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Racomitrium elongatum FRISVOLL, a neglected Slovakian bryophyte

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Abstract: Chorology, ecology and phytocoenology of *Racomitrium elongatum* Frisvoll is dealt with in the paper. The taxon is neglected in Slovakia and appears to be rather common in The Tatra Mts. The distribution map of the species in the Tatra Mts is presented.

Keywords: *Racomitrium elongatum*, The Tatra Mts, bryophytes, Slovakia.

Introduction

Racomitrium elongatum FRISVOLL hasn't been still recorded in Slovakia. The species is a member of the *Racomitrium canescens* (HEDW.) BRID. group with a boreal distribution (DÜLL 1994). *R. elongatum* (Fig. 1) differs from *R. canescens* (Fig. 2) by having leaves strongly keeled above, straight nerve ending in apex and hair point decurrent down margin (Fig. 3). *Racomitrium canescens* leaves are either not keeled or only bluntly keeled above, the nerve is usually forked above- extendig to 1/2 – 3/4 way up leaf and the hair point is rather wide, not decurrent down margin.

The distribution map of *Racomitrium elongatum* on a world scale was published by BEDNAREK-OCHYRA (1995). There are two main centres of occurrence in America – the Pacific part of the continent and Ontario. More limited distribution are found in New Foundland and Labrador.

In Europe, the moss occurrs abundantly in Iceland, Faroe Islands, West and South Fennoscandia – in areas of wet, oceanic climate. Also, *Racomitrium elongatum* is frequently found in the British Islands, Portugal, North Spain, France, Netherlands, Germany, and northern Poland. It has a scattered distribution in The Carpathians and The Alps with some isolated locations in the Balkan Peninsula, Apennine Peninsula, East and South Greenland and in Sicily. The most southerly location is in Madeira (BEDNAREK-OCHYRA, 1995).

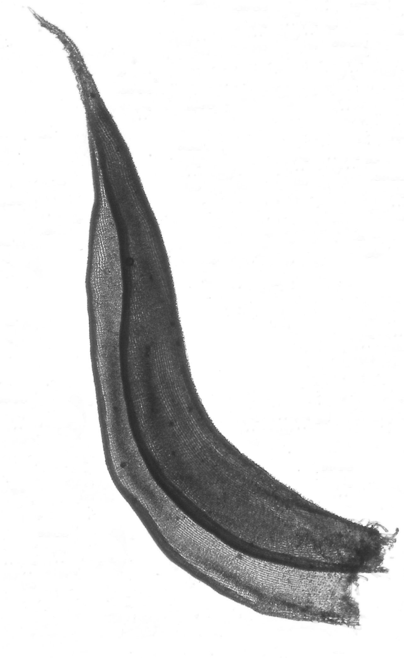


Fig. 1. *Racomitrium elongatum*, leaf

Fig. 2. *Racomitrium canescens*, leaf

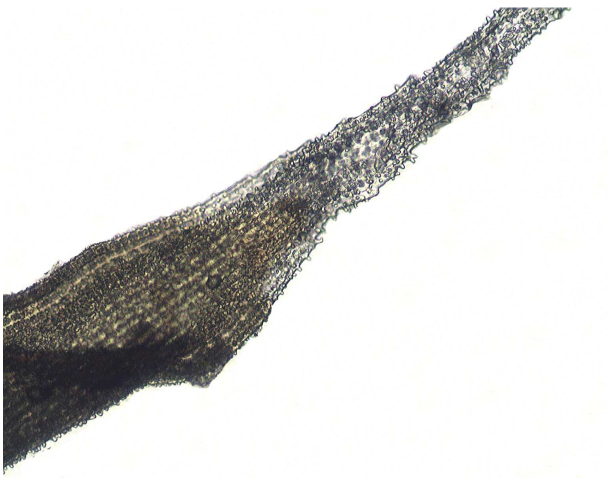


Fig. 3. *Racomitrium elongatum,* hair point decurrent down margin

In Poland, the occurrence is bicentric – Pomerania, which has an oceanic climate, and West Beskydes and The Tatras. In the Tatras, the moss reaches its highest altitude of 1700 m a. s. l. (BEDNAREK-OCHYRA 1995).

In Czech Republic, there are only poor information on the occurrence of the species. It is supposed, the habitats and the incidence of the species are similar to the species *R. canescens.* In lowland occurrs rarely, more often is met is mountains (VÁŇA et al. 2008).

OCHYRA & BEDNAREK-OCHYRA (2004) placed the species with tall, conical papillae (including *Racomitrium elongatum*) to the genus *Niphotrichum.*

The 3rd species of this *Racomitrium* group is *R. ericoides*. This north-oceanic species occurrs very rarely in the Tatra Mts in high-altitude level both on granite and limestone bedrocks.

Material and methods

Collection of *Racomitrium* specimens stored in the Museum of the Tatra National Park in Tatranská Lomnica, Slovakia, was submitted to revision. The plants were collected in 1954 – 2004.

The nomenclature follows KUBINSKÁ & JANOVICOVÁ (1998), or FRISVOLL (1983) respectively. All the specimens are stored in the Museum of the Tatra National Park in Tatranská Lomnica, Slovakia.

Results and discussion

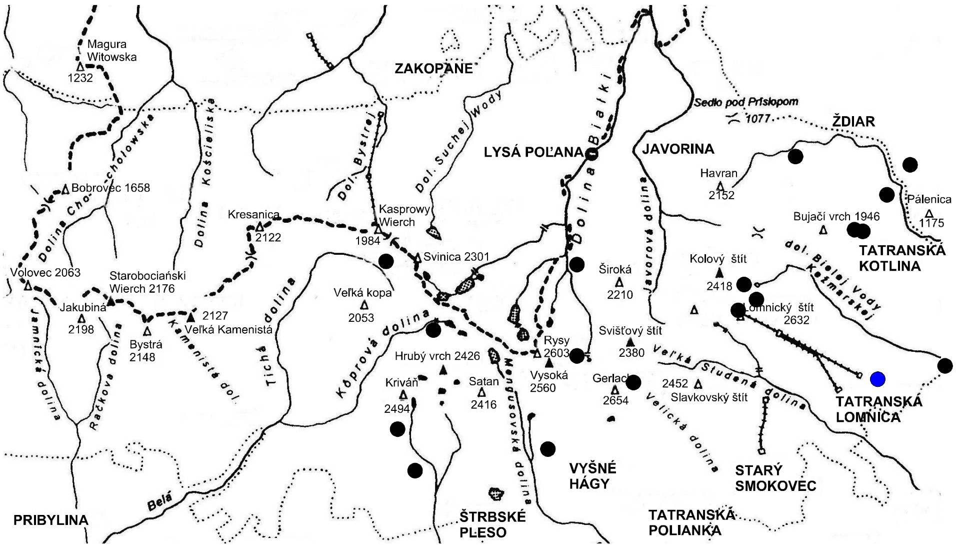
Revision of *Racomitrium* specimens stored in the Museum of the Tatra National Park in Tatranská Lomnica, has identified the following locations of *Racomitrium elongatum* in the Tatra Mts (Fig. 4):

1. The High Tatra Mts, Velická dolina valley, Kvetnica, granite rock, 1850 m a. s. l., leg. Šmarda, August 1954, specimen Nr.1/00205
2. The Belanian Tatra Mts, Dolina Siedmich prameňov valley, 1450 m a. s. l., leg. Šmarda, April 1957, specimen Nr.1/00761
3. The Belanian Tatra Mts, Dolina Siedmich prameňov valley, limestone, 1350 m a. s. l., leg. Šmarda, August 1960, specimen Nr.1/00783
4. The High Tatra Mts, Jahňací štít peak, soil, 2000 m a. s. l., leg. Šoltés, September 20, 1980, specimen Nr.1/01720
5. The High Tatra Mts, Tatranská Lomnica, intravilán, granite rock, 838 m a. s. l., leg. Šoltés, November 24, 1978, specimen Nr.1/01763
6. The High Tatra Mts, Tatranská Lomnica, intravilan, granite rock, 839 m a. s. l., leg. Šoltés, October 28, 1979, specimen Nr.1/01765
7. The High Tatra Mts, Bielovodská dolina valley, limestone, *Neckeretum crispae,* 1120 m a. s. l., leg. Šoltés, August 9, 1983, specimen Nr.1/04040
8. The High Tatra Mts, Mengusovská dolina valley, under Kôpky peak, *Calamagrostietum villosae*, soil, 1680 m a. s. l., leg. Šeffer, July 26, 1982, specimen Nr.1/04323

9. The West Tatra Mts, Tichá dolina valley, on a touristic footpath, soil, 1380 m a. s. l., leg. Šoltés, October 15, 1984, specimen Nr.1/04740
10. The High Tatra Mts, Kačacia dolina valley, the bank of Kačacie pleso lake, granite rocks, 1590 m a. s. l., leg. Šoltés, August 21, 1984, specimen Nr.1/04783
11. The High Tatra Mts, Kriváň peak, above Jamské pleso lake, touristic footpath, soil, 1570 m a. s. l., leg. Šoltésová, November 1, 1984, specimen Nr.1/04879
12. The High Tatra Mts, Velická dolina valley, on a touristic footpath, soil, 1690 m a. s. l., leg. Šoltésová, July 26, 1984, specimen Nr.1/04955
13. The High Tatra Mts, Kôprová dolina valley, fork to Temnosmrečinová dolina valley, soil, 1680 m a. s. l., leg. Šoltésová, July 17, 1984, specimen Nr.1/05034
14. The High Tatra Mts, Kriváň peak, *Junco-Oreochloetum*, soil, 1980 m a. s. l., leg. Šoltésová, August 24, 1985, specimen Nr.1/05056
15. The Belanian Tatra Mts, Skalka hillock, sandy soil in a spruce forest, 900 m a. s. l., leg. Šoltés October 12, 1986, specimen Nr.1/05351
16. The High Tatra Mts, Dlhý les kežmarský forest, rocky wall of a bridge, 790 m a. s. l., leg. Šoltés, June 4, 1993, specimen Nr.1/07269
17. The Belanian Tatra Mts, Monkova dolina valley, limestone, 1310 m a. s. l., leg. Šoltés, September 16, 1993, specimen Nr.1/07285
18. The Belanian Tatra Mts, Suchá dolina valley, calcic soil, 820 m a. s. l., leg. Šoltés, September 24, 1993, specimen Nr.1/07626
19. The High Tatra Mts, Dolina Zeleného plesa valley, *Luzuletum spadiceae*, soil, 1661 m a. s. l., leg. Šoltés July 6, 2004, specimen Nr.1/15237
20. The High Tatra Mts, Lomnický štít peak, top area, *Oxyrio-Saxifragetum carpaticae*, 2630 m a. s. l., leg. Šoltés, August 11, 2004, specimen Nr.1/15323

There is no information on the overall occurrence of *Racomitrium elongatum* in Slovakia but we think it is as abundant as *Racomitrium canescens*. According to BEDNAREK-OCHYRA (1995), the moss is growing abundantly in dry, sunny, sandy or clay habitats, in pine forests, on steep path sides, on dunes, in heaths and on grassy places. In the Tatra Mts it occurrs both on carbonate or granite bedrocks, from montane to the subalpine levels. The moss grows on sandy or humic soil, on rocks, bare soil, or directly on well trodden footpaths as well as covering old building structures. Its ecological requirements are similar to *Racomitrium canescens,* but requires more humid habitats.

The moss is part of the floristical composition of different communities, but doesn′t show any relation to syntaxon (BEDNAREK-OCHYRA 1995). In the Tatra Mts, we have recorded *Racomitrium elongatum* in the communities of the alliances *Calamagrostion villosae* PAWŁOWSKI et al. 1928, *Festucion pictae* KRAJINA 1933, *Juncion trifidi* KRAJINA 1933, *Androsation alpinae* BR. – BL. in BR.-BL. et JENNY 1926 and in the moss community determined as *Neckeretum crispae* ŠMARDA 1947. Accompanied species on granite rocks include *Diplophyllum taxifolium* (WAHLENB.) DUMORT.*, Gymnomitrion corallioides* NEES*,* *Tritomaria exsecta* (SCHMIDEL ex SCHRAD.) SCHIFFNER ex LOESKE, *Andreaea rupestris* (SCHMIDEL ex SCHRAD.) SCHIFFNER ex LOESKE, *Grimmia incurva* SCHWÄGR., *Hydrogrimmia mollis* (BRUCH & SCHIMP.) LOESKE, *Kiaeria FALCATA* (HEDW.) I. HAGEN, *Racomitrium sudeticum* (FUNCK) BRUCH & SCHIMP., *Sanionia uncinata* (HEDW.) LOESKE *and Schistidium apocarpum* (HEDW.) BRUCH & SCHIMP. On acid soil associates include *Polytrichum juniperinum* HEDW., *Dicranella heteromalla* (HEDW.) SCHIMP., *Dicranum scoparium* HEDW., *Pleurozium schreberi* (WILLD. ex BRID.) MITT., *Pohlia nutans* (HEDW.) LINDB., *Hylocomium pyrenaicum* (SPRUCE) LINDB., *Hypnum cupressiforme* HEDW., *Sphagnum compactum* LAM. & DC., *Philonotis seriata* MITT., *Polytrichum alpinum* HEDW., *Pleurocladula albescens* (HOOK.) GROLLE, *Pellia neesiana* (GOTTSCHE) LIMPR., *Pohlia drummondii* (MÜLL. HAL.) A. L. ANDREWS, *Racomitrium lanuginosum* (HEDW.) BRID., *Oligotrichum hercynicum* (HEDW.) LAM. & DC., *Pohlia nutans* (HEDW.) LINDB. and *Pogonatum urnigerum* (HEDW.) P. BEAUV. On limestone substratum, the moss is associated with *Entodon concinnus* (DE NOT.) PARIS, *Schistidium strictum* (TURNER) LOESKE ex MARTENSSON, *Schistidium apocarpum* (HEDW.) BRUCH & SCHIMP., *Tortella tortuosa* (HEDW.) LIMPR., *Ditrichum flexicaule* (SCHWÄGR.) HAMPE, *Neckera crispa* HEDW., *Campylium stellatum* (HEDW.) C.E.O. JENSEN, *Mnium thomsonii* SCHIMP., *Ptychodium plicatum* (SCHLEICH. ex F. WEBER & D. MOHR) SCHIMP., *Plagiochila porelloides* (TORR. ex NEES) LINDENB., *Leskea polycarpa* EHRH. ex HEDW.



● *Racomitrium elongatum* localities

Fig. 4. The distribution of *Racomitrium elongatum* in the Tatra Mts. Graphical source: TPN Zakopane

The species hasn′t been evaluated against the old IUCN system in Slovakia (KUBINSKÁ *et al*. 2001), and since that time the species hasn′t been included in the list of species occurring in Slovakia.

Racomitrium elongatum doesn' t satisfy any criteria of the threatened categories of IUCN (ECCB 1995; HALLINGBÄCK 1998; HALLINGBÄCK 2001; HALLINGBÄCK et al., 1998; IUCN 1994). In Czech Republic, the species is not redlisted as well (KUČERA & VÁŇA 2005).

Acknowledgement

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Sorbus hugh-mcallisteri, nom. nov. for *Sorbus apiculata* MCALLISTER 2005, nom. illeg.

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Mikoláš V. (2008): *Sorbus hugh-mcallisteri* nom. nov. for *Sorbus apiculata* McAllister 2005, nom. illeg. – Thaiszia – J. Bot. 18: 65-67. – ISSN 1210-0420.

Abstract: *Sorbus apiculata* MCALLISTER 2005 is a later homonym of *Sorbus apiculata* (KOVANDA) MIKOLÁŠ. The new name *Sorbus hugh-mcallisteri* MIKOLÁŠ is applied for the species. The species belongs to the section *Multijugae* (T.T.YU) MCALL. It is known from NW Yunnan, China. *Sorbus apiculata* (KOVANDA) MIKOLÁŠ 2004 is a member of *Sorbus danubialis* agg. (*Sorbus* subg. *Aria*) with the occurrence in Bohemia, Czech Republic.

Keywords: *Sorbus*, *Sorbus apiculata*, *S. hugh-mcallisteri*, Czech Republic, China

HUGH MCALLISTER, the best specialist of the genus of *Sorbus* s.s., recently described 28 species in his monograph of the genus (MCALLISTER 2005). The author accepts the genus *Sorbus* in its strict sense (with the type species *S. acucuparia* L)., splitting it up into 2 subgenera: subgenus *Sorbus* and subgenus *Albocarmesinae* MCALL. The latter includes species with fruits lacking chromoplasts and with white to crimson coloration. Some species have crimson petals, the character parallel to the European subg. *Chamaemespilus* (MEDICUS) K.KOCH of the genus *Sorbus* (or *Aria* (PERSOON) HOST if we accept the narrow concept of the genus *Sorbus* used by MCALLISTER). The species of the subgenus are distributed in the Sino-Himalayan floristic region. *Sorbus apiculata* MCALL. belongs to section *Multijugae* (T.T.YU) MCALL., including numerous microspecies. Other sections embraced in the subgenus *Albocarmesinae* are the following: sect. *Discolores* (T.T.YU) MCALL., *Insignes* (T.T.YU) MCALL. (the correct name of this section is *Albocarmesinae*, because the type species *S. insignis* of the subgenus belongs here), *Hypoglaucae* MCALL. and *Reductae*

[T.T.Yu) McAll.The section *Multijugae* is characteristic by combination of numerous leaflets (8 and more), soft fruits, flat inflorescence and petiole base not sheathing. *S. apiculata* McAll. (one of numerous microspecies of the section) is characterized by pearly white fruits, with moderately fleshy calyx lobes and 12-14 pairs of apiculate (name !), ovoid-oblong leaflets. It is one of probably apomictic microspecies in the section and its occurrence is recently known from NW part of Yunnan, China (NE of Zongdian, Hengduan Mts.), the well-known regional hot spot (Kelley 2006).

Sorbus apiculata (Kovanda) Mikoláš 2004 was validly published (comb. et stat. nov.) in the journal Thaiszia (vol. 13: p. 130, „2003“, 2004, basionym: *S. graeca* (Spach) Kotschy var. *apiculata* Kovanda, Acta Dendrol. Čechoslov. 3: p. 60, Icones: p. 61, Fig. 11, 1961). This microspecies is the member of the subgenus Aria, close to *S. danubialis* (Jáv.) Kárp. However, it is not probably a diploid species as it was published earlier (Jankun et Kovanda 1987). The species is probably tetraploid (Vít 2006) and it is characteristic by a pointed apex of little, rhombic leaves. The microspecies is, perhaps, an endemic of Bohemia, Czech Republic. The type comes from the vicinity of Zbraslav, Hradiště hill (central Bohemia; today the locality belongs to the southernmost part of Prague). The microspecies is probably widely distributed in Bohemia (Kovanda 1961, Janda 2006, pers.comm.). Kovanda (1961, p. 61) evaluates his *Sorbus graeca* var. *apiculata* as „not homogenous in its shut-in Bohemian area“. The typical specimens are (according to Kovanda 1961) growing in phyllites of lower Vltava region. Kovanda (1961) also gives data from the surroundings of Mohelno and Pavlov Hills (both in SE part of the Czech Republic) and even from surroundings of Hajnáčka and Humenné (central and eastern Slovakia). These plants, at least from the last locality (Mt. Sokol), are certainly not identical with this taxon (Mikoláš, pers. observ.). Probably *S*. *apiculata* (Kovanda) Mikoláš is growing only in Bohemia. *S. danubialis* agg. includes also several other narrow microspecies in Bohemia (Mikoláš, pers. observ.; Janda, pers. observ.).

Because the name *S. apiculata* (Kovanda) Mikoláš was validly published in 2004, the use of name *S. apiculata* McAll. (McAllister H.: The genus *Sorbus*. Mountain ash and other rowans, p. 234: 51. *Sorbus apiculata* McAll., 2005) is to be considered as a later homonym of the former (taxonomically of different species), and it is necessary to substitute it. I hereby propose a nomen novum (replacement name) for it. The name underlines the basic importance of Hugh McAllister for taxonomy of *Sorbus* s.s.

Sorbus hugh-mcallisteri **Mikoláš, nom. nov**. (*Sorbus apiculata* McAllister, The genus *Sorbus*, The mountain ash and other rowans, p. 234, nr. 51, The Royal Botanic Gardens, Kew, 2005), nom illeg., non *Sorbus apiculata* (Kovanda) Mikoláš (Thaiszia 13: p. 130, „2003“, 2004).

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I am obliged for the first information on publication of the name *Sorbus apiculata* MCALL. and data on the occurrence of *Sorbus apiculata* (KOVANDA) MIKOLÁŠ to Mr. P.JANDA (Slaný, Czech Republic) and RNDr. KAROL MARHOLD, CSc., senior lecturer (Bratislava) for nomenclatural advices and substantial English correction.

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Structure and adjective vegetations of grass-plots in Kyiv

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Meleghik O., Solomakha V. & Solomakha T. (2008): Structure and adjective vegetations of grass-plots in Kyiv. – Thaiszia – J. Bot. 18: 69-74. – ISSN 1210-0420.

Abstract: The paper present of ecological floristic classification of Kyiv grass-plots. Ecological floristic classification of given 5 classes (*Molinio-Arrhenatheretea, Agropyretea repentis, Plantaginetea majoris, Chenopodietea and Artemisietea vulgaris),* 8 alliances*,* 11 unions, 27 associations and 33 variants.

Floristic structure and qualitative adjectives of Kyiv grass-plots were investigated. Common evaluations of qualitative adjectives of Kyiv grass-plots coverings were cited. There are 63 alochtonic species among the ones found in the grass-plots on the territory of Kyiv. They include 35 species imported before the XVI century (archeophytes), and 28 brought later.

Keywords: grass-plots, syntaxonomia, vegetation, qualitative adjectives.

Introduction

Cities native habitant is mainly represented as the man-made grass cover or diversely transformed natural one. Natural cover is the most sensitive component of urban landscapes. It is the first to perceive even marginal environment changes; respond on their degradation or disappearance of certain plants specimens. Therefore, grass-plots vegetation in cities requires constant care and regeneration.

Plant cover of urban territories is represented by the large number of species and is highly diverse. As a whole it could be grouped into three main decorative compositions:

- tree and bush plantations;
- flower compositions;
- grass-plotts covers.

The contamination level of urban environment is dramatically increasing on the grounds of high scientific and technical progress pace, abrupt increase of newest technologies and industry intensification. As is known, vegetation is one of the most efficient stabilizing factors in the settlements. It is considered that optimum conditions for human being living in urban conglomerations are formed when trees and bushes make up by crown projection 20 - 30 % of explained by their universal peculiarities based on their permanent use independently of relief features and territory architecture.

Grass-plots perform important functions in urban environment. They improve environment's aestheticism, taking up the dust and toxic compounds, influencing on local ecological conditions. Another important characteristic of sod grasses in cities is their ability to hamper distribution of adventitious (quarantine, in particular) plants. Solid herbage and strong sod structure give no possibility to tap-root ruderal plants.

Material and methods

Grass-plots in Kyiv of different functional purposes and on various stages of their development were studied. The experiments were conducted during 2002 – 2005 by the means of standard methods. All phytocoenoses were analysed in the field using methods of Zürich-Montpelliér school (BRAUN-BLANQUET 1964, WESTHOFF & VAN DER MAAREL 1978). Geobotanical descriptions were made according to the J. Braun-Blanquet method. Sample grounds were selected in different city regions. Their sizes have varied from 4 to 100 m^2.

Results

There are several grass-plots' classification schemes. Scheme designed by A. A. LAPTEV (1983) includes various in structure functional aspect grass-plots associations which are combined into more general categories.

According to the Mytsik L.P. classification there are five categories which completely cover all grass-plots characteristics: classic grass-plot, ordinary, cultural and natural.

We posed a task to determine complete floristic composition of grass-plots comparing to the classification scheme of vegetation of Ukraine. After handling of all descriptions the following classification scheme was obtained.

Syntaxonomic vegetation scheme of grass-plots in Kyiv

Cl. *Molinio-Arrhenatheretea* R.Tx. 1937
Ord. *Arrenatheretalia elatioris* Pawl. 1928
Cynosurion cristati Br.-Bl. et R.Tx. 1943
Ass. *Plantagini lanceolatae-Festucetum rubrae* Scamoni 1956
P.l.-F.r. var. *Elytrigia repens*
P.l.-F.r. var. *typicum*
Festucetum rubrae Rübel 1912
F.r. var. *Elytrigia repens*
F.r. var. *typicum*
Lolio-Cynosuretum Buker 1941
L.-C.c. var. *Festuca rubra*
L.-C.c. var. *Poa pratensis*
L.-C.c. var. *typicum*
B.c. Lolium perenne *[Cynosurion]*
Agrostio tenuis-Trifolietum repentis (Walther 1977)
Leontodono-Poetum pratensis Anishczenko et L. Ishb. 1989
L.-P.p. var. *Elytrigia repens*
L.-P.p. var. *Festuca rubra*
L.-P.p. var. *typicum*
Poetum pratensis Stepanovič 1999
P.p. var. *Festuca rubra*
P.p. var. *Trifolium repens*
P.p. var. *Elytrigia repens*
P.p. var. *typicum*
B.c. Poa pratensis [Cynosurion]
Agropyretea repentis Oberd., Th.Mull. et Gors in Oberd. et al. 1967
Agropyretalia repentis Oberd., Th.Mull. et Gors in Oberd. et al. 1967
Convolvulo-Agropyrion repentis Gors 1966
Calamagrostietum epigeios Kost. in V.Solomakha. et al. 1992
C. ep. var. *typicum*
C. ep. var. *Dactylis glomerata*
Convolvulo-Agropyretum repentis Felf. (1942) 1943
C.-A.r. var. *Potentilla argentea*
C.-A.r. var. *Poa pratensis*
C.-A.r. var. *typicum*
Agropyretum repentis Gors 1966
A.r. var. *Lolium perenne*
A.r. var. *Poa pratensis*
A.r. var. *typicum*
Poetum pratensis-compressae Bornkamm 1974
Polygono arenastri-Poëtea annua Rivas-Martinez 1975 corr. Rivas-Martinez et al. 1991

Plantaginetalia majoris R. Tx. et Prsg. in R. Tx. 1950 em Rivas-Mart. 1975

Polygonion avicularis Br.-Bl. 1931

Cynodonto-Plantaginetum majoris Brun-Hool 1962

Polygonetum avicularis Gams 1927 em. Jehlik in Hejny et al. 1979

Plantagini-Lolietum perennis Beger 1930

L.-P.m. var. *Poa pratensis*

L.-P.m. var. *Trifolium repens*

L.-P.m. var. *typicum*

Poetum annuae Gams 1927

P.a. var. *Poa pratensis*

P.a. var. *typicum*

Juncetum tenuis (Diem., Siss. et Westh. 1940) Schwick.1944 em R.Tx. 1950

Prunello-Plantaginetum majoris Falinski 1963

Agrostio tenuis-Poetum annuae Gutte et Hilbig 1975

Agrostietalia stoloniferae Oberd. in Oberd. et al. 1967

Agropyro-Rumicion crispi Nordhagen 1940

Rumici crispi-Agrostietum stoloniferae Moor 1958

Potentillietum anserinae Rap. 1927 em Poss. 1964

Chenopodietea Br.-Bl. 1951 em Lohm., J. et R. Tx 1961 ex Matsz. 1962

Sisymbrietalia J. Tx. ex Matsz. 1962 em Gors. 1966

Malvion neglectae Gutte 1972

Malvetum neglectae Felf. 1942

Sisymbrion officinalis R.Tx., Lohm., Prsg. in R.Tx 1950 em Hejny et al. 1979

Matricarietum perforatae Kepczynska 1975

M. p. var. *Echinochloa crusgalli*

M. p. var. *typicum*

Chenopodietum albi-viridae Hejny 1979

Ch. al.-v. var. *typicum*

Ch. al.-v. var. *Lolium perenne*

Ch. al.-v. var. *Lolium multiflorum*

Ch. al.-v. var. *Portulaca oleracea*

Ch. al.-v. var. *Eragrostis minor*

Eragrostietalia J.Tx. in Poli 1966

Eragrostion (R.Tx. 1950) Oberd. 1954

Eragrostio-Amaranthetum albi Morariu 1943

E.-A. al. var. *Artemisia absinthium*

E.-A. al. var. *Festuca rubra*

E.-A. al. var. *Melilotus album*

E.-A. al. var. *Urtica dioica*

E.-A. al. var. *Typicum*

Digitario-Portulacetum (Felf. 1942) Timar et Bodrogkosi 1959
D.-P. var. *Berteroa incana*
D.-P. var. *Festuca ovina*
D.-P. var. *typicum*
Artemisietea vulgaris Lohm., Prsg. et al. ex von Rochow 1951
Meliloto-Artemisietalia absinthii Elias 1979
Potentillo-Artemision absinthii Elias (1979) 1980
Tanaceto-Artemisietum vulgaris Br.-Bl. corr. 1949
T.-A.v. var. *typicum*
T.-A.v. var. var. *Lolium perenne*
Dauco-Melilotion albi Gors em Elias 1980
Berteroetum incanae Siss. et Tidem. ex Siss. 1950
Artemisietalia vulgaris Lohm. in R.Tx. 1947
Arction lappae R.Tx. 1937 em Gutte 1972
Artemisietum vulgaris R. Tx. 1942
D.c. *Lactuca serriola* [Sisimbrion officinalis]

As is well seen from the scheme sod covers' vegetation in Kyiv constitutes of 27 associations, 33 variants, 2 basal and 1 decorative communities, which belong to the 11 unions, 8 orders and 5 classes.

There are 63 alochtonic species among the ones found in the grass-plots on the territory of Kyiv. They include 35 species imported before the XVI century (archeophytes), and 28 brought later. The first group includes *Anisantha tectorum* (L.) Nevski, *Atriplex patula* L., *Lepidium ruderale* L., *Portulaca oleracea* L., *Ranunculus repens* L., *Setaria glauca* (L.) Beauv. etc., the second – *Ambrosia artemisiefolia* L., *Eragrostis minor* Host., *Lolium multiflorum* Lam., *Saponaria officinalis* L., *Trifolium hybridum* L., etc. The xenophytes/archeophytes correlation is 1/1.25 with archeophytes domination. Such ration is typical for Steppe zone of Ukraine and Polesie, while in southern regions xenophytes are prevailed (PROTOPOPOVA 1991).

By the importing means this species are divided into two groups: acolutophytes – species imported occasionally and the ones that are spread via anthropogenic broken ecotopes; and ergasiophytes – species imported in purpose for cultivation, and widespread into natural phytocenosises. Xenophytes are represented mainly by the adventive species: *Amaranthus albus* L., *Anagallis arvensis* L., *Bromus squarrosus* L., *Iva xanthifolia* Nutt., *Sisymbrium officinale* (L.) Scop. etc. Ergasiophytes are represented with the small number of species – *Trifolium hybridum, Saponaria officinalis* L., *Raphanus raphanistrum* L., *Lolium multiflorum, Lepidotheca suaveolens* etc.

By the naturalization degree in the natural flora research area two plant species groups are marked out –agriophytes (15) and epoecophytes (48). Epoecophytes are the species spread only in disturbed ecosystems. They form ruderal communities *(Amaranthus retroflexus* L., *Capsella bursa-pastoris* (L.) Medik., *Chenopodium polyspermum* L., *Descurainia sophia* (L.) Webb. et Prantl, *Digitaria sanguinalis* (L.) Scop., *Galinsoga parviflora* Cav., *Xanthoxalis stricta*

(L.) Small etc.). Epoecophytes are resistant to the anthropogenic load which actually promotes their propagation and distribution. To agriophytes belong species widespread both in anthropogenic transformed landscapes and in natural phytocoenosises were they occupy a stable position. They include – *Juncus tenuis* Willd., *Phalacroloma annuum, Saponaria officinalis, Ranunculus repens, Lamium maculatum* etc.

Correlation between indigenous and adventive fractions formed during the years is considered as very important characteristic of synantropic flora of every region since it indicates flora synantropization degree (PROTOPOPOVA 1991).

Now urban flora in Kyiv includes more than 600 adventive species which mainly are expansive. Plants causing mass allergic illnesses among the population (quarantine weeds) constitute a high menace for the human health – *Ambrosia artemisiifolia, Artemisia absinthium* L., *A. vulgaris* L., *Iva xanthifolia,* etc. Forming of solid and highly efficient sod cover on the cities territories prevents penetration and distribution of quarantine species; promotes environment optimization and decreases flora advetization degree in the region.

Conclusions

Species composition of grass-plots in Kyiv includes 198 species of vascular plants, part of which are archeophytes (17, 68%) and part – kenophytes (14,14%). Most of the allohtonic species are weeds, part of which is quarantine.

It was established that plant communities of grass-plots cultural phytocoenosises belong to the 5 vegetation classes, which combine 11 unions and 27 associations: *Molinio-Arrhenatheretea, Agropyretea repentis, Plantaginetea majoris, Chenopodietea* and *Artemisietea vulgaris.*

The ruderal degree of decorative covers of different functions was determined. The overall assessment of grass-plots quality indicates on low quality of cultural phytocoenosises in Kyiv.

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Ecological analysis of the flora of saline sites in the northern part of Banat region in Vojvodina Province (Serbia)

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Knežević A., Stojanović S., Nikolić Lj., Džigurski D. & Ljevnaić B. (2008): Ecological analysis of the flora of saline sites in the northern part of Banat region in Vojvodina Province (Serbia). – Thaiszia – J. Bot. 18: 75-92. – ISSN 1210-0420.

Abstract: A long-term floristic study has determined the presence of 410 plant taxa in the flora of saline sites in northern Banat, the Vojvodina Province, Serbia. Of the determined taxa, 363 were included in the ecological analysis of the saline flora, i.e., all 348 determined species, all 14 determined subspecies and, because of its specific importance, only one variety, *Aster tripolium* var. *pannonicus* (Jacq.) Beck. Based on the analysis of mean values of ecological indexes (LANDOLT, 1977), we concluded that the saline soil of the studied region is moderately dry (F – 2.65), moderately basic (R – 3.30), moderately abundant with nitrogen (N – 3.08) and humus (H – 2.,95), poorly aerated (D – 3.89), highly saline (S_+ - 22.31 %), with a favorable thermal regime (T – 4.03), with the dominance of heliophytes (L – 3.85) which are well adapted to the conditions of the moderate continental climate (K – 3.24) that characterizes the studied region.

Keywords: Vojvodina Province, northern Banat, saline sites, flora, ecological index.

Introduction

Most of the natural plant cover of the Vojvodina Province (Serbia) has been eradicated as the crop and animal productions gradually intensified. There still remains about 10% of land which has a fairly well-developed natural plant cover. These areas exhibit halophytic characteristics because those are predominantly salinas. In recent years these areas have been exposed to the anthropogenic factor at an increasing rate. It is characteristic for the plant cover of the saline sites in the Vojvodina Province that it had developed intrazonally within the zonal forest-steppe community of the alliances *Aceri tatarici-Quercion* Zólyomi et Jakucs 1957 and *Festucion rupicolae* (*sulcatae*) Soó (1940) 1964.

Numerous authors have studied the saline flora and vegetation (SLAVNIĆ 1948; BODROGKÖZY & GYÖRFFY 1970; PARABUĆSKI 1979, 1980; KUJUNDŽIĆ 1980; KNEŽEVIĆ 1994, BUDAK 1998, SÁDOVSKÝ et al., 2004; ELIÁŠ et al., 2008, DÍTĚ et al. 2008; KNEŽEVIĆ et al. 2008). In recent years, in addition to floristic and phytocoenological studies, we have focused our attention on the bioindication ecology of halophytes.

The use of ecological indices as indicator values provides an opportunity to characterize all aspects of a plant species in a succinct, simple and comparable way. When characteristics of plant species are defined in that manner, they may be used for the assessment of ecological characteristics and quality class of a given site. In other words, each plant species may serve as a test organism that reflects the conditions, status and quality of its environment. Such plant species are most sensitive biodiversity indicators which characterize not only parts of their environment but also the entire environment as an integral system, reflecting not only the consequences of processes that take place in the environment but also their causes (STOJANOVIĆ et al. 1994).

The objective of this study was to outline the ecological characteristics of saline sites in northern Banat, the Vojvodina Province, on the basis of an analysis of ecological indices of the recorded taxa.

Materials and methods

The boundaries of the studied region are the watercourses of the rivers Tisza and Zlatica and the state border with Hungary and Romania. The saline sites in the region are predominated by limeless solonetz soils, which possess more or less columnar structure. Solonchak soils occur sporadically, in isolated spots. These soils had developed in consequence to the alluvial salinization by waters from the Carpathian basin (NEJGEBAUER et al. 1971). The subsequent regulation of the Tisza and Zlatica watercourses had prevented surface flooding, resulting in the occurrence of salt leaching in the studied saline sites.

The ecological indexes used in the analysis of basic environmental factors (humidity - F, chemical reaction - R, content of nitrogen and nitrogen compounds - N, content of humus (organomineral substances) - H, dispersion (aeration) of the substrate - D, salinity - S, light - L, temperature - T, and continentality - K) were taken from the publication 'Ökologische Zeigerwerte zur Schweizer Flora'

(LANDOLT 1977). The taxa which had not been mentioned by LANDOLT were characterized according to the publication ‘Monograph of Flora of Vascular Plants on the Saline Soils in the Banat Region (Yugoslavia)" (KNEŽEVIĆ 1994). In that publication, the criteria for determination of ecological indices were the papers of SOÓ (1964-1980), BORHIDY (1993), BODROGKÖZY (1970), KNEŽEVIĆ (1983), KNEŽEVIĆ et al. (1994, 1996, 1998, 2005, 2008), JANJATOVIĆ et al. (1990, 1992, 1995) and MERKULOV et al. (1999) and our own on-site observations. The supplement provides ecological indices for the recorded species, subspecies and one variety. The ecological indices supplied by LANDOLT are given in **bold** characters and those estimated by ourselves in normal characters.

Results and discussion

In a long-term floristic study of the flora of saline sites in the examined region, presence of 410 taxa of vascular plant was determined (KNEŽEVIĆ et al. 2005). Of the determined taxa, 363 were included in the ecological analysis of the saline flora, i.e., all 348 determined species, all 14 determined subspecies and, because of its specific importance, only the variety *Aster tripolium* var. *pannonicus* (Jacq.) Beck.

Tab. 1 shows the following parameters for the analyzed taxa: number of taxa with a certain numerical value of ecological index, their percentages and, except for the relationship with salinity, mean values of the ecological indexes.

Relationship between plants and humidity of the site (F)

The analysis of the ecological indexes for humidity (F) indicated the predominance of plant species with the ecological indexes F_2 (131 taxa; 36.09%), adapted to dry sites, and F_3 (102 taxa; 28.10%), adapted to moderately dry sites. The number of plant species with the ecological index F_1 was lower (53 taxa; 14.60%). Those were xerophytes, i.e., indicators of extremely dry sites. After the xerophytes there followed the indicators of humid sites, i.e., the plant species with the ecological index F_4 (45 taxa; 12.40%). The plant species with the ecological index F_5 were fewest (32 taxa; 8.81%). This group contained indicators of high humidity of the site.

The mean value of the ecological indexes for humidity for the analyzed taxa was 2.65, indicating that the saline sites in the studied region are moderately dry.

Relationship between plants and chemical reaction of the site (R)

There was a large dominance of neutrophilous species with the ecological index R_3 (212 taxa; 58.40%). The proportion of indicators of neutral to basic chemical reaction of the site, designated with the ecological index R_4, was also significant (129 taxa; 35.54%). There was a small number of indicators of acidic substrate, with by the ecological index R_2 (20 taxa; 5.51%). The presence of indicators of highly acidic sites, labeled as R_1, and indicators of highly basic sites, labeled as R_5, was minimal (1 taxon each; 0.27%).

The mean value of the ecological indexes for chemical reaction of the site was 3.30, indicating that the saline sites in the studied region are moderately basic.

Tab. 1. Ecological analysis of flora of saline sites in the northern part of Banat region in the Vojvodina Province

Ecological index	Numerical values of ecological index	Number of taxa	%	Mean value
F – humidity	1	53	14.60	**F – 2.65**
	2	131	36.09	
	3	102	28.10	
	4	45	12.40	
	5	32	8.81	
R – chemical reaction of the site	1	1	0.27	**R - 3.30**
	2	20	5.51	
	3	212	58.40	
	4	129	35.54	
	5	1	0.27	
N - nitrogen and nitrogen compounds	1	21	5.78	**N - 3.08**
	2	81	22.31	
	3	124	34.16	
	4	120	33.06	
	5	17	4.68	
H – humus	1	2	0.55	**H - 2.95**
	2	61	16.80	
	3	255	70.25	
	4	42	11.57	
	5	3	0.83	
D – dispersion (aeration)	1	0	0	**D - 3.89**
	2	5	1.38	
	3	119	32.78	
	4	149	41.05	
	5	90	24.79	
S – salinity	-	282	77.69	
	+	81	22.31	
L – light	1	0	0	**L - 3.85**
	2	2	0.55	
	3	82	22.59	
	4	264	72.73	
	5	15	4.13	
T – temperature	1	0	0	**T – 4.03**
	2	1	0.27	
	3	72	19.83	
	4	204	56.20	
	5	86	23.69	
K – continentality	1	1	0.27	**K - 3.24**
	2	45	12.40	
	3	195	53.72	
	4	108	29.75	
	5	14	3.86	

Relationship between plants and nitrogen and nitrogen compounds (N)

The analysis of the ecological indexes for the contents of nitrogen and nitrogen compounds indicated the prevalence of taxa with the ecological indexes N_3 (124 taxa; 34.16%) and N_4 (120 taxa; 33.06%). The proportion of taxa characterized by the index N_2 was significantly lower (81 taxa; 22.31%). The numbers of indicators of very poor sites, designated with the index N_1, and indicators of sites rich in nutrients, designated with the index N_5, were low (21 taxa or 5.78% and 17 taxa of 4.68%, respectively).

Based on the mean value amounting to 3.08, the saline sites in the studied region were considered to be moderately rich in biogenous nutrients.

Relationship between plants and humus content (H)

The analysis of the ecological indexes for the content of humus indicated a high predominance of taxa with the ecological index H_3 (255 taxa; 70.25%). This characterizes the studied saline sites as moderately rich in organomineral compounds. The indicators of low humus content designated with the ecological index H_2 were considerably fewer (61 taxa; 16.80%). The relative abundance of humus in the substrate was indicated by a small number of taxa with the ecological index H_4 (42 taxa; 11.57%). The numbers of indicators of humic sites, designated with the ecological index H_5, and indicators of sites poor in humus, designated with the ecological index H_1, were quite low (3 taxa or 0.83% and 2 taxa or 0.55%, respectively).

The mean value of the ecological index for humus content was 2.95, describing the studied site as moderately provided with humus.

Relationship between plants and dispersion (aeration) of the substrate (D)

Almost two thirds of the analyzed taxa were designated with the ecological indexes D_4 (149 taxa; 41.05%) and D_5 (90 taxa; 24.79%). Those were plant species adapted to a non-skeletal soil with a heavy mechanical composition. A significant presence of plant species designated with the ecological index D_3 (119 taxa; 32.78%) testified that the saline sites included also some well aerated locations. Indicators of soil with large particles, designated with the ecological index D_2, were scarce (5 taxa; 1.38%), while indicators of immature soil, i.e., plant species labeled with the ecological index D_5, could not be found at the saline sites of the studied region.

The mean value amounting to 3.89 indicates that the studied saline soils had unfavorable dispersion, i.e., poor aeration.

Relationship between plants and salinity (S)

The taxa designated with the ecological index S_+ made more than one fifth of the analyzed flora (81 taxa; 22.31%). This gives the halophytic character to the flora, despite the dominance of plants species designated with the ecological index S_- (282 taxa; 77.69%). The previous statement is based on the fact that the taxa bearing the ecological index S_- include numerous plants species which are tolerant to salinity as well as the species which avoid high salinity of the site by completing their vegetation in the spring, when salt concentration in the substrate is low due to abundant rainfall.

Relationship between plants and light (L)

Plant species designated with the ecological index L_4 were dominant in the analyzed flora (264 taxa; 72.73%). These species are adapted to full light but they also tolerate a certain degree of shading. The number of taxa with the ecological index L_3 was considerably lower (82 taxa; 22.59%). These species are indicators of half-shade. There was a small number of species with the ecological index L_5 (15 taxa, 4.13%). These species do not tolerate shading. The species designated with the ecological index L_2 were few (2 taxa, 0.55%). They are indicators of full shade. Indicators of deep shade, designated with the ecological index L_1, were absent.

The mean value of 3.85 was an indication of dominance of heliophytes (L_4) over semi-sciophytes (L_3).

Relationship between plants and temperature (T)

The analysis of ecological indexes for temperature showed that thermophilous plant species designated as T_4 (204 taxa, 56.20%) and true thermophiles designated as T_5 (86 taxa, 23.69%) dominated the flora of the studied saline sites. The participation of taxa with the ecological index T_3 was lower (72 taxa, 19.83%). These species were indicators of moderately warm sites. The presence of taxa designated as T_2, indicators of cold sites, was insignificant (1 taxon, 0.27%). Taxa from very cold sites, designated as T_1, were completely absent.

The mean value of 4.03 indicated a favorable temperature regime of the sites.

The analysis of adaptation of the plant species of the studied flora to the continental climate showed that the largest number of plant species were designated with the ecological index K_3 (195 taxa, 53.72%). This was an indication that moderately continental conditions dominated in the studied region. A considerable influence of typical continental conditions resulted in a large presence of taxa designated with the ecological index K_4 (108 taxa, 29.75%). Plant species with the ecological index K_2, indicating an influence of sub-oceanic climate, were present in lower numbers (45 taxa, 12.40%). The number of plant species of typical continental regions, designated with the ecological index K_5, was small (14 taxa, 3.86%). The presence of oceanic plant species, designated with the ecological index K_1, was insignificant (1 taxon, 0.27%).

The mean value of 3.24 confirmed that the moderate continental climate of the studied region was under a considerable influence of the typical continental climate.

Based on the bioindicator values of the analyzed flora, the saline sites in the region surrounded by the rivers Tisza and Zlatica and the state border with Hungary and Romania may be characterized as moderately dry, moderately basic, moderately abundant with nutrients, moderately abundant with humus, but poorly aerated. Their plant cover has halophytic characteristics, with heliophytes predominating under a favorable thermal regime of the moderate continental climate of the studied region.

The obtained results indicate that the saline pastures of northern Banat have a low annual biomass production, as observed earlier for the saline pastures of southeastern Banat (VUČKOVIĆ 1985). Their more productive parts are used primarily for grazing and hay production, and only exceptionally for crop production. The poorest sites should be used for the construction of fishponds and infrastructure facilities, in order to preserve the neighboring tracts of fertile land. Precise locations for the construction of these facilities could be recommended by analyzing the indicator values of individual stands of the studied plant communities.

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Supplement

Taxon	Ecological index								
	F	**R**	**N**	**H**	**D**	**S**	**L**	**T**	**K**
Abutilon theophrasti Meddik.	**2**	**3**	**4**	**3**	**4**	**-**	**4**	**5**	**3**
Achillea millefolium L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**3**	**3**
A. millefolium L. subsp. *collina* (Becker) Weis.	2	4	2	3	3	-	4	4	4
A. millefolium L. subsp. *pannonica* (Scheele) Hayek	2	3	4	4	3	-	4	4	4
A. setacea W. et K.	**1**	**3**	**2**	**2**	**3**	**-**	**4**	**5**	**5**
Acorellus pannonicus (Jacq.) Palla	**4**	**4**	**4**	**2**	**4**	**+**	**4**	**4**	**4**
Adonis aestivalis L.	**2**	**4**	**2**	**3**	**4**	**-**	**3**	**5**	**3**
A. flammea Jacq.	**2**	**4**	**2**	**3**	**4**	**-**	**3**	**5**	**3**
A. aestivalis L.	**2**	**4**	**2**	**3**	**4**	**-**	**3**	**5**	**3**
Agrimonia eupatoria L.	**2**	**4**	**3**	**3**	**4**	**-**	**4**	**4**	**3**
Agropyrum cristatum (Schreb.) P.B.	2	3	2	3	3	-	4	4	4
A. repens (L.) Beauv.	**3**	**3**	**4**	**2**	**3**	**+**	**4**	**3**	**3**
Agrostis alba L.	**4**	**3**	**3**	**3**	**4**	**-**	**4**	**5**	**2**
Ajuga genevensis L.	**2**	**3**	**3**	**3**	**4**	**-**	**3**	**4**	**4**
Alisma lanceolatum With.	**5**	**3**	**3**	**3**	**5**	**-**	**4**	**4**	**3**
A. plantago-aquatica L.	**5**	**3**	**3**	**3**	**5**	**-**	**4**	**4**	**3**
Allium atropurpureum Waldst. Et Kit.	2	3	2	3	4	-	4	4	3
A. scorodoprasum L.	**4**	**3**	**4**	**4**	**5**	**-**	**3**	**5**	**3**
A. sphaerocephalum L.	**1**	**4**	**2**	**2**	**3**	**-**	**4**	**4**	**4**
A. vineale L.	**2**	**3**	**3**	**3**	**4**	**-**	**4**	**4**	**2**
Alopecurus geniculatus L.	**4**	**3**	**4**	**3**	**5**	**+**	**3**	**4**	**3**
A. pratensis L.	**4**	**3**	**4**	**3**	**5**	**-**	**4**	**3**	**3**
Althaea officinalis L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**5**	**4**
Amarantus albus L.	**1**	**3**	**4**	**3**	**3**	**-**	**4**	**4**	**3**
A. crispus (Lesp. et Thev.) Terr.	2	3	4	4	3	-	4	4	5
A. retroflexus L.	**2**	**3**	**4**	**3**	**3**	**-**	**4**	**4**	**3**
Anagallis arvensis L.	**3**	**3**	**3**	**3**	**4**	**-**	**4**	**4**	**3**
Andropogon ischaemum L.	**2**	**3**	**2**	**2**	**3**	**-**	**5**	**5**	**4**
Antriscus caucalis M. B.	3	3	3	3	4	-	3	3	3
Arenaria serpyllifolia L.	**2**	**3**	**3**	**3**	**3**	**-**	**4**	**4**	**3**
Arrhenatherum elatius (L.) Mert. et Koch	**3**	**3**	**4**	**3**	**4**	**-**	**3**	**4**	**3**
Artemisia absinthium L.	**2**	**4**	**4**	**3**	**4**	**-**	**4**	**4**	**4**
A. austriaca Jacq.	2	3	3	3	3	-	4	4	4
A. maritima L. subsp. *monogyna* (W. et K.) Gams.	2	4	2	2	4	+	4	4	5
A. maritima L. subsp. *salina* (Willd.) Gams.	2	4	2	2	4	+	4	4	5
A. vulgaris L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**4**	**3**
Aster tripolium L. var. *pannonicus* (Jacq.) Beck	3	4	2	2	4	+	4	4	4
Astragalus cicer L.	**2**	**4**	**4**	**3**	**3**	**-**	**3**	**4**	**4**
Atriplex hastata L.	3	3	4	3	3	+	4	4	4
A. litoralis L.	3	3	2	2	4	+	3	4	3
A. tatarica L.	3	3	4	2	4	+	3	3	4
Ballota nigra L.	**2**	**3**	**5**	**3**	**4**	**-**	**4**	**5**	**4**
Beckmannia eruciformis (L.) Host.	5	4	4	3	5	+	4	3	4

Supplement – cont.

Taxon	F	R	N	H	D	S	L	T	K
Bellis perennis L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**3**	**3**
Berteroa incana (L.) DC.	**1**	**3**	**3**	**3**	**3**	**-**	**4**	**4**	**4**
Bidens cernuus L.	**5**	**3**	**5**	**4**	**4**	**-**	**4**	**4**	**3**
B. tripartitus L.	**5**	**3**	**5**	**4**	**4**	**-**	**4**	**4**	**3**
Bolboschoenus maritimus (L.) Palla	**5**	**4**	**3**	**3**	**5**	**+**	**4**	**4**	**3**
B. maritimus (L.) Palla var. *compactus* (Hoffm.)									
B. maritimus (L.) Palla var. *macrostachys* (Wild) Kneuc. f. *macrostachys*									
Bromus comutatus Schrad.	**2**	**3**	**3**	**3**	**5**	**-**	**3**	**4**	**3**
Bromus comutatus Schrad. f. *violaceus* Podp.									
Bromus erectus Huds.	**2**	**4**	**2**	**3**	**4**	**-**	**4**	**4**	**3**
B. inermis Leyss.	**2**	**4**	**3**	**3**	**3**	**-**	**4**	**4**	**4**
B. mollis L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**4**	**3**
Bupleurum pachnospermum Pančić	2	3	3	4	3	-	4	5	3
B. tenuissimum L.	**3**	**4**	**3**	**3**	**5**	**+**	**4**	**5**	**1**
Butomus umbellatus L.	**5**	**3**	**4**	**4**	**5**	**-**	**3**	**4**	**3**
Calystegia sepium (L.) R. Br.	**4**	**4**	**4**	**3**	**5**	**-**	**3**	**4**	**2**
Camphorosma annua Pall.	2	4	1	1	4	+	5	4	4
C. annua Pall. f. *nana* Moq.									
Capsella bursa pastoris (L.) Medik.	**2**	**3**	**4**	**3**	**4**	**-**	**4**	**3**	**3**
Carduus acanthoides L.	**1**	**3**	**4**	**3**	**3**	**-**	**4**	**5**	**2**
C. nutans L.	**2**	**4**	**4**	**2**	**3**	**-**	**4**	**4**	**3**
Carex divisa Huds	**4**	**4**	**3**	**3**	**3**	**+**	**5**	**5**	**2**
C. hirta L.	**3**	**3**	**3**	**3**	**4**	**-**	**3**	**4**	**3**
C. nutans Huds.	**3**	**3**	**3**	**3**	**3**	**-**	**4**	**5**	**4**
C. praecox Schreb	**2**	**4**	**2**	**2**	**3**	**-**	**4**	**4**	**4**
C. pseudocyperus L.	**5**	**4**	**3**	**4**	**5**	**-**	**4**	**4**	**4**
C. spicata Huds.	**3**	**3**	**4**	**3**	**5**	**-**	**4**	**3**	**3**
C. stenophylla Wahlbg.	**2**	**4**	**2**	**3**	**3**	**-**	**4**	**5**	**5**
C. vulpina L.	**5**	**4**	**2**	**4**	**4**	**-**	**3**	**4**	**3**
C. vulpina L. f. *minor* Peterm.									
C. vulpina L. f. *longibracteata* Beck									
Carthamus lanatus L.	**1**	**3**	**4**	**3**	**3**	**-**	**4**	**5**	**3**
Centaurea calcitrapa L.	**2**	**4**	**4**	**3**	**5**	**-**	**4**	**5**	**2**
C. cyanus L.	**2**	**3**	**3**	**3**	**4**	**-**	**4**	**4**	**4**
C. difusa Lam.	**1**	**4**	**4**	**2**	**3**	**-**	**4**	**5**	**3**
C. jacea L. subsp. *angustifolia* (Schrk.) Gugl.	**3**	**3**	**2**	**4**	**4**	**-**	**4**	**4**	**3**
C. jacea L. subsp. *angustifolia* (Schrk.) Gugl. var. *pannonica* (Heuff.) Gugl.									
C. scabiosa L. subsp. *sadleriana* (Janka) Aschers. et Graebn.	2	4	2	2	3	-	4	4	4
C. solstitialis L.	**2**	**3**	**4**	**2**	**4**	**-**	**4**	**4**	**4**
Centaurium pulchellum (Sw.) Druce.	**3**	**4**	**3**	**2**	**5**	**+**	**4**	**4**	**3**
C. uliginosum (W. et K.) Beck.	3	4	1	3	4	+	4	4	5

Supplement – cont.

Taxon	Ecological index								
	F	R	N	H	D	S	L	T	K
C. umbellatum Gilib.	3	3	3	3	4	-	4	4	3
C. umbellatum Gilib. f. *humile* (Dvorak) Soó									
Cephalaria transsilvanica (L.) Schrad.	1	4	1	1	2	-	4	4	3
Cephalaria transsilvanica (L.) Schrad. var. *allionii* (Kern.) Ravy									
Cerastium arvense L.	2	3	3	3	4	-	4	4	3
C. banaticum (Roch.) Heuff.	3	3	3	3	4	-	4	3	3
C. brachypetalum Desp.	1	4	1	3	3	-	4	4	3
C. caespitosum Gilib.	3	3	3	3	4	-	3	3	3
C. dubium (Bast.) Schwarz.	4	3	3	3	4	-	3	5	2
C. pumilum Curt.	1	4	2	3	3	-	4	4	2
C. semidecandrum L.	2	4	2	3	3	-	4	4	3
Chenopodium album L.	2	3	4	3	4	-	4	3	3
Ch. glaucum L.	3	3	5	3	4	+	4	4	4
Ch. polyspermum L.	3	3	4	3	4	-	4	4	3
Ch. rubrum L.	3	3	5	3	4	+	4	3	4
Ch. rubrum L. subsp. *botryo* (i) des Sm.	3	3	5	3	4	+	4	3	4
Ch. vulvaria L.	2	3	5	3	3	-	4	4	4
Chondrilla juncea L.	2	3	3	3	3	-	4	5	3
Chrysopogon gryllus (L.) Trin.	1	3	2	2	3	-	4	5	3
Ch. gryllus (L.) Trin. f. *flavencens* (Schur) Soó									
Cichorium intybus L.	2	4	3	3	5	-	5	4	3
Cirsium arvense (L.) Scop.	3	3	4	3	4	+	3	4	3
C. arvense (L.) Scop. var. *vestitum* Wimm. et Grab.									
C. canum (L.) All.	4	3	2	3	3	-	4	3	4
C. lanceolatum (L.) Scop.	3	3	4	4	4	-	3	3	3
Consolida orientalis (Gay.) Schröd.	2	3	4	3	3	-	3	4	2
C. regalis S.F.Gray.	2	5	3	3	3	-	3	4	4
Convolvulus arvensis L.	2	4	3	3	4	-	4	4	3
C. arvensis L. f. *microphyllus* Opiz									
Corispermum nitidum Kit.	2	4	2	3	3	-	4	4	4
Crepis capillaris (L.) Wallr.	3	3	3	3	4	-	4	4	3
C. foetida L. subsp. *rhoadifolia* (M.B.) Fiori et Paol.	1	3	4	3	3	-	4	5	3
C. setosa Hall.	1	3	4	3	3	-	4	5	3
C. setosa Hall. f. *gracilis* Rohlena									
Crypsis aculeata (L.) Aitt.	3	4	1	2	5	+	4	4	4
Cynodon dactylon (L.) Pers.	2	3	3	3	3	-	4	5	2
Daucus carota L.	2	3	2	3	3	-	4	4	3
Descurainia sophia (L.) Weeb.	2	3	4	3	4	-	4	3	4
D. sophia (L.) Weeb. var. *sophia* f. *minus* Bolzon ap. Hegi									
Dianthus pontederae Kerner	2	4	3	3	3	-	4	4	4
Dipsacus laciniatus L.	3	4	4	3	5	-	4	5	3
Echium vulgare L.	1	3	4	2	3	-	5	4	4
Epilobium adnatum Griseb.	4	3	3	4	5	-	3	4	2

Supplement – cont.

Taxon	Ecological index								
	F	R	N	H	D	S	L	T	K
Eragrostis megastachya (Koel.) Link	1	4	2	2	3	-	4	5	3
E. pilosa (L.) P.B.	1	2	3	2	3	-	4	5	3
Erigeron canadensis L.	2	3	3	3	4	-	4	4	3
Erodium cicutarium (L.) L.´ Hérit.	2	3	3	3	3	-	4	4	3
Erophila verna (L.) Schevall.	2	3	2	3	3	-	4	4	3
Eryngium campestre L.	2	4	3	3	3	-	4	5	3
Euclidium syriaca (L.) R. Br.	1	3	4	3	4	-	4	4	4
Euphorbia cyparissias L.	2	3	2	3	4	-	4	3	3
E. glareosa M.B.	1	4	1	4	4	-	4	4	4
E. palustris L.	4	4	4	4	5	+	3	4	2
E. platyphyllos L.	3	3	3	3	4	-	3	4	2
E. seguieriana Neck.	1	4	2	3	2	-	4	4	4
Falcaria vulgaris Bernh.	2	4	2	3	3	-	4	5	4
Festuca arundinacea Schreb.	4	4	4	3	5	-	4	3	3
F. pratensis Huds.	3	3	4	4	4	-	4	3	3
F. vallesiaca Sch.	1	3	2	2	3	-	4	4	5
F. vallesiaca Sch. subsp. *pseudovina* (Hack.) A. et G.	1	3	2	2	3	+	4	4	5
F. vallesiaca Sch. subsp. *pseudovina* (Hack.) A. et G. f. *rutila* Hack.									
Filago germanica L.	1	2	3	2	3	-	4	5	3
Filipendula hexapetala Gilib.	2	3	2	3	5	-	4	4	3
Fragaria viridis Duchense	2	3	3	3	4	-	3	5	4
Gagea pratensis (Pers.) Dumort.	2	4	4	3	5	-	4	5	4
Galega officinalis L.	4	3	4	3	4	-	3	5	3
Galium aparine L.	3	3	5	3	4	-	3	4	3
G. pedemontanum All.	2	2	2	3	3	-	3	5	3
G. tricorne Stokes	2	3	2	3	5	-	3	4	3
G. verum L.	2	4	2	3	5	-	4	4	4
Geranium columbinum L.	3	3	3	3	3	-	4	4	3
G. molle L.	2	3	4	3	3	-	4	4	3
G. sanguineum L.	2	4	2	3	3	-	3	4	4
Glechoma hederacea L.	3	3	3	3	4	-	3	4	3
Glyceria fluitans (L.) R. Br.	5	4	3	4	5	-	4	3	3
G. maxima (Hartm.) Holombg.	5	4	5	3	5	-	4	4	3
Glycyrrhiza echinata L.	3	3	2	3	3	-	4	4	3
Gratiola officinalis L.	5	3	3	4	5	+	3	4	4
G. officinalis L. f. *inundata* (Kit in Schultes) Soó									
Gypsophila muralis L.	3	2	1	2	3	-	4	4	4
G. muralis L. var. *muralis* f. *capillaris* Fick. et Schube									
Heleocharis palustris (L.) R.Br.	5	4	2	4	5	-	4	3	3
Heleochloa alopecuroides (Pill. et Mitterp.) Host	4	3	3	3	3	-	4	5	3
H. schoenoides (L.) Host	4	4	3	3	4	+	4	5	3
Helminthia echioides (L.) Gärtn.	3	3	4	4	4	-	4	5	2
Herniaria incana Lam.	1	3	2	2	3	-	4	3	4

Supplement – cont.

Taxon	Ecological index								
	F	R	N	H	D	S	L	T	K
Hibiscus trionum L.	3	3	3	3	4	-	4	5	4
Hieracium pilosella L.	2	3	2	3	4	-	4	3	4
Holosteum umbellatum L.	1	3	3	3	3	-	4	5	3
Hordeum maritimum subsp. *gussoneanum* (Parl.) A. et G.	2	4	3	3	5	+	5	4	3
H. murinum L.	2	3	4	2	3	-	4	4	4
Hypericum perforatum L.	2	3	3	3	5	-	3	4	3
Inula britannica L.	4	4	3	3	4	+	3	5	3
Juncus articulatus L.	4	3	2	3	5	-	4	3	3
J. atratus Krock.	4	2	3	4	5	-	4	4	2
J. bufonius L.	4	2	3	3	5	-	4	3	3
J. compressus Jacq.	4	3	3	3	5	+	4	3	3
J. compressus Jacq. var. *coartactus* E. Meyer ex Busch.									
J. compressus Jacq. var. *compressus* f. *porphyrocarpus* J. Murr.									
J. conglomeratus L.	4	2	3	4	5	-	4	3	2
J. gerardi Lois.	4	3	3	3	4	+	5	3	4
Kickxia elatine (L.) Dum.	2	3	3	3	4	-	4	5	2
Knautia arvensis (L.) Coult.	2	3	3	3	4	-	4	4	3
Kochia laniflora (Gmel.) Borb.	2	4	1	3	3	-	4	4	5
K. prostrata (L.) Schrad.	1	3	4	2	3	+	5	5	4
K. prostrata (L.) Schrad. l. *rubens* Lag.									
Koeleria gracilis Pers.	1	3	2	3	3	-	4	3	3
K. gracilis f. *violacea* R. et Sch.									
Lactuca saligna L.	1	3	4	3	4	+	4	5	4
L. serriola L.	2	3	3	2	3	-	4	5	4
Lamium amplexicaule L.	2	3	4	4	4	-	4	3	3
L. purpureum L.	3	4	4	3	4	-	4	3	3
Lathyrus aphaca L.	2	3	3	3	4	-	3	4	4
L. aphaca L. var. *aphaca* f. *laetus* Posp.									
L. hirsutus L.	2	4	3	3	3	-	3	4	4
L. tuberosus L.	2	4	3	3	5	-	4	4	4
Leonurus cardiaca L.	2	4	5	3	4	-	4	4	4
L. marrubiastrum L.	3	4	4	3	3	-	3	5	2
Lepidium campestre (L.) R.Br.	2	4	4	2	4	-	4	3	3
L. draba L.	2	3	4	3	4	-	3	4	4
L. perfoliatum L.	3	4	3	3	5	-	4	5	4
L. ruderale L.	2	3	4	2	3	-	4	4	4
L. ruderale L. f. *humile* Roch.									
Linaria genistifolia (L.) Mill.	2	4	2	3	3	-	4	4	4
L. vulgaris Mill.	2	3	3	3	4	-	4	4	3
Lithospermum officinale L.	3	4	3	3	4	-	3	4	3
Lolium perenne L.	3	3	4	3	5	-	4	3	3
Lotus corniculatus L.	2	4	3	3	4	-	4	3	3
Lotus corniculatus L. var. *pilosus* (Jord.) Posp.									

Supplement – cont.

Taxon	Ecological index								
	F	R	N	H	D	S	L	T	K
L. tenuis Kit.	3	4	2	3	5	+	4	4	2
Lycopus europaeus L.	5	3	3	5	5	-	3	4	3
L. europaeus L. f. *turfosus* Beck									
L. exaltatus L.	5	4	4	4	5	-	3	5	4
Lysimachia nummularia L.	4	3	4	3	5	-	2	4	2
L. vulgaris L.	4	3	3	4	5	-	3	4	3
Lythrum hyssopifolia L.	4	2	3	3	5	+	4	5	3
L. salicaria L.	4	3	3	4	5	-	3	4	3
L. virgatum L.	4	3	4	4	5	-	3	4	4
Marrubium peregrinum L.	2	4	2	2	5	-	4	4	4
M. vulgare L.	2	4	5	3	4	-	4	5	4
Matricaria chamomilla L.	3	3	3	3	4	+	4	4	3
M. chamomilla L. f. *salina (*Schur) Jáv.									
M. inodora L.	3	3	4	4	4	+	4	3	3
M. suaveolens (Pursh) Buch.	3	3	5	3	5	-	4	4	3
Medicago falcata L.	2	4	2	3	3	-	4	4	4
M. lupulina L.	2	4	3	3	4	-	3	4	3
M. lupulina L. f. *canescens* (Menvh.) Soó									
Melilotus officinalis (L.) Pallas	2	4	3	3	3	-	4	4	3
Mentha aquatica L.	5	3	3	4	5	-	3	4	3
Mentha aquatica L. f. *erromera* Top.									
M. longifolia (L.) Huds.	4	4	4	3	5	-	3	3	3
M. pulegium L.	4	3	4	4	5	+	3	5	2
M. pulegium L. f. *lactea* Borb.									
Muscari racemosum (L.) Mill.	2	4	3	3	4	-	4	4	3
Myosotis caespitose (Schultz.)	5	2	3	3	4	-	4	4	3
M. collina Hoffm.	1	3	2	2	3	-	4	4	4
M. palustris (L.) Nath.	4	3	4	4	5	-	3	3	2
Myosurus minimus L.	4	2	2	3	5	-	4	4	2
Nigella arvensis L.	2	4	3	3	3	-	4	4	2
Odontites rubra Gilib.	3	3	4	3	5	+	3	4	3
Oenanthe aquatica (L.) Poiret in Lam.	5	4	3	3	5	-	4	4	4
O. silaifolia M.B.	5	4	3	3	5	+	4	4	3
Oenothera biennis L.	2	3	3	3	4	-	4	4	3
O. strigosa (Rydb.) Mach. et Bush	3	3	3	3	4	-	4	4	3
Ononis spinosa L.	2	3	2	3	5	-	4	4	3
Onopordon acanthium L.	2	4	5	3	4	-	4	4	4
Ornithogalum gussonei Ten.	2	4	3	4	4	-	4	5	4
O. nutans L.	3	3	3	3	4	-	4	5	2
O. umbellatum L.	3	4	3	3	4	-	4	4	2
Orobanche caryophyllacea Sm.	2	4	2	3	3	-	4	4	4
Panicum crus-galli L.	3	3	5	3	4	-	3	4	3
Papaver dubium L.	2	2	3	3	4	-	3	4	4

Supplement – cont.

Taxon	Ecological index								
	F	**R**	**N**	**H**	**D**	**S**	**L**	**T**	**K**
P. rhoeas L.	**2**	**4**	**3**	**3**	**4**	**-**	**3**	**4**	**3**
Parentucellia latifolia (L.) Car.	3	3	2	3	3	+	4	3	2
P. latifolia (L.) Car. f. *albiflora* (Raul.) Dunjić									
Pastinaca sativa L.	**2**	**4**	**3**	**3**	**4**	**-**	**4**	**4**	**3**
Peplis portula L	**4**	**2**	**3**	**3**	**5**	**-**	**4**	**4**	**2**
Petrorhagia prolifera (L.) P. W. Ball.	**1**	**2**	**2**	**3**	**3**	**-**	**4**	**5**	**3**
Peucedanum officinale L.	**2**	**4**	**2**	**3**	**5**	**-**	**3**	**5**	**3**
Pholiurus pannonicus (Host) Trin.	3	4	2	3	5	+	4	4	4
Phragmites communis Trin.	**5**	**3**	**3**	**3**	**4**	**+**	**3**	**3**	**3**
Picris hieracioides L.	**2**	**4**	**4**	**2**	**4**	**-**	**4**	**4**	**3**
Pimpinella saxifraga L.	**2**	**3**	**2**	**3**	**4**	**-**	**4**	**3**	**4**
Plantago altissima L.	4	3	2	3	4	-	4	4	3
P. lanceolata L.	**2**	**3**	**3**	**3**	**4**	**-**	**3**	**3**	**3**
P. lanceolata L. var. *lanceolata*									
P. lanceolata L.var. *sphaerostachya* M.etK.									
P. major L.	**3**	**3**	**4**	**3**	**5**	**+**	**4**	**3**	**3**
P. maritima L.	2	4	2	2	4	+	3	3	5
P. media L.	**2**	**4**	**2**	**3**	**4**	**-**	**4**	**3**	**3**
P. schwarzenbergiana Schur.	3	3	3	2	5	+	4	4	4
P. tenuiflora W. et K.	3	4	1	3	5	+	4	3	4
Poa annua L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**3**	**3**
P. bulbosa L.	**1**	**3**	**3**	**2**	**3**	**-**	**5**	**4**	**4**
P. bulbosa L. f. *vivipara* Koel.									
P. pratensis L.	**3**	**3**	**3**	**4**	**4**	**-**	**4**	**3**	**3**
P. trivialis L.	**3**	**3**	**4**	**3**	**4**	**-**	**3**	**3**	**3**
Podospermum canum C.A. Mey.	2	4	2	2	4	+	4	4	3
P. canum C.A. Mey. var. *integrifolia* (Schur) Soó									
P. canum C.A. Mey. var. *tenuissima* Borb.									
Polygonum arenarium W. et K.	1	3	1	2	2	-	4	4	4
P. aviculare L.	**3**	**3**	**4**	**3**	**5**	**-**	**4**	**3**	**3**
P. aviculare L.subsp. *aequale* (Lindm.) A.et G.	3	3	3	3	4	-	4	3	3
P. lapathifolium L.	**3**	**3**	**4**	**3**	**3**	**-**	**5**	**3**	**3**
P. lapathifolium L. var. *tomentosum* (Schrk.) Bay.									
P. mite Schrank	**4**	**3**	**4**	**3**	**4**	**-**	**3**	**4**	**2**
P. patulum M.B.	2	4	2	2	4	+	4	4	4
P. persicaria L.	**3**	**3**	**4**	**3**	**3**	**-**	**4**	**3**	**3**
Portulaca oleracea L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**4**	**3**
Potentilla anserina L.	**3**	**3**	**4**	**3**	**5**	**+**	**4**	**3**	**3**
P. argentea L.	**1**	**2**	**2**	**2**	**3**	**-**	**4**	**3**	**4**
P. argentea L. var. *tenuiloba* (Jord.) M. Gusuleac.									
P. leucopolitana Müll.	**1**	**3**	**2**	**2**	**3**	**-**	**4**	**5**	**4**
P. reptans L.	**3**	**3**	**4**	**3**	**5**	**-**	**4**	**3**	**3**
P. supina L.	**3**	**4**	**4**	**3**	**5**	**-**	**4**	**5**	**3**
Prunella vulgaris L.	**3**	**3**	**3**	**3**	**4**	**-**	**4**	**3**	**3**

Supplement – cont.

Taxon	F	R	N	H	D	S	L	T	K
	Ecological index								
Prunus spinosa L.	**2**	**4**	**3**	**3**	**3**	**-**	**4**	**4**	**3**
P. spinosa L. f. *acuminate* (Clab.) Dom.									
Puccinellia limosa (Schur) Holmb.	3	4	2	2	4	+	4	4	4
Pulicaria vulgaris Gärtn.	**4**	**2**	**5**	**3**	**5**	**+**	**4**	**5**	**3**
Pycreus flavescens (L.) Rchb	**4**	**3**	**3**	**3**	**3**	**-**	**4**	**4**	**2**
Ranunculus acer L.	**3**	**3**	**3**	**3**	**4**	**-**	**3**	**3**	**4**
R. aquatilis L.	**5**	**3**	**4**	**4**	**5**	**-**	**3**	**4**	**2**
R. arvensis L.	**2**	**4**	**3**	**3**	**4**	**-**	**3**	**4**	**2**
R. lateriflorus DC.	4	3	1	3	5	+	4	4	4
R. paucistamineus Tsch.	**5**	**3**	**4**	**3**	**5**	**-**	**4**	**3**	**3**
R. pedatus W. et K.	**5**	**2**	**2**	**3**	**5**	**-**	**3**	**4**	**2**
R. repens L.	**4**	**3**	**4**	**3**	**5**	**-**	**3**	**3**	**3**
R. sardous Cr.	**4**	**3**	**3**	**3**	**5**	**+**	**4**	**4**	**2**
R. sceleratus L.	**4**	**4**	**5**	**4**	**5**	**+**	**4**	**4**	**3**
Rapistrum perenne (L.) All.	**2**	**3**	**4**	**3**	**4**	**-**	**3**	**5**	**4**
Rhinanthus borbasii (Dörfl.) Soó subsp. *borbasii*	2	4	3	3	3	+	3	3	5
Roripa austriaca (Cr.) Bess.	**4**	**3**	**4**	**3**	**3**	**-**	**3**	**4**	**4**
R. kerneri Menyh.	4	4	4	3	5	+	4	4	3
Rubus caesius L.	**4**	**3**	**4**	**3**	**4**	**-**	**2**	**4**	**3**
Rumex crispus L.	**3**	**3**	**4**	**2**	**4**	**+**	**4**	**3**	**3**
R. obtusifolius L.	**3**	**3**	**4**	**4**	**4**	**-**	**4**	**3**	**3**
R. palustris Sm.	**4**	**4**	**4**	**3**	**5**	**-**	**4**	**5**	**3**
R . patientia L.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**5**	**4**
R. stenophyllus Ledeb.	**3**	**4**	**2**	**3**	**3**	**+**	**4**	**3**	**3**
Salsola ruthenica Iljin	**3**	**3**	**4**	**2**	**3**	**+**	**5**	**5**	**4**
S. soda L.	3	4	4	3	4	+	4	4	4
Salvia nemorosa L.	**2**	**3**	**4**	**3**	**4**	**-**	**4**	**5**	**4**
S. verticillata L.	**2**	**4**	**4**	**3**	**3**	**-**	**4**	**4**	**4**
Saponaria officinalis L.	**2**	**4**	**4**	**3**	**3**	**-**	**3**	**4**	**3**
Scabiosa ochroleucha L.	**1**	**4**	**2**	**3**	**3**	**-**	**4**	**5**	**5**
Schoenoplectus lacuster (L.) Palla	**5**	**3**	**3**	**4**	**4**	**-**	**5**	**4**	**3**
S. lacuster (L.) Palla f. *conglomeratus* (Junge) Soó									
Scilla autumnalis L.	**1**	**4**	**2**	**3**	**3**	**-**	**4**	**5**	**2**
Scleranthus annus L.	**3**	**1**	**2**	**3**	**3**	**-**	**4**	**4**	**4**
S. annus L. f. *minimus* Schur.									
Sclerochloa dura (L.) Beauv.	**1**	**3**	**3**	**2**	**5**	**-**	**5**	**5**	**4**
Scleropoa rigida (L.) Griseb.	**1**	**4**	**3**	**2**	**3**	**-**	**5**	**5**	**2**
Scutellaria hastifolia L.	**5**	**3**	**4**	**5**	**5**	**-**	**3**	**5**	**3**
Sedum caespitosum (Cav.) DC.	1	4	1	2	4	+	5	4	3
Senecio jacobea L.	**3**	**3**	**3**	**3**	**4**	**-**	**4**	**4**	**2**
S. vernalis W. et K.	**2**	**3**	**3**	**2**	**3**	**+**	**4**	**4**	**4**
Setaria glauca (L.) P.B.	**2**	**3**	**4**	**2**	**3**	**-**	**4**	**4**	**3**
S. viridis (L.) P.B.	**2**	**3**	**4**	**2**	**4**	**-**	**4**	**4**	**3**

Supplement – cont.

Taxon	Ecological index								
	F	R	N	H	D	S	L	T	K
Silene alba (Mill.) Krause	**2**	**3**	**4**	**3**	**3**	**-**	**4**	**4**	**4**
S. multiflora (Ehrh.) Pers.	3	4	4	3	3	+	4	4	4
S. viscose (L.) Pers.	2	4	3	3	3	+	4	4	4
S. vulgaris (Moench) Garcke	**2**	**3**	**2**	**3**	**3**	**-**	**3**	**3**	**3**
Sinapis arvensis L.	**3**	**4**	**4**	**3**	**4**	**-**	**4**	**4**	**3**
Sisymbrium orientale L.	**2**	**3**	**4**	**3**	**4**	**-**	**4**	**5**	**2**
Sonchus arvensis L.	**3**	**3**	**4**	**4**	**4**	**+**	**3**	**4**	**3**
S. arvensis L. var. *uliginosus* (M.B.) Grec.									
S. asper (L.) Hill.	**3**	**3**	**4**	**3**	**4**	**-**	**4**	**4**	**3**
Spergularia media (L.) Presl.	**3**	**3**	**3**	**3**	**3**	**+**	**4**	**4**	**3**
S. salina J. et C. Presl.	3	3	3	3	4	+	4	4	3
Stachys germanica L.	**1**	**4**	**3**	**3**	**4**	**-**	**4**	**5**	**3**
Statice gmelini Willd. subsp. *hungaricum* (Klokov) Soó	2	3	1	2	4	+	4	4	4
S. gmelini Willd. subsp. *hungaricum* (Klokov) Soó f. *acuminatum* (Schur) Soó									
S. gmelini Willd. subsp. *hungaricum* (Klokov) Soó f. *obtusum* (Schur) Soó									
S. gmelini Willd. subsp. *hungaricum* (Klokov) Soó f. *hungaricum* (Schur) Soó									
Symphytum officinale L.	**3**	**3**	**4**	**4**	**4**	**-**	**3**	**4**	**3**
Taraxacum officinale Weber	**3**	**3**	**4**	**3**	**4**	**+**	**4**	**3**	**3**
Taraxacum serotinum /W.et.K./Poir. subsp. *bessarabicum* /Horn./ Hand.-Mazz.	3	4	1	3	4	+	4	4	4
Teucrium scordium L.	**5**	**4**	**3**	**5**	**5**	**+**	**4**	**5**	**3**
Thalictrum lucidum L.	**4**	**4**	**3**	**4**	**5**	**-**	**3**	**4**	**4**
Thesium linophyllum L.	**1**	**4**	**2**	**3**	**3**	**-**	**3**	**4**	**4**
Thlaspi arvense L.	**3**	**3**	**4**	**4**	**4**	**-**	**3**	**3**	**3**
Th. perfoliatum L.	**2**	**4**	**3**	**3**	**4**	**-**	**4**	**4**	**3**
Thymus glabrescens Willd.	**1**	**4**	**2**	**2**	**3**	**-**	**4**	**5**	**5**
Th. marschallianus Willd.	1	3	1	3	2	-	4	4	4
Th. serpyllum L.	2	3	1	2	3	-	4	2	4
Torilis arvensis (Huds.) Link.	**2**	**4**	**4**	**2**	**4**	**-**	**4**	**5**	**3**
Trifolium angulatum W.et K.	3	4	2	3	4	+	4	4	3
T. arvense L.	**1**	**2**	**1**	**2**	**3**	**-**	**4**	**4**	**4**
T. campestre Schreb.	**2**	**3**	**2**	**3**	**4**	**-**	**4**	**4**	**3**
T.campestre Schreb. var. *minus* (Koch) Gremli									
T. filiforme L.	**2**	**3**	**2**	**3**	**3**	**-**	**4**	**5**	**2**
T. fragiferum L.	**3**	**4**	**2**	**3**	**5**	**+**	**4**	**4**	**3**
T. hybridum L.	**3**	**4**	**4**	**3**	**4**	**-**	**4**	**3**	**3**
T. ornithopodioides (L.) Sm.	1	3	1	2	3	+	4	4	2
T. parviflorum Ehrh.	**1**	**3**	**2**	**2**	**4**	**+**	**4**	**4**	**3**
T. pratense L.	**3**	**3**	**3**	**3**	**4**	**-**	**3**	**3**	**3**
T. repens L.	**3**	**3**	**4**	**3**	**5**	**+**	**4**	**3**	**3**
T. repens L. f. *microphyllum* Larg.-Fossat									
T. scabrum L.	**1**	**4**	**1**	**3**	**3**	**-**	**4**	**5**	**3**

Supplement – cont.

Taxon	Ecological index								
	F	**R**	**N**	**H**	**D**	**S**	**L**	**T**	**K**
T. striatum L.	2	2	2	2	3	+	4	5	2
T. strictum (L.) Jusl.	1	3	1	3	3	+	4	4	2
T. subterraneum L.	1	2	2	3	3	-	4	5	2
T. vesiculosum Savi.	1	3	1	3	3	+	4	4	3
Turgenia latifolia (L.) Hoffm.	2	4	4	3	4	-	4	4	3
Typha angustifolia L.	5	4	3	3	5	+	4	4	3
T. latifolia L.	5	3	4	3	5	-	4	4	3
T. laxmannii Lepech.	5	3	3	3	5	-	4	4	3
Typhoides arundinacea (L.) Mnch.	5	3	4	3	4	-	3	4	3
Valerianella locusta (L.) Betcke	3	3	4	3	4	-	4	4	2
Ventenata dubia (Leers.) F. Schultz	1	3	2	2	3	-	3	5	3
Verbascum blattaria L.	2	4	4	3	3	+	4	5	3
V. phoeniceum L.	1	4	3	3	3	-	4	5	3
Verbena officinalis L.	3	3	4	3	5	-	4	4	3
Veronica anagallis-aquatica L.	5	3	4	4	5	-	4	4	3
V. anagallis-aquatica L. f. *angustifolia* Krösche									
V. anagalloides Guss.	5	3	4	4	5	-	4	5	2
V. arvensis L.	3	3	4	3	4	-	3	4	4
V. prostrata L.	2	3	3	3	3	-	4	4	5
Vicia angustifolia L.	2	3	3	3	4	-	4	5	4
V. hirsuta (L.) S.F. Gray.	2	3	2	3	4	-	4	3	3
V. striata M. Bieberst.	2	4	3	3	3	-	3	5	3
Viola arvensis Murr.	3	3	3	3	3	-	3	3	3
Vulpia myuros (L.) Gmel.	1	2	3	2	3	-	4	5	3
Xanthium italicum Moretti	3	3	5	3	2	+	4	5	3
X. spinosum L.	1	3	4	3	3	-	4	5	4

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Pollen size and viability in hybrid swarm populations of *Pinus mugo* Turra and *Pinus sylvestris* L.

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Abstract: Pollen size and viability in two hybrid swarm populations of *Pinus mugo* and *P. sylvestris* were evaluated using microscopic approach and in vitro germination test. Pollen size of the hybrid swarms was shown to be reduced in comparison with the pollen size of the adjoining control populations of *P. mugo* and *P. sylvestris*. The differences in pollen germination percentage of hybrid swarms at Habovka and Suchá Hora and control population of *P. mugo* at Roháče have not reached the level of statistical significancy. Statistically significant were only differences in pollen tube length. Hybrid swarms exhibited reduced pollen tubes of 15 % and 31 % in comparison with control populations. This indicate reduced vitality of pollen in hybrid swarms. The conclusion has been drawn postulating partial rather than complete sterility of the hybrid swarms.

Keywords: *Pinus mugo*, *P. sylvestris*, hybrid swarms, pollen, size, viability.

Introduction

The two subgenera of the genus *Pinus* seem to be genetically differentiated not only with respect to species crossability but also with regard to fertility of their interspecific hybrids. The soft pines (subgenus *Haploxylon* and/or *Strobus*) are very prone to hybridize mutually with embryo inviability acting as the principal reproductive barrier between species (KRIEBEL 1972). On the contrary, the hard pines (subgenus *Diploxylon* and/or *Pinus*) are much more differentiated genetically involving gametophytic incompatibility as a powerful mechanism of reproductive isolation between species (BUCHHOLZ 1944, MCWILLIAM 1959). The consequence of a higher hybridological afinity among soft pines is a higher degree of fertility of their interspecific hybrids than in the hard pines. SAX (1960) has reported of 11 % of pollen sterility in *P. griffithii* × *P. strobus* and of 30 % of sterile pollen in *P. parviflora* × *P. strobus* hybrids of the soft pines as compared with the 40-50 % share of sterile pollen in the hard pine hybrids of *P. contorta* × *P. banksiana*. We have also found considerable reduction of pollen viability in the two hybrid swarm populations of *P. mugo* and *P. sylvestris* in northern Slovakia reaching the level of 40-41 % of sterile pollen (KORMUŤÁK et al. 2007).

In continuation with these experiments the study on pollen viability has been undertaken involving both pollen size and pollen germinability parameters in some other populations of the hybrid swarms and of *P. mugo* species in the region. The objective of the study was to validate the conclusions about reduced pollen viability in the hybrid swarms on broader experimental and geographical bases. This aspect of *P. mugo* and *P. sylvestris* hybrid swarm populations has until now been neglected, the attention being preferentially oriented towards morphometric and anatomic traits of the needles (BUSINSKY 1998, BORATYŃSKA et al. 2003).

Materials and methods

Material

The study on pollen viability has included the hybrid swarm populations of Scots pine (*Pinus sylvestris* L.) and Swiss pine (*P. mugo* Turra) at Habovka and Suchá Hora in the western part of the High Tatras. The population of *P. mugo* at Roháče adjoining the hybrid swarm at Habovka was used as a control. The location of individual populations is given in Tab. 1. The pollen samples of 30 trees of *P. mugo* at Roháče, 15 trees of putative hybrids at Habovka and 27 trees of putative hybrids at Suchá Hora were collected in spring 2007. Mature microstrobili of individual trees were harvested shortly before shedding of pollen and then transferred to the laboratory. Pollen was extracted from desiccated microstrobili by sieving. The dry pollen was stored in a desiccator over silica gel at 4℃ for the period of 3 weeks and than used in germination test.

Tab. 1. Species and populations used in the experiment

Species/Hybrids	Locality	Altitude	Latitude	Longitude	Collect. year
P. sylvestris	O.Biely Potok	644 m	49°17'12"	19°33'18"	2006
P. mugo	Štrbské Pleso	1355 m	49°07'10"	20°03'41"	2006
Hybrid swarm	Habovka	815 m	49°16'25"	19°37'14"	2006
P.mugo	Roháče	1562-1720 m	49°12'27"	19°44'30"	2007
Hybrid swarm	Habovka	815 m	49°16'25"	19°37'14"	2007
Hybrid swarm	Suchá Hora	765 m	49°23'20"	19°47'11"	2007

In vitro germination

Pollen germination was tested at 25°C on medium consisting of 1.5 % agar and 10 % sucrose. Each sample was triplicated. After 48 h the number of germinating pollen was recorded from a sample of 100 pollen grains, whereas the pollen tube length in a sample of 30 pollen grains of each Petri dish.

Pollen size measurement

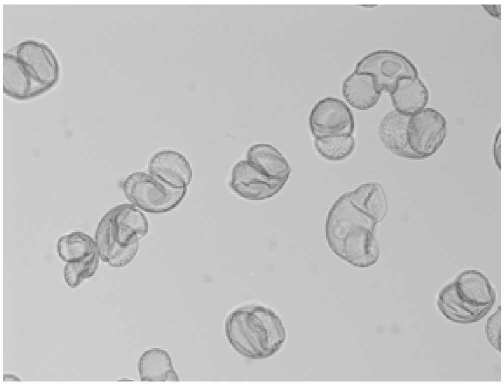
In study on pollen size variation a 1-year stored pollen was used following its acetolysis in a mixture of acetic acid and sulphuric acid (ERDTMAN 1943). Study involved the pollen samples which originated from 12 trees of each the hybrid swarm population at Habovka, *P.mugo* population at Štrbské Pleso in the central part of the High Tatras and *P. sylvestris* population at Oravský Biely Potok adjoining the hybrid swarm at Habovka (Tab. 1). The measurement of the pollen corpus breadth and height was done microscopically using 50 pollen grains of each tree (Fig. 1).

Statistics

The differences in pollen size and in pollen tube length and germination percentage between localities and trees were tested by nested ANOVA. Because the percentages were bimodally distributed, the germination data were stransformed using the arcsin transformation ($p' = \arcsin \sqrt{p}$). All calculations were done using the GLM procedure of SAS (SAS 1988).

Results

Comparative study on pollen size revealed substantial differences between *P. sylvestris* and *P. mugo* species. *P. mugo* pollen was shown to be larger than pollen grains of *P. sylvestris* (Tab. 2) but the hybrid swarm population at Habovka possesses the smallest pollen grains approaching in this respect *P. sylvestris* rather than *P. mugo.* No differences between *P. sylvestris* and *P. mugo* were found in the pollen corpus breadth/height ratio both species sharing the same ratios. Having little lowered ratio the hybrid swarm at Habovka has however deviated from the parental species in this parameter.



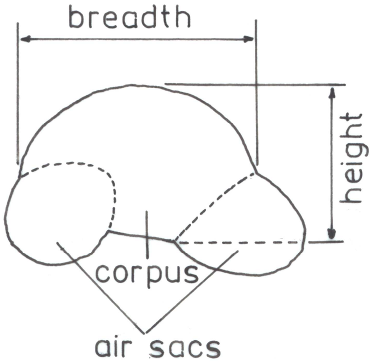


Fig. 1. Acetolysed pollen grains of *P. mugo* (left) and schematic drawing of pollen grain with traits measured (right).

It follows from Tab. 3 that differences between investigated populations were statistically significant with regard to the pollen corpus breadth (F 7.02**). The same was true of the pollen corpus height parameter (F 5.07*). On the contrary, the differences in the pollen corpus breadth/pollen corpus height ratio between individual populations have not reached the level of statistical significancy (F 1.55). It is worth of mentioning in this connection that all the three pollen size parameters investigated differed significantly between individual trees of the respective populations indicating profound individual variation in pollen size (Tab. 3).

Tab. 2. Pollen size in hybrid swarm at Habovka and in populations of parental species

Species/Hybrid	N	Pollen corpus breadth (μm) Mean ± SD	Pollen corpus height (μm) Mean ± SD	Breadth/height ratio
P. sylvestris	600	43.58 ± 3.91	33.75 ± 3.84	1.30 ± 0.14
Hybrid swarm	600	42.42 ± 4.23	33.41 ± 4.02	1.28 ± 0.15
P. mugo	600	45.47 ± 4.83	35.21 ± 4.52	1.30 ± 0.14

Tab. 3. Variance analysis of pollen corpus breadth in hybrid swarm at Habovka and in parental species

Source	D. f.	Sum of squares	Mean square	F value	Variance component [%]
Populations	2	2844.0	375278.0	7.02**	21.0
Individuals	33	6681.3	32499.2	13.12***	33.8
Error	1764	27222.4	400.1		39.9

Pollen viability tests has been preceded by a study on sucrose concentration effect in cultivation media. Among five concentrations tested the 10 % content of sucrose was found to be optimal for in vitro germination of *P. mugo* pollen (Tab. 4).

Tab. 4. Effect of sucrose concentration in cultivation medium on germination of *P. mugo* pollen (The pooled data from two trees)

Sucrose conc. [%]	N	Germination [%] Mean ± SD	N	Pollen tube length [μm] Mean ± SD
3	600	84.16 ± 1.60	180	81.51 ± 23.58
5	600	84.33 ± 2.87	180	87.71 ± 22.25
10	600	92.00 ± 1.09	180	99.51 ± 26.13
13	600	82.16 ± 2.31	180	76.92 ± 27.11
15	600	79.00 ± 9.38	180	71.08 ± 17.84

N – sample size referring to germination percentage (600) and to pollen tube length (180)

As far as pollen viability of hybrid swarm populations at Habovka and Suchá Hora is concerned both populations were shown to produce less viable pollen than control population of *P. mugo* at Roháče. The total amount of 62.24 % and 67.21 % of germinating pollen in hybrid swarms represents reduction of pollen viability of 5 % in the hybrid population at Suchá Hora and of 12 % at Habovka in comparison with the pollen germinability in *P. mugo* (Tab. 5). In spite of these differences the variance analysis confirmed statistical significancy of the differences at the individual level only (Tab. 6). The reduction of pollen germination potential in hybrid swarms has been paralleled by slowered pollen tube growth as evidenced by the average pollen tube length of 67.79 μm in hybrid swarm population at Habovka and of 55.44 μm length at Suchá Hora. The corresponding value in *P. mugo* population averaged at 80.41 μm deviating profoundly from the hybrid swarms (Tab. 7).

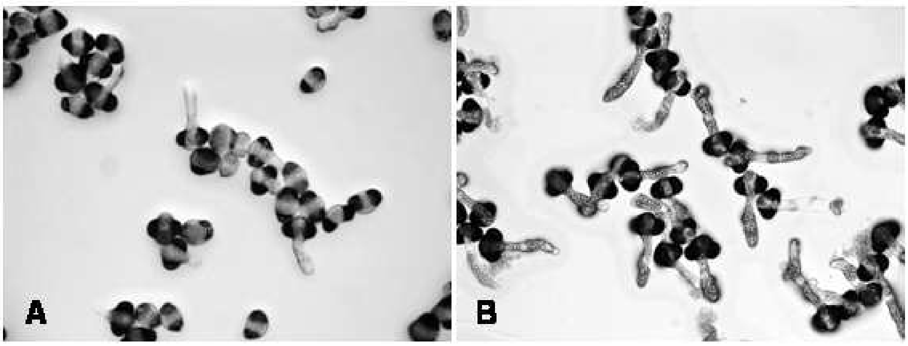


Fig. 2. Germinating pollen of hybrid swarm at Suchá Hora (A) and *P. mugo* at Roháče (B)

Tab. 5. Pollen viability parameters in hybrid swarms and in *P. mugo*

Species/Hybrids	Locality	Germination [%]		Pollen tube length (μm)	
		N	Mean ± SD	N	Mean ± SD
P. mugo	Roháče	88	70.46 ± 17.96	2640	80.41 ± 27.78
Hybrid swarm	Habovka	45	62.24 ± 23.66	1350	67.79 ± 36.93
Hybrid swarm	Suchá Hora	84	67.21 ± 17.41	2520	55.44 ± 19.65

Tab. 6. Variance analysis of pollen germinability in hybrid swarms and in *P. mugo* population

Source	D.f.	Sum of squares	Mean square	F value
Populations	2	0.25999945	0.12999972	1.47
Individuals	13	1.15153096	0.08857930	34.37***
Repetitions	116	0.29898530	0.00257746	0.9534
Error	28	0.11460826	0.00409315	
Corr. total	216	9.87887122		

Tab. 7. Variance analysis of pollen tube length in hybrid swarms and in *P. mugo* population

Source	D.f.	Sum of squares	Mean square	F value	Variance component [%]
Populations	2	750556.0	375278.0	11.55***	21.0
Individuals	70	2274950.5	32499.2	81.22***	33.8
Error	6437	2575673.7	400.1		39.9
Corr. total	6509	5601180.2			

Discussion

Among the aspects related to pollen viability in *P. sylvestris* and *P. mugo*, the studies aiming at optimizing cultivation media composition (CHIRA 1964), long-term storage of pollen (CHIRA 1971, OSTROLUCKÁ et al. 2003) and pollen viability variation at different stands in Slovakia (OSTROLUCKÁ et al. 1995) should be mentioned. Several studies have also appeared referring to pollen abortion and viability variation due to air pollution (FEDOTOV et al. 1983, FEDORKOV 1995, MIČIETA & MURIN 1998). Comparison of our experimental data with those published by other authors revealed some discrepancies which concern both characteristics studied, i. e. pollen size and pollen viability. CHIRA (1971) has for example reported of the non-acetolysed pollen corpus breadth ranging between 62.7 µm and 85.8 µm in *P. sylvestris* and between 62.7 µm and 75.9 µm in *P. mugo.* Taking into account relatively strong genetic control of this characteristic of the pollen, the observed discrepancy may be due to acetolysis treatment leading to destruction of the internal content of the pollen grains and to subsequent shrinking of the pollen corpus size. Obvious seem only the reasons of reduced pollen size in hybrid swarm populations which may be ascribed to the disturbed microsporogenesis in the swarms. It was shown in our previous study that increased frequency of meiotic disturbances occurring in hybrid swarm population at Habovka during anaphases I and II has resulted in a high frequency occurrence of aborted tetrads and aborted pollen grains leading to profound decline of pollen viability in 2005 and 2006 harvests (KORMUŤÁK et al. 2007). The same applies also for the 2007 harvest when the pollen germinability parameters of the hybrid swarms at Habovka and Suchá Hora have not reached the level of those ascertained in control population of *P. mugo* at Roháče. Especially it is true of the pollen tube length characteristics which may be taken as a convincing evidence of the lowered vitality of the hybrid swarms pollen.

Though statistically non-significant but optically conspicuous differences in germination percentage between hybrid swarms and control population of *P. mugo* may be ascribed to the detrimental effect of climatic conditions on microsporogenesis at high elevation of the locality Roháče (Tab. 1). A low amount of functional pollen under high mountain conditions is suggested to be very common (STERN & ROCHE 1974). In case of *P. mugo* population this amount has averaged at 70.46 % which is much lesser than pollen germinability observed at the localities Štrbské Pleso and Popradské Pleso which are located at lower elevations and where pollen germinability averaged during 2005-2006 at 82.83 % and 78.38 % respectively (KORMUŤÁK et al. 2007). It is worth of mentioning that CHIRA (1971) has reported of 60 % germinability of freshly collected pollen of *P. mugo* whose origin has not however been given. Using pollen samples from 7 localities of the High Tatras OSTROLUCKA & FLEISHER (1995) have illustrated both annual and site variations in germinability of *P. mugo* with germination percentage ranging between 48 % and 76 % and pollen tube length averaging at 82-123 µm. Profound effect of climatic conditions on the course of microsporogenesis in forest trees and resulting annual variation in quality of mature pollen seem to be a reasonable explanation of the outlined differences in pollen viability of *P. mugo* at Štrbské Pleso and Popradské Pleso as well. According to degree of sterility STEBBINS (1950) divided interspecific hybrids of plants into two groups. The first group is represented by the hybrids capable of producing some viable pollen and seed set through selfing, intercrossing between F_1 individuals or backcrossing to the parental species. The second group involves the hybrids which are completely sterile. Presented experimental data provided evidence of partial rather than complete sterility of the hybrid swarm population of *P. mugo* and *P. sylvestris*. This may be taken as an additional support for the conclusion of SAYLOR & SMITH (1966) about partially reduced reproductive capacity of the interspecific hybrids of hard pines.

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Book reviews

W. FREY & R. LÖSCH: Lehrbuch der Geobotanik. Pflanze und Vegetation in Raum und Zeit.2. Auflage [Handbook of geobotany. Plants and vegetation in space and time].

Springer/Spektrum Akademischer Verlag, Tiergartenstrasse 17, 69121 Heidelberg, Germany; 2004, XIV, 528 S., Geb., ISBN: 978-3-8274-1193-8, Price: $59.95.
http://www.springer.com/spektrum+akademischer+verlag/

The authors succeeded in creating the very actual and comprehensive textbook for students of geobotany. This second edition follows the last one in modern representation and it was fulfilled with some new, actual and, at the present time, necessary information for a geobotanist from parallel botanical disciplines. The textbook is well arranged and richly structured by its text, graphs, pictures, tables and schemes. The contents of teaching are divided into 10 chapters with other subchapters. After the first two introductory chapters, the third chapter Floristics and Areals presents floritic areals, cosmopolitanism and endemism, floristic geoelements, areal types, floristic structure of the Earth, biodiversity, species richness, phytogeographical areas and phytogeographical regions. The fourth chapter deals with geobotany itself, structure of communities, syntaxonomy, multivariable methods in phytocoenology, syntaxonomy and syndynamics. In the fifth chapter, the historical geobotany is discussed. The most space is devoted to plant ecology in the sixth chapter – from abiotic environmental conditions through autecology and ecological physiology, competitive relations to ecosystems and their modeling. In the seventh chapter, the ecological bases for populations and communities and reproductive ecology are presented. The eighth chapter deals with adaptations and strategies of living. The ninth chapter describes the individual vegetation zones and biomes in the Earth. The influence of human activities to biotopes, their conservation, risk to species and ecosystems are discussed in the tenth chapter. The textbook has a very rich list of literature, well arranged and informative graphs, schemes, tables and figures. At the beginning, there are explanatory notes to abbreviations, symbols and mathematical constants. At the end of the book, a comprendious alphabetical dictionary of terms helps to use the textbook more quickly and easily.

I can recommend this textbook to university students, teachers, employers in nature protection, in state administration and self-administration dealing with environmental problems, foresters, farmers and to everyone which is interested in vegetation and its conservation. It should not be missing in any library of educative institutions and environmental organizations.

S. MOCHNACKÝ

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Professor VIRA V. PROTOPOPOVA – 75 Anniversary

In 2008 East European scientific society celebrates a jubilee of famous Ukrainian botanist Prof. VIRA V. PROTOPOPOVA, laureate of M.G. Kholodny Prize of National Academy of Sciences of Ukraine, Honorary member of Ukrainian Botanical Society and head scientist researcher at the M.G. Kholodny Institute of Botany, NAS of Ukraine. She is well known as specialist in floristics, plant geography and systematics. In Ukrainian botany the name of V.V. Protopopova is mainly associated with the scientific field of synanthropic flora, including such phenomenon as invasions of alien species. She is well known specialist in orchids and ferns systematic as well.

VIRA V. PROTOPOPOVA was born on 2 March 1933 in Kharkiv. Her father, Prof. Dr. VIKTOR P. PROTOPOPOV, was a famous scientist, teacher and organizer of medicine science, academician of Ukrainian Academy of Sciences, head of department of psychophysiology at the Institute of physiology Academy of Sciences of Ukraine, mother, RYMMA V. SOBOLEVSKA, was a practical doctor.

V. PROTOPOPOVA begins her education in Kharkiv's school in 1941, and finished in Kiev's school in 1952. In this year, she entered the Taras Shevchenko State University and specialized in botany. Among her teachers were famous pedagogues and scientists, botanists, academicians DMYTRO K. ZEROV and OLEKSANDER V. TOPACHEVSKY, professors OLEXIY L. LYPA, associate professor PETRO M. BEREGOVYI, etc. During early students years VIRA PROTOPOPOVA starts to take part in scientific investigations, and prepared interesting works on systematic of *Lamiaceae* in Kaniv state reserve (Cherkasy Region), flora of Martyan Cape (the Crimea), and flora of Rzhyschev forest (Kyiv Region). In 1958 she finished the university with diploma on speciality „biology".

In 1956-1958, VIRA V. PROTOPOPOVA worked at the Academician O.V. Fomin Botanical Garden of Taras Shevchenko State University. Since 1958 VIRA V. PROTOPOPOVA has worked in department of systematics and floristics of vascular plants of M.G. Kholodny Institute of Botany, Academy of Sciences of Ukraine: as assistant (1958-1961), post-graduate (1961-1964), junior scientific researcher (1964-1974), senior scientific researches (1974-1992), and head scientific researcher (1992- until now).

In 1966, under supervising Prof. MYKHAYLO I. KOTOV, VIRA V. PROTOPOPOVA prepared and defenced her PhD degree work (candidate of biological sciences), with further publishing original monograph on this base („Alien plants of Forest-Steppe and Steppe of Ukraine ", 1973). Later, in 1989, V. V. PROTOPOPOVA defenced DrSc work (doctor of biological sciences), with publishing another monograph as well („Synanthropic flora of Ukraine and ways of its development", 1991). In 1996, these monographs together with numerous papers under generalized title „Theoretical and practical aspects of natural differentiation and synanthropization of spontaneous flora of Ukraine" were awarded with M.G. Kholodny Prize of National Academy of Science of Ukraine.

We are to elucidate the main results obtained by Prof. V. V. PROTOPOPOVA now. She was pioneered in exploring of composition of synanthropic flora in Ukraine, defining its general and regional features, distribution of the main groups of synanthropic species. It is offered and proved a hypothesis of threshold of a species diversity of synanthropic floras with working out the index for estimation of ecological condition in different regions. Prof. V. V. PROTOPOPOVA also analyzed 150-year history of adventization of Ukrainian flora and estimated factors and revealed reasons of alien plants area dynamics in Ukraine. All this serves as a basis for putting into practice scientific forecast of synanthropization of regional florae depending on environmental changes. In addition, the general directions of synanthropization and adventization of Ukrainian flora are determined, and ecological and floristic classification of alien plants is developed. It is offered original hypothesis on origin of some local endemics from archaeophytes, which opened new aspect in research of local endemism in anthropogenic transformed territory. She assumed that evolution of alien plants within the limits of secondary areas occured through hybridization and allopolyploidisation with the subsequent differentiation of sympatric and marginal races.

Prof. VIRA V. PROTOPOPOVA prepared detail, critical and systematic investigations of many taxa of natural and alien fractions of Ukrainian flora, such as Lycopodiophyta, Equisetophyta, Polypodiophyta, *Orchidaceae*, *Amaranthaceae*, *Chenopodiaceae*, *Oxalidaceae*, some group of *Asteraceae* (*Bidens* L., *Galinsoga*, *Helianthus*, *Xanthium*, etc.). The results obtained were included in many Manuals and Floras, such as «Manual of plants of Ukraine» (1965), «Weeds of Ukraine» (1970), «Manual of plants of Ukrainian Carpathians» (1974), «Red Data Book of Ukraine» (1980, 1996), «Flora of European part of the USSR» (vol. 2 – 1976; vol. 4 – 1979; vol. 5 –1981), «Flora of Eastern Europe» (vol. 7 – 1994), «Manual of higher plants of Ukraine» (1987), «Chorology of Ukraine» (1987), «Ecoflora of Ukraine» (2002). and Prof. V.V. Protopopova is authors and co-authors more than 200 publications in many scientific journals, such as Ukrainian Botanical journal, Botanical journal, Biological sciences (Russia), Acta Botanica Slovaca, Thaiszia (Slovak Republic), Euphytica (USA), etc.

During her teacher's career Prof. VIRA V. PROTOPOPOVA supervised 3 dissertations of post-graduates: Drs. IRYNA A. TYMCHENKO ("Structure of population of species of tribe *Neottieae* Lindl. (*Orchidaceae*) Ukrainian flora and its tendencies of changes in condition of synanthropization", 1996), TETYANA V. VASYLYEVA-NEMERTSALOVA („Synanthropic flora of near port towns of North-Western of Black Sea area", 1996), and IRYNA V. KOVTUN („Flora of Kamyanets Cis-Dnister", 2004); last years she was a professor at Pereyaslav-Khmelnytsky state pedagogical university.

Special interest of VIRA V. PROTOPOPOVA connected with a popularization of botanical knowledge. Together with her colleagues TETYANA L. ANDRIYENKO, BORYS V. ZAVERUKHA, SVITLANA S. MOROZYUK, LIDIYA S. PANOVA she prepared many interesting, substantial, and poetic works: „Botanical album" (1979), „Protected plants of Ukraine" (1983), „Steppe plants" (1983), „Plants-travellers" (1989), „Herbaceous plants" (1986), „Spring plants" (1987), „Herbaceous plants of Ukraine" (2007), „Spring plants of Ukraine" (2007). These educational books got a wide public acknowledgement.

During a long time Prof. VIRA V. PROTOPOPOVA was a member of Botanical division of National Commission on Red Data Book of Ukraine, member of editorial board of Ukrainian Botanical journal, member of Qualification Council of DrSc degree at M.G. Kholodny Institute of Botany, NAS of Ukraine, Head of section of history of sciences of Ukrainian Botanical Society, and now she is a member of Qualification Council of DrSc degree at M.M. Gryshko National Botanical Garden of NAS of Ukraine.

Colleagues also known VIRA V. PROTOPOPOVA as charming woman, with wide open soul and heart full of love to people.

Botanists, colleagues, and friends congratulate VIRA V. PROTOPOPOVA with 75 jubilee. Long live, Dear Professor!

K. ROSTAŃSKI, A. TERPO, S. MOCHNACKY,
M. SHEVERA, A. ILYINSKA, I. TYMCHENKO, A. YENA

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