-Pinetum nigrare* Martin 1961. V tretji sintezni razpravi o črnem in rdečem boru ter črnem gabru in malem jesenu (POLDINI & VIDALI 1999) fitocenozo s črnim borom poimenuje po veljavnem kodeksu *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967. V tej razpravi je kot samostojna subasociacija pod vplivom T. WRABERJA (1979) preučena tudi fitocenoza z rdečim borom brez črnega bora.

V Sloveniji se je prvi temeljiteje lotil problema fitocenz črnega in rdečega bora T. WRABER (1979). Fitocenozo je opredelil po Braun-Blanquetu kot *Pinetum austroalpinum* (Aichinger 1933) Br.-Bl. & Sissingh 1939 z dvema subasociacijama – *pinetosum nigrae* (Aichinger 1933) Br.-Bl. & Sissingh 1939 in – *pinetosum silvestris* (Aichinger 1933) Br.-Bl. & Sissingh 1939. Ta princip poimenovanja se je dolgo časa uporabljal pri nas, tudi zaradi vpliva M. WRABERJA (1960), ki je v svojem pregledu

gozdne vegetacije razpravljaj o asociaciji *Pinetum austroalpinum*. T. Wraber je preučeval črno borove gozdove v dolini Koritnice (Julijske Alpe).

DAKSKOBLER (1998) je tako kot T. Wraber preučeval črno borove gozdove v zahodnih Julijskih Alpah na vzpetini Treska pri Srpenici nad dolino Tolminke, po zračni liniji ne daleč od raziskovanega objekta T. Wraberja. Fitocenozo je korektno poimenoval po uveljavljenem kodeksu *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 z novo subasociacijo – *rhododendretum* Dakskobler 1998 in dvema variantama z vrstama *Rhododendron hirsutum* in *Asperula purpurea*. Fitocenozo je upravičeno označil kot geografsko varianto, in sicer *Fraxino orni-Pinetum nigrae* Martin-Bosse 1967 var. geogr. *Polygala nicaeensis* subsp. *forojulensis* Dakskobler 1998. Endemit *Polygala nicaeensis* subsp. *forojulensis* je odlična fitogeografska razlikovalnica za ožje območje jugovzhodnoalpskega območja in ne le lokalna razlikovalnica, kot jo navaja za svojo fitocenozo Dakskobler.

Leto kasneje je DAKSKOBLER (1998a) poročal o asociaciji *Fraxino orni-Pinetum nigrae* v gozdnem rezervatu Govci (Trnovski gozd) ter nato objavil analitsko tabelo (DAKSKOBLER 1999), v kateri je opisal novo geografsko varianto z vrsto *Primula carniolica*. Hkrati je primerjal združbi *Fraxino orni-Pinetum nigrae* in *Genisto januensis-Pinetum* (ibid.).

O črno borovih fitocenozah vzhodnih Alp so še pisali H. MAYER & HOFMANN 1969, H. MAYER 1974, WALLNÖFER 1993 in drugi. Morda bi opozorili na WALLNÖFERJEVO (1993) stališče, da za značilnico asociacije *Fraxino orni-Pinetum nigrae* za območje Avstrije šteje le vrsto *Euphorbia triflora* subsp. *kernerii* in razlikovalno vrsto *Laserpitium peucedanoides* z dodatkom dominantnih in konstantnih spremljevalk, ki pa so splošno razširjene ne le v borovih gozdovih, temveč tudi drugod. Vrsta *Euphorbia triflora* subsp. *kernerii* je vsekakor odlična značilnica za asociacijo *Fraxino orni-Pinetum nigrae* v jugovzhodnoalpskem prostoru s še drugimi vrstami, ki so navedene v sintezni Fitocenološki tabeli 2. Vrsta *Laserpitium peucedanoides* je tudi jugovzhodnoalpska vrsta, vendar številčno razširjena v drugih fitocenozah (npr. *Rhododendro-Rhododendretum hirsuti* oz. *Rhododendro hirsuti-Pinetum mugo*, *Genisto januensis-Pinetum*, *Carici sempervirentis-Pinetum nigrae*).

5.3.2 Podobnost fitocenoz v jugovzhodnem območju

Za primerjavo smo vzeli naslednje analitične tabele avtorjev, in sicer MARTIN-BOSSE (1967) 5 tabel, POLDINI (1967, 19669, POLDINI & VIDALI 1999) 3 tabele, T. WRABER (1979) 1 tabelo, DAKSKOBLER (1998) 1 tabelo, ZUPANČIČ & ŽAGAR (in situ) 1 tabelo, AICHINGER (1933) 2

tabeli in BRAUN-BLANQUET et al. (1939) 1 tabelo. Dodatno smo primerjali še črno borove in rdeče borove gozdove bližnje sosesčine iz dinarskega oziroma prehodnega dinarsko-jugovzhodnoalpskega območja. Primerjali smo jih s po dvema analitičnima tabelama ACCETTA (1993, 2001) in TOMAŽIČA (1940). Sintezna Fitocenološka tabela 2 povzema 18 analitičnih tabel prej omenjenih avtorjev. Primerjave so nam pokazale floristične in vegetacijske (fitocenološke) podobnosti in razlike. Na osnovi primerjanj smo lahko ugotovili sorodnost ali različnost fitocenoz. Zlasti je bilo pomembno, koliko se v fitocenozah pojavljajo iste ali različne vrste. Slednje (različne) smo izločili kot morebitne diagnostično pomembne vrste za to ali ono fitocenozo. Natančneje in trdneje smo lahko opredelili ali potrdili značilnice in razlikovalnice fitocenoze *Fraxino orni-Pinetum nigrae* (Fitocenološka tabela 2).

5.3.2.1 Značilnice asociacije *Fraxino orni-Pinetum nigrae*

H. MARTIN-BOSSE (1967) je izločila 16 značilnic za asociacijo *Fraxino orni-Pinetum nigrae*, in sicer »... *Allium ochroleucum* (= *A. ericetorum*), *Asperula longiflora* (= *A. aristata* subsp. *longiflora*), *Bupleurum canalense*, *Centaurea scabiosa* subsp. *fritschii*, *Crepis froelichiana* subsp. *incarnata* (*C. slovenica*), *Cytisus purpureus* (= *Chamaecytisus purpureus*), *Daphne alpina* (slaba!), *Laburnum alpinum* (slaba!), *Ostrya carpinifolia*, *Peucedanum austriacum* subsp. *rablense*, *Pinus nigra*, *Thymus longicaulis* ...«. Izbrane značilnice so, razen vrste *Laburnum alpinum*, upoštevane v njenih tabelah, dodana pa jim je še vrsta *Coronilla emerus* var. *emeroides*. Avtorica se je že med objavo razprave oziroma vegetacijskih tabel odločila o diagnostični neustreznosti »značilnice« *Laburnum alpinum* in imela zaradi slabe zastopanosti v fitocenozah pomisleke o vrstah *Daphne alpina* in *Galium purpureum*.

POLDINI (1969) je v glavnem sprejel predlagane značilnice Martin-Bossejeve, izločil pa je naslednje *Crepis froelichiana* subsp. *incarnata* (= *Crepis slovenica*), *Cytisus purpureus* (= *Chamaecytisus purpureus*), *Coronilla emerus*, *Fraxinu ornus*, *Ostrya carpinifolia* in *Pinus nigra*; pri tem se mu pridružujemo glede na našo analizo pogostnosti pojavljanja omenjenih vrst, ker so zastopane tudi v drugih podobnih fitocenozah črnega bora (Fitocenološka tabela 2). Njegova misel (ugotovitev) je, da sta le vrsti *Euphorbia kernerii* in *Bupleurum canalense* splošni (absolutni) značilnici za asociacijo *Fraxino orni-Pinetum nigrae*. Vrste *Allium ochroleucum* (= *A. ericetorum*), *Asperula longiflora* (= *A. aristata* subsp. *longiflora*), *Centaurea scabiosa* subsp. *fritschii*, *Euphrasia cuspidata*, *Ga-*

lium purpureum, *Peucedanum austriacum* subsp. *rablaense* in *Thymus longicaulis* pa uvršča med območne (teritorialne) značilnice, torej jim nekoliko znižuje diagnostično vrednost. Vrsti *Daphne alpina* in *Laburnum alpinum* nista zastopani v njegovih fitocenozah.

DAKSKOBLER (1998) je sprejel Poldinijevo zamisel o značilnicah asociacije *Fraxino orni-Pinetum nigrae*. Absolutni značilnici v njegovi fitocenozi nista prisotni, le tri teritorialne značilnice, in sicer *Allium ochroleucum* (= *A. ericetorum*), *Asperula aristata* in *Euphrasia cuspidata*. Dodal je še lokalno razlikovalnico *Polygala nicaeensis* subsp. *forojulensis*, ki je endemit in dobra fitogeografska razlikovalnica za ožje območje v jugovzhodnoalpskem prostoru.

Vrnimo se v preteklost, k prvemu AICHINGERJEVEMU (1933) opisu borove fitocenoze v jugovzhodnoalpskem prostoru v Karavankah. Prvotna fitocenoza, predhodnica asociacije *Fraxino orni-Pinetum nigrae*, je bila *Pinetum silvestris ericetosum* Aichinger 1933, za katero je Aichinger določil naslednje značilnice: *Coronilla vaginalis*, *Cytisus purpureus* (= *Chamaecytisus purpureus*), *Daphne cneorum* in *Platanthera bifolia*. Leta 1939 sta Braun-Blanquet in Sissingh preimenovala fitocenozo v *Pinetum austroalpinum* (Aichinger 1933), Braun-Blanquet & Sissingh 1939 in sprejela razen vrste *Cytisus purpureus* (= *Chamaecytisus purpureus*) vse druge Aichingerjeve značilnice. Namesto vrste *Cytisus purpureus* (= *Chamaecytisus purpureus*) sta se odločila za značilnico *Epipactis atropurpurea* (= *E. atrorubens*).

Na osnovi ugotovitev omenjenih avtorjev smo medsebojno primerjali fitocenoze – asociacije *Fraxino orni-Pinetum nigrae* (MARTIN-BOSSE 1967, POLDINI 1967, 1969, POLDINI & VIDALI 1999, T. WRABER 1979, DAKSKOBLER 1998, AICHINGER 1933, BRAUN-BLANQUET et al. 1939, ZUPANČIČ & ŽAGAR in situ) s še bližnjimi bistveno pomembnimi (relevantnimi) fitocenozami ACCETTA (1999, 2001) in TOMAŽIČA (1940) ter zaključili, da bi značilnicam in razlikovalnicam asociacije *Fraxino orni-Pinetum nigrae* ustrezale naslednje vrste:

ZNAČILNICE

Allium ericetorum Thore (= *A. ochroleucum* Waldst. & Kit.)¹ (JVE)
Coronilla vaginalis Lam.² (JVE)
Daphne cneorum L.² (JVE)
Euphorbia triflora Schott, Nyman & Kotschy subsp. *kerneri* (Huter) Poldini¹ (JVA)
Euphrasia cuspidata Host¹ (JVA)
Galium purpureum L.¹ (JVA)
Petasites paradoxus (Retz.) Baumg.² (JVE)
Asperula aristata L. (& *A. aristata* subsp. *longiflora*?)¹ (JVE)
Scleropodium purum (L. ap. Hedw.) Limpr.³

RAZLIKOVALNICE

Pinus mugo Turra subsp. *mugo*
Rhodothamnus chamaecistus (L.) Reichenb.
Salix glabra Scop.

Iz prejšnje vsebine tega poglavja je razvidno, da je Martin-Bossejeva zelo dobro opredelila pet značilnic (označene so z 1), dve (označeni sta z 2), ki odlično označujeta asociacijo *Fraxino orni-Pinetum nigrae* sta vzeti iz Aichingerjeve fitocenoze, in dve sta novi, ki dopolnjujeta ekološke značilnosti združbe. Večina značilnic je jugovzhodnoevropskih (JVE) ali jugovzhodnoalpskih vrst (JVA), izstopa vrsta *Asperula aristata*, ki jo POLDINI (1991) uvršča med mediteransko-montanske geoelemente, MEUSEL et al. (1992) pa med zahodnomeditransko-submediteranske vrste v montanskem pasu. Značilnici *Euphrasia cuspidata* in *Euphorbia triflora* subsp. *kerneri* sta relativna endemita in še posebej poudarjata fitogeografski položaj asociacije *Fraxino orni-Pinetum nigrae*. Vrsta *Allium ericetorum* je pravzaprav jugovzhodnoevropsko-ilirska vrsta, njeno pojavljanje je osredotočeno na širše območje jugovzhodne Evrope s prehodom v dinarski svet, zato se pojavlja tudi v fitocenozah asociacije *Genisto januensis-Pinetum* in *Daphno alpinae-Pinetum nigrae*. Lahko bi bili skeptični glede njene uvrstitve med značilnice, vendar daje asociaciji *Fraxino orni-Pinetum nigrae* ekološki pečat (subalpinska kamnita osončena rastišča). Značilnicam sta dodani vrsti *Petasites paradoxus* in *Scleropodium purum* (označeni sta s 3). Gorska (altimontanska) vrsta *Petasites paradoxus* se stalno pojavlja v manjši ali večji meri izključno v fitocenozah *Fraxino orni-Pinetum nigrae*. S svojo prisotnostjo nakazuje surova, pionirska, kamnita, meljasta, prodnata oziroma pesknata, skeletna, s humusom revna, sveža, ob nalivih namočena tla. Mah *Scleropodium purum* preferira sveža karbonatna (dolomitna) gozdna tla in je razširjen do drevesne meje. Pri nas v fitocenozah *Fraxino orni-Pinetum nigrae* doseže veliko pokrovnost in stalnost. Zaradi njenih ekoloških pokazateljev, predvsem pionirskega značaja, ju uvrščamo med značilnice, kar ustreza splošnim ekološkim razmeram rastišča fitocenoze *Fraxino orni-Pinetum nigrae*.

Primerjalna analiza (glej Fitocenološko tabelo 2) je pokazala, da naslednje predlagane značilnice Martin-Bossejeve ne pridejo v poštev zaradi slabega ali enostranskega pojavljanja (le v fitocenozah Martin-Bossejeve), in sicer *Bupleurum canalense*, *Centaurea scabiosa* subsp. *fritschii*, *Coronilla emerus*, *C. emeroideis* in *Daphne alpina*, ali zaradi splošne razširjenosti v drugih črnohorovih in rdečehorovih fitocenozah na karbonatni podlagi, kot so *Chamaecytisus purpureus*, *Crepis slovenica* (= *C. froelichiana* subsp. *incarnata*), *Epipactis atrorubens* (predlog Braun-Blanqueta & Sissingha), *Fraxinus ornus*, *Labur-*

num alpinum (tudi slabo zastopana), *Ostrya carpinifolia*, *Pinus nigra*, *Platanthera bifolia* (predlog Aichingerja) in *Thymus longicaulis*. Gornji ugotovitvi za omenjene vrste odvzemata možnost položaja dobrih značilnic. Nekatere od navedenih vrst pa tudi po svoji ekološki diagnozi ne sodijo v vrste značilnic fitocenozo *Fraxino orni-Pinetum nigrae*. Morda bi kazalo zaradi poimenovanja asociacije vrsto *Fraxinus ornus* uvrstiti med relativne razlikovalnice asociacije. Diagnostična vrednost vrste je omejena zaradi njene splošne dobre razširjenosti v vseh borovih gozdovih na karbonatnih tleh.

Razlikovalnice asociacije *Fraxino orni-Pinetum nigrae* nam nakazujejo njen sinhorološki položaj. Razširjene so v vzhodnoalpskem prostoru, zato so dobre razlikovalnice v primerjavi z borovimi gozdovi dinarskega območja. Poleg fitogeografske diferenciacije nakazujejo ekološke razmere v fitocenozah *Fraxino orni-Pinetum nigrae*, kjer uspevajo na dolomitnih/apnenčastih svežih z bazami bogatih tleh subalpskega sveta oziroma njemu prilagojenih rastiščih (strma, plitva, hladna pobočja alpskih dolin).

V osrednjem delu vzhodnih Alp (Ziljske in Karnijske Alpe, Posočje) se pojavlja posebna fitogeografska oblika asociacije *Fraxino orni-Pinetum nigrae* z jugovzhodnoevropsko vrsto *Peucedanum austriacum* (Jacq.) Koch subsp. *rablense* (Wulfen) Koch in relativnim endemitom stenomediteranskega porekla *Polygala nicaeensis* Risso subsp. *forojulensis* (Kerner) Graebn.

5.3.2.2 Medsebojna podobnost fitocenz

Z opredelitvijo značilnic in razlikovalnic asociacije *Fraxino orni-Pinetum nigrae* nas je zanimala medsebojna podobnost fitocenz iz različnih območij jugovzhodnoalpskega prostora, kjer je njena osrednja razširjenost. Predvsem nas je zanimala podobnost med fitocenozo MARTIN-BOSSEJEVE (1967) in našo (ZUPANČIČ & ŽAGAR in situ). Sørensenov indeks podobnosti ($\sigma = 67$) kaže na primerno podobnost, čeprav so v naši fitocenozi slabše ovrednotene (zastopane) značilnice in razlikovalnice, kar smo ugotovili že v poglavju 2.

Nadalje nas je zanimala podobnost med našo fitocenozo in fitocenozo T. WRABERJA (1979) (Sørensenov indeks $\sigma = 42$) ter našo in DAKSKOBLERJEVO (1998) fitocenozo (indeks $\sigma = 51$) ter med združenima fitocenzama Zgornjega Posočja (T. WRABER 1979 in DAKSKOBLER 1998) in našo (indeks $\sigma = 54$). Medsebojna podobnost fitocenz Zgornje Savske in Zgornje Savinjske doline ter Zgornje Soške doline je manjša kot med fitocenozo Martin-Bossejeve in našo, vendar je zadovoljiva. Manjši indeks podobnosti kaže upravičenost izdvojitve geografske variante z vrsto *Polygala nicaeensis* subsp. *forojulensis*.

Ob teh primerjavah se poraja vprašanje, kolikšna je podobnost med fitocenzama T. Wraberja oziroma Dakskoblerja in fitocenozo Martin-Bossejeve. Podobnost med fitocenzama T. Wraberja in Martin-Bossejeve $\sigma = 51$, med Dakskoblerjevo in fitocenozo Martin-Bossejeve pa $\sigma = 56$, kar je zadovoljivo. Mnogo boljši, in v vseh primerih primerjav najvišji, je indeks med združenima fitocenzama T. Wraberja in Dakskoblerja (Zgornje Posočje) ter med fitocenozo Martin-Bossejeve (avstrijska Koroška), kjer $\sigma = 70$.

Zanimala nas je še podobnost med fitocenzama T. Wraberja in Dakskoblerja. Ta je precejšnja (indeks $\sigma = 63$), kar smo tudi pričakovali zaradi bližnjih raziskovanih objektov v Zgornjem Posočju.

Ugotavljamo, da Sørensenovi indeksi podobnosti fitocenz kažejo na zadovoljivo do dobro podobnost in medsebojno uravnoveženost. Značilnice in razlikovalnice asociacije *Fraxino orni-Pinetum nigrae* so glede na njihovo razširjenost (sinhorologijo) in prilagodljivost ekološkim razmeram dobro izbrane ter nakazujejo fitogeografski položaj in življenjske razmere asociacije *Fraxino orni-Pinetum nigrae*. Floristična vsebina fitocenz *Fraxino orni-Pinetum nigrae* je precej izenačena, v njih pa popolnoma ali večinoma prevladujejo naslednje vrste, ki bi jih lahko označili kot vrste »značilne kombinacije« (glej Fitocenološko tabelo 2):

Pričakovano je bilo, da so v vseh fitocenzah v največji meri in enotno zastopane vrste razreda *Erico-Pinetea* s. lat. – teh je 18; k njim lahko uvrstimo še vrste *Fraxinus ornus*, *Ostrya carpinifolia*, *Salix glabra*, *Carex humilis*, *Asperula aristata* in *Euphrasia cuspidata* iz drugih razredov, ker imajo določeno diagnostično vrednost v fitocenozi *Fraxino orni-Pinetum nigrae*. Presečna zgovorna zastopanost 15 vrst razreda *Quercus-Fagetalia* s. lat., vendar je od teh 6 vrst ekološko (toplopljubne in suholjubne vrste) in deloma sinsistematsko (*Quercetalia pubescentis*, *Prunetalia spinosae*, *Festuco-Brometalia*) blizu razreda *Erico-Pinetea*; te so *Sorbus aria*, *Peucedanum oreoselinum*, *Polygonatum odoratum*, *Berberis vulgaris* in *Viburnum lantana*, k njim pa uvrščamo še vrsto *Helleborus niger* subsp. *niger* (*Aremonio-Fagion*), ki je razlikovalnica za podzvezo *Helleboro nigri-Pinenion*. Pregled Fitocenološke tabele 2 nam kaže, da imajo vrste razreda *Quercus-Fagetalia* s. lat. v fitocenzah *Fraxino orni-Pinetum nigrae* ekološko vlogo, saj nakazujejo občasno sveža rastišča, ki omogoča rast in preživetje fagetalnim vrstam. Nakazovalke svežosti rastišča so tudi redko zastopane vrste razredov *Betulo-Adenostyletea* (= *Mulgedio-Aconitetea*), *Scheuchzerio-Caricetea fuscae* s. lat. in *Thlaspietea rotundifolii* s. lat. ter tudi vrste razreda *Vaccinio-Piceetea* s. lat., ki jih je v »značilni kombinaciji« kar pet. Med fagetalnimi vrstami je opazna zastopanost vrst ilirske zveze *Aremonio-Fagi-*

ERICO-PINETEA s. lat.

ABSOLUTNO

Chamaecytisus purpureus
Helleborus niger subsp. *niger**
Amelanchier ovalis
Daphne cneorum
Erica carnea
Polygala chamaebuxus
Epipactis atrorubens
Carex alba
Pinus sylvestris
Calamagrostis varia
Buphthalmum salicifolium
Platanthera bifolia
 VACCINIO-PICEETEA s. lat.
Picea abies

QUERCO-FAGETEA s. lat.

Helleborus niger subsp. *niger*
Cyclamen purpurascens
Fraxinus ornus
Ostrya carpinifolia
Sorbus aria
Peucedanum oreoselinum
Berberis vulgaris

BETULO-ADENOSTYLETEA s. lat.
(MULGEDIO-ACONITETEA)

TRIFOLIO-GERANIETEA s. lat.
Vincetoxicum hircundinaria
 NARDO-CALLUNETEA s. lat.

SESLERIETEA s. lat.
*Globularia cordifolia*FESTUCO-BROMETEA s. lat.
*Teucrium montanum*MOLINIO-ARRHENATHERETEA s. lat.
Lotus corniculatus

THLASPIETEA ROTUNDIFOLII s. lat.

OSTALA VRSTA

* Razlikovalnica za *Helleboro nigri-Pinenion*.

on, v fitocenozah *Fraxino orni-Pinetum nigrae* se pojavlja od dveh do šest vrst. Te in še druge jugovzhodnoevropsko-ilirske vrste so diagnostične za ilirsko florno provinco.

PRETEŽNO

Crepis slovenica
Cotoneaster tomentosa
Pinus nigra
Rhamnus saxatilis
Gymnadenia odoratissima

Hieracium sylvaticum
Rubus saxatilis
Rhododendron hirsutum
Solidago virgaurea

Anemone trifolia
Fagus sylvatica
Melica nutans
Polygonatum odoratum
Pteridum aquilinum
Frangula alnus
Juniperus communis
Viburnum lantana

*Salix glabra**Anthericum ramosum*

Potentilla erecta
Genista germanica

Sesleria albicans
Biscutella laevigata

Euphorbia cyparissias
Carlina acaulis
Carex humilis
Prunella grandiflora
Asperula aristata & *A. a.* subsp. *longiflora* (?)
Galium verum

Betonica alopecuroides
Lathyrus pratensis
Euphrasia cuspidata

Campanula caespitosa

Sorbus aucuparia subsp. *aucuparia*

Na osnovi Sørensenovih indeksov podobnosti fitocenoz ($\sigma = 42-70$; pogosto 54-56) in pogostnosti pojavljanja vrst »značilne kombinacije« zaključujemo, da vse fitocenoze v sintezni Fitocenološki tabeli 2 v kolonah

1–14 uvrstimo v enotno fitocenozo *Fraxino orni-Pinetum nigrae*. Za dodatno potrditev enotne asociacije *Fraxino orni-Pinetum nigrae* smo analizirali še horološke in fitocenološke skupine ter biološki spekter fitocenoz.

5.3.3 Horološke skupine

V primerjavi med fitocenozami *Fraxino orni-Pinetum nigrae*, opisanih od avtorjev Zupančič & Žagar (Zgornja Savska dolina in Zgornja Savinjska dolina), T. Wraber & Dakskobler (Zgornja Soška dolina) in Martin-Bosse (avstrijska Koroška), ni bistvenih razlik med horološkimi skupinami. Ponekod so nekoliko manjši oziroma višji odstotki med posameznimi horološkimi skupinami, kar je razvidno iz Tabele 1. Ti ali oni odmiki so opazno različni pri seštevkju toploljubnih in hladoljubnih horoloških skupin. Precejšnja razlika je pri fitocenozi Martin-Bossejeve, kjer je povišana vsota toploljubnih horoloških skupin (43,6 %) od drugih dveh (37,4 % oz. 36,3 %). V vseh treh fitocenozah pa prevladujejo hladoljubne horološke skupine, kar potrjuje, da je rastišče fitocenoze *Fraxino orni-Pinetum nigrae* v predalpsko/alpskem območju zmerno sveže.

5.3.4 Fitocenološke skupine

Analiza fitocenoloških skupin (Tabela 2) je skladna z ugotovitvami, navedenimi v poglavju 2, in z analizo horologije fitocenoz, predvsem pa potrjuje zabukovljenost nekaterih fitocenoz zgornjesavskega in zgornjesavinjskega območja (Zupančič & Žagar) ali variante Martin-Bossejeve z vrsto *Fagus sylvatica* (Fitocenološka tabela 2, 5. stolpec). Te fitocenoze imajo manj vrst razreda *Erico-Pinetea*, kar da misliti o njihovi sekundarnosti. Najbolj pinetalna pa je fitocenoza Zgornjega Posočja (T. Wraber & Dakskobler) z manjšim odstotkom vrst razredov travišč *Festuco-Brometea* s. lat. in *Molinio-Arrhenatheretea*, kar jo uvršča med bolj ali manj optimalne fitocenoze *Fraxino orni-Pinetum nigrae*. Najbolj uravnovešena, lahko bi rekli celo standardna, je fitocenoza Martin-Bossejeve z avstrijske Koroške, kar kaže primerjava s prej omenjenima fitocenozama. Standardnost oziroma optimalnost te fitocenoze je pogojena oziroma potrjena s številčnostjo (67) in geografsko široko (na velikem območju) vzetih fitocenoloških popisov.

GEOELEMENTI	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse
	%	%	%	%	%	%
Evromediteranski	3,1	1,4	2,7			
Meditersko-montanski	19,9	20,5	21,3			
Meditersko-altanski	0,5	0,7	0,5			
Meditersko-pontski	2,0	1,4	2,7			
Pontski	4,1	4,1	3,8			
Jugovzhodnoevropski	1,6	0,7	3,3			
Južnoilirski	3,6	3,4	3,3			
Severnoilirski	2,6	2,7	4,9			
Subatlantski		0,7	1,1			
Stenomediterski		0,7		37,4	36,3	43,6
Evropski	16,8	15,1	16,9			
Evroazijski	13,2	8,9	12,5			
Evrosibirski	6,1	4,8	7,1			
Paleotemperatni	5,1	3,4	2,7			
Cirkumborealni	7,6	7,5	3,1			
Alpski	2,6	4,1	3,3			
Alpsko-karpatski	0,5	0,7				
Vzhodnoalpski	1,6	3,4	2,7			
Jugovzhodnoalpski	0,5	0,7	1,1			
Arktično-alpski	1,0	1,4	1,6			
Endemit	1,0	1,4	1,6			
Kozmopolit	0,5	1,4	0,5			
Slučajni		0,7				
Neopredeljene vrste	6,1	10,2	3,3	62,6	63,7	56,4
SKUPAJ	100,0	100,0	100,0			

Tabela 1: Horološke skupine v asociaciji *Fraxino orni-Pinetum nigrae*

FITOCENOLOŠKE SKUPINE	Zupančič & Žagar	Wraber & Dakskobler	Martin-Bosse
	%	%	%
<i>Erico-Pinetea</i>	11,7	19,5	16,7
<i>Vaccinio-Piceetea</i>	16,3	10,0	10,4
<i>Quercu-Fagetea</i>	28,5	20,1	25,0
<i>Adenostylo-Betuletea (=Mulgedio-Aconitetea)</i>	3,1	2,5	1,5
<i>Epilobietea</i>	1,5	0,6	1,0
<i>Trifolio-Geranietea</i>	6,1	8,8	6,7
<i>Nardo-Callunetea</i>	2,1	1,3	1,0
<i>Seslerietea</i>	7,7	6,3	6,7
<i>Festuco-Brometea</i>	8,6	6,3	10,4
<i>Molinio-Arrhenatheretea</i>	6,7	4,4	5,7
<i>Scheuchzerio-Caricetea fuscae</i>	2,1	2,5	2,0
<i>Thlaspietea rotundifolii</i>	1,5	3,8	4,1
<i>Asplenietea trichomanis</i>	1,5	5,7	5,7
Neopredeljene vrste	2,6	8,2	3,1
SKUPAJ	100,0	100,00	100,0

Tabela 2: Fitocenološke skupine v asociaciji *Fraxino orni-Pinetum nigrae*

5.3.5 Biološki spekter

Odstopanja med posameznimi fitocenozi niso velika. Nekoliko višje odstotke fanerofitov in hamefitov in manjše odstotke hemikriptofitov najdemo pri fitocenzah T. Wraberja in Dakskoblerja v Zgornjem Posočju, vendar ta odstopanja niso bistvena. Lahko bi trdili, da uspeva fitocenoza *Fraxino orni-Pinetum nigrae* v Zgornjem Posočju v nekoliko težjih življenjskih razmerah. Biološki spekter vseh treh (štirih) fitocenz kaže na življenjske razmere, ki vladajo med zmernim in planinskim pasom. Lahko bi rekli, da so v nekaterih območjih življenjske razmere bližje tistim v planinskem pasu,

predvsem zaradi višjega odstotka geofitov. Položaj raziskovanih območij povsem ustreza analizi biološkega spektra.

5.4 Razprava in zaključki

Vprašanje uvrstitve fitocenz na območju Zgornje Savske doline in Zgornje Savinjske doline (Zupančič & Žagar) ter Aichingerjeve in Braun-Blanquetove & Sissinghove iz avstrijskega dela Karavank ter deloma z območja Zgornje Soške doline (T. Wraber), kjer ni prisotna vodilna drevesna vrsta *Pinus nigra*, temveč le *P. sylve-*

ŽIVLJENJSKA OBLIKA	Zupančič & Žagar	T. Wraber & Dakskobler	Martin-Bosse
	%	%	%
FANEROFITI PHANEROPHYTA	15,3	19,1	17,5
P. scap.	5,6	6,8	6,0
P. caesp.	5,6	6,8	6,0
NP	4,1	5,5	5,5
HAMEFITI - CHAMAEPHYTA	17,8	21,3	16,9
Ch. suffr.	8,7	10,3	9,3
Ch. rept.	1,5	2,1	2,7
Ch. frut.	1,5	0,7	2,2
B. Ch.	5,6	7,5	2,7
L. Ch.	0,5	0,7	
HEMIKROPTOFITI - HEMICRYPTOPHYTA	47,9	41,8	48,9
H. scap.	34,2	27,4	32,8
H. ros.	7,1	8,2	9,3
H. caesp.	5,6	6,2	6,0
H. rept.	1,0		0,6
GEOFITI - GEOPHYTA	16,4	15,7	13,6
G. rhiz.	12,8	11,6	9,8
G. bulb.	3,6	3,4	2,7
G. rad.		0,7	1,1
TEROFITI - THEROPHYTA	2,6	2,1	3,3
T. scap.	2,6	2,1	3,3
SKUPAJ	100,0	100,	100,0

Tabela 3: Biološki spekter asociacije *Fraxino orni-Pinetum nigrae*

stris, smo rešili, na osnovi floristične in vegetacijske analize, da pripadajo asociaciji *Fraxino orni-Pinetum nigrae*. Ob tem se je pojavilo vprašanje, ali ne bi bilo bolje in natančneje, iz sinsistematskega in ekološkega vidika, da bi avtorica H. Martin-Bosse nazorneje poimenovala asociacijo, in sicer *Fraxino orni-Pinetum sylvestris-nigrae*. Analiza fitocenoz rdečega bora na karbonatni podlagi jugovzhodnoalpskega območja ni pokazala nobenih sintaksonomskih, sinekoloških in sinhoroloških posebnosti, da bi jo lahko oddvojili kot posebno asociacijo.

Fitocenoz *Fraxino orni-Pinetum nigrae* so v različnih območjih jugovzhodnoalpskega prostora v različnih stadijih razvoja od začetnih – inicialnih, pionirskih ali nadomestnih do optimalnih. Glede pojavljanja asociacijskih značilnic in razlikovalnic in tudi glede na floristično vsebino sta optimalnemu stanju najbližje fitocenoz Martin-Bossejeve in Poldinija (Fitocenološka tabela 2, koloni 1 in 7), ostale so nekje v sredini, v njih pa kakšen fitocenološki popis celo kaže na začetno inicialno stanje fitocenoz. Nekatere oblike fitocenoz pa so nastale sekundarno na primarnih rastiščih drugih fitocenoz, npr. na primarnih rastiščih bukovih gozdov.

Fitogeografski položaj jugovzhodnoalpskega prostora je nekoliko zapleten, ker ga obvladujeta ilirska in norijska (prenorijsko-slovenska) floristična provinca. To se kaže v prepletanju jugovzhodnoevropsko-ilirskih ter jugovzhodnoevropskih, jugovzhodnoalpskih in vzhodnoalpskih vrst, kar je nazorno prikazano v sintezni Fitocenološki tabeli 2. Na osnovi floristične in vegetacijske (sinsistematske) analize smo se odločili kot H. Martin-Bosse, da asociacijo *Fraxino orni-Pinetum nigrae* uvrstimo v ilirsko zvezo borovih gozdov *Fraxino orni-Pinetum nigrae-sylvestris* (Ht. 1958) Zupančič 2007 (= *Orneto-Ericetum* Ht. 1958) in po našem mnenju v podzvezo *Helleboro nigri-Pinion* (Ht. 1959) Zupančič 2007 (= *Orneto-Ericion dolomiticum* Ht. 1959).

Izbira oziroma določitev značilnic in razlikovalnic asociacije *Fraxino orni-Pinetum nigrae* nam je omogočila medsebojno primerjavo fitocenoz *Fraxino orni-Pinetum nigrae* z dopolnilnimi primerjavami borovih fitocenoz ilirske florne province s slovenskih Dinaridov, to je TOMAŽIČEVE (1940) asociacije *Genisto januesis-Pinetum*

ter ACCETTOVIH (1999, 2001) asociacij *Daphno alpinae-Pinetum nigrae* in *Carici sempervirentis-Pinetum nigre*. Na osnovi primerjave smo bolj ali manj objektivno določili značilnice in razlikovalnice asociacije *Fraxino orni-Pinetum nigrae*. Značilnice so bile izbrane iz fitocenoz Martin-Bossejeve, Aichingerja in Braun-Blanqueta & Sissingha. Razlikovalnice so nove in se nanašajo na razlikovanje med asociacijami *Fraxino orni-Pinetum nigrae* in asociacijami *Genisto januens-Pinetum*, *Daphne alpinae-Pinetum nigrae* in *Carici sempervirentis-Pinetum nigrae*. Pri primerjavi se je pokazalo, da moramo delno spremeniti značilnice asociacije *Genisto janueniss-Pinetum*. Vrsti *Chamaecytisus purpureus* in *Crepis slovenica* (= *C. incaranta*) zaradi svoje splošne razširjenosti v združbah borovih gozdov ne moreta imeti položaja značilnic za asociacijo *Genisto januens-Pinetum*. Tako ostanejo značilnice le *Genista januensis*, *Potentilla carniolica* in *Daphne blagayana*. Doda pa se razlikovalnica asociacije *Genisto januens-Pinetum*, in sicer jugovzhodnoevropsko-ilirska vrsta *Hacquetia epipactis* (Scop.) DC., ki zelo dobro razlikuje fitocenozo od prej omenjenih asociacij *Fraxino orni-Pinetum nigrae*, *Daphno alpinae-Pinetum nigrae* in *Carici sempervirentis-Pinetum nigrae*.

Primerjava borovih fitocenoz v sintezni Fitocenološki tabeli 2 med asociacijo *Fraxino orni-Pinetum nigrae* in prej imenovanimi asociacijami *Genisto-Pinetum*, *Daphno-Pinetum* in *Carici-Pinetum* kaže različno pojavljanje jugovzhodnoevropskih in vzhodnoalpskih vrst. V asociacijah *Genisto januens-Pinetum*, *Daphno alpinae-Pinetum nigrae* in *Carici sempervirentis-Pinetum nigrae* je mnogo manj jugovzhodnoevropskih in vzhodnoalpskih vrst, kar je razumljivo, ker pripadajo dinarskemu oziroma vmesnemu dinarsko-jugovzhodnoalpskemu območju. Vendar je v asociacijah *Daphno alpinae-Pinetum nigrae* in *Carici sempervirentis-Pinetum nigrae* precej več jugovzhodnoevropskih in vzhodnoalpskih vrst, kar asociaciji približuje fitocenozo *Fraxino orni-Pinetum nigrae*.

V razpravi je na novo opisana subasociacija *Fraxino orni-Pinetum nigrae laricetosum* na območju Karavank in Savinjskih Alp, v njej ni vodilne drevesne vrste *Pinus nigra*.

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Figure 1 Eastern Alpine association *Fraxino orni-Pinetum*
Slika 1 Vzhodnoalpska asociacija *Fraxino orni-Pinetum*

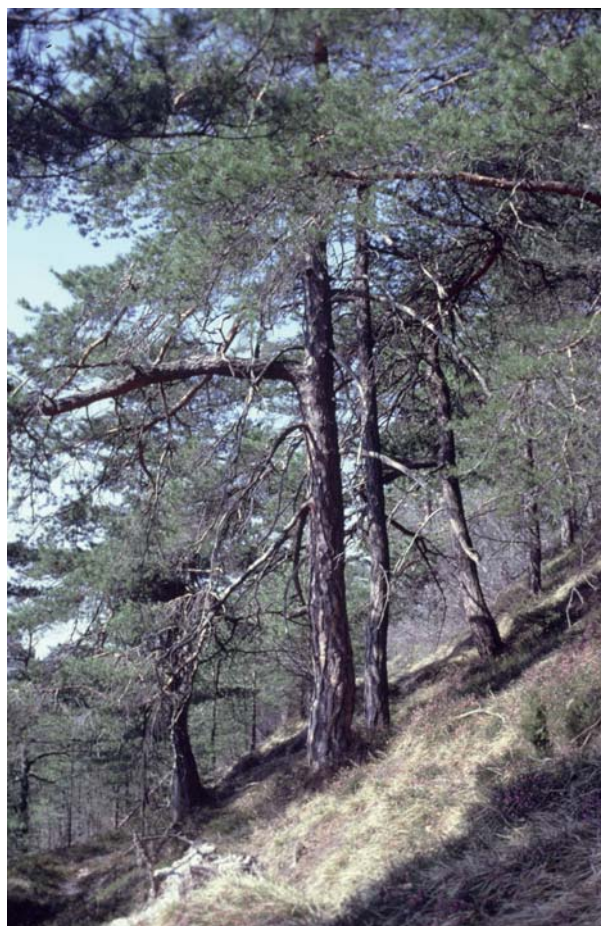


Figure 2 Dinarid association *Genisto januensis-Pinetum*
Slika 2 Dinarska asociacija *Genisto januensis-Pinetum*



Figure 3 Distinguishing species of the Eastern Alpine association *Rhododhamnus chamaecistus*
Slika 3 Razlikovalnica vzhodnoalpske asociacije *Rhododhamnus chamaecistus*



Figure 4 General distribution of the dolomitophilic species *Daphne cneorum* in Eastern Alpine and Dinarid pine associations
Slika 4 Splošno razširjena dolomitofilna vrsta *Daphne cneorum* v vzhodnoalpski in dinarski borovi asociaciji

PHYTOCENOLOGICAL TABLE (Fitocenološka tabela) 1: FRAXINO ORNI-PINETUM NIGRAE Martin Bösse 1967

	1	2	3	4	5	6	7	8	9	10	11	
Number of relevé (Zaporedna številka popisa)	161/62	142/62	119/62	135/62	3/74	4/74	3/77	6/90	38/97	7/90	8/90	
Working No of relevé (Delovna številka popisa)	20.9.62	4.9.62	24.8.62	28.8.62	20.6.74	20.6.74	27.5.77	13.7.90	4.9.97	13.7.90	13.7.90	
Date (Datum)	1080	1315	1110	1100	1020	950	800	690	790	620	530	
Altitude in m (Nadmorska višina v m)	W-N	SE	S	S	SE	S	S	SW	S	SW	SW	
Aspect (Nebesna lega)	70	40	45	20-50	40	40	35	45-50	30	40-45	40	
Slope in degrees (Nagib v stopinjah)	apn	dol, apn	apn	apn	dol	dol	dol	dol	mor/dol	dol	dol	
Bedrock (Geološka podlaga)	40	10	10	0-80	0	0	0	0	0	0	0	
Stoniness in % (Kamnitost v %)	I	80	60	40	60	60	50	50	60	50	80	
Cover (Pokrovnost) %: Tree layer (drevesna plast)	II	40	20	60	10	10	10	30	10	30	40	
Shrub layer (grmovna plast)	III	80	100	100	100	100	100	100	100	100	100	
Herb layer (zeliščna plast)	IV	0	0	20	0	0	0	0	0	0	0	
Moss layer (mahovna plast)		400	400	400	400	400	400	400	400	400	400	
Relevé (Velikost popisne ploskve) m ²	Š t a j e r s k a G o r e n j s k a Š t a j e r s k a											
Province (Pokrajina)	Z g o r n j a S a v i n j s k a d o l i -											
Location (Kraj popisov)	Huda Raduha Veža Planica Mala Pišnica Tabre Pod Tolsto Raduha Tabre Raduha											
Subassociation (Subasociacija)	| L A R I C E T O S U M D E C I D U A E | C A R I C E T O S U M H U M I L I S |											

Sinsistematska pripadnost (Sinsistematska pripadnost)
 Sinsistematska pripadnost (Sinsistematska pripadnost)

Presenca (Presenca)

CHARACTERISTIC SPECIES OF THE ASSOCIATION (Značilnice za asociacijo) FRAXINO ORNI-PINETUM NIGRAE Martin Bösse 1967

	1	2	3	4	5	6	7	8	9	10	11
EP ₃ Scleropodium purum	.	.	2.4	.	.	.	+2	+2	+3	.	.
TH Petasites paradoxus	+2	.	+	.
MA Allium ochroleucum	.	.	.	+	+
Q ₂ Euphrasia cuspidata	+	.	+	.
FB Galium purpureum	1.2	.	.	.	.
FP Asperula aristata	+	.
Daphne cneorum
Euphorbia triflora subsp. kernerii	+	.	.

DIFERENTIAL SPECIES OF THE ASSOCIATION (Razlikovalnice za asociacijo) FRAXINO ORNI-PINETUM NIGRAE

	1	2	3	4	5	6	7	8	9	10	11
A ₃ Salix glabra	+	.	.	.	.	.	.	+	.	+2	+
EM Rhodothamnus chamaecistus	1.2	.	.	+	.	.	.	.	.	+	.
EM Pinus mugo	.	.	.	+	.	1.2	.	.	.	.	.

DIFERENTIAL SPECIES OF THE SUBASSOCIATION (Razlikovalnice za subasociacijo) FRAXINO ORNI-PINETUM NIGRAE LARICETOSUM subass. nova

	1	2	3	4	5	6	7	8	9	10	11
VP ₁ Picea abies	I	1.2	3.1	2.2	2.1	1.2	+	+	-	+	1.1
	II	-	1.2	2.2	+	1.1	1.2	1.1	+	1.1	2.1
	III	-	+	+	-	-	-	-	-	-	-
VP ₂ Larix decidua	I	2.1	2.2	1.1	2.2	+2	.	.	.	.	5
	II	-	2.2	-	+	+	.	.	.	.	3

■ F₁ AREMONIO-FAGION (Ht. 1938) Török, Podani & Borhidi 1989

Helleborus niger subsp. niger	III	1	2	3	4	5	6	7	8	9	10	11	10
Cyclamen purpurascens			1.1	+0	1.1	2.2	1.2	2.2	+	2.1	+	+	10
Knautia drymeia subsp. drymeia		+	1.1	+	1.1	+	.	+	+	+	+	+	10
Anemone trifolia		.	+	.	.	.	.	.	.	+	.	.	6
Rhamnus fallax	II	+	.	.	.	1.2	+	1.2	.	+	.	.	4
													1

F₂ FAGETALIA SYLVATICAE Pawl. 1928

Euphorbia amygdaloides	III	1	2	3	4	5	6	7	8	9	10	11	10
Fagus sylvatica	I	2.2	1.1	+	1.1	.	-	.	-	+	.	+	4
Gymnocarpium robertianum	III	+	+	+	+	+	+	+	+	+	+	.	7
Acer pseudoplatanus	II	+	+	+	.	+	+	+	+	+	.	.	6
Melica nutans	III	+	+	+	.	+	.	.	.	+	.	+	6
Daphne mezereum	II	+	+	+	.	.	.	.	.	+	.	+	6
Digitalis grandiflora	III	+	+	+	.	.	.	1.2	.	.	.	.	5
Mercurialis perennis		1.1	+	.	+	.	.	.	.	+	.	.	4
Cephalanthera damasonium		+	+	+	+	.	.	.	.	.	.	.	3
Cephalanthera rubra		+	.	.	+	.	.	.	.	.	+	.	3
Galium laevigatum		+	.	.	.	.	.	.	+	.	.	.	3
Neottia nictus-avis		.	.	.	+	.	.	+	.	.	.	.	3
Viola reichenbachiana		.	.	.	.	.	.	+	.	.	.	.	3
Lonicera alpigena	II	.	+	1.1	.	.	.	.	.	.	.	.	2
Aquilegia nigricans	III	.	.	.	.	.	.	.	.	.	.	.	2
Campanula trachelium		+	.	.	+	.	.	.	.	.	.	.	2
Brachypodium sylvaticum		.	.	.	.	.	.	.	.	+	.	.	1
Epipactis helleborine		.	.	.	.	.	.	.	.	+	.	.	1
Euphorbia dulcis		.	.	.	.	.	.	.	.	+	.	.	1
Heracleum sphondylium		.	+	.	.	.	.	.	.	.	.	.	1
Lilium martagon		.	.	+	.	.	.	.	.	.	.	.	1
Mycelis muralis		.	+	.	.	.	.	.	.	.	.	.	1
Prenanthes purpurea		+	.	.	.	.	.	.	.	.	.	.	1
Salvia glutinosa		.	+	.	.	.	.	.	.	.	.	.	1
Symphytum tuberosum		.	+	.	.	.	.	.	.	.	.	.	1

OO FRAXINO ORNI-OSTRYION CARPINIFOLIAE Tomazič 1940

Fraxinus ornus	II	1	2	3	4	5	6	7	8	9	10	11	7
Ostrya carpinifolia		+	.	1.1	.	.	+	+	+	+	1.1	1.2	5

Q₂ QUERCETALIA PUBESCENTIS Br.-Bl. (1931) 1932 s. lat.

Sorbus aria	I	1	2	3	4	5	6	7	8	9	10	11	2
Peucedanum oreoselinum	III	.	.	.	+	+	+	+	+	1.1	+	+	10
													5

TG	TRIFOLIO-GERANIETEA SANGUINEI T. Müller 1961 s. lat.	1	2	3	4	5	6	7	8	9	10	11	
	Vincetoxicum hirundinaria							+2	+	+	.	11	4
	Viola hirta	III						1.1	+	+	.	1.1	4
TG	Anthericum ramosum					+			+	+	1.1	.	3
	Clinopodium vulgare								+	+	.	+	3
	Cruciata glabra					+			+	.	.	.	2
	Laserpitium latifolium								+	.	.	.	2
	Origanum vulgare					+			.	.	.	+	2
	Brachypodium rupestre								.	+2	.	.	1
	Astragalus glycyphyllos								.	.	.	.	1
	Thalictrum minus								+	.	.	.	1
	Trifolium rubens								.	.	.	.	1
	Veronica chamaedrys					+			.	.	.	.	1
NC	NARDO-CALLUNETEA Prsg. 1949												
	Potentilla erecta		2	3	4	5	6	7	8	9	10	11	6
	Ajuga pyramidalis	III	+	+	.	.	+	+	.	+	+2	+	2
	Thymus alpestris								.	+	.	.	2
	Genista germanica								.	.	.	.	1
S	SESLERIETEA Br.-Bl. 1948 em. Oberd. 1978 s. lat.												
	Sesleria albicans		2	3	4	5	6	7	8	9	10	11	6
	Globularia cordifolia	III		1.1	+3	.	.	+2	1.2	.	2.2	2.3	6
	Scabiosa lucida			+2	1.2	.	.	+2	+	+	+2	.	6
	Biscutella laevigata							1.1	+	+	+	+	5
	Acinos alpinus							+	+	+	+	.	4
	Allium ochroleucum							(+)	+	.	(+)	.	3
	Carduus defloratus							+2	.	1.2	.	+	2
	Globularia nudicaulis								.	.	.	.	2
	Dianthus sylvestris			+2	+	.	.	.	+	.	1.2	.	2
	Aster bellidiastrum								.	.	.	.	2
	Rhinanthus aristatus (=R. glacialis)								+	.	.	.	2
	Campanula scheuchzeri								+	.	+	.	1
	Helianthemum grandiflorum								.	.	+	.	1
	Phyteuma orbiculare								.	.	.	+	1
	Polygala alpestris								.	.	.	.	1
FB	FESTUCO-BROMETEA Br.-Bl. & R. Tx. 1943 s. lat.												
	Teucrium chamaedrys	III	2	3	4	5	6	7	8	9	10	11	7
	Stachys recta			+	.	.	+	1.2	+	+2	+	1.2	6
	Euphorbia cyparissias		1.1	1.1	1.1	+	.	.	.	+	.	+	6
	Carlina acaulis				+	.	.	1.1	+	+	.	+	6
								+2	.	+	+	.	5

RP2 QUERCETALIA ROBORIS-PETRAEAE R. Tx. (1931) 1937 s. lat.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Melampyrum pratense subsp. vulgatum	III 19 I	96 III	59 III	1 I	83 I	2 II	2 II				1 I					I ⁺		
Frangula alnus	IIa	63 II	112 II		2 I	94 III	94 III	2 II	50 IV		1 I	5 III						
	IIb	33 II	144 IV		85 II	--	--	--	--		--	--						
Pteridium aquilinum	III		112 III		7 IV	104 II	118 II	2 I	2 I		141 IV	65 III	2 ⁺		126 II	II ⁺	IV ⁺⁰⁺	
Galium lucidum						2 II	2 II		-I		2 II					V ⁺¹	V ⁻¹	
Hieracium laevigatum (?)											1 I							
Festuca heterophylla	I											3 II						
Quercus robur																	II ⁺⁰	
Betula pendula	II															1 I	--	

F1 AREMONIO-FAGION (Ht. 1938) Török, Podani & Borhidi 1989

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Cyclamen purpurascens	III 129 IV	238 IV	59 IV	4 III	297 IV	8 IV	25 IV	278 V	231 V	8 V	143 V	129 IV	4 ⁺¹	IV	41 V	296 V	V ⁺	V ⁻¹
Helleborus niger subsp. niger		36 I	268 IV	5 III	460 IV		72 I	86 III	25 II	102 III	617 V	221 III				230 II	IV ⁺¹	V ⁺²
Rhannus fallax	II -I		2 II		2 I				-I		1 I							
Lilium carnolicum	III		1 I															
Anemone trifolia			59 III		670 V	5 III	40 III	58 III	184 III	4 III	48 III	68 IV					III ⁺¹	
Knaulia drymeia subsp. drymeia			3 II		3 II						5 III					3 II	III ⁺	
Dentaria enneaphyllos					2 I		1 I									293 II		II ⁺
Euphorbia carniolica															1 I			
Melampyrum velebaticum															1 I			
Omphalodes verna																46 III		
Epimedium alpinum																1 I		
Hacquetia epipactis																	III ⁺	II ⁻¹

F2 FAGETALIA SYLVATICAE Pawl. 1928

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Melica nutans	III 63 I		112 II		292 I	48 II	56 II		23 I	104 IV	5 III	3 II				43 I	V ⁺	III ⁺¹
Aquilegia nigricans & A. vulgaris*	18 I*		59 III*		85 II*						2 II					171 IV	II*	III*
Euphorbia amygdaloides	18 I		2 II		87 III		1 I		1 II		54 V		2 ⁺				II ⁺	III ⁺
Acer pseudoplatanus	I -I			--					--		5 III						--	III ⁺
Mercurialis perennis	III -I			1 I					-I		1 I							III ⁺
Primula vulgaris	-I										47 II					230 II		III ⁺²
Viola reichenbachiana	-I						1 I				3 II							
Gymnocarpium robertianum					2 I				1 I	4 III	5 III					42 I		
Fagus sylvatica	I	1 I	56 I		1043 V	70 II	171 II	28 I	-I		206 III					188 I	V ⁺	V ⁺⁰⁻¹
	II	3 II	--		88 IV	--	36 I	3 II	-II		5 III				6 IV	IV ⁺⁰	IV ⁺⁰⁻³	
	III	--	3 II		7 IV	--	--	--	-II						--	--	--	--
Mycelis muralis		1 I									1 I							
Neottia nidus-avis			1 I		3 II						3 II							
Salvia glutinosa			2 II		2 I						1 I	3 II			2 I			III ⁺⁰⁺
Daphne mezereum	II		1 I								5 III							II ⁺
Cephalanthera rubra	III				2 I		2 I			3 II	3 II							

<i>Teucrium chamaedrys</i>	191	98 III	112 II	.	295 III	199 V	174 IV	.	.	5 III	141 IV	.	2*	.	38 II	.	V ⁺¹	V ⁺²
<i>Prunella grandiflora</i>	21	34 III	11	.	5 III	75 V	59 IV	.	.	7 IV	2 II	.	.	.	.	.	III ⁺¹	III ⁺¹
<i>Centaurea fritschii</i> & <i>C. scabiosa</i> *	11	66 III	.	3 II	21	3 II	2 II*	.	87 III	.	.	.	.	.	.	.	.	II*
<i>Carex caryophylla</i>	-1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gentiana ciliata</i>	-1	11	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.
<i>Thesium linophyllon</i>	-1	.	.	4 III	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Anthyllis vulneraria</i> & <i>A. polyphylla</i> *	.	11	11	125 II	.	.	1 I*	.	.	.	.	.	.	.	.	.	.	.
<i>Linum viscosum</i>	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Silene nutans</i>	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
<i>Arnica montana</i>	.	.	11	219 I	.	.	11	.	.	.	.	.	.	.	11	.	.	.
<i>Pimpinella saxifraga</i>	.	.	.	.	21	3 II	2 II	.	.	4 III	5 III	.	.	.	11	.	II*	.
<i>Brachypodium pinnatum</i>	.	.	.	.	.	175 IV	.	.	.	56 IV	.	.	.	.	.	.	.	.
<i>Centaurea jacea</i> & <i>C. bracteata</i> & <i>C. jacea</i> subsp. <i>angustifolia</i>	.	.	.	.	.	27 III	21 II	.	.	.	.	.	.	.	.	.	II*	.
<i>Scabiosa graminifolia</i>	.	.	.	.	.	5 III	3 II	.	.	.	.	.	.	.	.	.	.	.
<i>Aster amellus</i>	.	.	.	.	.	4 III	3 II	11	-1	.	11	.	.	.	.	.	III ⁺¹	III ⁺¹
<i>Asperula cynanchica</i>	.	.	.	.	.	4 II	3 II	.	.	.	.	.	.	.	9 V	3 II	.	.
<i>Polygala nicaeensis</i> & <i>P. n. subsp. mediterranea</i> (=P. <i>forjulensis</i>)	.	.	.	.	.	.	5 III	4 III	8 V	.	.	.	.	.	.	.	.	.
<i>Bromus erectus</i>	.	.	.	.	.	.	.	-1	.	.	.	.	.	.	.	.	.	.
<i>Silene vulgaris</i> subsp. <i>antelopum</i>	.	.	.	.	.	.	.	.	.	.	4 III	.	.	.	.	.	.	.
<i>Cirsium acule</i>	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.
<i>Cirsium pannonicum</i>	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	II*	.
<i>Ophrys sphecodes</i>	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.
<i>Sanguisorba minor</i>	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.	.	.
<i>Chamaespartium sagittale</i> (=Genistella <i>sagittalis</i>)	.	.	.	.	.	.	.	.	.	.	.	.	3 II	.	.	.	.	.
<i>Sesleria juncifolia</i> subsp. <i>kalmikensis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2750 V	3417 V	.	.
<i>Orchis mascula</i> subsp. <i>speciosa</i> (=O. <i>signifera</i>)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	11	.	.
<i>Grafia golaka</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	564 IV	.	.
<i>Allium carinatum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3 II	.	.
<i>Knautia fleischmannii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2 I	.	I*
<i>Allium pulchellum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III*	.
<i>Hladnikia pastinacifolia</i> (=H. <i>golaka</i>)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II*
MA MOLINIO-ARRHENATHEREIA Tx. 1937 s. lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Lotus corniculatus</i>	III	75 III	.	60 IV	3 II	4 III	4 III	58 III	.	8 V	51 IV	4 III	3*	III	5 III	88 IV	III*	IV*
<i>Euphrasia cuspidata</i>	21 III	31 I	57 II	64 II	.	2 II	2 I	19 II	1 II	4 III	2 II	.	.	.	.	.	.	.
<i>Galium mollugo</i> & <i>G. mollugo</i> subsp. <i>erectum</i>	117 II	.	170 IV	225 IV	5 III	.	.	.	.	.	4 III	.	.	.	.	.	.	.
<i>Leontodon hispidus</i>	188 I	.	.	.	.	.	11	.	.	3 II	.	5 III	.	.	.	.	.	.
<i>Betonica alopecuroides</i> (=B. <i>jacquinii</i> =B. <i>divulsa</i>)	191	109 I	.	4 III	.	75 IV	78 V	323 V	2 II	7 IV	254 IV	.	.	.	3 II	296 V	III*	IV ⁺¹
<i>Lathyrus pratensis</i>	18 I	252 III	.	.	5 III	.	3 II	57 II	.	3 II	3 II	126 III	2*	III	.	.	.	.
<i>Linum catharticum</i>	21	.	.	4 III	.	.	11	.	3 II	.	.	.	.	.	.	.	.	.
<i>Carex flacca</i>	.	111 II	11	.	21	.	.	.	.	.	.	.	.	.	.	.	III*	IV*
<i>Succisa pratensis</i>	.	68 I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dianthus sylvestris</i>	.	11	.	.	11	.	.	.	.	.	2 II	.	.	.	.	.	III ⁺¹	III*
<i>Genista tinctoria</i>	.	11	6 IV	.	21	2 II	2 I	.	.	.	11	.	.	.	.	.	.	.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
AS	<i>Saxifraga buseriana</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
HP	<i>Genista januensis</i>	.	.	.	.	.	.	.	.	.	52 II	2 II	.	.	.	4 III	46 III	IV ⁺²	V ⁺²	
EP2	<i>Senecio abrotanifolius</i>	.	.	.	.	.	.	.	.	.	.	3 II	.	.	.	.	.	.	.	.
MC	<i>Heliosperma quadridentatum</i>	.	.	.	.	.	.	.	.	.	.	2 II	.	.	.	.	.	.	.	.
S	<i>Edraianthus graminifolius</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3 II	1 I	.	.
FP	<i>Daphne blagayana</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1 I	2 I	I ⁺	II ⁺³
EP2	<i>Laserpitium gaudinii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Q2	<i>Peucedanum austriacum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
S	<i>Lathyrus laevigatus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
MA	<i>Centaurea stenolepis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
II	SOUTHEASTERN-EUROPEAN-ILLYRIAN SPECIES (Jugovzhodnoevropsko-ilirske vrste)																			
FP	<i>Pinus nigra</i>	I	4955 V	5500 V	2833 IV	1469 V	4750 V	3648 V	2732 V	3389 V	3648 V	5250 V	.	.	.	.	4286 V	5208 V	V ²⁻⁴	.
		IIa	636 V	298 III	696 IV	783 V	83 I	--	--	212 IV	570 V	--	.	4 ⁴⁻⁵	.	592 V	231 III	V ⁻¹	.	.
		IIb	56 II	94 II	309 IV	1 I	85 II	--	--	4 III	--	.	.	--	.	4 II	521 III	--	.	.
F1	<i>Cyclamen purpurascens</i>	III	129 IV	238 IV	59 IV	4 III	297 IV	8 IV	25 IV	278 V	231 V	143 V	129 IV	4 ⁺¹	IV	41 V	296 V	V ⁺	V ⁺¹	.
HP	<i>Chamaecytisus purpureus</i>		99 II	282 II	418 IV	.	83 I	.	484 V	1154 V	321 V	602 V	48 II	1 ⁺	II	.	.	V ⁺²	V ⁺¹	.
HP	<i>Crepis slovenica</i>		21 II	33 II	59 III	253 III	2 I	5 III	4 III	58 II	5 III	208 III	.	.	.	.	.	III ⁺	III ⁺	.
F1	<i>Helleborus niger subsp. niger</i>		36 I	268 IV	117 V	5 III	460 IV	.	72 I	86 III	25 II	102 III	617 V	221 III	.	.	.	IV ⁺¹	V ⁺²	.
S	<i>Allium ochroleucum</i>		18 I	.	.	.	.	.	5 III	3 II	1 I	50 IV	.	.	.	.	79 V	43 I	.	.
FB	<i>Centaurea fritschii & C. scabiosa*</i>		1 I	66 III	.	3 II	2 I	3 II	2 II*	.	.	.	.	.	.	.	.	.	.	II ⁺
F1	<i>Rhannus fallax</i>	II	- I	.	2 II	.	2 I	.	.	- I	.	1 I	.	.	.	.	.	.	.	.
AS	<i>Silene hayekiana</i>	III	- I	1 I	1 I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
F1	<i>Lilium carnioolicum</i>		.	1 I	1 I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
F1	<i>Anemone trifolia</i>		.	.	59 III	.	670 V	5 III	40 III	58 III	184 III	4 III	68 IV	.	II	.	.	.	III ⁺¹	.
F1	<i>Knautia drymeia subsp. drymeia</i>		.	.	3 II	.	3 II	.	.	.	.	5 III	.	.	.	.	.	3 II	III ⁺	III ⁺
	<i>Erysimum sylvestre</i>		.	.	.	1 I	.	.	.	.	.	.	.	.	.	.	.	.	.	I ⁺
F1	<i>Dentaria enneaphyllos</i>		.	.	.	.	2 I	.	.	.	.	.	.	.	.	.	.	293 II	.	.
EP2	<i>Homogyne sylvestris</i>		.	.	.	.	2 I	.	.	.	5 III	.	.	.	.	.	.	358 V	.	I I
EP2	<i>Frangula rupestris</i>	II	.	.	.	.	.	23 I	.	.	.	.	.	.	.	.	1 I	.	.	.
VP3	<i>Aposperis foetida</i>	III	.	.	.	.	.	.	1 I	.	.	.	.	.	.	.	.	.	.	II ⁺
F1	<i>Euphorbia carniolica</i>		.	.	.	.	.	.	.	.	1 I	.	.	.	.	.	.	.	4 III	II ⁺
F2	<i>Galium laevigatum</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II ⁺
Q2	<i>Campanula witasekiana</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FB	<i>Sesleria juncifolia subsp. kalmikensis</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NC	<i>Gentiana lutea subsp. symphyandra</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
F1	<i>Gentiana lutea subsp. symphyandra</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2750 V	3417 V	.
HP	<i>Melampyrum velebiticum</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2 II	314 IV	.
FB	<i>Potentilla carniolica</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1 I	3 II	.
F1	<i>Grafia golaka</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1 I	2 I	II ⁺
F1	<i>Omphalodes verna</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	564 IV	.
Q2	<i>Acer obtusatum</i>	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	46 III	.
F1	<i>Epimedium alpinum</i>	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1 I	.
S	<i>Globularia nudicaulis</i>	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	44 II	.
F1	<i>Hacquetia epipactis</i>		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1 I	.
			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	318 V	.
			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III ⁺

LEGEND (Legenda)**Analytical tables (Analitične tabele)**

- 1 - Orneto-Pinetum nigrae Martin-Bosse 1967 caricetosum humilis Martin-Bosse 1967
- 2 - Orneto-Pinetum nigrae Martin-Bosse 1967 calamagrostidetosum variae Martin-Bosse 1967
- 3 - Orneto-Pinetum nigrae Martin-Bosse 1967 calamagrostidetosum variae Martin-Bosse 1967 var. Petasites paradoxus Martin-Bosse 1967
- 4 - Orneto-Pinetum nigrae Martin-Bosse 1967 caricetosum humilis Martin-Bosse 1967 var. Arctostaphylos uva-ursi Martin-Bosse 1967
- 5 - Orneto-Pinetum nigrae Martin-Bosse 1967 calamagrostidetosum variae Martin-Bosse 1967 var. Fagus sylvatica Martin-Bosse 1967
- 6 - Orno-Pinetum nigrae Martin-Bosse 1961 subass. Carex humilis & subass. Molinia litoralis
- 7 - Fraxino orni-Pinetum nigrae Martin-Bosse 1967 pinetosum nigrae T. Wraber 1979 & pinetosum sylvestris T. Wraber 1979
- 8 - Pinetum austroalpinum Aichinger 1933 pinetosum nigrae T. Wraber 1979 & pinetosum sylvestris T. Wraber 1979
- 9 - Fraxino orni-Pinetum nigrae Martin-Bosse 1967 rhodothamnetosum Dakskobler 1998 var. Rhododendron hirsutum Dakskobler 1998 & var. Asperula purpurea Dakskobler 1998
- 10 - Pinus nigra - wälder Poldimi 1967
- 11 - Fraxino orni-Pinetum nigrae Martin-Bosse 1967 laricetosum Zupančič & Žagar 2010 & caricetosum humilis Martin-Bosse 1967
- 12 - Pinetum sylvestris ericetosum Aichinger 1933
- 13 - Pinetum sylvestris pinetosum nigrae Aichinger 1933
- 14 - Pinetum austroalpinum (Aichinger 1933) Br.-Bl. & Sissingh 1939
- 15 - Daphno alpinae-Pinetum nigrae Accetto 2001
- 16 - Carici sempervirentis-Pinetum nigrae Accetto (1996) 1999
- 17 - Genisto januensis-Pinetum Tomažič 1940 pinetosum nigrae Tomažič 1940 (Pineto-Genistetum januensis Tomažič 1940)
- 18 - Genisto januensis-Pinetum Tomažič 1940 (Pineto-Genistetum januensis Tomažič 1940)

Sinsistematska pripadnost

- AP Abieti-Piceion Br.-Bl. in Br.-Bl. et al. 1939
 CK Carici rupestris-Kobresietea bellardii Ohba 1974
 EM Erico-Pinion mugo Leibundgut 1948 n. inv.
 RV Rhododendro-Vaccinienion Br.-Bl. 1926 & Vaccinio-Piceion Oberd. 1957
 SC Scorzonero-Chrysopogonetalia Horvatić 1973 s. lat.
 SS Sedo-Scleranthetea Br.-Bl. 1955 em. Th. Müller 1961

Bedrock (Geološka podlaga)

- apn - limestone (apnenec)
 dol - dolomite (dolomit)