Fitosociologia vol. 44 (2): 3 -13, 2007

Syntaxonomic problems of the classes *Vaccinio-Piceetea* and *Erico-Pinetea* in Slovenia

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Abstract
The paper discusses the syntaxonomic problems of the classes *Vaccinio-Piceetea* and *Erico-Pinetea* in Slovenia, the easternalpine-dinarid and westbalkan regions. Some syntaxonomic units are corrected or renamed.

Key words: Balkan Peninsula, *Erico-Pinetea*, syntaxonomy, Slovenia, Southeast Europe, *Vaccinio-Piceetea*.

Riassunto
Problemi sintassonomici delle classi Vaccinio-Piceetea e Erico-Pinetea in Slovenia. Vengono analizzati problemi sintassonomici delle classi *Vaccinio-Piceetea* e *Erico-Pinetea* nel territorio alpino orientale-dinarico e balcanico occidentale della Slovenia. Alcune unità sintassonomiche vengono corrette o assumono nuova denominazione.

Parole chiave: *Erico-Pinetea*, Europa sudorientale, Penisola Balcanica, sintassonomia, Slovenia, *Vaccinio-Piceetea*.

Introduction

Contribution deals with syntaxonomic problems of the classes *Vaccino-Piceetea* and *Erico-Pinetea* in Slovenia. For the sake of better understanding, this paper deals with them in the wider sense, especially because of syntaxonomic harmonisation according to the new Codex.

In relation to floristic nomenclature, we took into consideration the work of Hayek (1927-1933), Janchen (1956-1960), Martinčič (ed.) *et al.* (1999), Mayer (1952) and Novak (1926, 1927, 1928). We took into account the manuscript material of Robic & Accetto (2001) in a review of forest vegetation of Slovenia. We made use of Meusel *et al*. (1965, 1978, 1992) for the horological (phytogeographical) distribution of plants.

Class *VACCINIO-PICEETEA* Br.-Bl. in Br.-Bl. *et al.* 1939 em. Zupančič (1976) 1980

I already wrote about the class *Vaccinio-Piceetea* in 1976 in a dissertation, then in a monograph on spruce communities in Slovenia in 1980 and 1999 and later, in 2000 and 2003, in papers on problems of the class *Vaccinio-Piceetea* (Zupančič, 1976, 1980, 1999, 2000, 2003, 2004).

Let me say at the start that in relation to syntaxonomy I am very cautious, to a certain extent conservative and I rely above all on the study by Braun-Blanquet *et al*. (1939). In my opinion, Braun-Blanquet's paper (1939) on the class *Vaccinio-Piceetea* is very considered and well argued on the basis of the then known European associations of this class. His synsystematic classification rests on a foundation of tabular phytocenological material by the European authors-phytocenologists of that time. Braun-Blanquet systematically collected this material and carefully carried out a synthesis. The order *Vaccinio-Piceetalia* with the alliances *Vaccinio-Piceion*, *Loiseleuri(et)o-Vaccinion* and *Pin(et)o-Ericion* was floristically reasoned in detail. He gave only framework floristic designations for other syntaxonomic units. With this monograph Braun Blanquet *et al*. (1939) scientifically grounded a preliminary, provisionally established order *Piceetalia excelsae* and alliance *Piceion excelsae* Pawlowski *et al*. (1928). As I have already written, (Zupančič, 1999) Pawlowski established the order and alliance.

It is only to be expected that Braun-Blanquet's syntaxonomic classification would experience some additions and also different interpretations. Some European authors have done this.

Oberdorfer (1957) placed the order *Pinetalia* Oberdorfer 1949 in the class *Vaccinio-Piceetea*, and he placed the sub-alliance *Eu-Vaccinio-Piceion* Oberdorfer 1957 in the order *Vaccinio-Piceetalia*. He placed the sub-alliance *Abieti-Piceion* Br.-Bl. in Br.-Bl. *et al.* 1939 in the alliance *Fagion* and order *Fagetalia*. Oberdorfer *et al*. (1992) later classified two alliances, *Dicrano-Pinion* (Libbert 1932) Matuszkiewicz 1962 em. Oberdorfer 1969 with sub-alliances *Dicrano-Pinenion* Oberdorfer 1992 and *Piceo-Vaccinion uliginosi* Oberdorfer 1992 and *Piceion abietis* Pawlowski in

Pawlowski *et al*. 1928 with sub-alliances *Vaccinio-Abietion* Oberdorfer 1962, *Vaccinio-Piceenion* Oberdorfer 1957 and *Rhododendro-Vaccinienion* Br.-Bl. in Br.-Bl. *et al*. 1939, in the order *Piceetalia abietis* Pawlowski in Pawlowski *et al*. 1928.

I do not agree with Oberdorfer's (1957) first syntaxonomic classification, that the sub-alliance *Abieti-Piceion* should be placed in the order *Fagetalia*. The sub-alliance *Abieti-Piceenion* contains poor to moderately acid piceetal species, which are a contact with the European alliance *Fagion sylvaticae* (Braun-Blanquet, 1939) or even more with the alliance *Quercion roboris-petraeae* (Malcuit 1929) Br.-Bl. 1932, although they are most frequently represented with great regularity in phytocenoses of the class *Vaccinio-Piceetea*. I prefer the more recent syntaxonomic classification of Oberdorfer *et al*. (1992) that the sub-alliance *Vaccinio-Abietion* Br.-Bl. in Br.-Bl. *et al*. 1939 nom. inv. is placed in the alliance *Piceion abietis* Pawl. in Pawl. *et al*. 1928.

Kielland-Lund (1981) supplemented Braun-Blanquet's synsystematic classification of the class *Vaccinio-Piceetea* with the order *Cladonio-Vaccinietalia* K.-Lund 1967 and alliances *Dicrano-Pinion* and *Phyllodoco-Vaccinion* Nord. 1936. The order *Cladonio-Vaccinietalia* with alliances and sub-alliances is adapted to boreal pine forests with many piceetal elements. The order *Vaccinio-Piceetalia* with the alliance *Vaccinio-Piceion* embraces spruce forests, which K.-Lund classifies in three sub-alliances (*Sphagno-Piceion, Eu-Piceion, Melico-Piceion*). I favour K.-Lund's (1981) syntaxonomic classification because he puts pine forests in the class *Vaccinio-Piceetea* although he delineated them floristically into two orders: *Vaccinio-Piceetalia* Br.-Bl. in Br.-Bl. *et al*. 1939 em. K.-Lund 1967, in which he placed spruce phytocenoses and the order *Cladonio-Vaccinietalia* K.-Lund 1967, which covers pine phytocenoses.

We must furthermore draw attention to the syntaxonomic classification of the class *Vaccinio-Piceetea* Wallnöfer (in Mucina *et al*., 1993). The class is divided into two orders, the order *Piceetalia excelsae* Pawlowski in Pawlowski *et al*. 1928 with alliances *Piceion excelsae* Pawlowski in Pawlowski 1928, *Dicrano-Pinion* (Libbert 1932) Matuszkiewicz 1962 and *Betulion pubescentis* Lohmeyer & R. Tx in R. Tx. ex Oberdorfer 1957 and the order *Athyrio-Piceetalia* Hadač 1962 with alliances *Chrysanthemo rotundifolii-Piceion* (Krajina 1933) Březina & Hadač in Hadač 1962 and *Abieti-Piceion* (Br.-Bl. in Br.-Bl. *et al*. 1939) Soó 1964. She extracted from the class the alliance *Erico-Pinion mugo* Leibundgut 1948 nom. inv. and placed it the class *Erico-Pinetea* Ht. 1959 and order *Erico-Pinetalia* Ht. 1959.

My proposal is that we classify the alliance *Erico-Pinion mugo* in the class *Vaccinio-Piceetea* and order *Vaccinio-Piceetalia* (Zupančič, 2004).

I have already written about the order *Athyrio-Piceetalia* and the alliance *Chrysanthemo rotundifolii-Piceion* (Zupančič, 1999, 2000), and I here repeat my opinion on this order and alliance: […] "Slovak phytocoenologist Hadač strove to separate spruce and fir phytocoenoses on rendzina and "grey forest soil", where the soil is poor acid, subneutral to alkaline with intensive nitrification and rich in hemikryptophytes (Hadač *et al*., 1969) from the order *Vaccinio-Piceetalia*. He proposed a new order *Athyrieto-Piceetalia* Hadač 1962. Within order *Athyrio-Piceetalia* he separated the alliance *Chrysanthemo rotundifolii-Piceion* (Krajina, 1933) Březina & Hadač in Hadač 1962 that unites "lowland" sprucewoods (Flurenwälder), where spruce dominates on granite foremost on quartzite and limestone debris with light humid soil (Hadač *et al*., 1969). Unfortunately the order *Athyrio-Piceetalia* and alliance *Chrysanthemo rotundifolii-Piceion* does not have any characteristics of its own. The choice of such a great number of relative differential species with a wide distribution are rather a product of computer choice than of deliberate ecological and floristic studies.

So such a division of the class *Vaccinio-Piceetea* might entitle us to separate special suballiances, alliance, or even order for the Illyrian floral province.

As long as we do not have enough material throughout Europe, any new syntaxonomical division seems to be premature, nevertheless risky." […](Zupančič, 1999).

[…] "M. Wraber (1963) in his paper on the association *Luzulo sylvaticae-Piceetum* tried to add the fullest possible list of plant characteristic species which enter into consideration, in the narrower or broader systematic sense, for spruce communities in Slovenia." […] (Zupančič, 1980). In our studies of spruce forests in Slovenia and on the basis of M. Wraber's findings, the idea occurred to me of more exact, clearly delineations of the syntaxonomic problem of the class *Vaccinio-Piceetea*. I have already written about the unallocated or clearly defined characteristic species and distinguishing species of the class *Vaccinio-Piceetea* in a dissertaion and later twice more (Zupančič, 1976, 1999, 2000).

From the aforementioned thoughts on the class *Vaccinio-Piceetea* follow conclusive thoughts on the authorship of syntaxonomic units of the order *Vaccinio-Piceetalia* and alliance *Vaccinio-Piceion*, which would

perhaps be most correct, as follows: *Vaccinio-Piceetalia* (Pawlowski in Pawlowski *et al*. 1928) Br.-Bl. in Br.-Bl. *et al.* 1939 em. K.-Lund 1967 and *Vaccinio-Piceion* (Pawlowski in Pawlowski *et al*. 1928) Br.-Bl. in Br.-Bl. *et al*. 1939.

Syntaxonomic review of associations of the class *Vaccinio-Piceetea* in Slovenia

VACCINIO-PICEETEA Br.-Bl. in Br.-Bl. *et al.* 1939 emend. Zupančič (1976) 1980
VACCINIO-PICEETALIA (Pawl. in Pawl. *et al.* 1928) Br.-Bl. in Br.-Bl. *et al.* 1939 emend. K.-Lund 1967
VACCINIO-PICEION (Pawl. in Pawl. *et al.* 1928) Br.-Bl. in Br.-Bl. *et al.* 1939
ABIETI-PICEENION Br.-Bl. in Br.-Bl. *et al.* 1939
Blechno-Abietetum Ht. (1938) 1950
Seslerio albicantis-Piceetum Eggler 1952 corr. Zupančič 1999
var. geogr. *Helleborus niger* Zupančič 1999
Luzulo albidae-Abietetum Oberd. 1957
Galio rotundifolii-Abietetum Oberd. ex M. Wraber 1959
var. geogr. *Epimedium alpinum* Marinček 1977
Avenello flexuosae-Piceetum M. Wraber ex Hadač in Hadač *et al.* 1969 corr. Zupančič 1999
var. geogr. *Aposeris foetida* Zupančič 1999
Erico-Piceetum Schweingruber 1972
var. geogr. *Helleborus niger* Zupančič 1999
Polysticho setiferi-Abietetum Ž. Košir 1994
Hieracio rotundati-Abietetum Marinček 1995
Stellario montanae-Piceetum (Zupančič 1976) Zupančič 1994 corr. 1999
Rhamno fallicis-Piceetum Zupančič 1999
Petasiti-Piceetum Zupančič 1999
VACCINIO-PICEENION Oberd. 1957
Mastigobryo-Piceetum (Schmidt & Geisb.) Br.-Bl. & Sissing in Br.-Bl. *et al.* 1939
Sphagno girgensohnii-Piceetum R. Kuoch 1954 corr. Zupančič 1982
var. geogr. *Carex brizoides* Zupančič 1982 corr. 1999
Asplenio-Piceetum R. Kuoch 1954
var. geogr. *Omphalodes verna* Accetto 1993
Bazzanio-Abietetum M. Wraber 1958
Luzulo sylvaticae-Piceetum M. Wraber 1963 corr. Zupančič 1999
var. geogr. *Hieracium rotundatum* Zupančič 1999
var. geogr. *Luzula nivea* Zupančič 1999
Adenostylo glabrae-Piceetum M. Wraber ex Zukrigl 1973 corr. Zupančič 1993
var. geogr. *Cardamine trifolia* Zupančič 1999
subvar. geogr. *Anemone trifolia* Zupančič 1999
subvar. geogr. *Luzula nivea* Zupančič 1999
subvar. geogr. *Cortusa matthioli* Zupančič 1999
Lonicero caeruleae-Piceetum (Zupančič 1976) Zupančič 1994 corr. 1999
Hacquetio-Piceetum (Zupančič 1976) Zupančič 1994 corr. 1999
Ribeso alpini-Piceetum Zupančič & Accetto 1994
Rhytidiadelpho lorei-Piceetum Zupančič 1981 emend. 1999
Aposerido-Piceetum Zupančič 1999
var. geogr. *Helleborus niger* Zupančič 1999
Laburno alpini-Piceetum Zupančič 1999
var. geogr. *Luzula nivea* Zupančič 1999
Prenantho purpureae-Piceetum Zupančič 1999

DICRANO-PINION (Libbert 1932) Matuszkiewicz 1962
Vaccinio myrtilli-Pinetum Kobendza 1930
var. geogr. *Castanea sativa* (Tomažič 1942) Zupančič 1996
Galio rotundifolii-Pinetum Zupančič & Čarni 1988
RHODODENDRO-VACCINION Br.-Bl. 1926
Junipero-Rhododendretum hirsuti Smettan 1981
ERICO-PINION MUGO Leibundgut 1948 nom. inv.
Rhodothamno-Rhododendretum hirsuti Br.-Bl. & Sissingh in Br.-Bl. *et al.* 1939 (emend. S. Wallnöfer 1993) corr. Zupančič & Žagar 2004
var. geogr. *Paederota lutea* Zupančič & Žagar 2004
Hyperico grisebachii-Pinetum mugo (Ht. 1938) ex T. Wraber, Zupančič & Žagar 2004
var. geogr. *Rhododendron hirsutum* T. Wraber, Zupančič & Žagar 2004
Rhodothamno-Laricetum deciduae (Zukrigl 1973) Willner & Zukrigl 1999

Class *ERICO-PINETEA* Ht. 1959

In discussing the class *Erico-Pinetea* and, consequently, the lower syntaxonomic units of this class, there is a need to focus on the basic discussion of the author of this class Horvat (1959). In this paper (Horvat 1959) he states two different opinions of two excellent botanists and phytogeographers, Beck-Mannagetta and Adamović, who studied the flora of the Balkan peninsular. The first, Beck-Mannagetta (1901 in Horvat, 1959: 18), is of the opinion that pine forests (Senj, Plesevica, Dinara) do not have characteristic elements like beech or karst forests. The second, Adamovic (1909 in Horvat, 1959), says that Austrian Pine (*Pinus nigra*) in western Serbia constructs independent stands or appears as an associated species in other phytocenoses. The question occurred to Horvat (1959) of whether continental pine stands have a clearly expressed rounded totality, floristic particularity or individuality. On the basis of his studies of the Dinarid massif, he came to the conclusion that pine phytocenoses have specific characteristic species that are distributed in relation to the geological base, whether they are on dolimites or serpentenite. Floristic differences are not just conditioned by the geological base, though, but also by the phytogeographic distribution of species. Horvat (1959) on the basis of these factors, geological bases and phytogeographic distribution of certain species, decided on two sub-alliances, a more or less more westerly, dolomite based *Orneto-Ericion dolomiticum* Ht. 1959 and more easterly (Balkan) *Orneto-Ericion serpentinicum* Ht. 1959 within the alliance *Orneto-Ericion* Ht. 1958 order *Erico-Pinetalia* Ht. 1959 and class *Erico-Pinetea* Ht. 1959. Horvat (1959) further established that Austrian Pine – *Pinus nigra* can be considered a characteristic species of basophilous pine forests and Scots Pine – *Pinus sylvestris* only as a differential species. Scots Pine – *Pinus sylvestris* has a wider ecological amplitude and is also distributed on extremely acid habitats (ibid) with species from the class *Vaccinio-Piceetea*.

By comparison of scrub pine between the alpine alliance *Pineto-Ericion* Br.-Bl. 1939 and the dinarid alliance *Orneto-Ericion* Ht. 1953, Horvat (1959) established that scrub pine of the two alliances have many species in common, considering in relation to the alpine alliance species of the order *Vaccinio-Piceetalia* and with the dinarid alliance species of the order *Quercetalia pubescentis*. On this basis, Horvat (ibid.) concluded that particular plant species of pine forests (pineetal species) exist that are characteristic of it. These species appear more or less in pine forests on serpentenite, i.e., in the sub-alliance *Orneto-Ericion serpentinicum*.

At the end of the paper, Horvat (1959) associates himself with the statement of E. Schmid (in Horvat, ibid) that the majority of pine forests are relict. We must here immediately make clear that we do not agree with this statement and decisively oppose the finding of palinologist Šercelj (1996). On the basis of numerous palinological studies, he explained the dynamics of the development of vegetation. It is not possible that any taxon or phytocenosis could persist in the same place indefinitely throughout all periods after glaciation.

Horvat (1938) already wrote about the Austrian Pine phytocenosis *Pinus nigra-Cotoneaster tomentosa* in 1938. Horvat then placed the phytocenosis in the alliance *Quercion pubescentis-sessiliflorae*. This classification is fairly similar to the classification of basophilous pine forests of Tomažič (1940) with the difference that he first classified these pine forests in a new alliance *Orneto-Ostryon* and this in the order

Quercetalia pubescentis.

Tomažič (1940, 1942) first studied pine forests in Slovenia. He placed basophilous pine forests on dolomite *Genisto januensis-Pinetum* Tomažič 1940 (= *Pineto-Genistetum januensis* Tomažič 1940) in the alliance *Fraxino orni-Ostryon* Tomažič 1940 (= *Orneto-Ostryon carpinifoliae* Tomažič 1940) and order *Quercetalia pubescentis*. Horvat (1959) did not agree with Tomažič's creation of a new alliance *Pineto-Genistetum,* in which he placed basophilous pine associations on dolomite in Slovenia. Briefly, he deleted the alliance *Orneto-Ostryon* Tomažič 1940, or its name, and included it in his newly named alliance *Orneto-Ericion* Ht. 1958. He was of the opinion that Tomažič's name of the alliance was not well chosen for pine forests, and because Tomažič included this alliance in the order *Quercetalia pubescentis*, in which pine forests do not belong. In particular, he did not like the naming of the alliance (*Orneto*) after the species *Fraxinus ornus*, which does not have similar characteristics to pine in any aspect (e.g. *Pinus nigra*, *P. sylvestris*) (ibid).

In fact, the alliance *Fraxino orni-Ostryon* Tomažič 1940 belongs to the order *Quercetalia pubescentis*, which unites continental thermophilous scrub or low forest with the species *Fraxinus ornus, Ostrya carpinifolia* and similar. We must extract from this alliance Tomažič's association *Genisto januensis-Pinetum* and include it in Horvat's sub-alliance *Orno-Ericion dolomiticum,* as we have provisionally called it.

We must furthermore comment here on the syntaxonomic classification by Wallnöfer (in Mucina *et al*., 1993) of the alliance *Fraxino orni-Ostryon* Tomažič 1940. Wallnöfer's syntaxonomic classification of the alliance *Fraxino orni-Ostryon carpinifoliae* Tomažič 1940 in the order *Erico-Pinetalia* and class *Erico-Pinetea* is not good. Tomažič (1940) wrote: […],"that the association *Pineto-Genistetum* belongs in the alliance *Orneto-Ostryon carpinifoliae* (= *Fraxino orni-Ostryon*), in the order *Quercetalia pubescentis-sessiliflorae* and in the class *Querco-Fagetea,* although they dominate in the tree layer of forests or Austrian Pine forests and there are in it some speciess that elsewhere are characteristic of the alliance *Pineto-Ericion*", […]. Tomažič's syntaxonomic classification of the alliance *Fraxino orni-Ostryon* in the order *Quercetalia pubescentis* is exact but his association *Genisto-Pinetum* must be taken out of this alliance and placed in Horvat's alliance *Fraxino orni-Ericion* or sub-alliance *Fraxino orni-Ericion* (*dolomiticum*). In the alliance *Fraxino orni-Ostryon* are classified thermophilous scrub and similar phytocenoses of the Illyrian floral province but certainly not pine forests. The syntaxonomic problem of pine forests is in their syngenesis. These are initial, pioneer phytocenoses, whose development goes towards more optimal phytocenoses of broadleaf forests, mainly beech phytocenoses in our (neogenetic) quartiary period. Pine phytocenoses remain on extreme and degraded habitats where there are not the conditions for development into more optimal phytocenoses.

As we have already indicated, Horvat (1959) compared alpine and dinarid pine forests on carbonates and found that they are two rounded units that show a common genetic alliance. It thus to some extent points to the development of a synsystematic classification of pine forests in the alpine world. The first investigators of the alpine world were Braun-Blanquet, Gams, Aichinger, Schmid etc.

Aichinger (1933) provisionally, and without documentation, established two alliances *Pinion silvestris calcicolum* and *Pinion silvestris silicicolum*, on the basis of his studies in the Karavanke.

Braun-Blanquet *et al*. (1939) provided reasoning for the alliance *Pineto-Ericion* Br.-Bl. 1939 and placed it in the order *Vaccinio-Piceetalia* and class *Vaccinio-Piceetea*; he confirmed it in 1950 and 1954 (Braun-Blanquet, 1950; Braun-Blanquet *et al.,* 1954).

Oberdorfer (1957) envisaged an alliance *Pinion* and order *Pinetalia* within the class *Vaccinio-Piceetea*. In 1992, together with associates (Oberdorfer *et al*., 1992) he accepted Horvat's class *Erico-Pinetea* Ht. 1959 and order *Erico-Pinetalia* Ht. 1959, in which he placed the alliance *Erico-Pinion* Br.-Bl. in Br.-Bl. *et al*. 1939 (= *Pineto-Ericion* Br.-Bl. 1939).

We have already discussed Wallnöfer's (Mucina *et a*l., 1993) syntaxonomic classification of the class *Erico-Pinetea*. We believe that only the alliance *Erico-Pinion sylvestris* Br.-Bl. in Br.-Bl. *et al*. 1939 nom. inv. (= *Pineto-Ericion* Br.-Bl. in Br.-Bl. *et al*. 1939) can be placed in the class *Erico-Pinetea*. The alliance *Fraxino orni-Ostryon carpinifoliae* Tomažič 1940 (= *Orneto-Ostryon carpinifoliae* Tomažič 1940) belongs to the order *Quercetalia pubescentis-petraeae,* as Tomažič (1940) already envisaged. We place the alliance *Erico-Pinion mugo* Leibundgut 1948 in the order *Vaccinio-Piceetalia* (Pawl. in Pawl. *et al*. 1928) Br.-Bl. in Br.-Bl. *et al*. 1939 em. K.-Lund 1967.

Wraber (1960) accepted Horvat's thesis of 1959 in entirety.

Zupančič (ed. *et al*., 1986) with associates, for the elaboration of a vegetation map of Yugoslavia to a scale of 1 : 200.000 accepted Horvat's syntaxonomic division,

with the addition of the alliance *Orno-Ostryon* Tomažič 1940, which covers only thermophilous broadleaf scrub.

The class *Erico-Pinetea* is syntaxonomically problematic; we have placed it among the classes *Querco-Fagetea* and *Vaccinio-Piceetea*. Developmentally, there is a relationship between the sub-alliance *Abieti-Piceenion* and even more, according to Braun-Blanquet's understanding, the alliance *Pineto-Ericion*, formerly *Erico-Pinion*, which some phytocenologists have extracted from the class *Vaccinio-Piceetea* and it has today a different syntaxonomic content in the class *Erico-Pinetea*, and the alliance *Fraxino orni-Ericion* ora *Erico-Fraxinion orni*. Horvat (1959) carefully showed the developmental and relationship principle at the very beginning of designating the order *Erico-Pinetalia*. The class *Erico-Pinetea* and order *Erico-Pinetalia* are floristically composed of species that frequently, even regularly, appear in associations of the classes *Querco-Fagetea* and *Vaccinio-Piceetea* or more precisely in the orders *Quercetalia pubescentis-petraeae* and *Quercetalia roboris-petraeae* and *Vaccinio-Piceetalia*, above all the sub-alliance *Abieti-Piceenion* (or order *Athyrio-Piceetalia*). In terms of its floristic and historical development aspects, the class is dubious. However, it has its own syngenetic and ecological profile which must probably be respected, especially in the region of the Balkan peninsular.

Our opinion is close to that of Beck-Mannagetta (1901 in Horvat, 1959), that pine forests do not have characteristic species. We would qualify this, that pine forests do not have exceptionally good characteristic species. We find that good characteristic species of pine forests are rare. For the most part, there are relative characteristic species, i.e., species that are frequent or very frequent in pine forests, but they are also present in oak, hornbeam-oak, beech, thermophilous broadleaf scrub and meadow communities. In order to define the order, alliances and sub-alliances, especially those that are ecologically or phytogeographically adjusted, differential species are of help; differential species to other syntaxonomical groups that are synergetically related to pine forests and clearly show the horological or ecological syntaxonomic unit. On this principle, Horvat (1959) already resolved the syntaxonomical distinction of pine forests from other forests and within pine forests a division into lower taxonomic units. On the example of Horvat, we are supplementing the syntaxonomic question of pine forests. These additions were necessary in order systematically to classify Slovene pine forests, too. We have tried to cover this question in entirety, from class to sub-alliance. On the basis of the results and opinions of Horvat (1959, 1962), Horvat *et al*. (1974), Braun-Blanquet (1950), Braun-Blanquet *et al*. (1939, 1954), Oberdorfer (1957, 1979), Oberdorfer *et al.* (1992), Wallnöfer (Mucina *et al*., 1993) and our own analyses, we have reached the following results and classifications of syntaxonomic units of pine forests:

Class *Erico-Pineetea* Ht. 1959

Class *Erico-Pineetea* Ht. 1959 covers the widest circle of forests of Scots (*Pinus sylvestris*) and Austrian Pine (*P. nigra*) of (partly) western, central, southeastern and (partly) eastern Europe on basophilous, ultra-basophilous and neutral habitats with characteristic species:
Aquilegia atrata Koch
Buphthalmum salicifolium L.
Calamagrostis varia (Schrad.) Host
Cirsium eristihales (Jacq.) Scop.
Festuca amethystina L.
Leontodon incanus (L.) Schrank
Molinia arundinacea Schrank
Pinus sylvestris L.
Platanthera bifolia (L.) L. C. Rich.
Pyrola chlorantha Sw.

Order *Erico-Pinetalia* Ht. 1959

Order *Erico-Pinetalia* Ht. 1959 in the area of class *Erico-Pinetea* unites heliophilous and xerothermic species for habitats of Scots (*Pinus sylvestris*) and Austrian Pine (*P. nigra*), which connects them in the widest sense in relation to distribution (horology) of species and ecological conditions. Characteristic species are:
Calamagrostis humilis (R. et Sch.) O. Schwarz
Carex alba Scop.
Chamaecytisus hirsutus (L.) Link
Crepis alpestris (Jacq.) Tausch f. *sylvatica*
Dianthus monspessulanus L.
Epipactis atrorubens (Hoffm.) Schult
Erica carnea L.
Euphorbia saxatilis Jacq.
Frangula rupestris (Scop.) Schur.
Gymnadenia odoratissima (Nath.) L. C. Rich.
Laserpitium gaudinii Moretti

Peucedanum austriacum (Jacq.) Koch subsp. *rablense* (Wulf.) Čelak
Potentilla alba L.
Polygala chamaebuxus L.

Alliance *Erico-Pinion sylvestris* Br.-Bl. in Br.-Bl. *et al.* 1939 nom. inv.

Alliance *Erico-Pinion sylvestris* Br.-Bl. in Br.-Bl. *et al.* 1939 nom. inv. connects westeuropean communities mainly of Scots (*Pinus sylvestris*) and partly Austrian Pine (*P. nigra*) on the eastern boundary of the area of distribution of the alliance. Habitats are on a carbonate geological basis. The following species are characteristic for the alliance: *Callianthemum anemonoides* (Joh. Zahlbr.) Endl., *Carex ericetorum* Pollich, *Carex ornithopoda* Willd., *Coronilla vaginalis* Lam., *Galium austriacum* Jacq., *Hippocrepis comosa* L., *Leucanthemum ircutianum* (Turez.) DC. s. lat., *Thlaspi montanum* L., *Vicia galloprovincialis* Poir.

Alliance *Fraxino orni-Pinion nigrae-sylvestris* (Ht. 1953) nom. nov. hoc loco

Synonym: *Orneto-Ericion* Ht. 1958 (Art. 34).
Characteristic species of the alliance: *Amelanchier ovalis* Med., *Centaurea triumfetti* All., *Cotoneaster tomentosa* (Ait.) Lindl., *Cytisus pseudoprocumbens* Markgr., *Daphne blagayana* Freyer, *Daphne cneorum* L., *Stachys recta* L., *Pinus nigra* Arnold, *Vicia villosa* Roth.

The alliance unites easteuropean basal and ultrabasal communities of Austrian (*Pinus nigra*) and Scots Pine (*P. sylvestris*) in the sense envisaged by Horvat (1959). In the west of its area of distribution it is not sharply delineated and covers or has some specifically "war zones" (Kampfzone) with the area of distribution of the alliance *Erico-Pinion sylvestris*. The alliances, or their characteristic species, overlap each other's areas. The renaming of the alliances is sensible since the dominant bearers of these phytocenoses are Austrian (*Pinus nigra*) and Scots Pine (*P. sylvestris*) and not Spring Heath (*Erica carnea*). Here and there *Fraxinus ornus* is a co-dominant species in these pine forests. In terms of floristic composition, the horology of the flora, ecological conditions and finally by the names of the alliances, the alliance *Erico-Pinion sylvestris* in the western Alps and *Fraxino orni-Pinion nigrae-sylvestris* in the south-easternalpine-dinarid region are relatively well distinguished.

Sub-alliance *Helleboro nigri-Pinenion* (Ht. 1959) nom. nov. hoc loco

Synonym: *Orneto-Ericion dolomiticum* Ht. 1959 (Art. 34, 49).
Characteristic species of the sub-alliance: *Chamaecytisus purpureus* (Scop.) Link., *Crepis incarnata* (Wulf.) Tausch, *Dorycnium germanicum* (Gremli) Rikli, *Genista januensis* Viv., *Genista radiata* (L.) Scoop., *Potentilla carniolica* Kern.
Differential species of the sub-alliance: *Helleborus niger* L. subsp. *niger*, *Iris graminea* L., *Rhamnus saxatilis* Jacq.

We have amended Horvat's (1959) sub-alliance *Orneto-Ericion dolomiticum* in view of the Codex into a suitably valid nomenclature. We have called the sub-alliance after a dolomitophilous southeasteuropean-illyrian species or sub-species *Helleborus niger* subsp. *niger*, which in terms of its ecology exemplorily indicates the dolomite habitat and, at the same time, designates the phytogeographic region of the wider Illyrian province. Although the sub-species *Helleborus niger* subsp. *niger* is more or less frequent in pine forests, its main area of distribution is in beech and thermophilous broadleaf scrub. It is considered a differential species in the sub-alliance. According to Horvat (1959, Table II) and according to our analyses and final judgement, we have chosen characteristic species of the alliance that are more or less permanent in pine phytocenoses and indicate a dolomite or dolomitophilous habitat. In fact, we consider them more as relative characteristic species of the sub-alliance. At the same time, they designate horologically the easternalpine-dinarid-(westbalkan) space.

Sub-alliance *Asplenio cuneifoliae-Pinenion* (Ht. 1959) nom. nov. hoc loco

Synonym: *Orneto-Ericion serpentinicum* Ht. 1959 (Art. 32, 49).
Characteristic species of the sub-alliance: *Asplenium adiantum-nigrum* L. subsp. *cuneifolium* (Viv.) A.G.

Distinguishing species of the sub-alliance:
Ecological-horological group: *Cardamine glauca* Spr. *Centaurea smolinensis* Hay., *Euphorbia serpentini* Novak, *Notholaena marantae* (L.) R. Br., *Sesleria latifolia* Deg. subsp. *serpentinica* Ht. (in litt.), *Silene*

zlatiborensis Novak.

HOROLOGICAL (PHYTOGEOGRAPHIC) GROUP: *Alyssum markgrafii* O. E. Schulz, *Bromus pannonicus* Kumm. & Sendt., *Crocus veluchensis* Ky., *Cytisus bosniacus* Beck., *Genista inermis* (Panč.) Koch, *Knautia dinarica* Borb., *Linaria concolor* Gris., *Melampyrum bosniacum* Ronn., *Potentilla australis* Krašan subsp. *malyana* Novak, *Primula columnae* Ten., *Scabiosa leucophylla* Borb., *Sesleria rigida* Heuff., *Silene paradoxa* L., *Stachys scardica* Gris., *Verbascum bosnense* Maly.

Horvat (1959) already established that of all the species that he envisaged as characteristic species of the sub-alliance *Orneto-Ericion serpentinicum*, only the species *Asplenium adiantum-nigrum* v. *serpentini* (= *A. adiantum-nigrum* subsp. *cuneifolium*) is bound to pine forests. On this basis and on the basis of our own analyses we decided to consider only the species *Asplenium adiantum-nigrum* subsp. *cuneifolium* to be a characteristic species, and all the other cited species to be differential species of an ecological-horological (phytogeographic) character. Species of the ecological-horological and horological (phytogeographic) groups have wider ecological amplitude and thrive on carbonate and serpentenite geological bases. These species are a composite part of other phytocenoses, namely oak, beech, whitebeam etc. forests and grasslands or non-forest communities. There is no doubt that they distinguish the eastern sub-alliance *Asplenio cuneifoliae-Pinenion* from the western sub-alliance *Helleboro nigri-Pinenion*; in the widest sense these differential species are considered to be among Balkan species.

At the very start of this paper, we took a position to the alliance *Fraxino orni-Ostryon carpinifoliae* Tomažič 1940. We classified it in the order *Quercetalia pubescentis-petraeae* Br.-Bl. 1931, as the author Tomažič (1940) had already himself done. The difference is that we place in the alliance only thermophilous continental broadleaf scrub or low forest of the Illyrian floral province. We have removed pine phytocenoses from the alliance, as well as Tomažič's association of Scots Pine and placed it in the sub-alliance *Helleboro nigri-Pinenion* alliance *Fraxino orni-Pinion nigrae-sylvestris.*

On the basis of Tomažič's (1940) study and our own analyses, by comparison of the pine syntaxa dealt with here, we have decided that the following are characteristic species for the alliance *Fraxino orni-Ostryon* Tomažič 1940: *Cotinus coggygria* Scop., *Euonymus verrucosa* Scop., *Euphorbia angulata* Jacq., *Fraxinus ornus* L., *Lilium bulbiferum* L., *Mercurialis ovata* Sternbg. & Hoppe, *Ostrya carpinifolia* Scop., *Pulmunaria australis* (Murr.) Sauer, *Quercus cerris* L., *Viola alba* Bess.

Syntaxonomic review of the class *Erico-Pinetea* in Slovenia

ERICO-PINETEA Ht. 1959
ERICO-PINETALIA Ht. 1959
FRAXINIO ORNI-PINION NIGRAE-SYLVESTRIS (Ht. 1958) nom. nov.
HELLEBORI NIGRI-PINENION (Ht. 1959) nom. nov.
Genisto januensis-Pinetum sylvestris Tomažič 1940
Fraxino orni-Pinetum nigrae Martin-Bösse 1961
Alno incanae-Pinetum sylvestris Poldini 1984 var. geogr. *Omphalodes verna* Zupančič & Žagar 1998
Brachypodio-Pinetum sylvestris Zupančič & Žagar 1997 corr. 1998
Carici sempervirentis-Pinetum nigrae Accetto (1996) 1999
Daphno alpinae-Pinetum nigrae Accetto 2001
Piceo-Pinetum sylvestris Tregubov 1957 (mscr.)

Systematic review of the associations of the alliance *Fraxino orni-Ostryon* in Slovenia:

QUERCO-FAGETEA Br.-Bl. & Vlieger 1937
QUERCETALIA PUBESCENTIS-PETRAEAE Br.-Bl. (1931) 1932
Quercion pubescentis-petraeae Br.-Bl. 1931
Ostryo-Carpinion orientalis Ht. (1954) em. 1958
Ostryo-Carpinenion Ht. (1954) 1959
FRAXINO ORNI-OSTRYON CARPINIFOLIAE Tomažič 1940
Cytisantho-Ostryetum M. Wraber (1960) 1961
Erico-Ostryetum Ht. 1956
Ostryo carpinifoliae-Fraxinetum orni Aichinger 1933
Rhododendro hirsuti-Ostryetum Franz 1991 (nom. prov.)

Conclusions

Dilemmas in the further division into lower syntaxa of the class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. *et al*. 1939 have appeared from its creation onwards. We are thinking here above all of the syntaxa of order, alliance and sub-alliance, which have been the subject of study of many European phytocenologists. Braun-Blanquet, Pawlowski, Oberdorfer, Kielland-Lund, Hadač and Wallnöfer most stand out. In Slovenia, M. Wraber was the first to study phytocenoses of the class *Vaccinio-Piceetea* and he created 4 new associations and adopted 4 associations from other European authors. He accepted without reservation Braun-Blanquet's syntaxonomic nomenclature. Zupančič began study of phytocenoses of the class *Vaccinio-Piceetea* in the sixties of last century and he intensified this research in the seventies. He created 11 new associations and corrected or supplemented 10 associations with geographic variants, sub-variants and forms. T. Wraber and Žagar occasionally collaborated with Zupančič in the study of scrub pine. The class *Vaccinio-Piceetea* was enriched with new or supplemented associations by Accetto (1 new and 1 supplemented association), Košir (1 new association), Marinček (1 new and 1 supplemented association), Tomažič (1 new association) and Čarni. Dakskobler studied and introduced a larch association of Austrian phytocenologists. Numerous associations are the result of descriptions of ecological and phytogeographical conditions in Slovenia and the wealth of flora, with more than 3.300 taxa. Zupančič went deeper into the subject and problems of the syntaxonomy of the class *Vaccinio-Piceetea* and created the appearance that is shown in this paper. Above all, he followed the best expert of the class *Vaccinio-Piceetea* , Braun-Blanquet, as is evident from the review of the class *Vaccinio-Piceetea* in Slovenia.

The class *Erico-Pinetea* Ht. 1959 was created very late, twenty years after the class *Vaccinio-Piceetea*. The reason for this is the fairly undefined aspect of the class *Erico-Pinetea* and the hard to determine syngenesis. We are certainly of the opinion that it should be classified between the classes *Querco-Fagetea* (relationship to the orders *Quercetalia pubescentis-petraeae* and *Quercetalia roboris-petraeae*) and *Vaccinio-Piceetea* (relationship to sub-alliance *Abieti-Piceenion* or order *Athyrio-Piceetalia*). The author of the class *Erico-Pinetea* and its best expert, Horvat, also ranked it in inverse order. Horvat dealt with the problem of the class *Erico-Pinetea* in a complex way, especially in the area of southeast Europe, where the species *Pinus nigra* and *P. sylvestris* dominate. On dolomite, dolomitised limestone and on ultrabasal serpentenite in southeast Europe and especially the Balkan peninsular, he could not accept in entirety the thesis of Braun-Blanquet or Oberdorfer, who place basal pine forests in the class *Vaccinio-Piceetea*, which is logical for acidic pine forests. Horvat supplemented this gap with a new class *Erico-Pinetea* Ht. 1959, order *Erico-Pinetalia* Ht. 1959, alliance *Orneto-Ericion* Ht. 1958 and sub-alliances *Orneto-Ericion dolomiticum* Ht. 1959 and *Orneto-Ericion serpentinicum* Ht. 1959. Europe accepted Horvat's syntaxonomic arrangement of the class *Erico-Pinetea*. More recently, Wallnöfer has dealt with this problem, but we only partially agree with her solutions.

Tomažič first studied pine forests in Slovenia and published two new pine associations: on dolomite and on non-carbonate rocks. He classified the first in a new alliance that he created *Orneto-Ostryon carpinifoliae* Tomažič 1940 and order *Quercetalia pubescentis-petraeae* Br.-Bl. (1931) 1932. Horvat did not agree with Tomažič's alliance *Orneto-Ostryon* and included it in his own newly created alliance *Orneto-Ericion*. M. Wraber followed Horvat, so that be placed the class *Erico-Pinetea* between the classes *Querco-Fagetea* and *Vaccinio-Piceetea.* In 1986 (Zupančič editor *et al*. 1986), we made minor corrections and accepted the alliance *Orno-Ostryon* in the order *Erico-Pinetalia*, so that we placed Tomažič's basal pine association in the sub-alliance *Orno-Ericion dolomiticum* Ht. 1959. After new findings, we classified only continental thermophilous scrub or low forest in the alliance. We have not to date gone in depth into the class *Erico-Pinetea*, probably also because of the few pine associations in Slovenia. Croatian phytocenologists have also not yet followed the requirements of the new Codex. In a review publication in Croatia (ed. Rauš *et al*., 1992) Šume classified pine phytocenoses in a division of relict (?) Austrian Pine forests of Dinarid and other communities on dolomite. In order to perform an adequate synthesis of pine phytocenoses in Slovenia under the valid norms of the Codex, we had to make a wider analysis of syntaxa oft concern in the eastalpine-dinarid and related region. We have tried to resolve the problems in terms of the valid Codex of 2000, as we have shown in this paper. We do not exclude the possibility of a different point of view and interpretation of the syntaxonomic classification of the classes *Vaccinio-Piceetea* and *Erico-Pinetea*. The class *Erico-Pinetea* cause particular difficulties, being more or less poorly defined syntaxonomically and remaining somewhat problematic.

Acknowledgement

My friend Professor dr. Ernest Mayer, the doyen of Slovene botanists, unselfishly helped me with floristic and phytogeographic problems. I am sincerely grateful for his assistance. I am also grateful to my friend Emeritus Professor dr. Livio Poldini, who encouraged me to write this paper.

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