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SAUSSUREA PORCII DEGEN (*ASTERACEAE*) IN THE SVYDOVETS MOUNTAINS (UKRAINIAN CARPATHIANS): LOCATION, COENOTIC CONDITIONS, POPULATION PARAMETERS AND CONSERVATION

Key words: Saussurea porcii, *Eastern Carpathians, endemic, threatened species, population, conservation*

Abstract

A new find of *Saussurea porcii* is reported from the Svydovets Mountains, Ukrainian Carpathians. It occurs on two adjacent wet calciferous sites in the stream valley between Troyaska and Tataruka Mts. at the altitude about 1300 m a.s.l. Exact location and coenotic conditions of the localities are described, as well as main population and individual parameters. The population is low-numbered, endangered and needs conservation. Presented results extend the knowledge on distribution and ecological needs of *S. porcii* — an extremely rare relict species endemic to the Eastern Carpathians.

Introduction

The Carpathians are considered one of the centers of biodiversity and endemism on Pan-European scale [10]. Ukraine shares a significant part of the Eastern Carpathians, but the regions of the highest biodiversity are situated mainly on the territory of Romania where endemic taxa are most abundant [6, 14, 22]. This is caused by more severe Pleistocene cooling that took place the Ukrainian Carpathians and their rather uniform geological structure, which is presented mostly by sandstone flysch. Therefore, the occurrence of scarce local endemics in the Ukrainian Carpathians is of special interest.

Perhaps, the most remarkable of such narrow East-Carpathian endemics is *Saussurea porcii* Degen, which was even called «half-legendary» [28: 124] and «the rarest of all known Carpathian plants» [8: 141]. It was discovered in 1856 by F. Porcius near Corongisu Mt. in the Rodna massif, Transylvanian part of the Eastern Carpathians on the territory of today's Romania (fig. 1, locality 1). Initially the plant was determined as *Saussurea serrata* DC. and that caused a sensation among the botanists, because the latter species was known mostly from Siberia. Later on A. Degen after detailed studies made a conclusion that the Carpathian plants present a separate species, which he called *Saussurea porcii* [12]. However, close affinity of *S. porcii* with a Siberian species *S. parviflora* (Poir.) DC. (= *S. serrata*) is still accepted [3, 4].

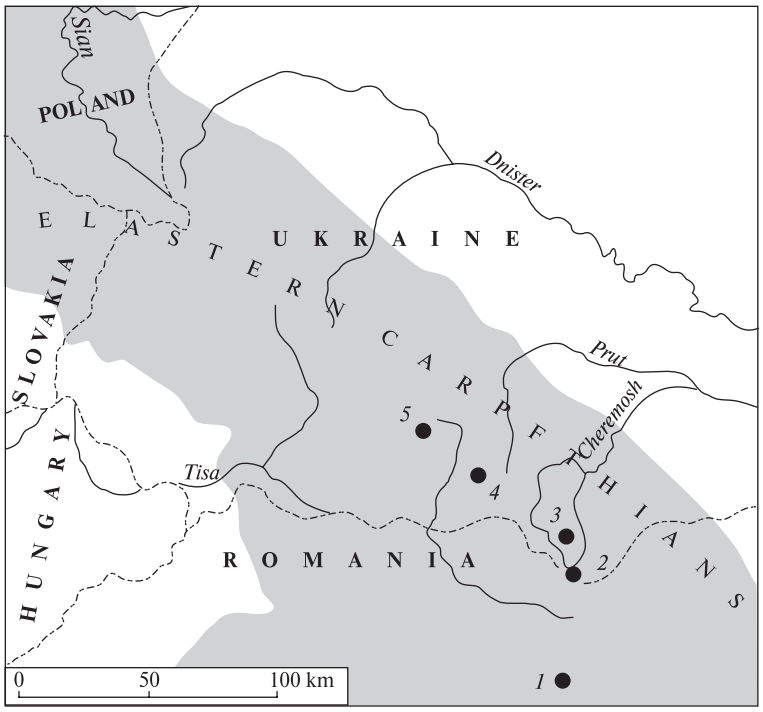

Fig. 1. Distribution of *Saussurea porcii* Degen. Symbols indicate: ■ — mountains; ● — localities (1 — in the Rodna (extinct), 2—3 — Chyvchyny, 4 — Chornohora, 5 — Svydovets Mts. — newly found)

In the 1920—1930 *Saussurea porcii* was also found in the Chyvchyny [29, 30] and Chornohora Mts. [15], i.e. on the territory of the Ukrainian Carpathians (fig. 1, localities 2—4).

The main region of the species distribution lies in the Chyvchyny Mts. at the headwaters of the White and Black Cheremosh rivers. The localities are restricted to two places: 1) southernmost part of the Chyvchyny massif on the slopes of Hnetiesa Mt. near the border with Romania and 2) about 11 km to the north on Hlystowaty Mt. near the pass of Shyya between the Chyvchyny and Hryniava Mts. In both places *S. porcii* occurs in several localities that suggests the existence of two metapopulations in the region. The localities are confined to peat bogs situated within 1380—1560 m a.s.l. [24].

In the Chornohora Mts. the species is known from the south-western foothill of Petros Mt. where it occurs on a mown fen meadow about 1350—1400 m a.s.l. [1, 2].

Recently we managed to find a new locality of the species in the Svydovets Mts. and further material presents the obtained data (fig. 1, lpcality 5; fig. 2).

Saussurea porcii is included into «European Red List ...» [16], «Red Data Book of Ukraine» [7], Romanian «Red List» [13] and is a species of top interest from the biogeographical and conservation points of view. It is considered extinct in the only known Romanian locality, i.e. in *locus classicus* in the Rodna Mts. [11, 13, 27].

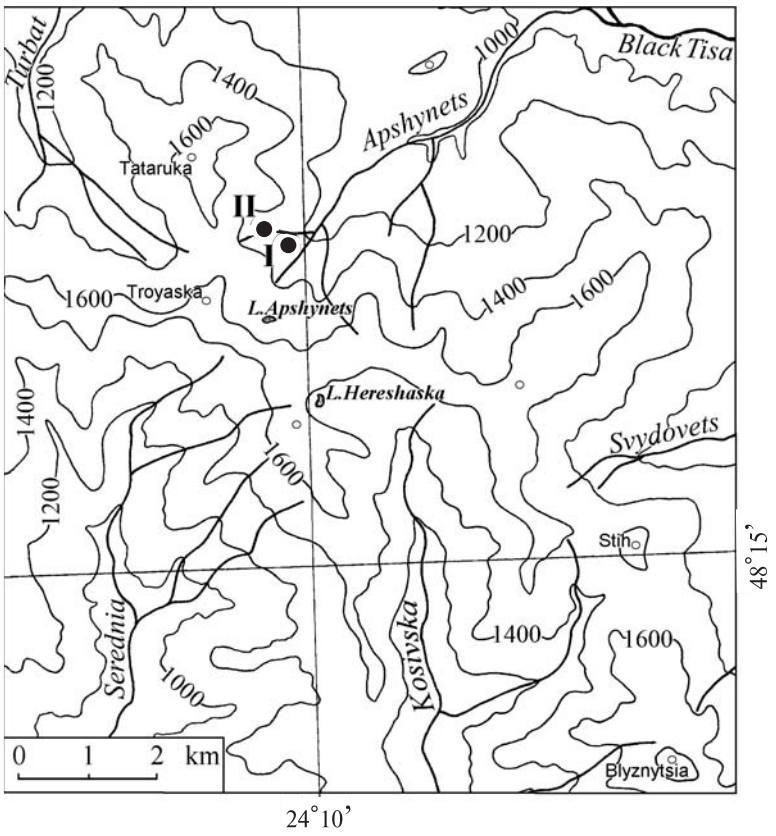

Fig. 2. Location of *S. porcii* in the Svydovets Mts. Symbols indicate: ● — species localities; I, II — numbers of the described stations

Material and Methods

The results presented below were obtained during field research performed in the central part of the Svydovets massif in July, 2005. Using meander search [17] we looked for localities of rare and threatened plant species and paid special attention to calciferous habitats.

The exact location of the site was determined in WGS-84 system with Garmin eTrex Global Positioning System (GPS) navigator with the accuracy of measurements within 10 metres.

A few individuals of Saussurea porcii were transplanted to the Botanical Garden of the I. Franko Lviv National University to provide off-site conservation of genetic pool of the population within the collection of critically endangered species in case of extinction in situ.

Species abundance was evaluated according to the grades of J. Braun-Blanquet's scale [9].

Much of the above information on the distribution of *Saussurea porcii* in the Chyvchyny Mts. was obtained from personal collections of B. Pawlowski and J. Madalski kept in the Herbarium of the W. Szafer Institute of Botany (*KRAM*) in Krakow, Poland.

Collected specimens are deposited in the Herbarium of the M.G. Kholodny Institute of Botany (*KW*) in Kyiv and the Herbarium of the I. Franko Lviv National University (*LW*).

Results

Location of the site and its coenotic conditions. A population of *Saussurea porcii* was discovered in the place of Podyna on two neighbouring stations in the stream valley between mountains of Troyaska and Tataruka in the central part of the Svydovets massif just on the border between Rakhiv and Tiachiv Districts, Transcarpathian (Zakarpattya) Region (fig. 2).

Station I is restricted to the peat bog lying on the gentle slope at the bottom of the north-eastern foothill of Troyaska Mt. at the altitude of 1295 m a.s.l. The slope has a northern aspect with a mean angle of about 3°. Geographical coordinates of the locality are: 48°17′30.5″N; 24°09′23.4″E.

The area of the site is about 400 m^2. Herb layer covers about 60 % of it, while mosses account for another 30 %. The species composition of vascular plants with corresponding grades of abundance is as follows: *Saussurea porcii* — +, *Carex paniculata* L. — 3, *C. hartmannii* Cajander — 3, *C. flava* L. — 1, *C. panicea* L. — +, *C. echinata* Murray — +, *Swertia perennis* L. subsp. alpestris (Baumg. ex Fuss) Simonk. — 1, *Eriophorum latifolium* Hoppe — 1, *Molinia caerulea* (L.) Moench — 1, *Astrantia majo*r L. — +, *Dactylorhiza cordigera* (Fries) Soo — +, *Equisetum sylvaticum* L. — +, *Alnus viridis* (Chaix) DC. — +, *Pinguicula vulgaris* L. — +, *Potentilla erecta* (L.) Rauchel — +, *Prunella vulgaris* L. — +, *Salix silesiaca* Willd. — +, *Trollius altissimus* Crantz — +; and bryophytes: *Campylium stellatum* (Hedw.) J. Lange & C. Jens. — 3, *Drepanocladus aduncus* (Hedw.) Warnst. — 2, *Rhytidiadelphus triquetrus* (Hedw.) Warnst. — 2, *Fissidens cristatus* Wils. — 1.

The soil is neutral with the pH (H_2O) value about 6.5. Present conditions of high moistening are most favourable for hygrophytous vegetation.

Station II is situated about 150 m to the west from the previous one at the altitude of 1300 m a.s.l. on the left bank of the stream that flows down from the cirque between Troyaska and Tataruka Mts. The aspect of the slope is south-eastern and its inclination is about 5°. The station has such geographical coordinates: 48°17′31.1″N; 24°09′18.1″E.

The area of the site is only 25 m^2. Herbaceous and shrub vegetation covers about 90 %. Following species are presented here: *Saussurea porcii* — +, *Carex paniculata* — 4, *C. sylvatica* Hudson — 1, *C. sempervirens* Vill. — 1, *C. pallescens* L. — 1, *C. panicea* — +, *Molinia caerulea* — 2, *Equisetum sylvaticum* — 1, *Equisetum palustre* L. — +, *Filipendula ulmaria* (L.) Maxim. — 1, *Salix silesiaca* — 1, *Astrantia major* — +, *Alnus viridis* — +, *Campanula serrata* (Kit.) Hendrych — +, *Crepis paludosa* (L.) Moench — +, *Cruciata glabra* (L.) Ehrend. — +, *Dactylorhiza cordigera* — +, *Potentilla erecta* — +, *Prunella vulgaris* — +, *Swertia perennis* subsp. *alpestris* — +, *Trollius altissimus* — +; *Valeriana simplicifolia* Kabath — +, *Veratrum album* L. — +, *Viola biflora* L. — +. In general, herbaceous vegetation is secondary and appeared in place of former Salici-Alnetum viridis schrub community, which had stretched along the stream, but was later destroyed by human activity that accompanied long-term grazing in the region. The patches of Alnus viridis and Salix silesiaca still remain in close vicinity with the site.

The pH (H_2O) value of the soil is 6.6, i.e. almost the same as in the previous site. This station, however, is much drier and its conditions may be characterized as hygromesophytous.

Both sites belong to *Caricetum paniculatae* association (*Magnocaricion alliance*). In addition to *S. porcii*, some other rare and threatened calciphilous taxa occur here as well, e.g. *Swertia perennis* subsp. *alpestris*, *Carex hartmannii* and *Pinguicula vulgaris*. However, the species composition in the Svydovets locality is poorer than in the habitats of *Saussurea porcii* known from the Chyvchyny Mts. where *Festuca porcii* Hackel and *F. apennina* De Not occur that are characteristic for *Cariceto-Festucetum porcii* association (*Carex paniculata* & *Festuca porcii*), which is endemic to the Eastern Carpathians [23, 24]. Analysis of the data from literature shows that *Carex paniculata* occurs in all its known from the Ukrainian Carpathians localities and dominates in most of them. Other species common to all the localities are: *Carex flava*, *C. echinata*, *Dactylorhiza cordigera*, *Filipendula ulmaria*, *Potentilla erecta* and *Astrantia major* [1, 2, 24].

Population and individual parameters. Both described above sites present a single metapopulation of *Saussurea porcii*, which consists of two smaller subpopulations inhabiting stations I and II.

Four fertile and 7 sterile individuals were found in station I, while the number of these groups in station II was 12 and 20 respectively. Thus, the overall population number is very low and makes 43 individuals. This may shaw that the population is endangered. Rather low percentage of sterile individuals within the whole population (62.8 %) may be caused by poor recruitment via seed reproduction.

Due to clonal growth and rhizome branching each mature individual consists of several modules. A fertile individual has up to 5 flower stems and 1—3 sterile shoots. Rhizomatous growth is sympodial and annual increments make 10 to18 mm. On the late stage of the life history clonal disintegration occurs. However, it is accompanied by senescence and does not play an important role in sustainment of the population. Height of fertile shoots ranges within 45—74 cm (58.5±2,5 cm on average) and of sterile ones — within 18—28 cm. The number of capitula per flower stem is 8 to 34. The vitality of individuals is significantly lower than in plants from Hlystovatyi in the Chyvczyny Mts. where according to our data from 2004 the height of fertile individuals ranged within 53—98 cm.

The Svydovets population is the least numerous in comparison with the other species localities from the Ukrainian Carpathians, i.e. from the Chyvchyny and Chornohora Mts. as appears from the published data [1, 2, 24] and our former field observations. Population viability is low and reliable prognosis on its survival in the long-term perspective is problematic. The above data lay down a landmark for future monitoring the population.

Most probably, the stunted condition of the population is caused by severe anthropogenic impact, namely grazing and accompanying trampling that took place in the past and had a significant influence upon the vegetation all around. However, grazing has almost stopped last years and will hardly restore in future because cattle breeding became unprofitable in the remote mountain regions of the Ukrainian Carpathians like all over Europe. Possibly, the Svydovets population is recovering now and will gradually increase, especially on its indigenous peat bog habitat in station I.

On the other hand, the relict character of the species, its extreme rarity and extinction in the Romanian locality may suggest that it is prone to natural decline [11].

Conservation considerations. *Saussurea porcii* is a very stenotopic species and a set of quite special habitat conditions is needed to provide viability of its populations. According to our observations and published data [1, 23], all known populations of the species are restricted to calciferous peat bogs or moist meadows within 1295-1560 m a.s. l. The habitats that meet all these demands (in high content of calcium in soil, proper moistening and narrow altitudinal range) are extremely rare in the Ukrainian Carpathians. They may be treated as so-called «habitat islands», i.e. the sites with very special conditions differing from their surrounding [19, 20, 26]. Probability of a colonization event of such an «island» from similar rather remote sites is very low. This explains the fact that *S. porcii* does not occur in all the suitable habitats.

Localities of *S. porcii* are of great conservation value, because they harbour many other species included into the «Red Data Book of Ukraine» [7] occur there, e.g. *Festuca porcii*, *Carex buxbaumii*, *Carex davalliana*, *Dactylorhiza cordigera*, *Pinguicula vulgaris* and *Swertia perennis* subsp. alpestris [1, 2, 24]. The three latter taxa occur in the described above Svydovets locality, as well as a rather rare calciphilous sedge *Carex hartmannii*.

Thus, the discovered locality deserves conservation that could be provided by including it into the Svydovets massif of the Carpathian Biosphere Reserve. In addition to the place of Podyna, where *S. porcii* occurs, the whole stream valley and the cirque between Troyaska and Tataruka Mts. deserve the status of the core zone, because that territory is remarkable for its biodiversity. Very numerous populations of *Gentiana lutea* L., *Narcissus angustifolius* Curtis, *Pinguicula vulgaris* and *Swertia perennis* subsp. *alpestris* — taxa from the «Red Data Book of Ukraine» [7] — occur here.

Conclusion

The discovery of *Saussurea porcii* in the Svydovets Mts. allows to revise some of the existing opinions concerning that species. First, its localities are not that unique and the species range is somewhat wider than it was considered and includes four massifs of the Eastern Carpathians — the Rodna, Chyvchyny, Chornohora and Svydovets Mts. The main part of the range and all its known remaining localities are situated on the territory of Ukraine (fig. 1). The largest distance between localities, i.e. in the Rodna Mts. (where the species is already extinct) and in the Svydovets Mts. is about 110 km.

Second, referring *S. porcii* to high-mountain or subalpine species [5, 20, 28] is not quite appropriate that especially concerns the discovered site from the Svydovets Mts. situated at 1295—1300 m a. s. l. Actually all the species localities are restricted to the altitudinal zone of mountain spruce forests, which in the biogeographical aspect correspond to boreal forests of Siberia, where lies the main part of the range of a closely related species *Saussurea parviflora*. The latter species occurs mostly in Western and Eastern Siberia, Northern Mongolia and Nort-Eastern China, but its westernmost localities are also scattered in European part of Russia about 300 km to the west from the Urals [3, 4, 22, 23]. The distance between these stations and the localities of *S. porcii* in the Carpathians is very large and makes about 2400 km. Such a considerable disjunction in the range of these

two species as well as there morphological differentiation suggest a rather early time of their divergence. Most authors refer *S. porcii* to Tertiary relicts [8, 24, 26, 29]. However, taking into account rather oligothermic conditions of its habitats and definite Siberian genetic links B. Pawlowski suggested that it could have migrated to Europe during the severest cooling in the Pleistocene [22, 61].

Possibly, the Carpathians are also a secondary center of diversity for other taxa of Siberian origin, e.g. *Ligularia sibirica* (L.) Cass. s. l. and *Cortusa matthioli* L. s. l. that demonstrate some variability in the region.

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SAUSSUREA PORCII DEGEN (*ASTERACEAE*)
НА СВИДОВЦІ (УКРАЇНСЬКІ КАРПАТИ): МІСЦЕЗНАХОДЖЕННЯ, ЦЕНОТИЧНІ УМОВИ, ПОПУЛЯЦІЙНІ ПАРАМЕТРИ ТА ОХОРОНА

Повідомлено про знахідку *Saussurea porcii* на Свидовці в Українських Карпатах. Вид трапляється у двох близько розташованих вологих кальценосних осередках у долині струмка поміж горами Трояска і Татарука на висоті близько 1300 м над р.м. Вказане точне місцезнаходження і фітоценотичні умови оселищ, а також основні популяційні та індивідуальні параметри. Популяція є нечисленною, знаходиться під загрозою і потребує охорони. Наведені результати поглиблюють відомості про поширення та екологічні потреби *S. porcii* — вкрай рідкісного реліктового виду, ендемічного для Східних Карпат.

Ключові слова: Saussurea porcii, *Східні Карпати, ендемік, популяція, охорона.*

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SAUSSUREA PORCII DEGEN (*ASTERACEAE*)
НА СВИДОВЦЕ (УКРАИНСКИЕ КАРПАТЫ): МЕСТОНАХОЖДЕНИЯ, ЦЕНОТИЧЕСКИЕ УСЛОВИЯ, ПОПУЛЯЦИОННЫЕ ПАРАМЕТРЫ И ОХРАНА

Сообщается о находке *Saussurea porcii* на Свидовце в Украинских Карпатах. Вид встречается в двух близлежащих влажных кальценосных местообитаниях в долине ручья между горами Трояска и Тататрука на высоте около 1300 м над у.м. Указывается точное расположение и ценотические условия местопроизрастаний, а также основные популяционные и индивидуальные параметры. Популяция является малочисленной, находится под угрозой исчезновения и нуждается в охране. Приведенные результаты углубляют сведения о распространении и экологических потребностях *S. porcii* — крайне редкого реликтового вида, эндемического для Восточных Карпат.

Ключевые слова: Saussurea porcii, *Восточные Карпаты, эндемик, популяция, охрана.*