

# SCIRPUS GEORGIANUS HARPER – A NEW SPECIES IN SLOVENIAN FLORA AND CHARACTER SPECIES OF THE ASSOCIATION *DACTYLORHIZO MAJALIS- SCIRPETUM GEORGIANI* ASS. NOVA

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## Abstract

*Scirpus georgianus* Harper, a species, native of North America and new to Slovenia, was found in the Krakovo forest (near Kostanjevica, Malence and Virgin forest reserve); moreover, a new community *Dactylorhizo majalis-Scirpetum georgiani* ass. nova was described after close examination of stands. The characteristic inflorescence clearly distinguishes the mentioned species from the other two of the genus *Scirpus* L., section *Scirpus* (*S. sylvaticus* L. and *S. radicans* Schkuhr); new key for genus *Scirpus* L. was also made. The studied species thrives in wet meadows, where it sometimes builds larger stands, as well as in gaps in swamps where there is still enough light. On the basis of specific ecological conditions of sites and multivariate analyses, the mentioned stands were classified into a new community, which was given the name *Dactylorhizo majalis-Scirpetum georgiani*. The mentioned community thrives on drier sites than the community *Scirpetum sylvatici* Rački 1931, which is similar to it.

## Izveček

Na območju Krakovskega gozda (v bližini Kostanjevice, Malenc, krakovskega pragozda) smo našli za Slovenijo novo vrsto *Scirpus georgianus* Harper, ki izhaja iz Severne Amerike; po preučitvi sestojev pa smo opisali tudi novo združbo *Dactylorhizo majalis-Scirpetum georgiani* ass. nova. Od ostalih dveh vrst iz rodu *Scirpus* L., sekcije *Scirpus* (*S. sylvaticus* L. in *S. radicans* Schkuhr), se vrsta na prvi pogled loči po značilnem socvetju; izdelan je bil tudi nov ključ za rod *Scirpus* L. Vrsta uspeva na mokrotnih travnikih, kjer ponekod gradi večje sestoje in na presvetlitvah v močvirnih gozdovih. Na podlagi specifičnosti ekoloških razmer rastišč in multivariatnih analiz smo te sestoje uvrstili v svojo združbo, ki smo jo poimenovali *Dactylorhizo majalis-Scirpetum georgiani*. Ta združba uspeva na bolj suhih rastiščih kot podobna združba *Scirpetum sylvatici* Rački 1931.

**Key words:** *Dactylorhizo majalis-Scirpetum georgiani*, *Scirpus*, phytosociology, flora, ecology, wet meadows, Slovenia

**Ključne besede:** *Dactylorhizo majalis-Scirpetum georgiani*, *Scirpus*, fitocenologija, flora, ekologija, mokrotni travniki, Slovenija

## 1. INTRODUCTION

On the basis of intensive investigation of vegetation in south-eastern Slovenia in the last decade, several works have been published so far. Forest vegetation, especially distribution and characteristics of forest communities (Marinček & al. 2003a, b), virgin forests (Marinček & Marinšek 2003), individual forest communities (Košir & Marinček 1999), willow stands (Šilc 2003), riparian and tall forb vegetation (Čarni 1995), weed vegetation (Šilc 2003) and wet grasslands (Seliškar 1993; Zelnik 2003) have all been studied in the mentioned region.

The investigation of wet meadows was also stimulated by a demarcation-line between the alliances *Molinion* and *Deschampsion*, which was established by Horvatić (1939). Later on, these topics, namely distribution and ecology of communities in wet meadows, became the scope of our further detailed investigation (Zelnik 2003).

During the research work in glades of the south-western part of the Krakovo forest the species *Scirpus georgianus* Harper – new to Slovenian flora – was found. In Slovenia two species of the genus *Scirpus* L. s. str. have been known so far (Martinčič & al. 1999), the widespread species *S. sylvaticus* L. and

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also *S. radicans* Schkuhr. Our attention was drawn by inflorescences, different from the ones of wood club rush; moreover proliferating spikelets were found later on as well; therefore the fact of having to deal with the species *Scirpus sylvaticus* L. started to be seriously dubious. After the specimens had been analysed, consulting several determination keys enabled us to discover that it was actually *Scirpus georgianus* (Zelnik 2002).

Consequently the relevés were classified into its own community, namely *Dactylorhiza majalis-Scirpetum georgiani* ass. nova on the basis of characteristics concerning ecological site-conditions, multivariate analyses and its unique physiognomy.

### 1.1 Distribution and taxonomic problems

The species is native of North America, where 15 other species, including the closely related *S. atrovirens* Willd., of the genus *Scirpus* L., section *Scirpus* thrive as well. It is spread over natural and human-disturbed wetlands (wet meadows, marshes, edges of lakes and ponds, draining-ditches) from Texas to Georgia in the south to the Great Lakes and Newfoundland in the north. (Whittemore & Schuyler 2002)

This species is similar to wood club-rush (*Scirpus sylvaticus*) (Fig. 4), nevertheless it has a typical inflorescence (Fig. 2 & 3) which differentiates it at a glance from the other two species *S. sylvaticus* L. and *S. radicans* Schkuhr, because 4-35 spikelets (largest at least 16) (Whittemore & Schuyler 2002) form head-shaped fascicles, which are at the apices of ultimate rays of different length, jutting out in all directions, or else fascicles of spikelets are aggregated, in mostly head-shaped clusters. Mature spikelets are brownish red, brown, greenish brown or blackish brown (Kiffe 1998), while those of wood club-rush are blackish green; they often proliferate in bulblets (Fig. 3). In order to be distinguished from the most similar, closely-related and sometimes misidentified and/or mixed up with species *S. atrovirens* Willd.; Kiffe (1998) states that there are not only differences in leaf-structure, but also major differences in the number of perianth-bristles and size of spikelets and nuts. *S. georgianus* is mostly completely lacking in perianth-bristles, in some cases 1-3 bristles, shorter than the nut are found, which can rarely reach  $\frac{3}{4}$  of length of a nut; nut (0.6-)0.8-1.1 mm long (Kiffe 1998, Whittemore & Schuyler 2002). When examining *S. atrovirens* six perianth-bristles are found as a rule, which are

shorter or slightly longer than nuts, the length of which is (0.8-)1-1.3 mm (Kiffe 1998, Whittemore & Schuyler 2002). Spikelets and glumes (scales) of this species are a bit longer.

About the distribution of the studied species, some troubles occur due to taxonomic problems and equalling the species *S. georgianus* with *S. atrovirens*. The naturalized taxon with the name *S. atrovirens pallidus* Britton was mentioned as early as 1903 in northern France (Fournier 1990). The species, named *S. atrovirens* Willd. is frequently mentioned as being occasional in Central Europe as well as in northern France and possibly naturalized (DeFilipps 1980, Lambinon & al. 1992), where it thrives in tractions of damp forests (swamps). The species with the mentioned name is stated as being rare in Germany (Oberdorfer 1994) as well as in north-western Italy (Pignatti 1982). However, this taxon has not been recorded yet in Croatia, Austria and Switzerland. For Germany, Kiffe (1998) mentioned the species *Scirpus georgianus* Harper, but not *S. atrovirens*; or other synonyms (e.g. *S. atrovirens* var. *georgianus* (Harper) Fernald, *Scirpus atrovirens* auct. non Willd. s. str.). On the basis of taxonomic revision of the genus *Scirpus* s. str. in North America, Schuyler (1967) had already stated that there are two distinctly separated species: *S. atrovirens* and *S. georgianus*. At the same time Kiffe (1998) states that it is not yet clear whether *S. atrovirens* has ever been found in Germany, that is to say in Central Europe; it might have been *S. georgianus* in all cases.

The thriving of *S. atrovirens* has not yet been recorded in Slovenia, so this problem has not appeared here. The studied species was probably introduced by members of the North American Mycological Association, who visited the Krakovo virgin forest reserve in the 1980's.

## 2. MATERIALS AND METHODS

### 2.1 Area of research

The swampy area of the Krakovo forest is covered with grey and light brown clays. At Kostanjevica, the thickness of clay is 2.5 m; those layers are supposed to belong to the last glacial period (Würm). Within paludal sediments, there are thinner layers of light soil, which alternate with clayey and organogenic marshy sediments (Pleničar & Premru 1977).

Various soil types have developed on this ground and all of them are more or less hydromorphic,

variously manifested amphigleys, hypogley and riverine soil (Zupan 1996). Here, soil moisture is increased not only by a high level of ground water, but also by rain water which is perched in upper horizons because of the almost impermeable layers. During the periods of abundant precipitations special conditions are therefore created, namely waterlogged or even inundated soil. Dystric and gleyic soil, which is acid, nutrient-poor and waterlogged during the period of abundant precipitations especially in spring, is predominant in this area.

The climate of the Krško basin is classified into a type of temperate continental climate of eastern Slovenia, namely a Pannonian climate (Ogrin 1996). Average April temperatures are higher than October ones or the same, average annual rainfall being from 800 to 1000 mm, as is characteristic of this climate type. The Krško basin belongs to the area of transit to the Pannonian climate, the influence of which is diminishing westwards (Gams 1962). The average annual rainfall in Kostanjevica, which is situated on the southern edge of the Krakovo forest, is 1169 mm and 1083 mm in Smednik (Zupančič 1996), situated on its northern edge.

The Krško basin is classified into the Subpannonian phytogeographical area (Wraber 1969). According to phytogeographical classification by Zupančič & al. (1987), this area is classified into the Krško-Bizeljsko district of Pannonian subsector, west Dinaric sector and into the Illyrian flora province.

The studied species *Scirpus georgianus* thrives on forest edges and in gaps in swamps and damp woods of the following communities: *Pseudostellario europaeae-Carpinetum betuli*, *Pseudostellario europaeae-Quercetum roboris*, *Carici elongatae-Alnetum glutinosae*, *Carici brizoides-Alnetum glutinosae*. Distribution of the above listed forest communities is presented in Marinček & al. (2003a).

## 2.2 Methods

Vegetation was sampled and elaborated according to the standard central European method (Braun-Blanquet 1964; Westhoff & van der Maarel 1973). Vegetation relevés were made in 2001 and 2002, in June, when vegetation was optimally developed. The size of plots varies from 8 to 32 m<sup>2</sup> and adjusts to the microrelief. The criterion for the choice of a plot was homogeneity of vegetation.

Only combined cover and abundance values are indicated in the table. Cover-abundance values

were transformed according to van der Maarel (1979). Numerical analyses of relevés were carried out using the computer program SYN-TAX (Podani 2001); the hierarchic classification method (Complete Linkage Clustering) was performed. The dissimilarity of relevés was measured by the Similarity ratio complement.

Nomenclature of ferns and flowering plants follows Martinčič & al. (1999), with the exception of *Scirpus georgianus* Harper, which is in accordance with Schuyler (1967), Kiffe (1998), Whitemore & Schuyler (2002). Plant taxa were classified into syntaxa, taking into consideration the synthesis works of Mucina & al. (1993) and Oberdorfer (1994). The classification of individual syntaxa by the principle of increasing complexity follows Oberdorfer (1994). During the process of defining character species, principles suggested by Dierschke (1994) were taken into consideration. Nomenclature of the newly described association is in accordance with the code of Weber & al. (2000).

Apart from flora and vegetation, abiotic factors were examined as well. Representative soil samples were taken from chosen plots and analysed at the Centre for Soil and Environmental Sciences of the Biotechnical Faculty. In accordance with standard methods the following soil factors were measured: pH, content of plant-accessible potassium and phosphorus, content of organic matter and total nitrogen, C/N ratio, soil texture, content of exchangeable basic cations (Ca, Mg, K, Na), electric conductivity of soil.

After analysis and comparisons of several keys for genus *Scirpus* L., through the compilation of these a new one was made, which now enables the determination of all known species from this genus in Central Europe.

## 3. RESULTS AND DISCUSSION

### 3.1 *Dactylorhizo majalis-Scirpetum georgiani* ass. nova hoc loco (Tab. 1, holotypus Tab. 1/ 3)

Syntaxonomic scheme:

*Molinio-Arrhenatheretea* R.Tx. 1937 em. R.Tx. 1970

*Molinietales* Koch 1926

*Calthion* R.Tx 1937 em. Bal.-Tul. 1978

*Calthenion* R.Tx 1937 em. Bal.-Tul. 1978

*Dactylorhizo majalis-Scirpetum georgiani* ass. nova

**Table 1:** Analytical table of association *Dactylorhiza majalis-Scirpetum georgiani* ass. nova hoc loco  
**Tabela 1:** Analićna tabela asociacije *Dactylorhiza majalis-Scirpetum georgiani* ass. nova hoc loco

Relevé number	1	2	3	4	5			
Day	13	17	13	13	6			
Month	6	6	6	6	6			
Year (+ 2000)	01	02	01	01	01			
Altitude (m)	153	153	153	153	151	presence	frequency %	frequency class
Plot size (m <sup>2</sup> )	24	12	12	8	32			
coverage (%)	98	98	98	96	100			
<b>Character species of the association</b>								
Scirpus georgianus	5	5	5	5	4	5	100	V
Ca <b>Calthion</b>								
Lysimachia vulgaris	1	1	+	+	2	5	100	V
Dactylorhiza majalis	+	.	+	+	.	3	60	III
Senecio aquaticus agg.	1	.	+	.	+	3	60	III
Valeriana dioica	+	.	+	.	.	2	40	II
Myosotis scorpioides	+	.	.	.	.	1	20	I
Caltha palustris	.	.	+	.	.	1	20	I
Cirsium oleraceum	.	.	.	1	.	1	20	I
MO <b>Molinietalia</b>								
Gratiola officinalis	1	2	2	3	+	5	100	V
Betonica officinalis	+	+	+	1	3	5	100	V
Lythrum salicaria	+	1	+	+	+	5	100	V
Juncus conglomeratus	+	1	+	+	1	5	100	V
Juncus acutiflorus	+	2	1	+	.	4	80	IV
Juncus effusus	2	+	.	+	+	4	80	IV
Centaurea carniolica	.	.	+	+	+	3	60	III
Succisella inflexa	.	.	+	+	.	2	40	II
Stachys palustris	.	.	+	.	.	1	20	I
Ophioglossum vulgatum	.	.	.	+	.	1	20	I
Carex distans	.	.	.	+	.	1	20	I
Selinum carvifolia	.	.	.	.	1	1	20	I
Succisa pratensis	.	.	.	.	+	1	20	I
MA <b>Molinio-Arrhenatheretea</b>								
Plantago lanceolata	+	+	+	+	.	4	80	IV
Holcus lanatus	1	1	+	.	3	4	80	IV
Anthoxanthum odoratum	+	1	.	+	1	4	80	IV
Ajuga reptans	+	+	.	.	1	3	60	III
Ranunculus acris	+	.	+	+	.	3	60	III
Centaurea macroptilon	.	.	.	+	1	2	40	II
Leucanthemum ircutianum	.	.	.	+	2	2	40	II
Lotus corniculatus	.	.	.	+	+	2	40	II
Festuca pratensis	.	.	.	+	+	2	40	II
Trifolium pratense	.	.	.	+	+	2	40	II
Festuca rubra agg.	.	.	.	.	+	1	20	I
Centaurea jacea	.	.	.	.	+	1	20	I
PP <b>Potentillo-Polygonetalia</b>								
Ranunculus repens	+	1	+	+	+	5	100	V
Carex hirta	+	.	+	+	+	4	80	IV
Lysimachia nummularia	+	.	.	.	.	1	20	I
Mentha x verticillata	.	.	1	.	.	1	20	I
Potentilla reptans	.	.	.	1	.	1	20	I
AR <b>Arrhenatheretalia</b>								
Cynosurus cristatus	+	+	+	+	+	5	100	V

Relevé number	1	2	3	4	5			
<i>Prunella vulgaris</i>	+	.	+	+	1	4	80	IV
<i>Trifolium patens</i>	.	.	.	.	+	1	20	I
<i>Hypochaeris radicata</i>	.	.	.	.	+	1	20	I
<i>Rumex acetosa</i>	.	.	.	.	+	1	20	I
<b>SC Scheuchzerio-Caricetea fuscae</b>								
<i>Agrostis canina</i>	3	3	3	+	1	5	100	V
<i>Carex flava</i> agg.	+	+	+	+	+	5	100	V
<i>Juncus articulatus</i>	+	+	+	+	+	5	100	V
<i>Carex panicea</i>	+	1	+	+	+	5	100	V
<i>Ranunculus flammula</i>	+	1	1	.	.	3	60	III
<i>Taraxacum palustre</i>	+	+	+	.	.	3	60	III
<i>Orchis palustris</i>	.	.	+	+	.	2	40	II
<i>Veronica scutellata</i>	+	.	.	.	.	1	20	I
<i>Viola uliginosa</i>	.	.	+	.	.	1	20	I
<b>PM Phragmiti-Magnocaricetea</b>								
<i>Lycopus europaeus</i>	+	.	+	+	+	4	80	IV
<i>Galium palustre</i>	.	+	+	.	+	3	60	III
<i>Iris pseudacorus</i>	.	.	+	.	.	1	20	I
<b>CU Calluno-Ulicetea</b>								
<i>Potentilla erecta</i>	+	+	.	+	+	4	80	IV
<i>Carex pallescens</i>	.	+	+	.	+	3	60	III
<i>Carex leporina</i>	.	+	.	.	.	1	20	I
<i>Danthonia decumbens</i>	.	.	.	+	.	1	20	I
<i>Luzula campestris</i> agg.	.	.	.	.	+	1	20	I
<i>Nardus stricta</i>	.	.	.	.	+	1	20	I
<i>Briza media</i>	.	.	.	.	+	1	20	I
<b>O Other (ostale)</b>								
<i>Anemone nemorosa</i>	.	.	+	.	+	2	40	II
<i>Leucojum vernum</i>	.	.	+	.	.	1	20	I
<i>Erigeron annuus</i>	.	.	.	.	+	1	20	I
<i>Salix cinerea</i>	.	.	.	.	+	1	20	I
<i>Calystegia sepium</i>	.	.	.	.	+	1	20	I
<i>Populus tremula</i>	.	.	.	.	+	1	20	I
<i>Cirsium</i> sp.	.	.	.	.	+	1	20	I

**Localities of the relevés from Table 1:**

1: 0158/1 Krakovo virgin forest reserve; 2: 0158/1 Krakovo virgin forest reserve;  
 3: 0158/1 Krakovo virgin forest reserve; 4: 0158/1 Krakovo virgin forest reserve;  
 5: 0158/1 Malence, Robič.

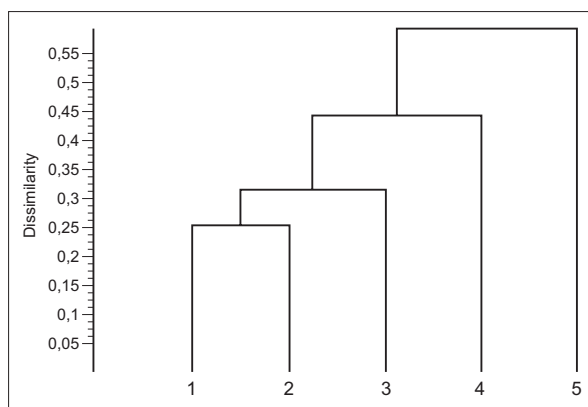
**Lokalitete popisov iz table 1:**

1: 0158/1 Pragozdni rezervat Krakovski g.; 2: 0158/1 Pragozdni rezervat Krakovski g.;  
 3: 0158/1 Pragozdni rezervat Krakovski g.; 4: 0158/1 Pragozdni rezervat Krakovski g.;  
 5: 0158/1 Malence, Robič.

As for *Scirpetum sylvatici* Raški 1931, so too this association is defined by its character species *Scirpus georgianus* (Tab. 1). This species is exclusively characteristic for the association if it appears as a dominant species and edifier of the association, the physiognomy of which makes it explicitly different from contact communities, besides the different soil conditions. Apart from the dominant species *Scirpus georgianus*, there are no other character species and, hence, some phytosociologists

may think that – like *Scirpetum sylvatici* – this association is not very well defined.

Despite different contact communities these stands are similar enough (Fig. 1) to be defined as specific association. They are distinguished from the contact communities by dominance of a character species as well as by absence of several species of the class *Molinio-Arrhenatheretea*, especially of the order *Arrhenatheretalia*, as those sites are too wet and thus too infertile for these species to thrive.



**Figure 1:** Dendrogram of the association *Dactylorhizo majalis-Scirpetum georgiani* ass. nova (Tab. 1; Complete linkage, complement of Similarity ratio).

**Slika 1:** Dendrogram asociacije *Dactylorhizo majalis-Scirpetum georgiani* ass. nova (tab. 1; metoda največjih razdalj, komplement indeksa podobnosti)

No data concerning the studied community have been found in the literature, due to the fact that this Northern American species rarely occurs in Europe and is still in the phase of spreading.

These stands were only found in two meadows (glades) of the Krakovo forest, because the dominant and/or character species has not yet spread elsewhere so far.

### 3.1.1 Floristic composition

The majority of the species in relevés (Tab. 1) are characters of the class *Molinio-Arrhenatheretea* and order *Molinietalia*, respectively. Within the mentioned order, the character species of the alliance *Calthion* are the most common, so the association was classified into this alliance. Further classification into suballiance *Calthenion* is evident from the management-type of the wet meadow, as the classification on the base of character species of suballiances is sometimes not possible.

Species from the class *Scheuchzerio-Caricetea fuscae* are also frequent, what indicates the fen characteristics of the studied meadows, namely *Agrostis canina*, *Juncus articulatus*, *Carex flava* agg., *C. panicea*, *Ranunculus flammula*, *Taraxacum palustre*, *Orchis palustris*, *Viola uliginosa*, *Veronica scutellata*. There are also many character species of the class *Calluno-Ulicetea* such as *Potentilla erecta*, *Carex pallescens*, *C. leporina*, *Luzula campestris* agg., *Danthonia decumbens*, *Nardus stricta*, which give evidence that the sites are oligotrophic.

Species which often occur in the contact community *Angelico-Cirsietum oleracei*, such as *Cirsium oleraceum*, *Carex distans* and many other species from the class *Molinio-Arrhenatheretea*, do not occur here.

### 3.1.2 Synecology

The community is similar in appearance to *Scirpetum sylvatici* Ralski 1931, there are some similarities regarding ecology as well; however, like the dominant species itself, it thrives in a slightly less wet soil, which is poorer in bases. The soil is acid and base-poor (dystric), pH value is among the lowest, measured in this area (4.6 on average), like in other communities belonging to the acidophilous group of suballiance *Calthenion* (e.g. *Agrostio-Juncetum conglomerati* Šegulja 1974). (Zelnik 2003)

The content of total nitrogen in the soil is relatively high in comparison with other communities of wet meadows in the research area. The content of exchangeable Ca in the soil is low, while the content of Mg is relatively high, namely 6.5 meq / 100 g of soil.

### 3.2 *Scirpus georgianus* Harper – character and edicator species of the association

During the period from 1997 to 2002, *S. georgianus* Harper (Fig. 2), the third species from genus *Scirpus* (L.) for Slovenia, was found in the area of the southern part of the Krakovo forest. The localities belong to quadrants 0158/1 and 0158/2 according to Central European mapping (Fig. 5). This species thrives in a wet meadow, on the forest edge as well as at a draining ditch. Smaller stands and individual specimens were also found in swamp, along the Ressel path. The studied species was probably introduced by members of the North American Mycological Association, who visited the area of the Krakovo virgin forest reserve in the 1980's.

The German name for *S. georgianus* Harper is 'Schwarzgrüne Simse' (Kiffe 1998), in translation »blackish green bulrush«, which is more suitable for the species *S. atrovirens*. In English-speaking countries, the name 'Georgia bulrush' (translation of a Latin name) is used for the mentioned taxa, therefore the Slovene name 'georgijski sitec' is more appropriate.



**Figure 2:** Herbarium specimen of the species *Scirpus georgianus* Harper (Herbarium of the Academy of Natural Sciences of Philadelphia nr. PH 1023385)

**Slika 2:** Herbarijski primerek vrste *Scirpus georgianus* Harper (Herbarium of the Academy of Natural Sciences of Philadelphia nr. PH 1023385)

### 3.2.1 Key

After examination of several determination keys for genus *Scirpus* we have found out that none of them contained all four known species (*S. sylvaticus*, *S. radicans*, *S. georgianus*, *S. atrovirens*). In order to enable easy and exact determination of the mentioned species in Slovenia and Central Europe respectively, a new key was compiled on the basis of keys in Martinčič & al. (1999), Oberdorfer (1994), Kiffe (1998), Whittemore & Schuyler (2002).

### Key for the genus *Scirpus* L., Sect. *Scirpus* in Central Europe:

- 1 Spikelets mostly in fascicles at the apices of ultimate rays of inflorescence or aggregated in heads.
  - 2 Inflorescence mostly lax, spikelets in fascicles of 2–5(–8) at apices of ultimate rays. Scales (glumes) blackish-green. Perianth-bristles retrorsely barbed on the whole. Leaves light green.....*S. sylvaticus*
  - 2\* Inflorescence always compact, spikelets in dense fascicles of 4–35(–110), mostly head-shaped, at the apices of the ultimate rays. Scales brownish. Perianth-bristles smooth below. Leaves dark green.....  
.....(*S. atrovirens* agg.)
  - 3 Perianth-bristles mostly absent, sometimes 1–3 bristles, shorter than nut (rarely equaling). Nut (0.6–)0.8–1.1 mm long. Spikelets 2–4 mm long; scales (1–)1.2–1.8 mm long.....*S. georgianus*
  - 3\* Perianth-bristles usually 6, shorter than or slightly longer than nut. Nut (0.8–)1–1.3 mm long. Spikelets 2–5(–8) mm long; scales (1.2–)1.4–2.1 mm long.....*S. atrovirens*
- 1\* Spikelets solitary, mostly with long pedicels, but plants often sterile with prolonged and reclining non-flowering shoots rooted at their apices.....*S. radicans*



**Figure 3:** Bulblets burst into leaf, species *Scirpus georgianus* Harper

**Slika 3:** Vzbrsteli brstiči, vrsta *Scirpus georgianus* Harper



Figure 4: Inflorescence of the species *Scirpus sylvaticus* L.  
Slika 4: Socvetje vrste *Scirpus sylvaticus* L.

### 3.2.2 Localities in Slovenia

- 0158/1 Slo.: Dolenjska – Posavje, the Krakovo forest, wet meadow and traction near virgin forest reserve. Leg.: I. Zelnik, June 13th 2002 (herbarium of ZRC SAZU, nr.: 8391; Herbarium of the Academy of Natural Sciences of Philadelphia nr.: PH 1023385).
- 0158/1 Slo.: Dolenjska – Posavje, the Krakovo forest, Malence, meadow and ditch at a forest lane on the south-western edge of the Krakovo forest, direction north from the Robič farm. Leg.: I. Zelnik, Sept. 20th 2001 (author's herbarium).
- 0158/2 Slo.: Dolenjska – Posavje, the Krakovo forest, Kostanjevica, at the (Ressel) forest lane on the edge of a marshy area. Leg.: I. Zelnik, Sept. 5th 2002 (author's herbarium).

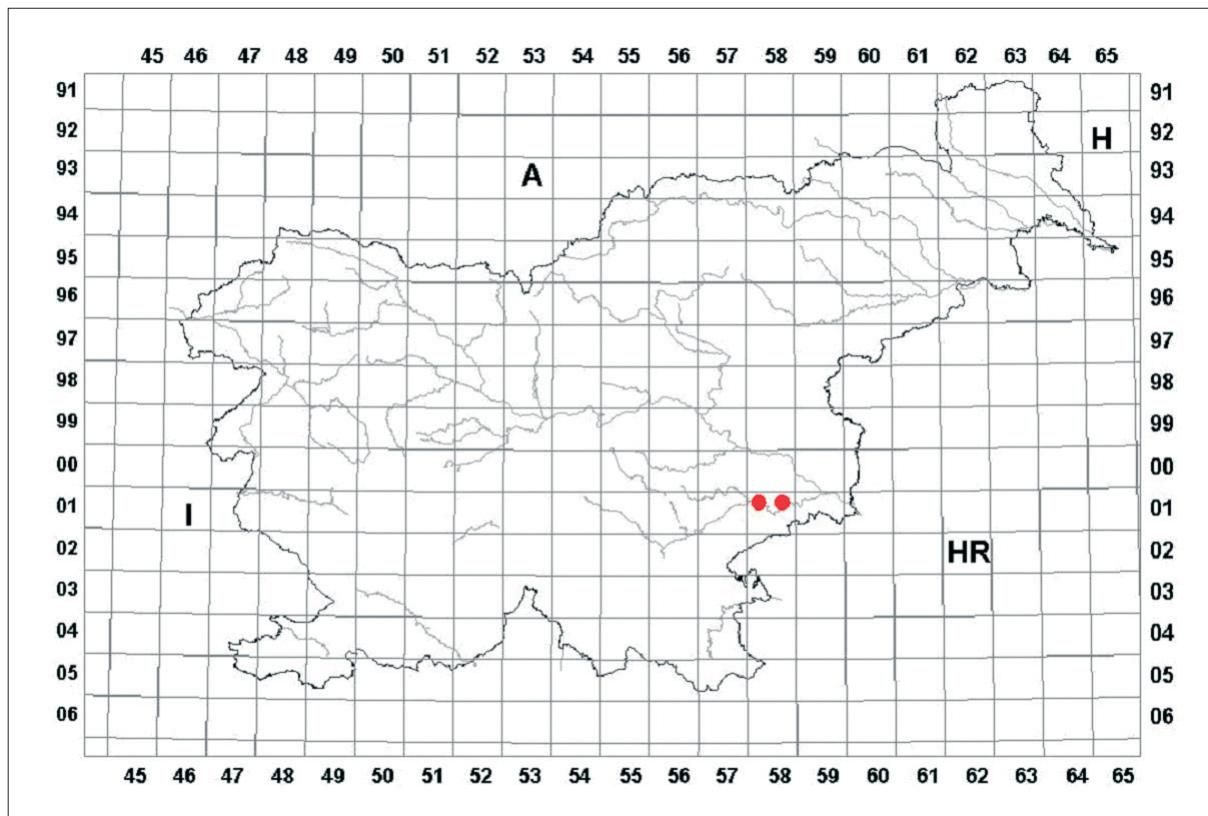


Figure 5: Localities of the species *Scirpus georgianus* Harper in Slovenia  
Slika 5: Lokalitete vrste *Scirpus georgianus* Harper v Sloveniji



### 3.2.3 Species ecology

The largest stands of species *Scirpus georgianus* Harper thrive in an extensively cultivated wet meadow on a glade beside the Krakovo virgin forest reserve, where its population visibly increases every year. On the northern and southern edge of the meadow, which is mown once a year, it builds extensive and dense stands, covering an area of 40–100 m<sup>2</sup>, whereas in the middle of the meadow it occurs more or less individually, mostly in depressions. The sites of the studied species are less wet than sites of the species *S. sylvaticus* L. as it was stated also by DeFilipps (1980). The species has probably spread elsewhere from this meadow.

The species thrives in a stand (measuring cca. 80 m<sup>2</sup>) on the slightly shaded edge of an extensively cultivated wet meadow near the village of Malence, and individually in hollows in the middle of the meadow as well; moreover, in the year 2003 it was also found on the forest edge around that meadow and at a draining-ditch by the road.

Smaller stands and individual specimens were found along the Ressel path, especially in gaps, where there is still enough light, on forest ground, in tractions and at draining-ditches along the forest lane, about a kilometre towards the interior of the forest. The Ressel path connects all the sites, therefore the conclusion was drawn that the species spreads in an antropochorous way, as is also confirmed by the fact that its fruits are likely to fasten on clothes; on the other hand, the fact that its fruits are eaten by birds indicates its endozoochorous propagation.

On the basis of the distribution of the species *Scirpus georgianus* Harper and its preferences for the specific sites, we have defined it as a character species of the order *Molinietalia* and, more specifically, of the alliance *Calthion*.

## 4. ACKNOWLEDGMENTS

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## 5. POVZETEK

***Scirpus georgianus* Harper – nova vrsta v slovenski flori in značilna vrsta asociacije *Dactylorhizo majalis-Scirpetum georgiani* ass.nova**

V sklopu raziskav vegetacije jugovzhodne Slovenije v zadnjem desetletju smo še posebej intenzivno proučevali mokrotne travnike. Tako smo v letih 1997–2002 na jasah v jugozahodnem delu Krakovskega gozda našli za Slovenijo novo vrsto – *Scirpus georgianus* Harper. Domovina vrste je Severna Amerika, kjer je razširjena po mokriščih od Teksasa in Georgije na jugu do Velikih jezer in Nove Fundlandije na severu. Od ostalih dveh vrst iz rodu *Scirpus* L. (*S. sylvaticus* L. in *S. radicans* Schkuhr), ki jih sicer najdemo v Sloveniji, se vrsta loči po značilnem socvetju, kjer so klaski v šopih na koncu togih vejic, periantove ščetine pa večinoma manjkajo.

Taksonomska problematika in enačenje vrst *S. georgianus* in *S. atrovirens* onemogočata natančen pregled razširjenosti obravnavane vrste v Evropi. Na osnovi taksonomske revizije rodu *Scirpus* v Severni Ameriki pa Schuyler (1967) trdi, da gre za dve jasno ločeni vrsti: *S. atrovirens* in *S. georgianus*. Kiffe (1998) celo navaja, da še ni jasno, ali je bil *S. atrovirens* s. str. sploh kdaj najden v srednji Evropi ali gre v vseh primerih za *S. georgianus*.

Na podlagi specifičnosti ekoloških razmer rastišč, multivariatnih analiz in značilne fiziognomije sestojev smo te uvrstili v posebno združbo in opisali novo asociacijo z imenom *Dactylorhizo majalis-Scirpetum georgiani* ass. nova.

Močvirno območje Krakovskega gozda prekrivajo gline iz mlajšega würma, na katerih so nastala bolj ali manj hidromorfna tla (amfiglej, hipoglej, obrečna tla). Tla so distrična in v času obilnejših padavin razmočena. Ploskve v sklopu ekstenzivno gojenih mokrotnih travnikov kosijo enkrat letno.

Vegetacijo smo popisovali po standardni srednjeevropski metodi (Braun-Blanquet 1964). Numerične analize smo izvedli s programskim paketom SYN-TAX (Podani 2001), z metodo hierarhične klasifikacije (Complete Linkage Clustering, komplement koeficienta podobnosti). Poimenovanje novo opisane združbe je v skladu s kodeksom Weber & al. (2000).

Na izbranih popisnih ploskvah smo nabrali vzorce tal, pri katerih smo izmerili: pH, vsebnosti

dostopnega kalija in fosforja, organske snovi in skupnega dušika, C/N razmerje, teksturo tal, vsebnost izmenljivih bazičnih kationov (Ca, Mg, K, Na), električno prevodnost tal.

Združba ima podoben videz kot *Scirpetum sylvatici* Raški 1931, definirana je namreč predvsem z dominanco vrste *Scirpus georgianus*. Poleg značilnic razreda *Molinio-Arrhenatheretea* in reda *Molinietalia*, ki so v sestojih najštevilnejše, tu najdemo tudi značilnice razreda *Scheuchzerio-Caricetea fuscae* ter razreda *Calluno-Ulicetea*, ki nakazujejo oligotrofno stanje.

Sintaksonomski položaj združbe:

*Molinio-Arrhenatheretea* R.Tx. 1937 em. R.Tx. 1970

*Molinietalia* Koch 1926

*Calthion* R.Tx 1937 em. Bal.-Tul. 1978

*Calthenion* R.Tx 1937 em. Bal.-Tul. 1978

*Dactylorhizo majalis-Scirpetum georgianum*  
ass. nova

Združba, tako kot tudi sama dominantna vrsta, uspeva na nekoliko manj vlažnih in z bazami revnejših tleh kot *Scirpetum sylvatici* Raški 1931. Tla so kisla, revna s hranili, predvsem z bazami, oziroma kalcijem. Tu so pH vrednosti med najnižjimi od izmerjenih na tem območju, vsebnosti skupnega dušika pa so, v primerjavi z drugimi združbami mokrotnih travnikov, relativno visoke (Zelnik 2003).

Vrsta *Scirpus georgianus* uspeva na travniku pri rezervatu Krakovski pragozd, na mokrotnem travniku, gozdnem robu ter ob odvodnem jarku ob cesti pri Malencah, SV od Kostanjevice in drugod ob Resslerji poti. Sklepamo, da se vrsta razširja antropohorno (plodovi se pritrjujejo na oblačila) in endozoohorno – s plodovi se namreč hranijo ptice.

Za slovensko ime vrste *S. georgianus* Harper predlagamo ime »georgijski sitec« – prevod latinškega imena, ki je bolj utemeljeno kot »črno zeleni sitec« (nem. Schwarzgrüne Simse), ki ga za to vrsto uporablja Kiffe (1998), saj je to preveč podobno prevodu imena *S. atrovirens* – »temno zeleni sitec«.

Po pregledu številnih ključev za rod *Scirpus* smo ugotovili, da noben ne vsebuje vseh štirih vrst, ki uspevajo na območju srednje Evrope (*S. sylvaticus*, *S. radicans*, *S. georgianus*, *S. atrovirens*). Za enostavno in zanesljivo določanje omenjenih vrst v Sloveniji oziroma srednji Evropi smo s kombinacijo obstoječih ključev v Martinčič & al. (1999), Oberdorfer (1994), Kiffe (1998), Whittemore & Schuyler (2002) izdelali novega:

Ključ za rod *Scirpus* L., Sect. *Scirpus* v srednji Evropi:

- 1 Klaski večinoma glavičasto združeni na koncu vejic ali pa vsi klaski združeni v šope.
- 2 Socvetje večinoma rahlo, po 2–5(–8) klaskov v šopih na koncu vejic socvetja. Pleve črnkasto-zelene. Perigonove ščetine v celoti hrapave, z izrastki, ki so obrnjeni proti bazi. Listi svetlo zeleni.....*S. sylvaticus*
- 2\* Socvetje vedno glavičasto zgoščeno, po (4–)8–35(–110) klaskov v šopih na koncu vejic socvetja. Pleve rjavkaste. Perigonove ščetine hrapave le v zgornjem delu. Listi temno zeleni.....(*S. atrovirens* agg.)
- 3 Perigonove ščetine večinoma manjkajo, včasih najdemo 1–3 ščetine, ki so krajše od ahene (redko enako dolge). Ahene dolge (0,6–)0,8–1,1 mm. Klaski 2–4 mm dolgi; pleve 1,2–1,8 mm dolge.....*S. georgianus*
- 3\* Perigonovih ščetin ponavadi 6, krajše ali rahlo daljše kot ahena. Ahene (0,8–)1–1,3 mm dolge. Klaski 2–5 mm dolgi (redko več); pleve 1,4–2,1 mm dolge.....*S. atrovirens*
- 1\* Klaski posamični, večinoma dolgopecljati, vendar rastlina pogosto sterilna, s podaljšanimi in lokasto upognjenimi, na koncu ukoreninjenimi poganjki.....*S. radicans*

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