

# NOMENCLATURE ADJUSTMENTS AND NEW SYNTAXA OF THE ARCTIC, ALPINE AND ORO-MEDITERRANEAN VEGETATION

Milan CHYTRÝ<sup>1\*</sup>, Fred J. A. DANIËLS<sup>2</sup>, Romeo DI PIETRO<sup>3</sup>,  
Natalia KOROLEVA<sup>4</sup>, Ladislav MUCINA<sup>5</sup>

## Abstract

During preparation of the European checklist of vegetation units (EuroVegChecklist), it became clear that some earlier described syntaxa need to be typified in order to stabilize nomenclature and some new syntaxa need to be described. Here we propose nomenclature adjustments and formal description of four new alliances for the Arctic, alpine and oro-Mediterranean vegetation of Europe, Greenland and Anatolia. First, we typify the class *Juncetea trifidi*. Second, we describe four new alliances, such as the *Puccinellion nuttallianae* (Low-Arctic salt steppes of Greenland; class *Saxifrago tricuspadatae-Calamagrostietera purpurascensis*), *Dryado octopetalae-Caricion arctisibiricae* (Arctic tundra vegetation of north-eastern European Russia; class *Carici rupestris-Kobresietea bellardii*), *Leontopodio nivalis-Elyinion myosuroidis* (southern European alpine tundra vegetation; class *Carici rupestris-Kobresietea bellardii*) and *Lagotido uralensis-Caricion ensifoliae* (alpine tundra vegetation of the Southern Ural Mountains; class *Juncetea trifidi*). Two new associations are described within the first two of these alliances. Finally, we present an interpretation of the alliance *Muscario-Scillion nivalis*.

**Keywords:** alpine grasslands, Anatolia, Europe, EuroVegChecklist, Greenland, International Code of Phytosociological Nomenclature (ICPN), syntaxonomy, tundra.

## Izvlček

Med pripravo evropskega seznama vegetacijskih enot (EuroVegChecklist) je postalo jasno, da je potrebno za utrditev nomenklature nekatere zgodnejše opise sintaksonov veljavno tipizirati oziroma opisati nove sintaksonne. V članku predlagamo nomenklaturne popravke in formalne opise štirih novih zvez za arktično, alpinsko in oro-mediteransko vegetacijo Evrope, Grenlandije in Anatolije. Najprej smo tipificali razred *Juncetea trifidi*. Kot drugo smo opisali štiri nove zveze: *Puccinellion nuttallianae* (nizke arktične slane stepe Grenlandije; razred *Saxifrago tricuspadatae-Calamagrostietera purpurascensis*), *Dryado octopetalae-Caricion arctisibiricae* (vegetacija arktične tundre severovzhodne evropske Rusije; razred *Carici rupestris-Kobresietea bellardii*), *Leontopodio nivalis-Elyinion myosuroidis* (vegetacija južno-evropske alpinske tundre; razred *Carici rupestris-Kobresietea bellardii*) in *Lagotido uralensis-Caricion ensifoliae* (vegetacija alpinske tundre gorovja južnega Urala; razred *Juncetea trifidi*). V teh zvezah smo opisali dve novi asociaciji. Na koncu predstavljamo interpretacijo zveze *Muscario-Scillion nivalis*.

**Ključne besede:** alpinska travišča, Anatolija, Grenlandija, Mednarodni kodeks fitocenološke nomenklature (ICPN), sintaksonomija, tundra.

<sup>1</sup> Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic. E-mail: chytry@sci.muni.cz

<sup>2</sup> Institute of Biology and Biotechnology of Plants, Schlossplatz 8, D-48143 Münster, Germany. E-mail: daniels@uni-muenster.de

<sup>3</sup> Department of Planning, Design and Technology of Architecture, Section Environment and Landscape, Sapienza University of Rome, Via Flaminia 72, I-00196 Rome, Italy. E-mail: romeo.dipietro@uniroma1.it

<sup>4</sup> Polar-Alpine Botanical Garden-Institute of the Kola Science Center, Russian Academy of Sciences, Kirovsk, Murmansk Province, Russia. E-mail: flora012011@yandex.ru

<sup>5</sup> Iluka Chair in Vegetation Science and Biogeography, School of Plant Biology, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009, Perth, Australia; Department of Geography and Environmental Studies, Stellenbosch University, Private Bag X1, Matieland 7602, Stellenbosch, South Africa. E-mail: Laco.Mucina@uwa.edu.au  
Department of Botany and Microbiology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia.

\* Corresponding author

**Nomenclature:** Vascular plants: Euro+Med PlantBase (www.emplantbase.org, accessed on 14 Sep 2014); The Plant List (www.theplantlist.org, accessed on 14 Sep 2014) for species not included in the Euro+Med PlantBase; Egorova (1999) for subspecies of *Carex bigelowii*; Conti et al. (2005) for subspecies of *Androsace vitaliana*. Mosses: Hill et al. (2006). Lichens: Santesson et al. (2004).

## 1. INTRODUCTION

During the preparation of the publication ‘*Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities*’ (Mucina et al. submitted; hereafter referred to as ‘EuroVegChecklist’), thousands of published syntaxonomical concepts of European phytosociological classes, orders and alliances were assessed. Syntaxonomic names related to these concepts were checked, especially whether they comply with the rules of the International Code of Phytosociological Nomenclature (Weber et al. 2000; ICPN hereafter). In many cases, these revisions revealed a need for formal description of new vegetation units, nomenclature changes or adjustments, or stabilization of the currently used names by typification. In order to separate these technical nomenclatural issues from the EuroVegChecklist itself, we have embarked on publishing a series of papers complementing the EuroVegChecklist by formally describing new syntaxa, providing nomenclature adjustments and discussing the contentious syntaxonomic concepts.

This paper, focusing on Arctic, alpine and oro-Mediterranean vegetation is one of the series. It aims to (1) contribute to stabilization of syntaxonomic nomenclature by typification of the originally broadly-conceived class of *Juncetea trifidi*, (2) formally describe four new alliances accepted in the EuroVegChecklist, and (3) clarify the syntaxonomic position of a problematic alliance reported from the Balkans and Anatolia.

## 2. *JUNCETEA TRIFIDI*: TYPIFICATION OF AN OLD BUT SOMETIMES WRONGLY REJECTED CLASS NAME

(by Milan Chytrý)

In the original diagnosis of the class *Juncetea trifidi* Hadač in Klika et Hadač 1944 (*Juncetea trifidi* Hadač 1944), Klika & Hadač (1944: 281–

283) included four orders, all validly described by Braun-Blanquet (in Braun-Blanquet & Jenny 1926), such as the ‘*Androsacetalia alpinae* Br.-Bl. 1926’, ‘*Salicetalia herbaceae* Br.-Bl. 1926’, ‘*Caricetalia curvulae* Br.-Bl. 1926’ and ‘*Rhodoreto-Vaccinietalia* Br.-Bl. 1926’. Grabherr (1993: 343–344) considered the class name *Juncetea trifidi* Hadač in Klika et Hadač 1944 as a *nomen nudum* according to Art. 2b of ICPN, and also as a *nomen ambiguum* because of the broad delimitation of this class presented by Klika & Hadač (1944). Therefore Grabherr (1993) included the alpine grasslands on acidic bedrock in the class *Caricetea curvulae* Br.-Bl. 1948. Similarly, Mucina (1997) and Dúbravcová & Jarolímek (2007) assumed that the name *Juncetea trifidi* Hadač in Klika et Hadač 1944 lacked a sufficient original diagnosis. Consequently Mucina (1997) used a younger name *Juncetea trifidi* Hadač 1946 for this class, and Dúbravcová & Jarolímek (2007) used the name *Caricetea curvulae* Br.-Bl. 1948, considering the *Juncetea trifidi* Hadač 1946 being also a *nomen ambiguum*.

Here we argue that the name *Juncetea trifidi* Hadač in Klika et Hadač 1944 is not a *nomen nudum*. Although Klika & Hadač (1944) included only few recent papers in the list of references, these authors indicated in the introductory Czech text (p. 249) that their survey of syntaxa expands on an earlier survey published in the book *Praktikum rostlinné sociologie, půdoznalství, klimatologie a ekologie* (Klika & Novák 1941): “It is clear that some unification is needed, and our overview aims at it. It is a follow up of the corresponding part of the ‘Praktikum rostlinné sociologie, půdoznalství, klimatologie a ekologie’. Praha, Melantrich 1941. To save space, we refer to it in some parts. For higher units we indicate a list of diagnostic species of classes, orders and alliances. These, along with a brief ecological characterization, enable distinguishing particular units.” (translated from Czech). Further (on p. 257) they referred again to this book and to Volume 4 of *Bibliographia Phytosociologica* (Tüxen et al. 1943) for the list of references to the author citations of syntaxa: “Papers are found in a corresponding list of references in the ‘Praktikum...’, papers from the for-

mer Polish Carpathians and Slovakia are listed in *Bibliographia Phytosociologica Fasc. 4. 'Germania Pars II.' Hannovera 1943, which contains a list of literature related to the Sudeten lands, Slovakia, former Poland and former Carpathian Ruthenia.*" (translated from Czech). Therefore, several class names were published validly by Klika & Hadač (1944) by using an indirect reference to an earlier original diagnosis according to Art. 2b of ICPN. This interpretation of the new names published in Klika & Hadač (1944) was also accepted, for example, by Michl et al. (2010: 147). Original diagnoses of the orders included in the original diagnosis of the class name *Juncetea trifidi* Hadač in Klika et Hadač 1944 and containing the name-giving species *Juncus trifidus* are also referred to indirectly through the *Praktikum* (Klika & Novák 1941), which contains the reference to 'Braun-Blanquet (1926)'. Although in most cases this paper is referred to as 'Braun-Blanquet & Jenny (1926)', it can be also referred to as 'Braun-Blanquet (1926)' because the author statement (in German) on the title page of the paper reads: '*J. Braun-Blanquet unter Mitwirkung von Hans Jenny*' ('*J. Braun-Blanquet with collaboration of Hans Jenny*'). Otherwise, as the title of the paper, the series and the volume number in which it is published are correctly cited (except for '*Neue Denkschr. ...*' instead of '*Denkschr.*'), this bibliographic reference is unambiguous in the sense of the Art. 2b of ICPN.

The *Juncetea trifidi* Hadač in Klika et Hadač 1944 is also not a *nomen ambiguum*, in spite of the fact that nowadays the four orders of its original diagnosis are included to four vegetation classes (*Thlaspietea rotundifolii* Br.-Bl. 1948, *Salicetea herbaceae* Br.-Bl. 1948, *Juncetea trifidi* Hadač in Klika et Hadač 1944 and *Loiseleurio procumbentis-Vaccinietea* Eggler ex Schubert 1960) as recognized by the EuroVegChecklist and most of the current European literature. According to the Art. 36 of ICPN, the reason for proposing a *nomen ambiguum* status could be its frequent use "*in a false sense that excludes its type so that its re-introduction in its original correct sense would be a source of continual errors*" (Weber et al. 2000). However, this is not the case here since, to our knowledge, no lectotype has ever been selected from the four available orders included in the original diagnosis of the class. In nearly all syntaxonomic overviews that used the class name *Juncetea trifidi* Hadač in Klika et Hadač 1944 (e.g. Oberdorfer 1993, Coldea 1997, Malinovsky & Kricsfalusy 2000, Kočí 2007, Matuszkiewicz 2007) this name was

used for vegetation of alpine grasslands on acidic soils such as those classified within the *Caricetalia curvulae* Br.-Bl. in Br.-Bl. et Jenny 1926, i.e. one of the orders included in the original diagnosis of this class. Rivas-Martínez et al. (2002) published a proposal to conserve the name *Caricetea curvulae* Br.-Bl. 1948 against the name *Juncetea trifidi* Hadač in Klika et Hadač 1944, but there was no reason for doing so.

In order to stabilize the use of the validly described class name *Juncetea trifidi* Hadač in Klika et Hadač 1944, we typify it by choosing the order name *Caricetalia curvulae* Br.-Bl. in Br.-Bl. et Jenny 1926 as its nomenclature type (*lectotypus hoc loco designatus*).

### 3. PUCCINELLION NUTTALLIANAE: A NEW ALLIANCE OF THE ARCTIC SALINE STEPPES

(by Fred J. A. Daniëls)

#### *Puccinellion nuttallianae* Daniëls *all. nov. hoc loco*

Included concepts: *Puccinellia deschampsioides* sociations of the *Puccinellia deschampsioides-Braya linearis* Sociation Group in Böcher (1954: Table 24: 1–11, 20–22)

Name-giving species: *Puccinellia nuttalliana* (Schult.) Hitchc. (syn.: *Puccinellia deschampsioides* T. J. Sørensen)

Nomenclature type (*holotypus hoc loco designatus*): *Puccinellietum nuttallianae* Daniëls in Chytrý et al. 2015 (this paper, see below)

Diagnostic taxa of the alliance: *Artemisia campestris* subsp. *borealis*, *Braya humilis*, *B. linearis*, *Calamagrostis purpurascens*, *Draba daurica*, *D. incana*, *Gentiana detonsa*, *Lomatogonium rotatum*, *Plantago maritima* subsp. *borealis*, *Primula stricta*, *Puccinellia nuttalliana*, *Hennedilla heimii* and *Cladonia pyxidata*.

This alliance belongs to the class *Saxifrago tricuspidatae-Calamagrostietea purpurascens* Drees et Daniëls 2009 and the order *Saxifrago tricuspidatae-Calamagrostietalia purpurascens* Drees et Daniëls 2009. It comprises the Low-Arctic salt-steppe vegetation of xero- and mesophytic grasslands containing (sub)halophilous species. This vegetation occurs on loess or clay deposits accumulated at foot slopes of mountain ridges and on the shores of salt lakes in the continen-

tal Low-Arctic regions of Greenland characterized by very dry and relatively warm summers and very dry and cold winters. The substrates are subjected to extreme fluctuations in soil moisture regime. So far the plant communities of this alliance have mainly been known from the inland of West Greenland (Drees & Daniëls 2009). The group of plant communities of the *Puccinellion nuttallianae* was assigned by Böcher (1954) to the ‘*Puccinellia deschampsoides-Braya linearis* Sociation Group’ within the ‘*Puccinellia deschampsoides-Gentiana detonsa* Type’ and the ‘*Artemisia borealis-Calamagrostis purpurascens-Arctostaphylos uva-ursi* Vegetation Complex’. This complex comprises the sub-Low Arctic continental xerophytic grasslands, dwarf-shrub vegetation as well as associated willow scrub.

***Puccinellietum nuttallianae* Daniëls *ass. nov. hoc loco***

Nomenclature type relevé (*holotypus hoc loco designatus*): Böcher (1954: relevé 4 in Table 24 of the ‘*Puccinellia-Cornicularia* sociation’)

Character and dominant species: *Puccinellia nuttalliana*

Constant taxa: *Artemisia campestris* subsp. *borealis*, *Puccinellia nuttalliana*, *Silene taimyrensis*, *Cephaloziella* spp., *Caloplaca citrina*, *Cetraria aculeata*, *Cladonia pyxidata*, *Cyanophyceae* spp.

Böcher (1954) described the *Artemisia borealis-Calamagrostis purpurascens-Arctostaphylos uva-ursi* complex from continental south-western Greenland, including three ‘types’. One of these is the *Puccinellia deschampsoides-Gentiana detonsa* Type, comprising two ‘sociation groups’: the *Puccinellia deschampsoides-Braya linearis* Sociation Group and the *Sisyrichium montanum* Sociation Group. The former sociation group comprises *Puccinellia deschampsoides* sociations, *Calamagrostis purpurascens* sociations, *Kobresia myosuroides* sociations and *Dryas integrifolia* sociations. Each sociation is distinguished by its floristic composition and species dominance derived from vegetation plots from different sites. In the syntaxonomic classification of the Braun-Blanquet approach, these Böcher’s vegetation units could be recognised as associations. The *Puccinellia-Cornicularia* sociation rich in *Artemisia borealis* is interpreted here as a new association – the *Puccinellietum nuttallianae*.

**4. *DRYADO OCTOPETALAE-CARICION ARCTISIBIRICAE*: A NEW ALLIANCE OF THE ARCTIC TUNDRA**

(by Natalia Koroleva)

***Dryado octopetalae-Caricion arctisibiricae* Koroleva et Kulyugina *all. nov. hoc loco***

Syn.: *Carici arctisibiricae-Dryadion octopetalae* Koroleva et Kulyugina 2010 *prov.* (Arts. 2b & 3b)

Name-giving taxa: *Dryas octopetala* L., *Carex bigelowii* subsp. *arctisibirica* (Jurtz.) Á. Löve et D. Löve

Nomenclature type (*holotypus hoc loco designatus*): *Dryado octopetalae-Caricetum arctisibiricae* Koroleva et Kulyugina in Chytrý et al. 2015 (this paper, see below)

Diagnostic taxa: *Astragalus alpinus* subsp. *arcticus*, *Carex bigelowii* subsp. *arctisibirica*, *Dryas octopetala*, *Eritrichium villosum*, *Pedicularis oederi*, *Salix reticulata*, *Saxifraga hieracifolia*, *S. hirculus*, *Thalictrum alpinum*

This new alliance belongs to the class *Carici rupestris-Kobresietea bellardii* Ohba 1974 and the order *Thymo arctici-Kobresietalia bellardii* Ohba 1974. The alliance was proposed by Koroleva & Kulyugina (2010) as a preliminary concept (*nomen provisorium*) and without an original diagnosis, hence it was invalidly published according to the Arts. 2b and 3b of ICPN. Here we perform the formal validation of this alliance.

The alliance comprises closed-canopy (cover of 70–80%, in places up to 100%) tundra vegetation dominated by *Dryas octopetala* and *Carex bigelowii* subsp. *arctisibirica* with *Salix polaris*, *S. reticulata* and mesophytic hypo-Arctic grasses showing high constancy values. The moss layer is well-developed and composed of mesophytic pleurocarpous mosses. This vegetation includes the species-richest plant communities in the sub-Arctic tundra.

The *Dryado octopetalae-Caricion arctisibiricae* is similar to the *Kobresio-Dryadion* Nordhagen 1943, which occurs mainly in Svalbard and the Scandinavian mountains. In contrast to the *Kobresio-Dryadion*, *Dryado-Caricion* lacks species such as *Carex atrata*, *C. hepburnii*, *C. misandra* and *C. rupestris*, and it is of more mesophytic nature because of the co-dominance of *Dryas octopetala* and *Carex bigelowii* subsp. *arctisibirica* and the constant presence of herbs and grasses.

The vegetation of this alliance occurs on small to medium-sized, well-drained, relatively warm and moderately snow-protected hilltops and on south- and west-facing slopes of hills ('musyures'). It occupies clayey, sandy and gravelly soils, in some places with frost-boiling patches. It occurs in the southern and typical tundra of north-eastern European Russia, namely in the Malozemel'skaya Tundra, Bol'shezemel'skaya Tundra and in the Pay-Khoy Mountains on the Yugorskiy Peninsula (bioclimatic zones D and C, and partly also E according to the Circumpolar Arctic Vegetation Map; Walker et al. 2005). It is rather rare in the western part of this area (Malozemel'skaya Tundra) and becomes more widely distributed to the east of Bol'shezemel'skaya Tundra and the Pay-Khoy Mountains.

The differences between the *Dryas*-dominated plant communities of Fennoscandia and those of the Pechora Plain could be partly explained by different geology and Quaternary environmental history. Fennoscandia was entirely glaciated, and the repeated glacier retreats were leaving behind well-drained soils developed on bare rocks, coarse moraine debris and fluvio-glacial deposits. In contrast, glaciations and sea transgressions in the Pechora Plain accumulated mainly glacial till and fluvial deposits.

Differentiation of the North European *Dryas*-dominated tundra at the alliance level corresponds to the eco-geographical division of the Arctic (Aleksandrova 1980), according to which the tundra of the Kola Peninsula and of the northern Pechora Plain differ at the level of sub-provinces; the former is related to the Kola Sub-province of the East-European-West-Siberian Province of sub-Arctic tundra, and the latter is related to the East-European Sub-province. This differentiation also matches the floristic division of the Arctic (Yurtzev 1994), in which the northern Pechora Plain belongs to the specific Kanin-Pechora Sub-province.

***Dryado octopetalae-Caricetum arctisibiricae*  
Koroleva et Kulyugina ass. nov. hoc loco**

Nomenclature type relevé (*holotypus hoc loco designatus*): Russia, Yugorskiy Peninsula, Pay-Khoy Mountains, top of the hill near Sareyakhato Lake, 69°01'21.4"N, 62°11'7.9"E, altitude 213 m, total vegetation cover 100%; sampled by E. Kulyugina using the 8-degree Braun-Blanquet scale in June 2010.

Vascular plants (cover: 95%): *Carex bigelowii*

subsp. *arctisibirica* 4, *Dryas octopetala* 2b, *Salix polaris* 2b, *Persicaria vivipara* 1, *Salix lanata* 1, *Vaccinium vitis-idaea* 1, *Astragalus alpinus* subsp. *arcticus* +, *Equisetum scirpoides* +, *Festuca ovina* +, *Hedysarum hedysaroides* subsp. *arcticum* +, *Luzula nivalis* +, *Myosotis asiatica* +, *Pedicularis* sp. +, *Petasites frigidus* +, *Poa arctica* +, *Pyrola grandiflora* +, *Ranunculus monophyllus* +, *Salix reticulata* +, *Stellaria longipes* +, *Valeriana capitata* +, *Eutrema edwardsii* r, *Persicaria bistorta* r, *Saxifraga hieracifolia* r, *S. hirculus* r.

Bryophytes (70%): *Hylocomium splendens* 3, *Leptobryum pyriforme* 1, *Ptilidium ciliare* 1, *Tomentypnum nitens* 1, *Dicranum angustum* +, *D. majus* +, *D. spadiceum* +, *Polytrichum hyperboreum* +.

Lichens (5%): *Peltigera aphthosa* 1, *Thamnolia vermicularis* 1, *Cetraria islandica* +, *Cladonia amaurocraea* +, *C. arbuscula* +, *C. gracilis* +, *C. macroceras* +, *C. subfurcata* +, *Flavocetraria cucullata* +, *F. nivalis* +, *Lobaria linita* +, *Peltigera canina* +, *Stereocaulon alpinum* +.

**5. LEONTOPODIO NIVALIS-ELYNION  
MYOSUROIDIS: A NEW ALLIANCE  
OF THE SOUTHERN EUROPEAN  
ALPINE TUNDRA**

(by Romeo Di Pietro)

***Leontopodio nivalis-Elynyon myosuroidis* (Blasi et Di Pietro in Blasi, Di Pietro, Fortini et Catonica 2003) Di Pietro et Mucina all. nov. et stat. nov. hoc loco**

(*Leontopodio nivalis-Kobresion myosuroidis* all. nov., stat. nov. et nom. mut. propos.)

Basionym: *Leontopodio nivalis-Elynyon myosuroidis* Blasi et Di Pietro in Blasi, Di Pietro, Fortini et Catonica 2003 (as suballiance)

Synonym *pro parte min.*: *Seslerion apenninae* Furnari in Bruno et Furnari 1966

Name-giving species: *Leontopodium nivale* (Ten.) Hand.-Mazz., *Kobresia myosuroides* (Vill.) Fiori (syn.: *Elyna myosuroides* (Vill.) Janch.)

Nomenclature type: *Leontopodio nivalis-Elynetum myosuroidis* Feoli-Chiapella et Feoli 1977 (identical with the holotype of the *Leontopodio nivalis-Elynyon myosuroidis*)

Character taxa: *Achillea barrelieri* subsp. *barrelieri*, *A. barrelieri* subsp. *mucronulata*, *Adonis distorta*, *Alyssum cuneifolium*, *Androsace vitaliana* subsp. *praetutiana*, *Artemisia umbelliformis* subsp. *eri-*

*antha*, *Carex parviflora*, *Crepis magellensis*, *Eri-geron epiroticus*, *Gentiana brachyphylla* subsp. *favratii*, *G. nivalis*, *Leontopodium nivale*, *Oxytropis campestris*, *Pedicularis verticillata*, *Saxifraga exarata* subsp. *ampullacea*, *Silene acaulis* subsp. *acaulis*, *Trifolium noricum* subsp. *praetutianum*

Differential species vs. the *Seslerion apenninae*: *Carex capillaris*, *C. ericetorum*, *C. rupestris*, *Oxytropis neglecta*, *Polygonum viviparum*, *Potentilla crantzii*, *Salix retusa*, *Sedum atratum*

Differential taxa vs. the *Oxytropido-Elynion*: *Carex kitaibeliana*, *Edraianthus graminifolius*, *Festuca violacea* subsp. *italica*, *Gentianella columnae*, *Helictochloa versicolor* subsp. *praetutiana*, *Pedicularis elegans*, *Sesleria juncifolia*, *Trinia dalechampii*

The alpine tundra vegetation is easily identifiable in the Pyrenees, the Alps and the Carpathians while it becomes rare towards lower latitudes, e.g. in the Apennines and in the Balkans. The stronger influence of the pronounced summer drought and consequent upward shift of the vegetation belts might have caused the impoverishment of the circumboreal and arctic-alpine flora in southern Europe after the end of the last glaciation. In the Apennines, the alpine belt is currently clearly distinguished only at the highest altitudes of Gran Sasso (2912 m), Majella (2786 m) and Monti di Laga (2445 m), which have relatively large areas above the altitude of 2300 m. In contrast, the alpine belt is absent or restricted to small patches in other Central Apennine mountain ranges that reach remarkable altitudes only through isolated peaks such as Mt Velino (2486 m) and Mt Vettore (2454 m). Neither the Northern Apennines nor the Southern Apennines have an alpine belt. The Northern Apennines are too low (maximum altitude: Mt Cimone, 2165 m) and therefore almost completely lacking the high-altitude primary grasslands except for some spatially restricted communities of the classes *Juncetea trifidi*, *Elyno-Seslerietea* (*Caricion ferrugineae*) and *Salicetea herbaceae* (Tomaselli & Petraglia 2003; Gennai et al. 2014). The Southern Apennines are higher than the Northern Apennines (max. alt.: Serra Dolcedorme, 2265 m) but the stronger influence of the Mediterranean climate and the weak effect of the Quaternary glaciations have caused an extreme impoverishment of the arctic-alpine species pool and the dominance of the regional endemics (e.g. *Sesleria calabrica*, *S. nitida*) and amph-Adriatic elements (*Carex kitaibeliana*, *Festuca bosniaca*) (Bonin 1978, Di Pietro 2010).

The syntaxonomy of the natural grasslands in the alpine belt of the Central Apennines has been studied by various authors starting from Furrer & Furnari (1960). All the papers published before 1980 classified the primary grasslands of the alpine belt to the alliance *Seslerion apenninae* Furnari in Bruno et Furnari 1966 (order *Seslerietalia tenuifoliae* Horvat 1930 or *Seslerietalia apenninae* Lakušić 1969; class *Elyno-Seslerietea* or *Festuco-Seslerietea*). Pedrotti et al. (1982) were the first to make reference to the Ohba's class *Carici-Kobresietea* wherein they included the association *Carici-Elynetum myosuroidis*. Subsequently Biondi et al. (1999, 2000) added more associations (*Leontopodio-Elynetum*, '*Caricetum rupestris-kitaibeliana*' and *Seslerio-Dryadetum octopetalae*) that were classified by the latter authors to the alliance *Oxytropido-Elynion*. Blasi et al. (2003), in partial agreement with the proposal made by Oriolo (2001) for the Eastern Alps, classified these associations and the new association *Galio-Silenetum acaulis* to a new suballiance - the *Leontopodio nivalis-Elynenion myosuroidis* of the *Seslerion apenninae*. This suballiance was proposed in order to distinguish the primary 'alpine tundra' from the primary and secondary grasslands occurring in the subalpine and montane belts. Later Blasi et al. (2005) and Di Pietro et al. (2008) included in the *Leontopodio-Elynenion* further two new associations (*Leontopodio nivalis-Seslerietum* and *Helianthemo alpestris-Festucetum italicae*) described from the Majella Massif. Finally, Lancioni et al. (2011), although having confirmed the concept of the *Leontopodio-Elynenion* for the Central Apennines, proposed to re-classify the *Leontopodio-Elynenion* from the *Seslerion apenninae* (*Elyno-Seslerietea*) to the *Oxytropido-Elynion* (*Carici-Kobresietea*).

In order to recognize the floristic, coenological and biogeographic features of the alpine belt vegetation in the Apennines and to match this biogeographic phenomenon within the taxonomical framework currently accepted for the other mountain ranges of southern Europe, we propose here to up-rank the suballiance *Leontopodio nivalis-Elynenion myosuroidis* Blasi et Di Pietro in Blasi, Di Pietro, Fortini et Catonica 2003 to the rank of an alliance. The nomenclature type is the association *Leontopodio nivalis-Elynetum myosuroidis* Feoli-Chiapella et Feoli 1977 designated as the type of the suballiance *Leontopodio-Elynenion* by Blasi et al. (2003). The lectotype of the association *Leontopodio-Elynetum* was designated by Biondi et al. (2000).

The *Leontopodio-Elynion* includes *Kobresia myosuroides* swards of the windy ridges, *Silene acaulis* cushion-like tundra and pioneer communities of *Carex firma*, *C. rupestris* and *Dryas octopetala*. The *Sesleria juncifolia* primary dry grasslands of the alpine belt are also included in the *Leontopodio-Elynion*. The characteristic component of the alliance includes Apennine endemics, amph-Adriatic elements and south-eastern European mountain species that do not reach the Alps. The group of circumboreal species that was formerly considered as characteristic of the *Leontopodio-Elynion* (Blasi et al. 2003) has been re-interpreted here as the group of species delimiting the *Leontopodio-Elynion* against the *Seslerion apenninae*. The decision not to include the alpine vegetation of the Apennines in the alliance *Oxytropido-Elynion*, originally described for the Alps (Gams 1936, Braun-Blanquet 1949) and also applied by some authors (Ohba 1974, Feoli-Chiapella & Feoli 1977) to the Italian Peninsula, has several reasons. Firstly, many species of the *Oxytropido-Elynion* are absent in the Apennines and the Balkans (e.g. *Agrostis alpina*, *Antennaria carpatica*, *Erigeron uniflorus*, *Festuca quadriflora*, *Lloydia serotina*, *Oxytropis halleri*, *O. jacquinii*). Secondly, the communities of the *Oxytropido-Elynion* are spatially in contact with the *Seslerietalia caeruleae* communities whereas the communities of the *Leontopodio-Elynion* are in contact with the *Seslerietalia tenuifoliae* communities. Species such as *Sesleria caerulea* or *Carex sempervirens* appear with high-frequency in the *Oxytropido-Elynion* communities but are completely absent from the *Leontopodio-Elynion* where they are substituted by the amph-Adriatic elements such as *Sesleria juncifolia* and *Carex kitaibeliana*. In the classification of the *Leontopodio-Elynion* to the higher syntaxa, we prefer the criterion of biogeographical history over the strictly floristic one. On the basis of this criterion the relict stands of the primary alpine tundra occurring on the summits of the highest sub-Mediterranean mountain ranges are viewed as impoverished remnants of vegetation that dominated these areas during the Pleistocene glacial maxima and enabled repeated establishment of the Arctic flora in the southern European mountains. Although the Holocene climatic amelioration resulted in incursion of South European and Mediterranean-montane elements into this vegetation, we include the *Leontopodio-Elynion* to the arctic-circumboreal order *Oxytropido-Elyneta* of the class *Carici-Kobresietea*.

The distribution of the *Leontopodio nivalis-Elynion* is the same as proposed by Blasi et al. (2003) for the original suballiance, i.e. restricted to the Central Apennines. The following associations are currently included in this alliance:

1. *Leontopodio nivalis-Elynetum* Feoli-Chiapella et Feoli 1977
2. *Carici kitaibeliana-Elynetum* Pedrotti 1982
3. *Seslerio juncifoliae-Dryadetum* Biondi et al. 1999
4. *Caricetum rupestris-kitaibeliana* Biondi et al. 2000
5. *Galio magellensis-Silenetum acaulis* Blasi et al. 2003
6. *Helianthemo alpestris-Festucetum italicae* Blasi et al. 2005
7. *Leontopodio nivalis-Seslerietum juncifoliae* Blasi et al. 2005

However, if a less restrictive taxonomical approach is adopted, the *Leontopodio-Elynion* distribution could be extended to include the highest altitudes of the mountain ranges of the central and southern Balkan Peninsula (Simon 1958, Lakušić 1970, Horvat et al. 1974) due to the occurrence of shared amph-Adriatic high-altitude species such as *Artemisia umbelliformis* subsp. *eriantha*, *Carex kitaibeliana*, *Leontopodium nivale* and *Sesleria juncifolia*. Except for the fundamental paper of Ohba (1974), who included the order *Crepidetalia dinaricae* in the class *Carici-Kobresietea*, all the taxonomical schemes for the Balkan Peninsula (Lakušić 1969, 1970, Horvat et al. 1974, Redžić 2003, Redžić et al. 2011, Šalja & Redžić 2012) included the vegetation of the alpine belt either to the *Seslerietalia tenuifoliae* (western Balkans) or to the *Onobrychido-Seslerietalia* (central-eastern Balkans); both orders belong to the *Elyno-Seslerietea*. However in the south-western Dinarides and in Bulgaria there are several mountain ranges that support a true alpine belt (e.g. Durmitor, Prokletije, Šar-Planina-Korab, Pirin, Rila) where some relicts of the circumboreal arctic-alpine glacial flora still occur (Stevanović et al. 2009). Using the criterion of biogeographical history as mentioned above the *Elyno-Edraianthetum serpyllifolii* Lakušić 1964, *Elyno-Edraianthetum alpini* Lakušić 1964 and *Trifolio-Caricetum rupestris* Horvat ex Horvat et al. 1974 would find their optimal taxonomical position in the class *Carici-Kobresietea*, most probably within the extended *Leontopodio nivalis-Elynion* or another, regional alliance of the *Carici-Kobresietea*. If an

Apennine-Balkan delimitation of the *Leontopodio-Elynyion* was accepted, the mountain ranges of Korab, Prokletije, Rila and Pirin would represent the southernmost limit of the *Carici-Kobresietea* in south-eastern Europe.

## 6. LAGOTIDO URALENSIS-CARICION ENSIFOLIAE: A NEW ALLIANCE OF ALPINE GRASSLANDS OF THE SOUTHERN URALS

(by Milan Chytrý & Ladislav Mucina)

### *Lagotido uralensis-Caricion ensifoliae* Chytrý et Mucina *all. nov. hoc loco*

Nomenclature type (*holotypus hoc loco designatus*):

*Rhodiolo-Caricetum ensifoliae* Ishbirdin, Mullagulov et Yanturin 1996

Pseudonym: *Anemonastro-Festucion ovinae sensu* Ishbirdin, Mullagulov et Yanturin 1996 *non* Chytrý, Pešout et Anenonov 1993

Name-giving taxa: *Lagotis uralensis* Schischk., *Carex bigelowii* subsp. *ensifolia* (Gorodkov) Holub

Diagnostic taxa: *Anemone narcissiflora* subsp. *biarmiensis*, *Campanula rotundifolia*, *Carex bigelowii* subsp. *ensifolia*, *Cerastium krylovii*, *Festuca igoschiniae*, *Hieracium iremelense*, *Juncus trifidus*, *Lagotis uralensis*, *Ligusticum mutellinoides*, *Persicaria alpina*, *Poa alpigena*, *Saussurea xuralensis*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Aulacomnium turgidum*, *Hylocomium splendens*, *Polytrichum commune*, *Rhytidium rugosum*, *Cetraria islandica*, *C. laevigata* Rass., *Cladonia arbuscula*, *C. rangiferina*, *C. stellaris*, *Flavocetraria cucullata*

This alliance belongs to the class *Juncetea trifidi* Hadač in Klika et Hadač 1944 and the order *Juncetalia trifidi* Daniëls 1994. It includes the alpine tundra vegetation occurring above the timberline in the summit area of the Southern Ural Mountains, specifically on Mt Iremel' at altitudes above 1100 m. This vegetation comprises open stands of graminoids and herbs with a well-developed layer of bryophytes and lichens. The herb layer is usually dominated by graminoids such as *Carex bigelowii* subsp. *ensifolia*, *C. vaginata*, *Festuca igoschiniae*, *Juncus trifidus* and at wet sites also *Eriophorum vaginatum*. It includes several endemic taxa of the Ural Mountains such as *Anemone narcissiflora* subsp. *biarmiensis*, *Cerastium krylovii*, *Festuca*

*igoschiniae*, *Hieracium iremelense*, *Lagotis uralensis* and *Saussurea xuralensis*. Dwarf shrubs *Vaccinium uliginosum* and *V. vitis-idaea* are common. The moss layer is dominated by the mosses *Aulacomnium turgidum*, *Hylocomium splendens*, *Polytrichum commune* and *Rhytidium rugosum*, and lichens *Cetraria islandica*, *C. laevigata*, *Cladonia arbuscula*, *C. rangiferina*, *C. stellaris* and *Flavocetraria cucullata*.

This vegetation was described in detail by Ishbirdin et al. (1996), however, it was classified as part of the *Anemonastro-Festucion ovinae* Chytrý et al. 1993 – an alliance originally described from the alpine mountain tundra near Lake Baikal in southern Siberia (Chytrý et al. 1993). Both the mountain tundra in the Baikal region and that in the Urals are characterized by several species typical of the Arctic tundra and absence of the alpine species typical of more southern mountain ranges, therefore they belong to the order *Juncetalia trifidi* Daniëls 1994. However, the species composition of the stands in the Urals is transitional between corresponding communities occurring in the European and Siberian mountain ranges, from which they are geographically isolated by extensive plains. Moreover, they contain several endemic species. Given the alliance concept used for the high-mountain grasslands in the EuroVegChecklist, this clearly supports the status of the Ural alpine tundra vegetation as a discrete alliance.

## 7. MUSCARIO-SCILLION NIVALIS: THE MYSTERY OF AN ELUSIVE ALLIANCE

(by Ladislav Mucina)

Lovrić & Rac (1989) described the *Muscario-Scillion nivalis* Lovrić et Rac 1989 ('*Muscario-Scillion nivalis* (Quez. prov.) Lov. et Rac 1988' on p. 34 or '*Muscario-Scillion nivalis* Lov. & Rac' on p. 40 in Table I). This unit is supposed to encompass the 'snow-bed' vegetation of the Balkans and the Asia Minor, typical of deep high-altitude karstic sinkholes experiencing longer snow cover, snow-rich stormy winters, and drought and intensive insolation in summer. According to these authors this vegetation is ecologically very different from the typical snow-bed vegetation of the *Salicetea herbaceae*. We agree with this assessment to the degree that the snow-beds in this area (and to small extent also those of the Greek Peninsula) should



be considered as belonging to a different class – the *Trifolio anatolici-Polygonetea arenastris* Quézel 1973. The concept of a single alliance (*Muscario-Scillion nivalis*) over the large geographic expanses (from the northern Balkans as far as the Turkish-Iranian border) is, however, highly unrealistic and not supported by the data presented in Lovrić & Rac (1989).

Lovrić & Rac (1989) classified twelve associations (names are given in original connotation) within this alliance (here we use the original forms of the names):

1. '*Narcisso-Gentianetum nivalis* Lov. et Rac (1988)'
2. '*Muscario-Scilletum nivalis* (Lov. et Rac) prov.'
3. '*Myosotido-Gentianetum nivalis* Lov. (1975) 1988'
4. '*Croco-Trifolietum pilczii* prov.'
5. '*Croco-Scilletum subnivalis* (Quez. prov. 1965) Lov. et Rac 1989a'
6. '*Gentiano-Scilletum subnivalis* Lov. et Rac'
7. '*Ornithogalo-Muscarietum bourgaei* Quézel (1973)'
8. '*Corydalo-Fritillarietum pinardii* (Krause in Rikli 1948) prov.'
9. '*Fritillario-Scilletum nivalis* Lov. et Rac (1989)'
10. '*Arabido-Scilletum ingridae* Lov. et Rac (1989a)'
11. '*Muscario-Scilletum armenae* prov.'
12. '*Sibbaldio-Gentianetum nivalis* Lov. et Rac'

The *Muscario-Scillion nivalis* Lovrić et Rac 1989 appears to be (serendipitously) validly described because at least the '*Ornithogalo-Muscarietum bourgaei* Quézel (1973)' (recte: *Muscario bourgaei-Ornithogaletum brevipedicellati* Quézel 1973; orig. form (Quézel 1973: 205): 'Association à *Muscari bourgaei* et *Ornithogalum brevipedicellatum*') was validly described at the time of the description of the *Muscario-Scillion nivalis*, referred to its original diagnosis by an unambiguous bibliographical reference to Quézel (1973) and indicated at p. 135 as the type of the alliance name (in Croatian: 'nomenklaturni prototip cijele sveze *Muscari-Scillion*'). Moreover, the diagnostic species of the alliance are listed in Table 1 of Lovrić & Rac (1989).

By inclusion of all the mentioned associations, eight of which appear to be merely *nomina nuda*, the authors created a biogeographically, ecologically and especially floristically very heterogeneous syntaxon spanning Croatia (associations 1, 2, 3), Macedonia and Hellas (ass. 4, 5, 6), Anatolia (ass. 7, 8, 9, 10, 11) and Lazistan (ass. 12). Due to obscure nature of most of the associations included in the original diagnosis and poor relevant material presented in Lovrić & Rac (1989), it is

impossible at this stage to establish the syntaxonomy of the communities listed in the *Muscario-Scillion nivalis* coined for the East Mediterranean snowfields, from the Dinarides and the central and south-eastern mountain ranges of the Balkan Peninsula.

Lovrić & Rac (1989) classified their *Muscario-Scillion nivalis* into the '*Trifolio-Polygonetalia* Quez.' (obviously the *Trifolio anatolicae-Polygonetalia arenastris* Quézel 1973) and further into the '*Arrhenatheretea* Br.-Bl.'. However, because of the selection a nomenclatural type from Anatolia, the *Muscario-Scillion nivalis* becomes a synonym of the *Bolanthion frankenioidis* Quézel 1973 (p. 202 and seq.). This alliance was classified within the order *Trifolio anatolici-Polygonetalia arenastris* Quézel 1973 and the class *Trifolio anatolici-Polygonetea arenastris* Quézel 1973 (see also Quézel et al. 1993).

Thus the syntaxonomic summary should read:

*Trifolio anatolici-Polygonetea arenastris* Quézel 1973  
*Trifolio anatolici-Polygonetalia arenastris* Quézel 1973  
*Bolanthion frankenioidis* Quézel 1973  
 Syn.: *Muscario-Scillion nivalis* Lovrić et Rac 1989

## 8. ACKNOWLEDGEMENTS

We thank Jean-Paul Theurillat and Wolfgang Willner for their very helpful comments on a previous version of this paper. M. C. was supported by the Czech Science Foundation (Centre of Excellence PLADIAS, 14-36079G).

## 9. REFERENCES

- Aleksandrova, V. D. 1980: The Arctic and Antarctic: their division into geobotanical areas. Cambridge University Press, Cambridge.
- Biondi, E., Ballelli, S., Allegranza, M., Taffetani, F., Frattaroli, A. R., Guitan, J. & Zuccarello, V. 1999: La vegetazione di Campo Imperatore (Gran Sasso d'Italia). *Braun-Blanquetia* 16: 33–53.
- Biondi, E., Ballelli, S., Allegranza, M. & Taffetani, F. 2000: La vegetazione del Corno Grande (2912) nel Gran Sasso d'Italia (Appennino centrale). *Fitosociologia* 37: 152–168.

- Blasi, C., Di Pietro, R., Fortini, P. & Catonica, C. 2003: The main plant community types of the alpine belt of the Apennine chain. *Plant Biosystems* 137: 83–110.
- Blasi, C., Di Pietro, R. & Pelino, G. 2005: The vegetation and landscape of alpine belt karst-tectonic basin in the Majella mountain (central Apennines). *Plant Biosystems* 139: 357–385.
- Böcher, T. W. 1954: Oceanic and continental vegetational complexes in southwest Greenland. *Meddelelser om Grønland* 148 (1): 1–336.
- Bonin, G. 1978: Contribution à la connaissance de la végétation des montagnes de l'Apennin centro-meridional. Thesis, Univ. Marseille, Marseille.
- Braun-Blanquet, J. 1949: Übersicht der Pflanzengesellschaften Rätians (IV). *Vegetatio* 2: 20–37.
- Braun-Blanquet, J. & Jenny, H. 1926: Vegetations-Entwicklung und Bodenbildung in der alpinen Stufe der Zentralalpen (Klimaxgebiet des *Caricion curvulae*). Mit besonderer Berücksichtigung der Verhältnisse im schweizerischen Nationalparkgebiet. *Denkschriften der Schweizerischen Naturforschenden Gesellschaft* 63: 181–349.
- Chytrý, M., Pešout, P. & Anenonov, O. A. 1993: Syntaxonomy of vegetation of Svjatoj Nos Peninsula, Lake Baikal 1. Non forest communities. *Folia Geobotanica et Phytotaxonomica* 28: 337–383.
- Coldea, G. 1997: *Juncetea trifidi*. In: Coldea, G. (ed.), *Les associations végétales de Roumanie*. Tome 1. Les associations herbacées naturelles. Presses universitaires de Cluj, Cluj, pp. 195–201.
- Conti, F., Abbate, G., Alessandrini, A. & Blasi, C. (eds.) 2005: An annotated checklist of the Italian vascular flora. Palombi, Roma.
- Di Pietro, R. 2010: Phytosociological features of *Sesleria calabrica* (*Poaceae*), an endemic species of Pollino-Orsomarso mountains (southern Italy). *Acta Botanica Gallica* 157: 539–554.
- Di Pietro, R., Pelino, G., Stanisci, A. & Blasi, C. 2008: Phytosociological features of *Adonis distorta* and *Trifolium noricum* subsp. *praetutianum*, two endemics of the Apennines (Peninsular Italy). *Acta Botanica Croatica* 67: 175–200.
- Drees, B. & Daniëls, F. J. A. 2009: Mountain vegetation of south-facing slopes in continental West Greenland. *Phytocoenologia* 39: 1–25.
- Dúbravcová, Z. & Jarolímek, I. 2007: *Caricetea curvulae* Br.-Bl. 1948. In: Kliment J. & Valachovič M. (eds.), *Rastlinné spoločenstvá Slovenska 4. Vysokohorská vegetácia*. Veda, Bratislava, pp. 319–339.
- Egorova, T. V. 1999: *Osoki* (*Carex* L.) Rossii i sopredel'nykh gosudarstv (v predelakh byvshego SSSR). Sankt-Peterburgskaya gosudarstvennaya khimiko-farmatzevticheskaya akademiya, Sankt-Peterburg & Missuriiskii botanicheskii sad, Sent-Luis.
- Feoli-Chiapella, L. & Feoli, E. 1977: A numerical phytosociological study of the summits of the Majella massive (Italy). *Vegetatio* 34: 21–39.
- Furrer, E. & Furnari, F. 1960: Ricerche introdotte sulla vegetazione di altitudine del Gran Sasso d'Italia. *Bollettino dell'Istituto botanico della Università di Catania* 2: 143–201.
- Gams, H. 1936: Beiträge zur pflanzengeographischen Karte Österreichs. 1. Die Vegetation des Grossglocknergebietes. *Abhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 16 (2): 1–79.
- Gennai, M., Foggi, B., Viciani, D., Carboognani, M. & Tomaselli, M. 2014: The *Nardus*-rich communities in the northern Apennines (N-Italy): a phytosociological, ecological and phytogeographical study. *Phytocoenologia* 44: 55–80.
- Grabherr, G. 1993: *Caricetea curvulae*. In: Grabherr, G. & Mucina, L. (eds.), *Die Pflanzengesellschaften Österreichs. Teil II. Natürliche waldfreie Vegetation*. Gustav Fischer Verlag, Jena, pp. 343–372.
- Hill, M. O., Bell, N., Bruggeman-Nannenga, M. A., Brugués, M., Cano, M. J., Enroth, J., Flatberg, K. I., Frahm, J.-P., Gallego, M. T., Garilleti, R., Guerra, J., Hedenäs, L., Holyoak, D. T., Hyvönen, J., Ignatov, M. S., Lara, F., Mazimpaka, V., Muñoz, J. & Söderström, L. 2006: An annotated checklist of the mosses of Europe and Macaronesia. *Journal of Bryology* 28: 198–267.
- Horvat, I., Glavač, V. & Ellenberg, H. 1974: *Vegetation Südosteuropas*. Gustav Fischer Verlag, Stuttgart.
- Ishbirdin, A. R., Mullagulov, R. Yu. & Yanturin, S. I. 1996: Rastitel'nost' gornogo massiva Iremel': sintaksonomiya i voprosy okhrany. Institut biologii UNT RAN, Ufa.
- Klika, J. & Hadač, E. 1944: Rostlinná společenstva střední Evropy. *Příroda* 36: 249–259, 281–295.
- Klika, J. & Novák, V. 1941: *Praktikum rostlinné*

- sociologie, půdoznalství, klimatologie a ekologie. Melantrich, Praha.
- Kočí, M. 2007: Acidofilní alpské trávníky (*Juncetea trifidi*). In: Chytrý M. (ed.), Vegetace České republiky 1. Travninná a keříčková vegetace. Academia, Praha, pp. 76–83.
- Koroleva, N. E. & Kulyugina, E. E. 2010. Predvaritel'nyi obzor vysshikh sintaksonomicheskikh edinits v evropeiskom sektore Russkoi Subarktiki. In: Remigailo, P. A. (ed.), Geobotanicheskie i resursovedcheskie issledovaniya v Arktike: sbornik nauchnykh trudov. Yakutskii nauchnyi tsentr SO RAN, Yakutsk, pp. 129–133.
- Lakušić, R. 1969: Vergleich zwischen den *Elyno-Seslerietea* Br.-Bl. der Apenninen und der Dinariden. Mitteilungen der Ostalpin-Dinarischen Pflanzensoziologischen Arbeitsgemeinschaft 9: 133–143.
- Lakušić, R. 1970: Die Vegetation der Südöstlichen Dinariden. Vegetatio 21: 321–373.
- Lancioni, A., Facchi, J. & Taffetani, F. 2011: Syntaxonomical analysis of the *Kobresio myosuroidis-Seslerietea caeruleae* and *Carici rupestris-Kobresietea bellardii* classes in the central southern Apennines. Fitosociologia 48: 3–21.
- Lovrić, A. -Ž. & Rac, M. 1989: Reliktna visokoplaninska vegetacija najhladnijih vrhova na južnim Primorskim Dinaridima i njezino paleogeografsko porijeklo. Acta Biokovica 5: 131–148.
- Matuszkiewicz, W. 2007: Przewodnik do oznaczenia zbiorowisk roślinnych Polski. Ed. 3. Wydawnictwo Naukowe PWN, Warszawa.
- Malinovsky, K. A. & Kricsfalusy, V.V. 2000: Roslynnist' Ukraïny. Tom 1. Vysokogirna roslynnist'. Fitosotsiotsentr, Kyïv.
- Michl, T., Dengler, J. & Huck, S. 2010: Montane-subalpine tall-herb vegetation (*Mulgedio-Aconitetea*) in central Europe: large-scale synthesis and comparison with northern Europe. Phytocoenologia 40: 117–154.
- Mucina, L. 1997: Conspectus of classes of European vegetation. Folia Geobotanica et Phytotaxonomica 32: 117–172.
- Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J., Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F. J. A., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J. H. J., Lysenko, T., Didukh, Ya. P., Pignatti, S., Rodwell, J. S., Capelo, J., Weber, H. E., Solomeshch, A., Dimopoulos, P., Aguiar, C., Freitag, H., Hennekens, S. M. & Tichý, L.: Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science (submitted).
- Oberdorfer, E. 1993: *Juncetea trifidi*. In: Oberdorfer, E. (ed.), Süddeutsche Pflanzengesellschaften. Teil II: Sand- und Trockenrasen, Heide- und Borstgras-Gesellschaften, alpine Mager- und Borstgras-Gesellschaften, Schlag- und Hochstauden-Fluren. 3. Auflage. Gustav Fischer Verlag, Jena, pp. 204–207.
- Ohba, T. 1974: Vergleichende Studien über die alpine Vegetation Japans 1: *Carici rupestris-Kobresietea bellardii*. Phytocoenologia 1: 339–401.
- Oriolo, G. 2001: Naked rush swards (*Oxytropido-Elynon* Br.-Bl. 1949) on the Alps and the Apennines and their syntaxonomical position. Fitosociologia 38: 91–102.
- Pedrotti, F. 1982: La végétation des Monts de la Laga. In: Guide Itinéraire Excursion Internationale de Phytosociologie en Italie centrale (2–11 juillet 1982). Università di Camerino, Camerino, pp. 571–577.
- Quézel, P. 1973: Contribution à l'étude phytosociologique du massif du Taurus. Phytocoenologia 1: 131–222.
- Quézel, P., Barbero, M. & Akman, Y. 1993: Typification de syntaxa décrits en région méditerranéenne orientale. Ecologia Mediterranea 18 (1992): 81–87.
- Redžić, S. 2003: The syntaxonomy and syngensis of the *Elyno-Seslerietea* Br.-Bl. 1948 in the Balkan Peninsula. Annali di Botanica N. S. 3: 53–74.
- Redžić, S., Barudanović, S., Trakić, S. & Kulijer, D. 2011: Biodiverziteteta in endemo-reliktnost vaskularnih rastlink raških gorovij Prej, Čvrstica in Čabulja, Bosna in Hercegovina. Acta Carsologica 40: 527–555.
- Rivas-Martínez, S., Díaz, T. E., Fernández-González, F., Izco, J., Loidi, J., Lousã, M. & Penas, Á. 2002: Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomic checklist of 2001. Itinera Geobotanica 15: 1–922.
- Šalja, E. & Redžić, S. 2012: Ekološko-floristička diferencijacija planinskih rudina na karbonatima klase *Elyno-Seslerietea* Br.-Bl. 1948. Posebna izdanja ANU BIH 147 (22): 231–247.
- Santesson, R., Moberg, R., Nordin, A., Tonsberg, T. & Vitikainen, O. 2004: Lichen-forming and

- lichenicolous fungi of Fennoscandia. Museum of Evolution, Uppsala University, Uppsala.
- Simon, T. 1958: Über die alpinen Pflanzengesellschaften der Pirin-Gebirges. *Acta Botanica Academiae Scientiarum Hungariae* 1–2 (1957): 159–189.
- Stevanović, V., Vukojičić, S., Šinžar-Sekulić, J., Lazarević, M., Tomović, G. & Kit Tan 2009: Distribution and diversity of Arctic-Alpine species in the Balkans. *Plant Systematics and Evolution* 283: 219–235.
- Tomaselli, M. & Petraglia, A. 2003: La biodiversità vegetale dell'Appennino tosco-emiliano e la sua conservazione. *Informatore Botanico Italiano* 35: 377–382.
- Tüxen, R., Wagner, H., Becker, W., Jahns, W. & Pohl, F. 1943: *Bibliographia Phytosociologica*. Fasc. 4. Germania. Pars II. Hannovera.
- Walker, D. A., Raynolds, M. K., Daniëls, F. J. A., Einarsson, E., Elvebakk, A., Gould, W. A., Katenin, A. E., Kholod, S. S., Markon, C. J., Melnikov, E. S., Moskalenko, N. G., Talbot, S. S., Yurtsev, B. A. & the other members of the CAVM Team 2005: The Circumpolar Arctic vegetation map. *Journal of Vegetation Science* 16: 267–282.
- Weber, H. E., Moravec, J. & Theurillat, J.-P. 2000: International Code of Phytosociological Nomenclature. 3rd edition. *Journal of Vegetation Science* 11: 739–768.
- Yurtsev, B. A. 1994: Floristic division of the Arctic. *Journal of Vegetation Science* 5: 765–776.

Received 27. 9. 2014

Revision received 14. 11. 2014

Accepted 17. 11. 2014