ROMÂNIA
UNIVERSITATEA DIN BUCUREŞTI
GRĂDINA BOTANICĂ "D. BRANDZA"

ACTA HORTI BOTANICI BUCURESTIENSIS
39

editura universității din bucurești®
2012

Editor: Editura Universității din București

Acta Horti Botanici Bucurestiensis (text in English and summaries in Romanian) is published once a year by the Botanical Garden "D. Brandza", University of Bucharest (Șoseaua Cotroceni 32, 060114, București, România) and it is available for exchange. The abstracts are available on the Botanical Garden "D. Brandza" web page: www.gradina-botanica.ro

Acta Horti Botanici Bucurestiensis is indexed in Ulrich's Periodicals Directory since 1976.

ISSN 1453-8830

CONTENTS

Ata Horti Bot. Bucurest. **39**: 5–17
Bucureşti 2012

FESTUCA BUCEGIENSIS – ANATOMICAL, HISTOLOGICAL AND ECOLOGICAL DATA

SÂRBU Anca[*], SÂRBU Ion[**], PASCALE Gabriela[*]

Abstract: The present paper focuses on the species *Festuca bucegiensis*, a plant with a significant conservation value for the Natura 2000 Site Bucegi, and with an important phyto-geographical value (endemic) for Romania. The paper completes with detailed information the very limited anatomical and histological data available in the literature, highlighting the characteristics that can be used in order to recognise the species. By evaluating the ecological requirements of the species in regard to temperature, humidity and trophicity, this study warns of the plant's sensitivity to the forecasted climate changes and the potential effects of anthropic activities.
Key words: *Festuca bucegiensis*, conservation value, plant structure, environmental changes, plant sensitivity

Received 01 October 2012 *Revision accepted 22 October 2012*

Introduction

This paper focuses on the study of *Festuca bucegiensis* Markgraf – Dannenb. (*F. glacialis* auct. non (Miégeville ex Hackel) K. Richter), which is a pioneer species on the eroded fields and skeletal soils of Romania, considered a rare plant (Oltean et al. 1994) and a vulnerable taxon (Oprea 2005). It is a plant with a significant phyto-geographical importance, being present in Romania as endemic to the Southern Carpathians: Bucegi, Făgăraş, Parâng (Fig. 1).

The species was mentioned under the name *Festuca glacialis* auct., non (Miégeville ex Hackel) K. Richter in the studies published in Romania up to 1978 (Beldie 1967, Beldie 1972), and after 1978, with the publishing in the Botanical Journal of the Linnean Society of the article "New taxa and names in European *Festuca* (Gramineae)" (Markgraf-Dannenberg 1978), it was considered under its current name *Festuca bucegiensis* Markgr.-Dannenb. (Beldie 1979, Ciocârlan 2009).

Given the high conservation and phyto-geographical value of the species, this paper aims to provide a range of information to complete the few anatomical and histological data available in the literature (Beldie 1972).

Another key aspect taken into account regards the evaluation of this plant's sensitivity to the anthropological impact and to the predicted climate changes that will come to affect plants in the protected areas of Europe in the coming 80 years (Araújo et al. 2011). It is worth noting here the anthropic generative processes such as eutrophication, but also a series of effects of climate change predicted for the period 2000–2080 (temperature increase by 1.1–6.4°C, reduced rainfalls, extended droughts)

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and included as early since 2007 in The Forth/ 4th Report of the Intergovernmental Panel on Climate Change (IPCC 2007).

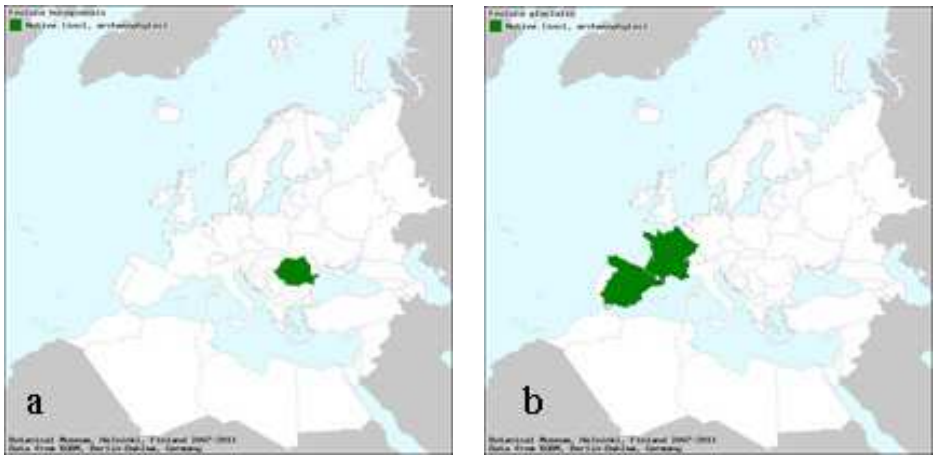

Fig. 1. The distribution of the species *Festuca bucegiensis* (a) and *F. glacialis* (b) in Europe (Botanischer Garten und Botanisches Museum Berlin-Dahlem: EURO-MED PlantBase)

All these aspects have determined us to pay attention to *Festuca bucegiensis*, a very valuable plant in the context of biodiversity conservation of the Natura 2000 Site Bucegi. Our research took place within the framework of the project HABIT-CHANGE *Adaptive management of climate-induced changes of habitat diversity in protected areas*, implemented through the CENTRAL EUROPE Programme, co-financed by ERDF, a project addressed to Bucegi Natural Park, which is an integral part of the Natura 2000 Site Bucegi.

Material and methods

Festuca bucegiensis was identified in September 2010, in the area Coştila (2416 m altitude) of Bucegi Natural Park, in the structure of the Natura 2000 habitat: 6170 (Alpine and subalpine calcareous grasslands).

The plants collected match the description provided in The Flora of Romania; they are caespitose, have a small size (5–7 cm high) and the leaves are 2–3 cm long (Figs 2, 3). The leaves are conduplicate, and the anatomical character of recognition, as marked in the literature (Beldie 1972), is the presence of three distinct sclerenchymatous strings (Fig. 4).

The plants of *Festuca bucegiensis* collected in the field were preserved in 70° ethyl alcohol, for a period of six months. On this material, anatomical and histological analyses were subsequently conducted, focusing on the flowering stem and the stem leaves.

The anatomy of the flowering stem was analysed on cross sections in the internode, made in the lower, median and upper thirds of the flowering stem.

The anatomy of the stem leaf was analysed on cross sections made on the lower, median and upper thirds of the lamina.

The characteristics of the leaves' epidermis (adaxial and abaxial) were analysed in the median and upper thirds of the lamina, in apical view.

In order to prepare the microscopic slides, the biologic material, once sectioned, sorted and clarified, was subjected to various staining techniques: double staining with Iodine Green and Alum Carmine, staining with Sudan III, staining with Phloroglucinol Hydrochloric acid (Şerbănescu-Jitaru et al. 1983).

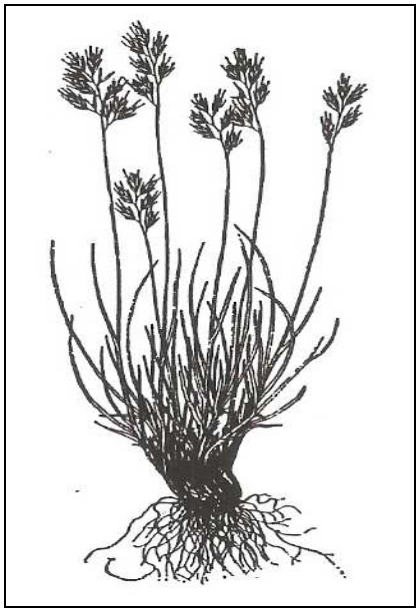

Fig. 2. Festuca bucegiensis – habitus
(The Flora of Romania, vol XII, 1972)

Fig. 3. Festuca bucegiensis – habitus, Coştila, Bucegi Natural Park, 2012
(Photo: Anca Sârbu)

The microscopic slides obtained were analysed in optical microscopy, in normal and polarised light. Their examination and micro-photographing were performed on a Docuval optical microscope.

In order to assess the potential sensitivity of the plants of *Festuca bucegiensis* to environment changes (anthropic and climatic), there were considered the ecological categories that the plants belong to, correlated with three key factors: temperature, humidity and trophicity. In order to determinate the species ecology, the scales set out by Ciocârlan (2009) were used.

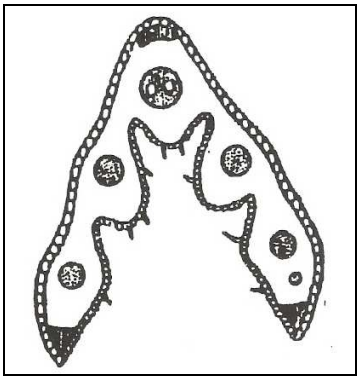

Fig. 4. Festuca bucegiensis – cross section on lamina
(The Flora of Romania, vol XII, 1972)

Results and discussion

The lamina

The lamina is conduplicate, soft, glabrous to glabrescent, V-shaped in the cross section. On the adaxial side it displays costal areas and 4 valleculae (Fig. 5).

The width of the lamina decreases from the base to the top. The measurements conducted on the edge of the lamina show 1900 µm on the lower third, 1700 µm in the median third, and 1400 µm in the upper third. The same trend can also be observed for the thickness of the lamina at the level of the median vein. This reaches in the lower third 460 µm, 380 µm in the median third, and only 330 µm in the upper third.

Fig. 5. Festuca bucegiensis, cross section through the lamina in the median third, highlighting the ribs and valleculae of the adaxial side (Photo: Anca Sârbu)

The adaxial epidermis (superior) consists mainly of long and short cells, arranged in alternation throughout the whole surface of the coastal areas. The long cells are rectangular (100–220 µm x 15–29 µm) and have thickened and dotted cellular walls, whereas the short cells (18–22 µm x 10–12 µm) are most often arranged in pairs (Fig. 6). In terms of structure, they are different: one of them has a suberified wall (cork cell), and the other a silicified wall (silica cell) (Toma & Gostin 2000, Beck 2005). The presence of SiO_2 at the level of the cellular wall of the silica cells offers the abrasive character of the leaves of many grasses. In the structure of the adaxial epidermis there can also be found bulliform cells, tector hairs and stomata. The bulliform cells have thin walls and increased dimensions towards the base of the valleculae (Fig. 5). Tector hairs (30–60 µm long) are unicellular and straight (Fig. 7) but also unicellular and curved in the upper half (Fig. 8).

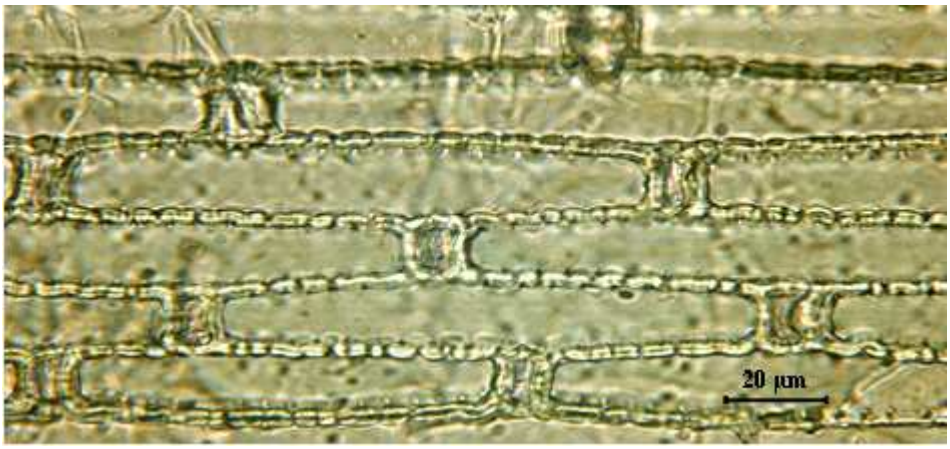

Fig. 6. Festuca bucegiensis, adaxial epidermis in apical view, highlighting the long rectangular cells and the short cells arranged in pairs (Photo: Anca Sârbu)

Fig. 7. Festuca bucegiensis, cross section thourgh the lamina in the median third, emphasising the straight tector hairs at the level of the adaxial epidermis (Photo: Anca Sârbu)

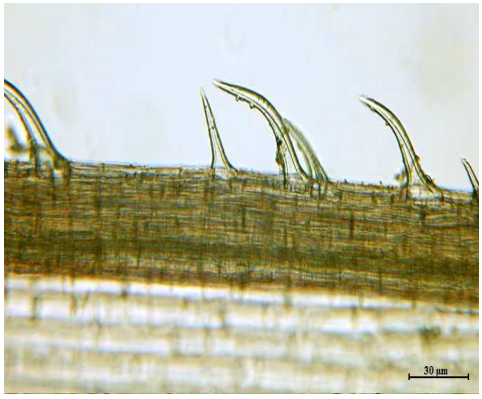

Fig. 8. Festuca bucegiensis, adaxial epidermis in apical view, emphasising the straight and curved tectors hairs (Photo: Anca Sârbu)

The stomata are grass-type (with two semicircular annex cells), arranged slightly below the level of the epidermis cells. They have a frequency of 424 stomata/1 mm^2 of lamina in the median third and of 576 stomata/1 mm^2 of lamina in the upper third, and are present both at the level of the coastal areas and, most often, on the sides of the valleculae, next to the bulliform cells.

The abaxial epidermis is also mainly composed of long and short epidermal cells. In cross section these cells are more or less isodiamteric and have thickened cellular walls, especially the outer ones, which are also slightly suberized (Sudan III) (Figs 10, 11).

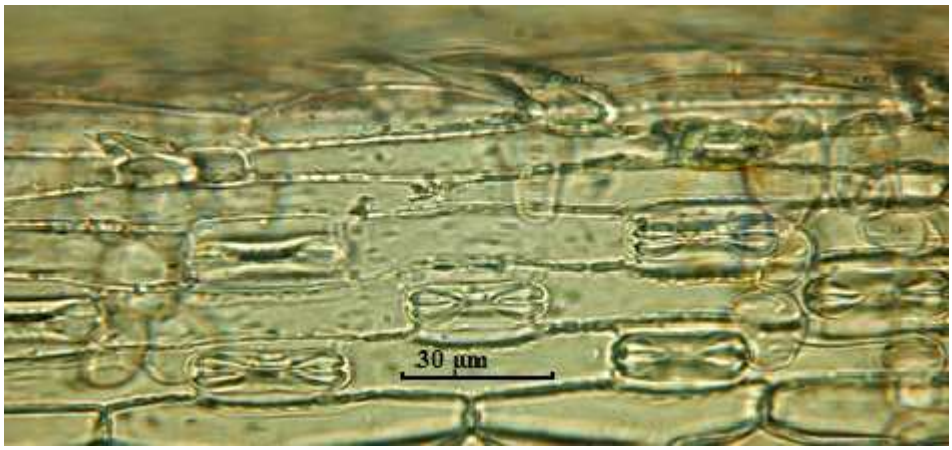

Fig. 9. Festuca bucegiensis, adaxial epidermis in apical view, highlighting the stomata (Photo: Anca Sârbu)

The long cells (100–250 µm x 20–30 µm) are rectangular, have thickened and sinuous walls, forming a micro-relief on the abaxial side of the lamina. The short cells (20–25 µm x 12–16 µm) are often displayed in pairs: one cell with a suberized wall and one with a mineralised (silicified) wall. The stomata are very rare, 4–5 stomata/1 mm^2 of lamina. The tector hairs are unicellular, curved, 25–40 µm long and very rare.

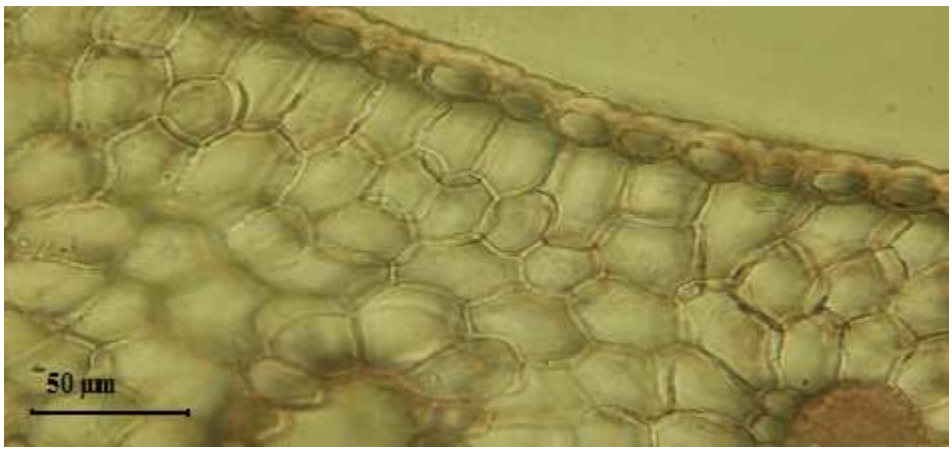

Fig. 10. Festuca bucegiensis, cross section through the lamina on the median area, emphasising the aspect of the abaxial epidermis cells in cross section (Photo: Anca Sârbu)

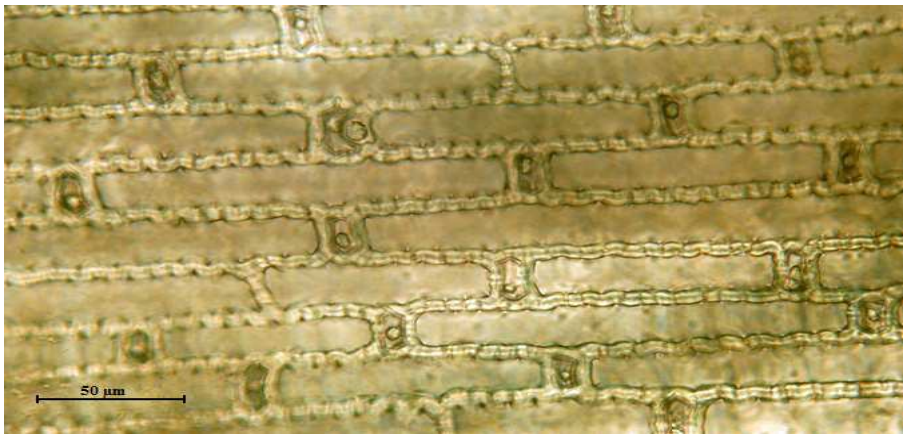

Fig. 11. Festuca bucegiensis, abaxial epidermis in apical view, emphasising the long rectangular cells and the short cells arranged in pairs (Photo: Anca Sârbu)

The mesophyll consists of an assimilating parenchyma. The cells of the subepidermal chlorenchyma (1–2 abaxial layers and 1 adaxial layer) are slightly elongated anticlinal. The rest of the assimilating cells are shorter, have relatively different shapes and are radially disposed around the veins, giving a relatively homogenous appearance (Fig. 12).

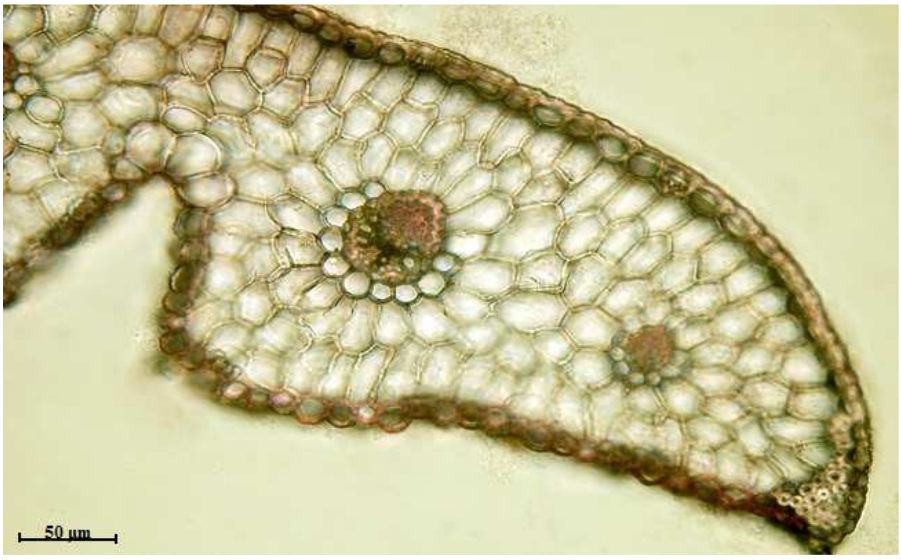

Fig. 12. Festuca bucegiensis, cross section through the lamina in the median third, showcasing the characteristics of the mesophyll (Photo: Anca Sârbu)

In the structure of the lamina, there were revealed 5–7 vascular bundles, of an almost circular shape (in transversal section), whose dimensions decrease centrifugal: a big median bundle (50–80 μm diameter), median side bundles (30–40 μm diameter), and small marginal bundles (20–30 μm diameter) (Fig. 5). The big vascular bundles are collateral, closed type, while smaller bundle only contain parenchyma elements of phloem and xylem.

The vascular bundles are surrounded by two bundle-sheaths: an external perifascicular parenchymatous sheath and an internal perifascicular mechanical sheath, the latter composed of cells with cellulose walls, unevenly thickened, centripet and slightly suberized (Fig. 13).

The observations made over the sections treated with Sudan III and respectively Phloroglucinol Hydrochloric acid, revealed the fact that in the structure of the cellular walls of the perifascicular mechanical sheath cells, the secondary deposits of polysaccharides reach a remarkable thickness, and the deposits of lignin are absent (Fig. 14).

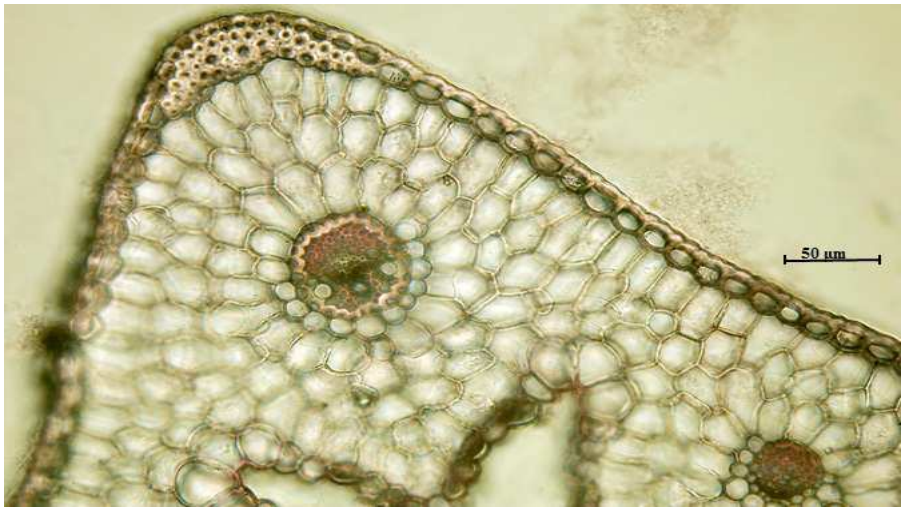

Fig. 13. Festuca bucegiensis, cross section through the lamina, in the median third, emphasising the median vascular bundle and of its two perifascicular sheaths
(Photo: Anca Sârbu)

The sclerenchyma tissue is represented (in transversal section) at the lamina level, by three thin hypodermic areas: one located next to the median rib, and two located at the edges of the lamina (Fig. 5). This character used for the recognition of the species, is maintained throughout the whole length of the lamina.

Sclerenchyma cells have evenly thickened walls, but not lignified. Their analysis in polarised light sustains the polysaccharide nature of the cellular walls.

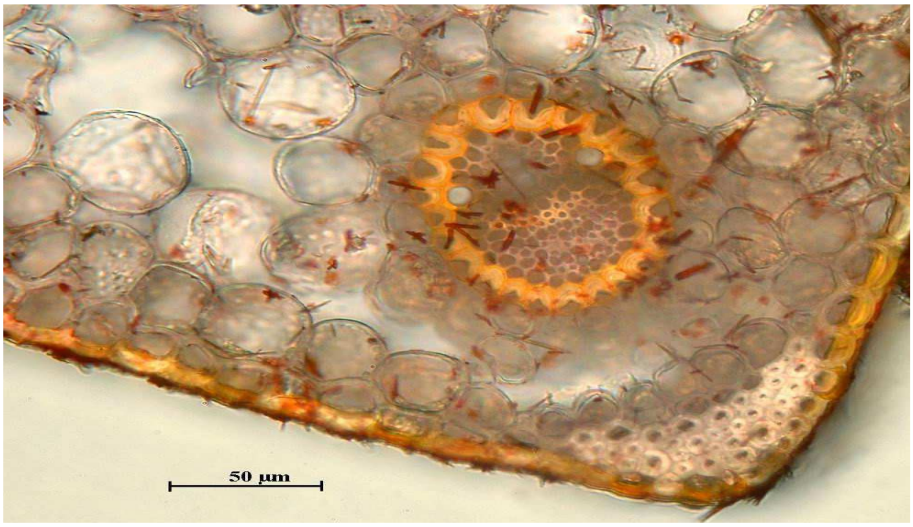

Fig. 14. Festuca bucegiensis, cross section through the lamina, in the median third, highlighting the characteristic of the cellular walls of the cells from the structure of the mechanic perifascicular sheath (Photo: Anca Sârbu)

Flowering stem

The flowering stem is short (5–7 cm long) and its contour changes from the base to the top: in the lower third the contour is almost circular, in the median third it becomes sinuous (Fig. 15) and in the upper third it becomes tricostate (Fig. 16). The stem narrows slightly from the base (~400 µm diameter) to the top (~325 µm x 400 µm diameter).

The epidermis of the stem is formed from almost isodiametric cells, with walls clearly thickened. Next to the cortical bundles of assimilating parenchyma, the epidermis cells are clearly bigger (Fig. 17).

The cortex is pluristratified (5–6 layers), sclerenchymatous and it comprises of 6 longitudinal bundles of similar tissue. In the lower third, these bundles are well individualised (Fig. 17), whereas in the median and upper thirds these are converging two by two (Figs 15, 16).

The vascular cylinder is an atactostele with a diameter of about 250 – 300 µm. It includes six vascular bundles of collateral, closed type, arranged on two concentric circumferences of the atactostele (Figs 15, 16). The three external vessel bundles are small, often only contain parenchyma elements of phloem and xylem and are embedded in the sclerenchyma. The three internal vascular bundles are big and are separated from the fundamental parenchyma of the vascular cylinder through a mechanical sclerenchymatous sheath.

The fundamental parenchyma of the vascular cylinder is sclerified, and its cells increase their dimensions in a centripetal direction.

In the centre of the stem there is a medullary cavity of rexigenous origin, which is gradually reduced from the bottom of the stem (~175 µm diameter) to its top (~110 µm diameter) (Figs 15, 16).

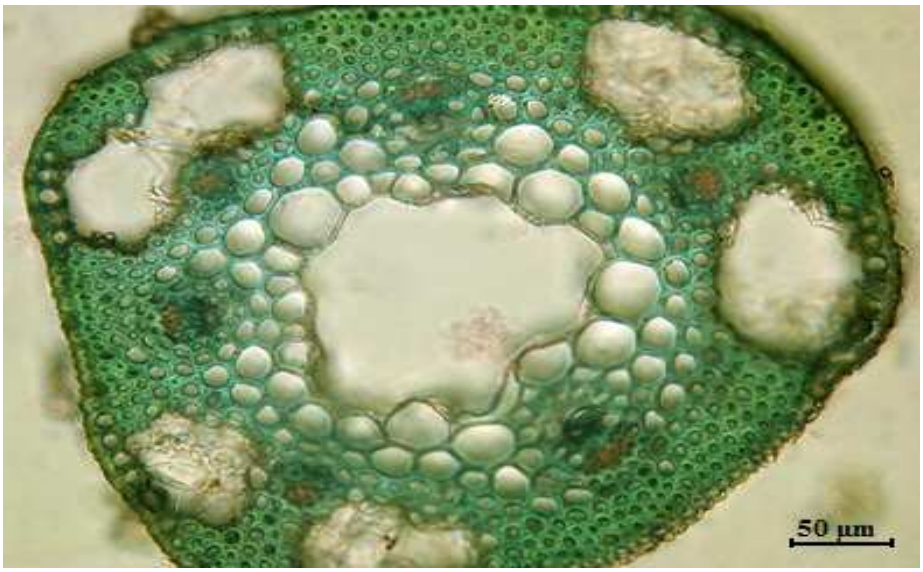

Fig. 15. Festuca bucegiensis, cross section through the stem in the median third
(Photo: Anca Sârbu)

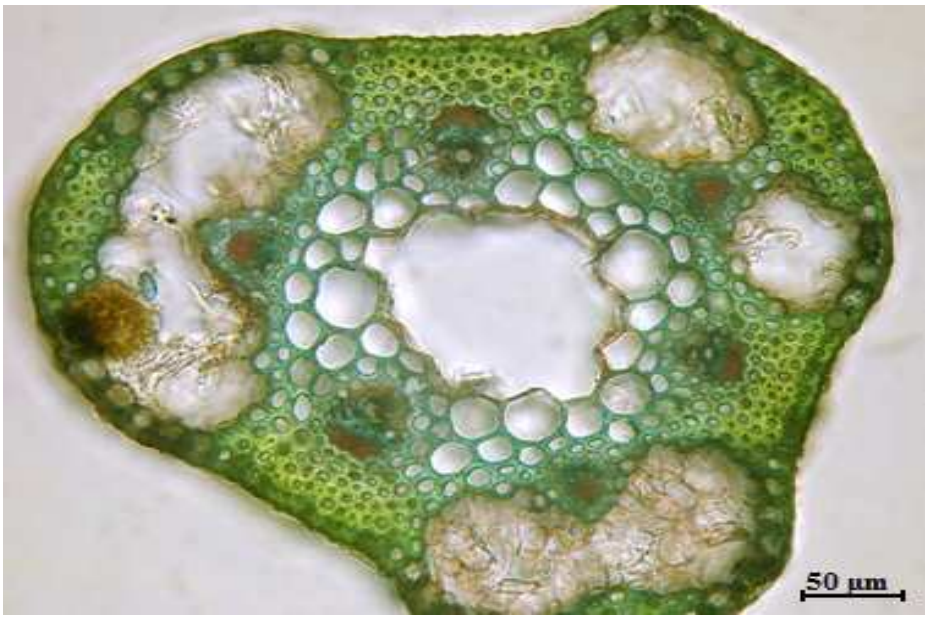

Fig. 16. Festuca bucegiensis, cross section through the stem in the upper third
(Photo: Anca Sârbu)

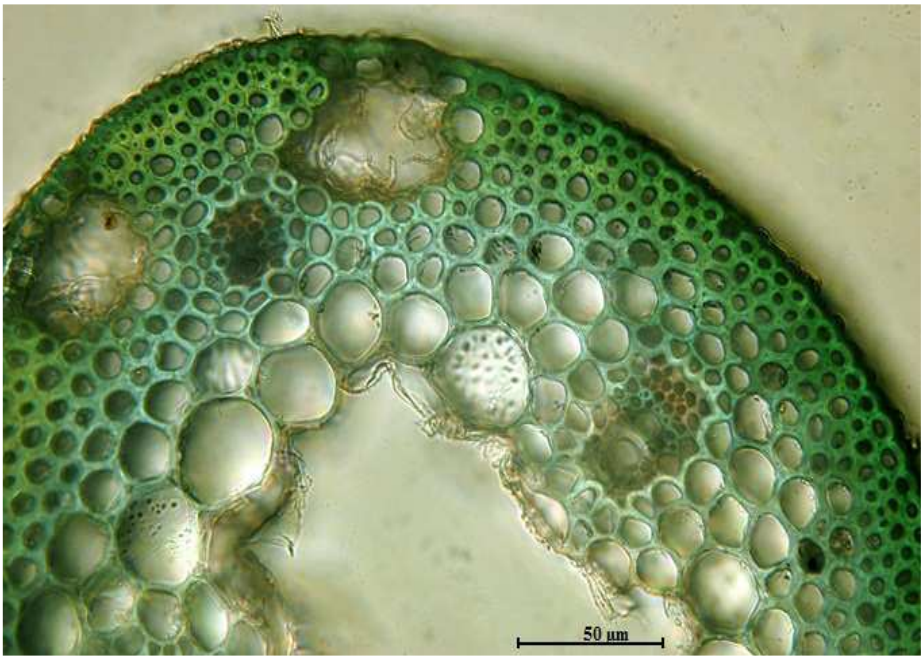

Fig. 17. Festuca bucegiensis, cross section through the stem in the lower third
(Photo: Anca Sârbu)

Species sensitivity

The sensitivity of the species *Festuca bucegiensis* to the potential climate changes and anthropological actions was assessed on the basis of the analysis of the ecological requirements of the plant.

Thus, this plant is a hekistothermophyte which needs low temperatures (annual averages of –2.5° – 5°C), characteristic of the cold conditions of the alpine climate. The plant is less sensitive to drought, being classified in the xeromesophyte – mesophyte category. It is a plant sensitive to eutrophication, an oligotrophic plant (T = 10 – 30 on the trophicity scale). In this context, the temperature increase and the excessive grazing (noted at the level of the alpine meadows of the Bucegi Mountains) represent, without any doubt, threatening factors worthy of being taken into account.

Conclusions

The specimens of *Festuca bucegiensis* collected from the Bucegi Mountains are small-sized, being at the lower limit of the dimensions presented in the species characterisation of *Festuca glacialis*, in the Flora of Romania, vol. XII.

The shape of the foliar lamina and the species recognition characters of the material we collected are according to the graphic representation used in the characterisation of the species *Festuca glacialis*, in the Flora of Romania, vol. XII, which allows us to assume that there was used biological material from this country (Romania).

The investigations conducted over the flowering stem and the stem leaves provide new anatomical and histological information, supported by microphotographs and microscopic measurements.

The data regarding the perifascicular sheaths in the structure of the lamina is also remarkable as they reveal that they are formed of cells with polysaccharide, slightly suberized, irregular and centripetal thickened cellular walls, and not of sclerenchymatous cells with lignified walls.

Our research demonstrates the presence of the identification structural characteristics, not only at the median area of the lamina, but all throughout the length of the organ.

The evaluation of the ecological characteristics of the species highlights its sensitivity to the potential environment changes (anthropological and climatic) and especially to the temperature increase and to soil degradation through eutrophication.

Acknowledgements: The present research activity was developed in the frame of the HABIT-CHANGE project, IMPLEMENTED THROUGH THE central Europe Programme co-financed by the ERDF.

HABIT-CHANGE adaptive management for protected areas
CENTRAL EUROPE COOPERATING FOR SUCCESS.
EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND
This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF

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FESTUCA BUCEGIENSIS – DATE ANATOMICE, HISTOLOGICE ŞI ECOLOGICE

Rezumat: Prezenta contribuție se ocupă de studiul speciei *Festuca bucegiensis*, plantă cu valoare conservativă semnificativă pentru Situl Natura 2000 Bucegi şi cu valoare fitogeografică (endemit) pentru România. Lucrarea completează cu informații detaliate puținele date anatomo-histologice existente în literatura de specialitate, accentuând caracterele utilizabile în recunoaşterea speciei. Prin evaluarea cerințelor ecologice ale speciei față de temperatură, umiditate şi troficitate, aceste cercetări avertizează asupra sensibilității plantei față de prognozatele schimbări climatice şi potențialele efecte ale activităților antropice.

Cuvinte cheie: *Festuca bucegiensis*, valoare conservativă, structura plantei, modificări de mediu, sensibilitatea plantei

Acta Horti Bot. Bucurest. **39**: 19–21
Bucureşti 2012

VARIABILITY OF THE SPECIES *CAREX HALLERIANA* IN ROMANIA

CIOCÂRLAN Vasile*

Abstract: The paper presents a new taxon for the Romanian flora – *Carex halleriana* Asso. var. *lerinensis* Christ. Having different characters than *Carex halleriana* subsp. *halleriana*, that is – lanceolate glumes which are obviously longer than the utricles, and its own range, i.e. the Mediterranean region and the Balkan Peninsula, it was raised to the subspecies rank: *Carex halleriana* Asso. subsp. *lerinensis* (Christ.) Ciocârlan comb. nova.
Key words: *Carex halleriana*, variability, Romania

Received 05 November 2011 *Revision accepted 15 September 2012*

Introduction

Carex halleriana Asso. has a very wide range: Southern and Central Europe, North-Western Africa, South-Western Asia (Luceño 2007).

In spite of its extended range, the species is evenly presented within the literature, with no variability (Chater 1980, Şerbănescu 1966, Luceño 2007). In Spain (Luceño 2007) the species grows in the altitude range 0–2400 m. But there are two infraspecific taxa which are differently appraised: *C. halleriana* subsp. *corsica* (Mabille) Cif. et Giacom., recognized only by Kerguélen (1993), and *C. halleriana* var. *lerinensis* Christ. accepted only by the Flore complète de France (Douin 1934) and by the Flora Reipublicae Popularis Bulgaricae (Kitanov & Vălev 1964). All the other floras present the two infraspecific taxa as synonimic with *Carex halleriana*.

Material and methods

The identification of the material which was harvested by the author in 1992, 1993 and 2011, from Tulcea County, Taşburum Hill (Dealul Taşburum), to the East of the Enisala Fortress (Cetatea Enisala) proved to be a difficult enterprise. An extended bibliography documentation was needed, including herbarium research: Cl, BUAG, BUCA. The difficulty of the determination stemmed from the existence of contradictions between the characters of the personal material and those presented within the bibliographical sources.

Carex halleriana is described as follows: densely caespitous plant with the utricles slightly longer or at most equal with the ovate glumes (Şerbănescu 1966, Chater 1980, Luceño 2007)

The author's material has short rhizomes which connect small and dense clumps, while the glumes are lanceolate with an acute tip, and are obviously longer than the utricles (Figs 1b, 1c).

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Results and discussion

After a rigorous analysis of the material of *Carex halleriana* from Romania we reached the conclusion that in Romania there grow both *Carex halleriana*, with ovate glumes which are shorter or at most equal with the utricles, and *Carex halleriana* with lanceolate glumes, with an acute long tip, which are obviously longer than the utricles. Regarding the growing pattern, although the majority of the bibliographical sources (Şerbănescu 1966, Chater 1980, Luceño 2007) describe it as "densely caespitous plant", there is one exception (Bässler 2002) which mentions „plant without stolons, with rhizome". It is true that the plant has short rhizomes connecting small and dense tufts.

In regard to the range, in Central Europe grows *Carex halleriana* subsp. *halleriana* (Oswald 1994, Bässler 2002), while in the Mediterranean region (Douin 1924) and the Balkan Peninsula (Hayek 1933) grow both the typical species as well as *Carex halleriana* var. *lerinensis* Christ. We mention that in Bulgaria (Kitanov & Vălev 1964) grows only *Carex halleriana* var. *lerinensis*.

In Romania there grow *Carex halleriana* subsp. *halleriana* and *Carex halleriana* var. *lerinensis* the latter being found in Dobrogea. Given the characters of the taxon *Carex halleriana* var. *lerinensis*, including its range, we think that it should be ranked as a subspecies.

In conclusion, in Romania, *Carex halleriana* Asso. presents two subspecies:

1. *Carex halleriana* subsp. *halleriana* with ovate glumes, which are shorter or at most equal with the utricles (Fig. 1a). Main range in Central Europe (Austria, Germany, Hungary, Slovakia).

2. *Carex halleriana* subsp. *lerinensis* (Christ.) Ciocârlan comb. nova.

Basionym: *Carex halleriana* Asso. var. *lerinensis* Christ. Bull. Soc. Bot. Belg. XXIV, 2 (1885) 14. Lanceolate glumes, having a long acute tip, obviously longer than the utricles. Obvious rhizomes (Figs 1b, 1c).

The material was introduced in the BUAG herbarium no. 23400.

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VARIABILITATEA SPECIEI *CAREX HALLERIANA* ÎN ROMÂNIA

Rezumat: Lucrarea prezintă un taxon nou în flora României – *Carex halleriana* Asso. var. *lerinensis* Christ. Acest taxon, având caractere deosebite față de *Carex halleriana* subsp. *halleriana* şi anume – glume lanceolate evident mai lungi decât utriculele şi areal propriu, regiunea mediteraneană şi Peninsula Balcanică, a fost ridicat la rang de subspecie: *Carex halleriana* Asso. subsp. *lerinensis* (Christ.) Ciocârlan comb. nova.

Cuvinte cheie: *Carex halleriana*, variabilitate, România

a)  b) 

c) 

Fig. 1. Carex halleriana a) subsp. *halleriana*, glumes + utricle; b) subsp. *lerinensis*, glumes + utricle; c) roots + rhizomes (orig.)

Acta Horti Bot. Bucurest. **39**: 23–25
Bucureşti 2012

TRIFOLIUM REPENS SUBSP. *PROSTRATUM* IN THE ROMANIAN FLORA

CIOCÂRLAN Vasile*

Abstract: The paper presents a new taxon for the Romanian flora – *Trifolium repens* L. subsp. *prostratum* Nyman and the characters of this taxon.
Key words: *Trifolium repens* subsp. *prostratum*, Romania

Received 05 November 2011 *Revision accepted 15 September 2012*

Introduction

The vascular flora of Romania is relatively well known thanks to the outstanding work – Flora of Romania, vol. I–XIII (Săvulescu 1952–1976), and to the synthesis papers subsequently published.

Flora is a dynamic element and with the change of the ecological conditions the range of the species also changes. In the last two-three decades the extension towards the north of the range of the Southern, Balkan and Sub-Mediterranean species was noticed, thus also reaching Romania.

Material and methods

In this paper, a new taxon for the Romanian flora is described. This taxon was known so far from the Mediterranean region: France (Coombe 1968, Kerguélen 1993), Italy (Fiori 1969), Albania (Coombe 1968), Germany (Rothmaler 1970, Bässler 2002).

In Romania the taxon was harvested by the author in 1963 from the Slănicului de Buzău Valley (Valea Slănicului de Buzău), in the flooded meadow next to the Slănic de Buzău stream. The material was deposited at the BUAG herbarium, sheet no. 23932. Our taxon might be identical with the one which was reported by Schur (1866) from Tălmaciu – Sibiu, as *T. repens* L. a *prostratum* Schur, *T. repens* L. var. *typicum* A. et G. f. *microphyllum* (Lagr.-Foss.) A. Nyár. (Nyárády 1957), but this latter material could not be seen; Drăgulescu (2003), quoting Schur (1866), mentions this taxon from Tălmaciu.

Results and discussion

We present below the characters of the subspecies.

Trifolium repens L. subsp. *prostratum* Nyman (*T. biasoletti* Steud. et Hochst.; *T. biasolettianum* Steud. et Hochst. ex Koch; *T. repens* subsp. *prostratum* (Biasoletto) Rothm.; *T. prostratum* Biasoletto).

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Low growing plant, with the stem branched from the base, the ramifications are creeping, 8–10 (–15) cm in length (Fig. 1). The petioles are hairy. The leaflets are obcordate, glabrous, small, of 5–10 mm, with secondary veins well developed on the lower surface and ended with obvious mucros. The peduncule of the inflorescence, at least in the young stage, is hairy under the head. Heads of 14–18 mm in diameter; the pedicels are recurvate, with rare hairs, much like the 10-veined calyx. Corolla is pale pink, at least the banner. Ecologically, this species grows on sandy and stony alluvia and probably on very weakly salty lands at the Slănicul de Buzău.

Although the description of this taxon mentiones that only the petioles are hairy (Coombe 1968, Bässler 2002), our material also features slightly hairy peduncles, character which corresponds to f. *pubescens* Peterm., according to Soó (1966).

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TRIFOLIUM REPENS SUBSP. *PROSTRATUM* ÎN FLORA ROMÂNIEI

Rezumat: Lucrarea prezintă un taxon nou în flora României: *Trifolium repens* L. subsp. *prostratum* Nyman şi caracterele acestui taxon.

Cuvinte cheie: *Trifolium repens* subsp. *prostratum*, România

Fig. 1. Trifolium repens L. subsp. *prostratum* Nyman (orig.)

Acta Horti Bot. Bucurest. **39**: 27–37
Bucureşti 2012

PLANTAGO SERPENTINA IN ROMANIA

CIORTAN Ioana[*], NEGREAN Gavril[**]

Abstract: The article firstly sets up the taxonomy of *Plantago serpentina* in Romania. It then moves on to identify the taxon as a new species for Romania. Original data, descriptions and original keys are presented for the species of *Plantago* with narrow leaves. The article also contributes with information regarding some aspects of vegetation for Romania. Finally, it completes the chorology in Europe for this endemic taxon and corrects previous information referring to *Plantago maritima*.
Key words: *Plantago serpentina*, taxonomy, chorology, key, Oltenia, Romania

Received 12 October 2011 *Revision accepted 29 August 2012*

Introduction

Serpentine is the original rock of chrysoprase itself, which was formed after the autometamorphical transformations of ultra basic rocks (dunite, peridotite, piroxenite, etc.) (magnesium silicate hydrolysis). Serpentine is an ultra basic rock formed essentially by minerals such as antigorit, crisotil, lizardit, amesit, but which is accompanied by many subordinate and accessory minerals (chromites, nickel minerals, magnetite, amphiboles, garnets and olivine, etc.). It is greenish-grayish, with spots, similar to the snake's skin. From a gemological point of view, they could be classified in common, noble, asbestiforms serpentines, and primal and secondary minerals associated to them (Ghiurcă 2002).

In the Mehedinți Mountains, within the crystalline patch type Sebeş drifted over the Danubian Autochthonous, there is mentioned the presence of serpentines in the Bahna crystalline patch at Prejna, Dâlbocița, Podeni (Ciolanul Mare, Câmpul lui Ciopec), Costești, Sulița Peack, Plătica Peack, Vodița Valley, Vârciorova Valley, Chița Mountain, Baia de Aramă, Rudina, Ungureanului Hill, Firizu Hill (Rădulescu & Dimitrescu 1966), and serpentines from Camena Valley, La Margină Hill, Grădeşnița Valley, which would be a continuation of the Massif Ciolanu Mountain serpentines (Focşa & Hurduzeu 1967). In addition to these areas, serpentines occur at Porțile de Fier, in two places: Jidoștița Valley and Ogaşul lui Sânpetru (Focşa & Hurduzeu 1967, Ghiurcă 2002) (Fig. 1).

In the area where we conducted research the geological formation is well represented (18 appearances of serpentine in the whole Geopark Plateau Mehedinți where so far investigated).

Our research had as purpose the comparative study of the serpentine flora from the Geopark Plateau Mehedinți. With this occasion, we discovered the *Plantago serpentina* species – which we consider a distinct species from *Plantago maritima*.

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This species, as well as a reduced number of other species (*Armeria maritima* subsp. *halleri*, *Notholaena marantae*, *Asplenium cuneifolium*, *Silene bupleuroides*), colonises these sites.

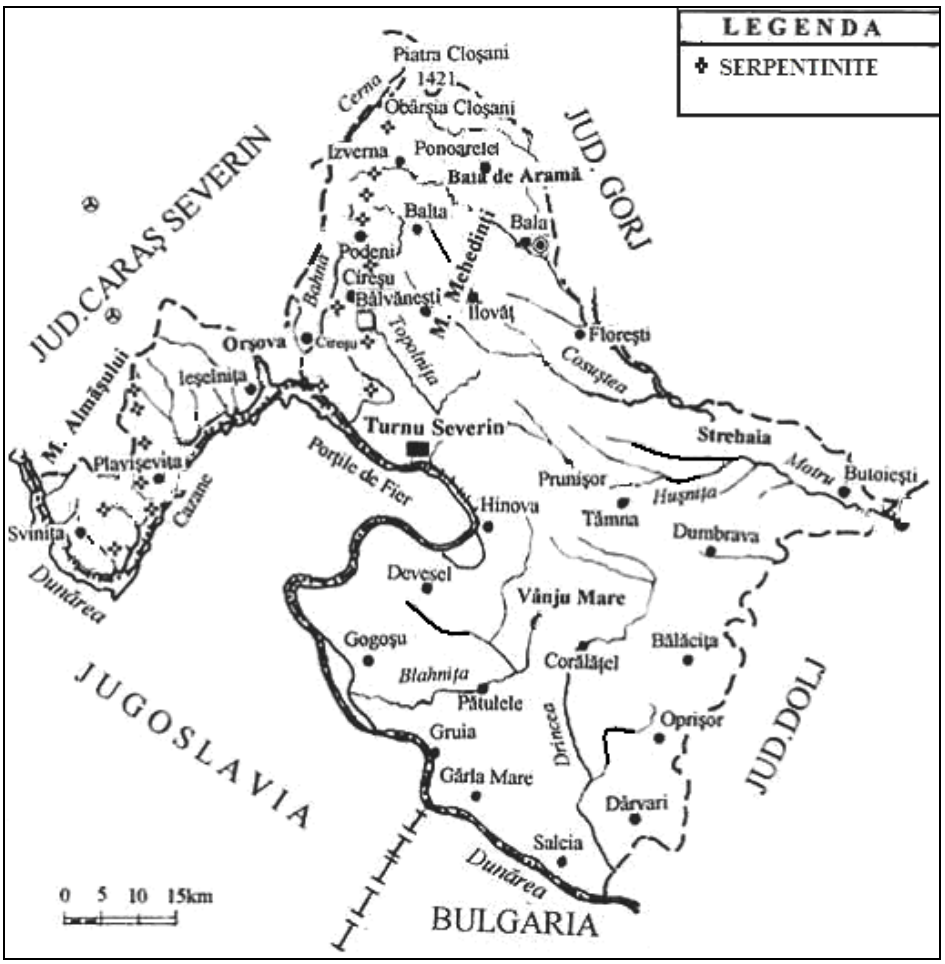

Fig. 1. Distribution of the serpentines in Mehedinți and Almăş Mountains

Material and methods

The research study involved field trips, observations on living material *in situ* and *ex situ*, from the herbarium material. Comparisons with other species with similar morphology were made. Species description was made using living material transplanted in the Botanical Garden of Craiova. A key to species with narrow leaves, present in Romania, was established. Plant material was photographed, collected and herborised. Herbarium specimens were deposited in the Herbarium of the Botanical Garden "Alexandru Buia" of Craiova [CRAI] and Botanical Garden "Alexandru Borza" of Cluj-Napoca [CL]. Herbarium abbreviations follow Holmgren et al. (1990).

Results

Genus ***Plantago*** L. – Gen. pl. [ed. I (1737) 28], ed. V (1754) 133 – *Psyllium* Fuss Fl. Transs, exc. (1866) 545, p. p. – Pătlagină (in Romanian), Plantains. This genus consists of over 200 species, spread around the globe.

In Romania, plantains are herbaceous plants, perennial, rarely annual, with leaves in basal rosettes, with one or more spikes (spherical or cylindrical), sometimes without rosette of leaves and stems more or less branched. The leaves have parallel veins, entire edges, rarely more or less lobed or fidate. Flowers 4-merous, more or less actinomorphic. Calyx with 4 separate sepals, more or less united, persistent. Corolla membranous, gamopetalous, brown, white or pink. Petals 4. Stamens 4, filaments and anthers exerts easily mobile, yellow, brown or violet. Ovary superior, with two lodges, each with 1 – many eggs. Seeds oblong, more or less rough, endospermic. Fruit a capsule (Paucă 1961).

Seventeen species have been reported in Romania (Ciocârlan 2009).

Taxonomy and Nomenclature

Plantago serpentina All. [*Plantago maritima* L. subsp. *serpentina* (All.) Arcangeli; *Plantago maritima* L. var. *serpentina* (All.) Pilger; *Plantago strictissima* L.].

The following Flora, the plant is treated as subspecies [***Plantago maritima*** L. subsp. ***serpentina*** (All.) Arcang. Comp. fl. ital. 499. 1882)]:

– Flora Iberica (www.floraiberica.org) with syn.: *Plantago serpentina* All., Auct. Syn. Stirp. Taurin. 8 (1773); *P. maritima* subsp. *loscosii* (Willk.) Malag., sin. Fl. Ibér. 66: 1045 (1976); *P. maritima* var. *integralis* (DC.) Pilg. in Repert. Spec. Nov. Regni Veg. 34: 150 (1933); *P. serpentina* var. *gypsicola* Pau in Bol. Soc. Aragonesa Ci. Nat. 9: 57 (1910).

– Flora Europaea (Chater & Cartier 1976) – is described with specification "it is probably only an ecological variant".

– Flora Germany (Wisskirchen & Haeupler 1998) with basionym: *P. serpentina* All. – Auct. syn. Stirp. Taurin. etc.; syn.: *P. strictissima* L. – Fl. Monsp. 10 (1756) nom inval. (nom. nud); *P. strictissima* L. – Amoen. Acad. 4: 478 (1859); *P. maritima* var. *serpentina* (All.) Brand – W. D. J. Koch Syd. Deutsch. Schweitz.

– Bulgarian Flora (Dimitrov & Trifonov 2006): *Plantago maritima* subsp. *serpentina* (All.) Arcang.

Also, as a subspecies is treated in the following databases:

– Flora Europaea Search Results, Royal Botanic Garden Edinburgh database (rbg-web2.rbge.org.uk): nomenclature status provisionally: ***Plantago maritima*** L. subsp. ***serpentina*** (All.) Arcang. [Comp. Fl. Ital. ed. 1 499 (1882)], syn.: *Plantago serpentina* All.

– French Botanical Network Tela Botanica (www.tela-botanica.org): ***Plantago maritima*** L. subsp. ***serpentina*** (All.) Arcang., syn.: *P. bidentata* Murith; *P. halleri* Rapin; *P. serpentina* All.; *P. strictissima* L.; *P. wulfenii* Bernh. ex Willd.; *P. serpentina* Vill.; *P. maritima sensu* auct.).

– GRIN Taxonomy for Plants (www.ars-grin.gov), with syn.: (≡) *P. serpentina* All. (basionym)] [Auctarium synops. meth. stirp. horti reg. Taurine 8. 1773 (Mélanges Philos. Math. Soc. Roy. Turin 5:60. 1774)].

– Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity (ww2.bgbm.org).

As a species, ***Plantago serpentina*** All., the plant is treated in: Flora of Central Europe (Hegi 1965), with syn.: *P. wulfenii* Bernh., *P. maritima* Kogh. z T. nec L.); Flora Helvetica (Lauber & Wagner 2000, Suter & Hegetschweiller 1822); Flora Italy (Pignatti 1982); Fischer & al. (2005).

Fig. 2. Distribution of *Plantago serpentina* in Europe (compilation from luirig.altervista.org)

General distribution: Lu, Hs, Ga, Ge, He, It, Si, Co, Sa, Slo, Au, Cro, Ser, BH, Al, Mac, Cos, Rm & Kry, Bu – Rhodopi Mts (Eastern): humid places in the plateau, peak Kartal Bunar Tepe, above Gorni Yurutsi village, c. 1000 m, MG-07, 13.07.2004, coll. V. Trifonov (SOM 162566) (Dimitrov & Trifonov 2006) (Fig. 2).

Species distribution in Romania

In the Romanian Flora, for the species ***Plantago maritima*** L. only var. ***serpentina*** (All.) Pilg. L.c. (1938) 181 – *P. serpentina* All. Auctuar. In Misc. Taur. V (1774) 60 – *P. bidentata*. Murith. bot. Val. 85 is described, from Cluj area: Cluj at Cojocna, Someşeni; Turda. Reg. Braşov: Sibiu. But the description (bracts narrow, succulent, keeling, both the calyx long ciliated. Leaves narrow, rigid, with short hairs) does not correspond to the plant we are referring to. Some characters (leaves bi-dentate) of the species indicated as synonymous – *P. bidentata*. Murith., în bot. Val. 85. (bibdigital.rjb.csic.es) [***Foliis bi-dentatis***, ***saepe scabris***. – *P. bidentata*. Murith. Bot.Val. 85. – *P. gramínea*. Schleich. Cal. 35 (non Lamk.). (V.S.!) — *P. áspera*. Gaud. helv. 1. p. 403. – *P. serrata*. Hall. fil. in not. inéd.] do not correspond with any other descriptions of the species *P. serpentina* All. or the plants examined by us. A similar description is made in the Flora Helvetica (Suter & Hegetschweiller 1822): „***fol. linearibus***, ***subbidentatis***, ***albo-marginatis***, ***spica cylindrica multiflora***, ***bracteis lanceolatis acutiusculis***". Therefore, we consider this indication to be erroneous, the more so as no indication of ecology corresponds to the literature: *P. serpentina* is a mountain plant [(500–) 600–2000 (–2200) m alt.], not a lowland or up hills plant.

The species was cited by Ciocârlan (2009) from Cluj and Sibiu, with name of *Plantago strictissima* L. though *P. strictissima* L. – Fl. Monsp. 10 (1756) nom. inval. (nom. nud) (www.floraweb.de; www.nhm.ac.uk). But the plant described has characters contrasting with what has been described both in Flora Europaea and Flora Italy, meaning that the plant is described as mesothermophile, xeromesophile, found in meadows on poor soils without the indicated altitude. Also, the flowering period does not correspond with indications from other floras, namely: VI–VIII to IV–VII.

Description of the plant from living material collected by authors in Mehedinți County, serpentines from Ciolanul Mare and transplanted in the Botanical Garden Craiova: Perennial, hemycryptophitic plant, with many rosettes (Fig. 3), 10–30 cm height. Stock leafy only at the apex. Scap serpentiforme (snake-like) (Fig. 4a), cylindrical in section, smooth (without fossess or edges), to 4–8 cm height, covered with lanceolate, cylindrical, whitish-translucent hairs, 1–2 mm lenght, alternatively-

articulated (with some articles wider), cleave, which gives an canescent aspect. Linear leaves, c. 7–12 cm × 1–2 mm, set-ciliated on the narrow edges (cartilaginous white striped), glaucescents, with non-obvious median ribbed. Spikes simple (Figs 4a, 4b), c. 2–3 cm × 4–5 mm. Bracts green, smaller than/or about egalling the K, ovate, c. 3–3.5 mm, boat-shaped, strongly keeled, only the bottom (1/2 inf.) wide white edge (scarious), with the edge cilia, smooth and unbounded in the upper half, which narrows sharply; the insertion point on the scape and their base are long white lanate. Sepals 4, ovate, boat-shaped, green keeled, with white membranous margins, red-acuminate, top with a small tuft of hairs: 2 posterior, green keeled-rounded, with wide margins, white membranous, which overlap to base; 2 previously, under the bracts, green keeled-sharp, ciliate, as well as white membranous margins. Both bracts and sepals, over the entire surface present points that appear to be the roots of hairs (?). Corolla tube hairy, lobes c. 1.2 × 2.0–2.2 mm. Anthers yellow, linear (with parallel edges), at 2.5 mm L. Stigma white, glandulous-ciliated, 6–8 (9) mm lenght, to maturity brown. The whole plant has a dusty look. Flowering: IV–IX.

Fig. 3. Rosette stage (in situ)

Because the plant can be confused with *Plantago maritima* s. l., the necessity of comparing the two taxa with life material as much as with herbarium material has risen. The plant was compared with herbarium materials derived from the district **Sibiu**: ***Plantago maritima*** L. – Ocna Sibiului, alt. c. 500–600 m [CRAI: 1096, 1097, 1098] (Ioana Ciortan 22 VII 2004) and ***Plantago holosteum*** Scop. – Distr. **Vâlcea**: Cozia Massif, Marele Abrupt, in saxosis (gneiss), 29 V 1975, G. Negrean [HGN]. Cozia Massif, Marele Abrupt, in saxosis (gneiss), 28 VIII 1975, G. Negrean [BUCM; HGN]. Cozia Massif, Scocul Durducului, in saxosis (gneiss), 26 VII 1975, G. Negrean [HGN]. Cozia Massif, Marele Abrupt, prope Scocul Ursului, in saxosis (gneiss), alt. c. 1500 m, 25 VI 1975, G. Negrean [HGN]. Gallia, Central Massif, Ardèche: Annonay SE, Vallé

du Cance, gneiss, 45°13′...″N, 04°19′...″E, 21 X 1996, G. Negrean [HGN]; Distr. **Hunedoara**: Ohaba-de-sub Piatră, in saxosis (gneiss), 15 V 2009, G. Negrean [BUCA; CL; HGN]. „Inter pagos Ciopea et Ohaba-de-sub Piatră, alt. c. 400 m, 11 VI 1918", leg. Mus. Bot. Cluj, ander *Plantago carinata* [FRE 1345; CL]. „In petrosis abruptis supra viam ferream inter pagos Ciopea et Ohaba-de-sub Piatră, alt. 350 m, 4 VI 1950", leg., E. I. Nyárády, ander *Plantago carinata* [CL 194.717; 259.818]. „In lapidosis ad Ohaba × Ponor in folth... Herb. Janka, Aug. (?)", ander *Plantago carinata* syn. *Plantago transsilvanica* [CL 37.671]. „In collibus lapidosis inter pagos Csopea et Kőalja – Ohába, comit Hunyad, c. 500 m, 19 VI 1911", M. Péterfi, ander *Plantago recurva* L. [CL 81.295]. „Hunyad vármegyei Ohaba melleti köves dombokon, Julius h", Haynald, ander *Plantago carinata* [CL 37.678].

In conclusion, we can say that there are sufficient differences between the two taxa so that we can describe them as two different species.

a  b 

Fig. 4: a – Plants with serpentiniforme stem and spikes (in situ);
b – Flowering plants (ex situ, in Botanical Garden of Craiova)

Chorology – ***Plantago serpentina*** All. (*Plantago maritima* L. subsp. *serpentina* (All.) Arcangeli) – Mehedinți Mountains, Creasta Poiana Ciolanul Mic, serpentines, 44°56′47.08″N, 22°32′12.29″E, alt. circa 1028 m, 27 VII 2007, G. Negrean [BUC; HGN]. Gornenți N, Mehedinți Mountains, ad cacumine Ciolanul Mic, serpentines in herbosis, 44°56′40.53″N, 22°31′58.13″E, alt. circa 1022 m, 10 VI 2010, G. Negrean (N 15.283) [BUCA; CAREI; CL]. Mehedinți Mountains, Poienile Ciolanul Mic, serpentines, in herbosis, 44°56′39.697″N, 22°31′58.013″E, alt. c. 1010 m, 14 VII 2011, G. Negrean & Ioana Ciortan [BUCA; CL]. Mehedinți Mountains, Poienile Ciolanul Mic, cacumine ut Ciolanul Mare, serpentines, in herbosis, 44°56′17.188″N, 22°31′19.939″E, alt. circa 1135 m, 14 VII 2011, G. Negrean & Ioana Ciortan [BUCA; CL]. Gornenți NW, ad pedem Montes Ciolanul Mare, serpentines, 44°55′48,155″N, 22°30′58,246″E, alt. c. 900 m, 9 V 2011, Ioana Ciortan & G. Negrean [CL; CRA]. Ad pedem Montes Ciolanul Mare, serpentines, 44°56′00.597″N, 22°30′41.544″E, alt. 1010 m, 15 VI 2010, G. Negrean (15.446) [CL]. Mehedinți Mountains, Pietrele Vinete, 44°53′34.770″N, 22°29′46.595″E, alt. 1015 m, 20 VIII 2010, G. Negrean [HGN]. Mehedinți Mountains, Comorişte Mountain, serpentines, 44°52′30.259″N, 22°28′42.297″E, alt. 870 m, 15 VI 2010, G. Negrean [CL]. Mehedinți Mountains, La Comorişte, serpentines, 44°52′34.375″N, 22°28′38.372″E, alt. c. 900 m, 24 VIII 2010,

G. Negrean (N 15.657) [HGN]. Gornovița N, Simazului Hill, 44°55′57,91″N, 22°38′03,73″E, alt. c. 545 m, 2 VII 2012, G. Negrean (N 18.462) [CL], idem, 7 VIII 2012, Ioana Ciortan & G. Negrean [CRAI].

Key to Romanian species of *Plantago* with narrow leaves

1a. Plants with branched stems, opposite leaves 2
1b. Plants with unbranched stems, basal leaves in rosettes 3
2a. Annual plants
P. scabra Moench (*P. indica* L. nom. illegit.; *P. arenaria* Waldst. & Kit.)
2b. Perennial plants
P. sempervirens Crantz. (*P. cynops* L.)
3a. Plants with corolla tube hairy 4
3b. Plants with corolla tube hairless. Succulent rosette leaves. Annual plants
P. tenuiflora Waldst. & Kit.
4a. Annual plants, with linear-lanceolate leaves, dentate to 1-2-pinnatifid. Bracts ovate and subacute, abruptly attenuate into a long apex
P. coronopus L.
4b. Perennial plants, with entire leaves 5
5a. Plants with leaves ± rigid, keeled on the underside, triangular cross-section. Bracts longer than calyx
P. holosteum Scop.
5b. Plants with leaves flat or semicircular cross section. Bracts shorter or about equalling the calyx 6
6a. Plants at places ± wet, salty, with ± thinck and leaves, at 2–6 (–15) mm wide, glabrous. Bracts ovate, very short setulose-ciliate, as calyx. Posterior sepal ovate.
P. maritima L.
6b. Mountaine plants (600–2000 m alt.), serpentinites plants, with rigid leaves, at 1–2 mm wide, glabrous, with ciliate, narrow cartilaginous margins. Bracts very short setulose-ciliate at carena, membranous wing to ½ lower, lanceolate, long acuminate. The posterior sepal lanceolate.
P. serpentina All. (*P. maritima* L. subsp. *serpentina* (All.) Arcang.)

Discussion

It is probably that this is the true *Plantago serpentina*, serpentines specific, highly developed in the studied area. Other indications of Flora of Romania (Paucă 1961: 418) or Illustrated Flora of Romania (Ciocârlan 2009: 674) refers to *P. maritima*, the salting plant, whose distribution is at low altitude. In Flora Europaea (Chater & Cartier 1976: 41) is treated as a subspecies, with indication „it is probably only an ecological variant, and is located in southern Europe, at altitudes above 2000 m". The small morphological differences and also the substrate compels us to consider *Plantago serpentina* an independent species. In fact, so does Ciocârlan (2009: 674), but he treats it as a synonym for *Plantago strictissima* L., occuring on salty substrate, at low altitude in the districts Cluj and Sibiu [***Plantago maritima*** L. subsp. ***ciliata*** Printz (subsp. *serpentina* (All.) Arcangeli; *P. salsa* Pallas). – Sibiu (Schur 1866; Fl. Rm)]. **Subunits**: f. *angustissima* Schur – Ocna Sibiului (Schur 1866; Fl. Rm). f. *heterophylla* Mert. & Koch – Ocna Sibiului (Schur 1866; Fl. Rm) (Drăgulescu 2010: 467) f. *angustissima* Schur –

Ocna Sibiului (Schur 1866; Fl. Rm). Ruşi (Fuss 1869, HF) (HF = Herb. Fuss). Oprea (2005: 340) reviews just prior information and he adds Dobrogea to the chorology. Drăgulescu (2003: 293) awarded on the *Plantago maritima* subsp. *serpentina* to some choronyms the salting. While *Plantago serpentina* All. or *P. maritima* subsp. *serpentina* (All.) Arcang. are admitted, *Plantago strictissima* L. taxon status is unclear (The Plant List 2011) (www.theplantlist.org).

Conclusion

The paper indicates a new species for Romania, on serpentines, and the species taxonomy is clarified.

Acknowledgmenst: We thank the staff of the Geopark Plateau Mehedinți (Mr. Meilescu Cornel, Mrs. Monica Păunescu, Mr. Păunescu Sorin, Mr. Isverceanu Emilian and Mr. Chiliban Marius) for the support they offered us in the field work and beyond.

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PLANTAGO SERPENTINA ÎN ROMÂNIA

Rezumat: Articolul pune la punct taxonomia acestui taxon, cel puțin la noi. Apoi o semnalează ca (veritabil) nouă pentru România. Se prezintă descrieri originale cu date inedite, o cheie originală, pentru speciile cu frunze înguste. Mai prefigurează aspecte inedite de vegetație pentru România. Nu în ultimul rând, completează corologia la nivel european a acestui taxon endemic în Europa şi o corectează, informațiile anterioare referindu-se la *Plantago maritima*.

Cuvinte cheie: *Plantago serpentina*, taxonomie, corologie, cheie, Oltenia, România

Acta Horti Bot. Bucurest. **39**: 37–42
Bucureşti 2012

SPIRAEA CANA IN ROMANIA

CIORTAN Ioana [*], NEGREAN Gavril[**]

Abstract: This paper reports a new species, quite rare – *Spiraea cana* – from Romania – Mehedinţi and Caraş-Severin County [Mehedinţi Mountains (Domogled, Cociu and Camena Mountain) and Mehedinţi Plateau, the Topolniţa Cave area and Anina Mountains]. The paper presents the diagnoses in Latin from literature sources, the distribution map in Europe and chorological map for Romania.
Key words: *Spiraea cana*, rare plants, taxonomy, chorology, sozology, conservation measures, Oltenia, Romania

Received 12 October 2011 *Revision accepted 29 August 2012*

Introduction

Genus *Spiraea* L. – deciduos shrubs. Leaves simple, rarely lobed, entire or serrate, usually short, exstipulate. Inflorescence paniculate, corymbose or umbellate. Petals white or pink; stamens 15 to numerous; carpels 5, free. Follicles dehiscent along the ventral suture. Seeds several (Dostál 1968).

In Europe there are 7 spontaneous species, and in Romania only 4, and many others cultivated. From our information, the plant was cultivated in Romania until 2000 (Zanoschi & Toniuc 2000). According to these authors, there are cultivated 45 taxa of the genus *Spiraea*, in Romania, in various parks and gardens.

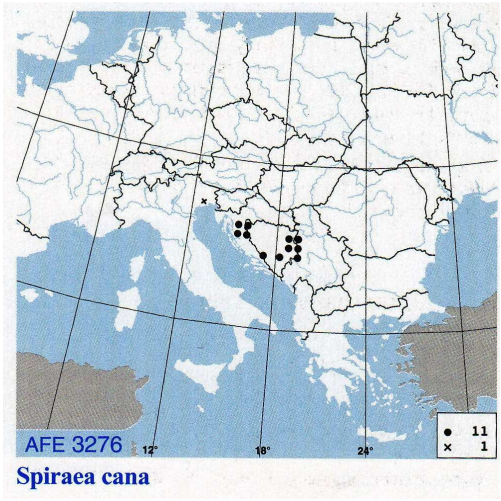

Fig. 1. Distribution of *Spiraea cana* in Europa (from Atlas Florae Europaeae)

Spiraea cana Waldst. & Kit. Pl. Rar. Hung. 3: 252 (1807) – family *Rosaceae*, order *Rosales* Bercht. et J. Presl [*S. cana* var. *typica* Beck; *S. media* Franz Schmidt subsp. *cana* (Waldst. & Kit.) Novák] is a plant that grows only in Europe (European endemite, floristic element Daco – NW-Balkan) known in Croatia and Montenegro. In Flora Europaea (Tutin et al. 1964–1980, Tutin et al. 1996) the plant is indicated from Former Yugoslavia and Italy, but in Atlas Florae Europaeae (Kurtto et al. 2004) is cited as possibly an extinct plant in Italy

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(Fig. 1). The plant has recently been indicated from Serbia: Serbia (Southwest): "the town of Sjenica, Trijebine River Gorge, limestone, 1100 m, rocky places, DN-18, 29.04.2006, coll. V. Stevanović, M. Niketić, S. Vukojičić & G. Tomović [BEOU 20746]. The species was previously recorded in Serbia for W Serbia (Jovanović 1972). According to the recent literature data (Kurtto et al. 2004), the new founding near the town of Sjenica in Serbia represents southern- and easternmost locality of the total species range" (Tomović et al. 2006).

We discovered *Spiraea cana* in the Plateau Mehedinți Geopark, in the area of Topolnița Cave (Gaura lui Ciocârdie) and on rocks at Camena. In both places only 3–4 specimens were found in 2010 (G. Negrean) and in 2011 we counted about 10 specimens at Gaura lui Ciocârdie (G. Negrean and Ioana Ciortan).

Material and methods

After discovering the plant we identified the collected material using Flora Europaea and compared it with the original text of the description, also with images from Icones Plantarum of Waldstein-Wartemberg & Kitaibel (1807) and descriptions of Flora Croatica (Calasantio-Schlosser & Farkaš-Vukotinović 1869).

The paper presents diagnoses in Latin from literature sources (Waldstein-Wartemberg & Kitaibel 1807, Dostál 1968, Calasantio-Schlosser & Farkaš-Vukotinović 1869), and also the distribution map in Europe and chorological map for Romania.

Generally, species nomenclature is according to Flora Romania (Săvulescu 1952–1976), Flora Europaea (Dostál 1968, Tutin et al. 1964–1980, Tutin et al. 1996) and The Euro+Med PlantBase (ww2.bgbm.org). Herbarium acronyms follow Holmgren et al. (1990).

The plant material was photographed, collected and herborized. Herbarium specimens were deposited in the Herbarium of the Botanical Garden "Alexandru Buia" of Craiova [CRAI] and Botanical Garden "Alexandru Borza" of Cluj-Napoca [CL].

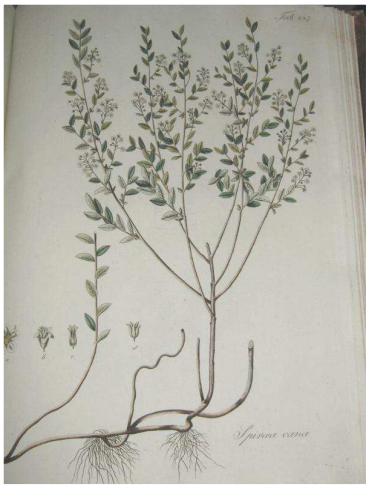

Fig. 1. Spiraea cana W. & K. (Descriptiones et Icones Plantarum, Tab. 227)

Results and discussion

We present below the description of the plant.

Description from Descriptiones et Icones Plantarum: ***Spiraea cana*** W. & K., descr. pp. 252–253, Tab. **227**: „Habitat in altis & præruptis rupibus calcareis, quæ ſiniſtro lateri lacus Plitviczenſis penultimi, Milovanovo Jezero dicti, in Croatia montoſa adſtant. Floret ſub finem Maji" (Waldstein Wartemberg & Kitaibel 1807) (Fig. 1).

Description from Flora Croatica, **1869** (gen. 44: p. 116): „Foliis ovalibus acutis, ramulorum floralium autem obtusis integerrimis utriuque molle pubescentibus, subtus incano-subsericeis; corymbis pedunculatis. — Fruticulus humilis, gracilis ramosissimus ramis gracilibus patentibus; flores minuti albi, pedicelli filiformes; petala orbiculata; capsules pubescentes. ħ. In

saxosis montium Velebit veluti in monte Slavnik, in subalpinis alpis Debelo-berdo ad Mali-Halan et in rupibus ad lacus Plitvicenses et quidem ad Milanovo-jezero. Syll. fl. cr. – Vis. fl. dalm. 1751 in rupestribus elatioribus in Monte-Santo (Debelo-berdo) in montibus Velebit. – Rchb. fl. g. 4032. Mj.-Jn. . . ***Sp***. ***cana*** **WK**." (Calasantio-Schlosser & Farkaš-Vukotinović 1869).

Description from Flora Europaea: ***Spiraea cana*** Waldst. et Kit., Pl. Rar. Hung. 3: 252 (1807). „Up to 1 m; stem terete, hairy when young. Leaves up to 3.5 × 1.5 cm, elliptical to broadly lanceolate, tapering abruptly at both ends, entire, or rarely with 2–3 teeth at the apex, dark green above, pale green and tomentose beneath. Inflorescence up to 2 cm wide, pedunculate. Hypanthium hairy; sepals revolute; petals c. 2 mm, orbicular, withe or grey-white, shorter than stamens. Follicles hairy, with remains of style at apex" (Dostál 1968).

The plant was presented at a scientific meeting held in Iași and published without details in a brief summary (Negrean 2008), specifying that it has not been indicated previously in the Romanian Flora (Borbás 1890, Buia 1956, Ciocârlan 2009). At the last moment, however, reviewing our extensive bibliography on the Romanian flora (Negrean Gavril, unpubl. data), we found that the plant was reported from "Banat", without further details (Wenzig 1888).

In our note we clearly indicate *Spiraea cana* in Romania (Fig. 2), at considerable distance from the classical plant location, making a comprehensive description of the species, and the choronyms belonging to Mehedinți Mountains (Domogled, Cociu and Camena Mountain) and Plateau Mehedinți, in the Topolnița Cave area.

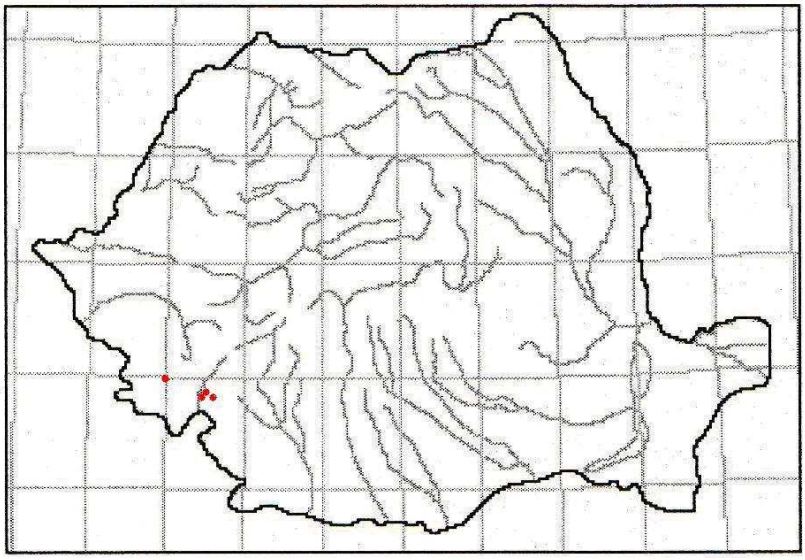

Fig. 2. Distribution of *Spiraea cana* species in Romania

The plant was found on Camena Mountain accompanied by the next species: *Carduus candicans*, *Syringa vulgaris*, *Digitalis grandiflora*, *Calamagrostis arundinacea*, *Ferula sadleriana*, *Campanula sphaerothrix*, *Spiraea chamaedryfolia*, *Potentilla*

chrysantha, *Seseli libanotis*, *Jurinea glycacantha*, *Pinus nigra* subsp. *banatica*, *Athamanta turbith*, *Alyssoides utriculata*, *Juniperus sabina*, *Inula ensifolia*, *Allium flavum*, *Genista radiata*, *Fraxinus ornus*, *Cotinus coggygria*, *Asplenium ceterach*, *Hypericum rochelii*, *Dianthus petraeus*, *Teucrium montanum*, *Sesleria rigida*, *Galium purpureum*, *Seseli libanotis*, *Cerastium banaticus*. It was also found at the exit of Topolnița from Topolnița Cave with: *Acinos alpinus* subsp. *majoranifolius*, *Arabis hirsuta* s.l., *Arabis turrita*, *Asplenium ceterach*, *Aurinia petraea*, *Carduus candicans*, *Cotinus coggygria*, *Euonymus verrucosus*, *Fraxinus ornus*, *Fritillaria orientalis*, *Jovibarba heuffelii*, *Petrorhagia saxifraga*, *Sedum sexangulare*, *Seseli rigidum*, *Syringa vulgaris*, *Viburnum lantana*.

Chorology. ***Spiraea cana*** Waldst. & Kit. – *Anina Mountains*: CS – On the rocky coast near the Bozovici village, 9 V 1977, leg. P. Peia (as *Spiraea media* Schmidt), rev. G. Negrean, 12 XII 2011 [CL 628175]. *Mehedinți Mountains* and *Plateau Mehedinți*: Cireşu E, Topolnița Valley, supra „Gaura lui Ciocârdie", to the exit of Topolnița from Topolnița Cave, 44°48′42.646″N, 22°33′30.690″E, alt. circa 370 m, 17-IV-2007, G. Negrean (N 8809) [BUC]; 15-VI-2007, G. Negrean (N 9378) [HGN]; 4-VII-2007, G. Negrean (N 9654); 6-V-2011, Ioana Ciortan & G. Negrean (GN: 15.050) [CL; CRAI]. *Mehedinți Mountains*: Camena Mountain, supra Izbucul Camenei, 44°54′12.345″N, 22°29′35.512″E, alt. c. 1100 m, 22-VII-2009, 4–5 large shrubs, G. Negrean [BUC; CL]; Domogled Mountain: ridge, in herbosis, 44°52′33″N, 22°26′28″E, alt. c. 1080 m, 14-VI-1994, G. Negrean (as *Spiraea media* Franz Schmidt subsp. *media*) (rev. GN, 2010); in herbosis ad cacumine, 44°52′33″N, 22°26′28″E, alt. c. 1080 m, 14-VI-1994, G. Negrean (as *Spiraea media* Franz Schmidt subsp. *media*) (rev. GN, 2010); the most western peak, 44°52′36″N – 22°26′17″E, 15-XI-2011, Ioana Ciortan, G. Negrean; Domogled Mountain & Cociu Mountain VII-1994, G. Negrean [CL; CRAI].

Importance. The plant is of great scientific importance, because it is an European endemite confined to a very limited area. It is an interesting component of the thermophilic flora of the Plateau Mehedinți Geopark. It is highly ornamental, especially during the flowering period.

Limiting factors. The discovered populations of *Spiraea cana* are located at the Northeast limit of its native area and consist of only few individuals. The harsher climate of this area could also be a limiting factor. The biology of the species is unknown.

Conservative measures. The plant is located in two strictly protected areas of the Plateau Mehedinți Geopark, generally in inaccessible places. It would be necessary to ensure the conservation of the plant in botanical gardens. Also, the study of plant biology is required. We also recommend further research in order to retrieve the plant in other areas of the Mehedinți Mountains, especially in the area Domogled – Vârful lui Stan. *Spiraea cana* is not threatened by humans and animals because it grows in inaccessible places. No fungal limiting factors have yet been detected. Plant monitoring is required.

Conclusions

Thanks to these findings, a new wood species is reported for the Romanian Flora. This species is particularly interesting because it is both complex (Daco-Balkan element) and decorative. The plant is quite rare, requiring protection and to be included

in national red lists and hopefully in the next edition of the *Red Book of Vascular Plants from Romania* (Dihoru & Negrean 2009).

Acknowledgments: We thank the staff of the Plateau Mehedinți Geopark (Mr. Meilescu Cornel, Mrs. Monica Păunescu, Mr. Păunescu Sorin, Mr. Isverceanu Emilian and Mr. Chiliban Marius) for the support they offered us in our filed research.

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SPIRAEA CANA ÎN ROMÂNIA

Rezumat: Lucrarea prezintă o nouă specie lemnoasă, destul de rară, *Spiraea cana*, indicată pentru prima dată din România, judeţele Mehedinţi şi Caraş-Severin [Munţii Mehedinţi (Muntele Domogled, Muntele Cociu, Muntele Camena) şi Podişul Mehedinţi, zona Peşterii Topolniţei şi Munţii Aninei]. Se face descrierea speciei din literatura de specialitate, se prezintă răspândirea la nivel european şi se realizează o hartă corologică pentru România.

Cuvinte cheie: *Spiraea cana*, plante rare, taxonomie, corologie, sozologie, măsuri de conservare, Oltenia, România

Acta Horti Bot. Bucurest. **39**: 43–51
Bucureşti 2012

SOME POPULATION STRUCTURE FEATURES AND BIOMETRICAL OBSERVATIONS ON *SANGUISORBA OFFICINALIS* IN DĂBÂCA COMMUNE (CLUJ COUNTY, ROMANIA)

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Abstract: This paper presents a study on two subpopulations of *Sanguisorba officinalis* (*Rosaceae*) conducted in 2010 in Dăbâca commune, Cluj County, Romania. These two distinct groups of the population are distributed on separate hay meadow surfaces with a different land use history and actual degree of abandonment. The meadows harbor populations of the rare butterflies *Maculinea nausithous* and *M. teleius* which have as the sole host plant *S. officinalis*. Recent abandonment of mowing and intensification of grazing could influence in a negative way both the occurrences of the endangered butterflies and of their host plant; therefore, conservation strategies have to be developed on the basis of population studies. Our study compares the two subpopulations of *S. officinalis* in terms of their size, density of individuals, distribution pattern, and correlation to vegetation structure characteristics as well as some morphometric features. Our results show that *S. officinalis* can be found only in a part of the studied surfaces, with different values for the two meadows. This can be caused by different soil and underground water conditions, vegetation types as well as different past and actual land use. Further studies about the relationship between *S. officinalis* population characteristics and these factors are necessary in order to establish successful management recommendations.

Key words: *Sanguisorba*, hay-meadow, land-use, population size, distribution, density, morphometrical method

Received 29 February 2011 *Revision accepted 24 August 2012*

Introduction

Changes in land-use are considered to be one of the greatest threats to many plant species and habitats, both through intensification of agriculture as well as abandonment followed by shrub encroachment. The remaining areas are exposed to strong fragmentation processes (WallisDeVries et al. 2002). Agricultural intensification and abandonment of farming cause landscape degradation, increased risk of erosion and biodiversity loss (Stoate et al. 2009). The most affected by these processes are the highly specialized and sensitive species that require specific types of habitats with a special combination of biotic and abiotic conditions (Habel et al. 2007). The situation is even more serious for those species whose life cycle is very complex and depends on several other species, like the butterflies of the genus *Maculinea* (*Lepidoptera*, *Lycaenidae*): they depend on a synecological system of

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specific host plants and specific *Myrmica* spp. (*Hymenoptera*, *Formicidae*) host ants and are currently considered highly endangered throughout Europe, mainly because of the abandonment of traditional land-use during the past decades (Whynhoff 2001, Habel et al. 2007, Vodă et al. 2010).

Sanguisorba officinalis L. is one of the most important limitating factors for two endangered large blue butterfly species, *Maculinea nausithous* (Bergsträsser 1779) and *M. teleius* (Bergsträsser 1779), because it represents the sole host plant species on which the adults lay their eggs (Durka et al. 2008) and the only feeding resource for the first larvae stages.

The Great Burnet (*Sanguisorba officinalis)* is a perennial herb that occurs throughout the Palaearctic, from Western Europe to Alaska and Japan. In central Europe, it is a characteristic component of wet and intermittently wet grassland types belonging to the order *Molinietalia caeruleae* Koch 1926 (Rothmaler 2005, Sanda et al. 2008). Regarding the ecological preferences, it is a mesophilous, micromesotherm species, showing a large tolerance for the ionic content of the soil (Popescu & Sanda 1998). Apart from sexual reproduction, plants are able to spread vegetatively by short rhizomes (Durka et al. 2008). Each branch ends in an inflorescence; one inflorescence contains up to 100 flowers, each of them developing into one fruit containing a single seed (Fig. 1). Flowering lasts from June to September (Buia 1956).

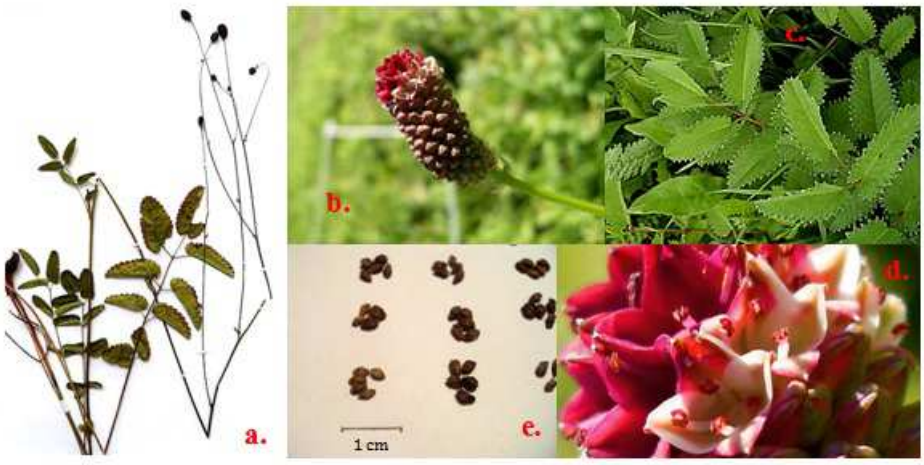

Fig. 1. Morphological aspects of *Sanguisorba officinalis:*
a. individual; b. inflorescence; c. basal leaves; d. flowers; e. fruits

Sanguisorba officinalis is not quoted in the red lists of threatened plant species in Romania and occurs in several places of the wider study area (Hills of Cluj). Nevertheless, the Great Burnet inhabits some vulnerable habitats like meso-hygrophilous and hygrophilous grasslands which in the study area are threatened by abandonment of the traditional management practices and overgrazing. Thereby, information regarding the structure and dynamics of *S. officinalis* populations and the vegetation types inhabited by this species, have a great significance for developing conservation strategies to protect the habitats in which the species occurs, their high

plant and animal diversity and not least several butterfly species of the genus *Maculinea* listed on the EC Habitats Directive's annexes II and IV.

Therefore, we studied population and morphometrical characteristics for two subpopulations of the Great Burnet. We define a subpopulation as a local population of a metapopulation, which is linked with the other subpopulations in the area by dispersal (Begon et al. 2006). The subpopulations were selected together with specialists of the genus *Maculinea*, who concurrently studied population characteristics of the butterflies.

Material and methods

The observations were carried out in Dăbâca commune, about 40 km North of Cluj-Napoca (Transylvania). Geographically, the area belongs to the so called "Hills of Cluj", the South-Eastern part of the Someş Plateau, which borders on the Transylvanian Depression. The soils belong to two zonal soil groups: podsolized illuvial soils (argiluvisol) and chernozemic soils (mollisol) on marl and argillaceous marlstone (Pop 1996). The mean annual temperature is 8–9°C, the annual mean precipitation reaches 600–700 mm (Pop 2001).

Two study sites were selected, both situated on the northern slope of Cocoşului Hill: Fânaţul Domnesc (FD) and Fânaţul Sătesc (FS). The sites differ in their land use history: both were used as traditional meadows up to the 1970ies, when mowing continued in FS whereas FD was used as cattle pasture for about two decades. During the 1990ies both meadows were again mowed regularly, followed by a period of increasing abandonment of mowing, as well as increasing sheep grazing.

The vegetation types in which the Great Burnet occurs belong to the alliances *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951 and *Molinion caeruleae* Koch 1926.

Data were collected from August to October 2010. First, the two subpopulations were established by delimitating a polygon including all visible individuals of *S. officinalis* in the two hay meadows. In this paper the term individual refers to ramets, which in many cases are just individual leaves. Then plots of 1 m^2 were distributed randomly on the whole surface of the polygons using a GIS programme (ArcMap 9.3, Hawth's Tools). For a confindence level of 95% and a confidence interval of 5% the representative sample size was calculated to be 380 plots for Fânaţul Sătesc and 382 for Fânaţul Domnesc using a sample size calculator available online (Creative Research Systems). In each quadrat we estimated the dominance of *S. officinalis* (%/m^2), the cover of soil with vegetation (%), shrubs (%) and *Molinia caerulea* (%) and determined the abundance of *S. officinalis* (individuals/m^2), the number of inflorescences as well as the height of the vegetation (in five points: corners and center of the plot).

For the biometrical study we considered around 70 sample plots in each polygon. Three individuals were systematically chosen from each of these 1 m^2 plots and the following data were collected: the plant height, the size of the basal leaf (length and width), the number and size of the inflorescences (for the highest and lowest branches) and the phenological stage of the inflorescences. For 30 randomly chosen individuals per polygon we counted the number of flowers per inflorescence and the size of the leaflets.

Regarding the statistical analysis, Excel 2003 and R 2.12.2 programmes were used. The collected data were transformed with the following functions: $ln(x + 1)$ for

the numerical variables and $p' = \arcsin\sqrt{x}$ for the percentage variables. Correlation was calculated by linear regression, using the coefficient of determination.

For the estimation of the total abundance of *S. officinalis* individuals in the whole polygon we used the formula N = (A/a) * n, where **N** is the estimated total population size, **A** the area, **a** the area of the sample quadrat and **n** the number of individuals per quadrat, that is the density (Kingsolver 2006). In order to calculate n, we considered only the plots in which *S. officinalis* occured and calculated the median, because the data is not distributed symetrically, but skewed right.

The index of dispersion was calculated with the following formula $I = s^2/\bar{x}$, where **I** is the index of dispersion, $\mathbf{s^2}$ the variance and $\bar{x}$ the mean (Krebs 1999).

Results and discussion

a. The size of the subpopulations. Although the polygon surface in Fânațul Sătesc (FS) is about four times smaller than in Fânațul Domnesc (FD), the total number of recorded individuals is more than five times greater than in Fânațul Domnesc (Table 1). Similarly, the maximal number of *S. officinalis* indiviuals found in one 1 m^2 is considerably higher in FS (Table 1).

In FD we found *S. officinalis* individuals in 63 out of 382 $1m^2$–plots, which is a percentage of 16.5%. This can be interpreted as follows: *S. officinalis* can be found on 16.5% of the polygon area, that is on 2.5 ha. For FS the percentage is much higher: 52.6% of the polygon area or 2 ha (Table 2). The results indicate, that the density of *S. officinalis* is twice as high in FS compared to FD (table 2). For the parameter A we took the area in which *S. officinalis* occured (2.5 ha for FD and 2 ha for FS).

The estimated total size of the subpopulations of *S. officinalis* is ca. 300,000 ramets in FD and ca. 474,000 ramets in FS (Table 2).

b. Spatial distribution. The spatial distribution of *S. officinalis* dominance in the hay-meadow polygons illustrates a possible clumped distribution, what corresponds with our field observations (Fig. 2a and 2b). For both hay-meadows the values of the variance/mean ratio are significantly greater than 1 (32.65 for FD and 34.46 for FS), what indicates a highly aggregated spatial distribution and a low dispersion of the individuals. It is interesting, that the index is quite similar in both meadows even though the population size differs considerably.

Table 1

Measured population characteristics of *S. officinalis*

Hay-meadow	Area size (ha)	No. of plots	No. of plots with Soff	Total no. of individuals	Max. no. of individuals / plot
FD	*15.2*	*382*	63	1,114	102
FS	*3.7*	*380*	200	6,107	151

FD – Fânațul Domnesc; FS – Fânațul Sătesc; Soff – *S. officinalis*; max. – maximum; no. – number.

Table 2

Calculated population characteristics of *S. officinalis*

Hay-meadow	% of area with Soff	Area (ha) with Soff (A)	Density (median) (n)	Estimated total population size (N)
FD	16.5	2.5	*12*	*301,181*
FS	52.6	2.0	*24*	*474,013*

FD – Fânațul Domnesc; FS – Fânațul Sătesc; Soff – *Sanguisorba officinalis.*

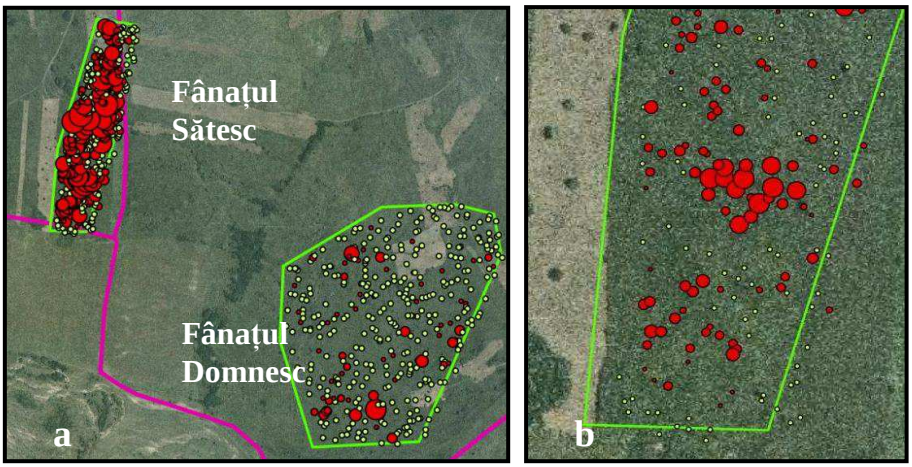

Fig. 2. a. Spatial distribution of the dominance of *S. officinalis* in FS and FD; b. detail for FS (source orthophoto: National Agency for Cadastre and Land Registration).
● *S. officinalis*'s dominance ● Samples without *S. officinalis*

c. Number of inflorescences. The number of *S. officinalis* inflorescences could play a major role for the population size or the reproductive success of *Maculinea nausithous* and *M. teleius*. In FD we counted 269 inflorescences in the sample population of 1,114 *S. officinalis* ramets, whereas in FS 1,817 inflorescences for 6,107 individuals could be found (Table 3). The estimated total number of inflorescences which was calculated by multiplying the median with the polygon area in which *S. officinalis* can be found, is about 125,500 inflorescences in FD and 180,000 inflorescences in FS, that is the estimated total number is 1.4 times higher in Fânațul Sătesc than in Fânațul Domnesc.

From the data for the biometrical study we could calculate the percentage of generative individuals compared to the sample size: 16.3% for FD (24 from 147 individuals counted) and 35.6% for FS (81 from 228 individuals counted). However, these percentages could be too high, because the flowering plants were chosen with priority over the vegetative ones for measuring the biometric parameters.

Table 3

Overview of the flowering individuals characteristics

Hay-meadow	No. of quadrats	Total no. of inflor.	Density (median)	The estimated total no. of inflor.
FD	382	269	*5*	*125,490*
FS	380	1,817	*9*	*180,000*

FD – Fânațul Domnesc; FS – Fânațul Sătesc; inflor. – inflorescences; no. – number.

d. Correlation between S. officinalis – vegetation – Molinia caerulea. From the analysed parameters (vegetation cover, vegetation height, cover of shrubs and *Molinia caerulea*) only the average vegetation height and the dominance of *Molinia caerulea* turned out to be significantly correlated with the dominance of *S. officinalis* (Fig. 3a and 3b). The dominance of *Molinia caerulea* and that of *S. officinalis* are positively correlated (Fig. 3a), but the low coefficient of determination ($r^2 = 0.16$) indicates a weak

relation between the two parameters. A weak positive correlation (r^2 = 0.08) was obtained also between *S. officinalis* dominance and average vegetation height (fig. 3b). The latter indicates a weak trend that in stands with higher vegetation, the cover of *S. officinalis* tends to be bigger.

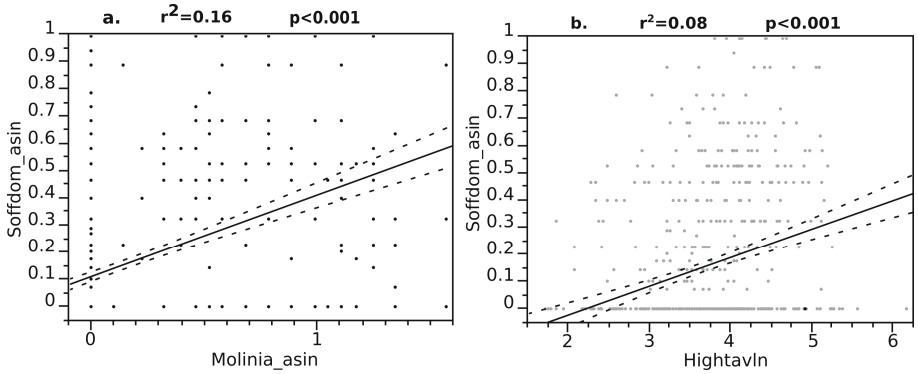

Fig. 3. Relation between the dominance of *Molinia caerulea* (a), the average vegetation height (b) and the dominance of *S. officinalis*
(Molinia_asin = dominance of *M. caerulea*; Hightavln = average vegetation height; Soffdom_asin = dominance of *S. officinalis;* r^2 = coefficient of determination; p = p value)

Our results indicate that only a small percentage of the variation of the dominance of *S. officinalis* (16% and 8%) is explained by the variation of the dominance of *Molinia caerulea* and the average vegetation height; the remaining variation being determined by factors, which have not been considered in our study.

e. Biometrical observations on Sanguisorba officinalis

Basal leaves biometry. Morphometric data were collected for 375 individuals (147 – FD and 228 – FS), distinguishing between vegetative and generative ramets. The basal leaves of the vegetative individuals are in general bigger (both, longer and wider) than the basal leaves of the generative individuals (Table 4). According to our data, the mean and minimum of the basal leaves of the vegetative individuals are bigger in Fânațul Sătesc than in Domnesc, whereas in case of the generative individuals, mean, maximum and minimum are higher in Fânațul Domnesc (Table 4). According to our observations the vegetation in FS is in general denser and higher, especially due to a higher abundance of *Molinia caerulea*. This could cause more shade for the *S. officinalis* ramets, leading to bigger leaves than in FD. However, the same conditions do not seem to cause also bigger basal leaves of the generative individuals.

An interesting question is, if the detected morphometrical differences between the two *S. officinalis* subpopulations are adaptive modifications or if they are genetically fixed.

Inflorescence biometry. *A* similar analysis has been performed for the inflorescences, too. In FD the average lenght and width of the inflorescences are bigger than in FS, but the inflorescences are more uniform than in FS, that is, show less extreme values (Table 5). This could be a first hint that the variability of the inflorescence size is greater in FS than in FD.

Table 4

Biometrical linear measurements of *Sanguisorba officinalis* basal leaves

Hay-meadow	L b.l. med. (cm)		L b.l. max. (cm)		L b.l. min. (cm)		w b.l. med. (cm)		w b.l. max. (cm)		w b.l. min. (cm)	
	V	F	V	F	V	F	V	F	V	F	V	F
FD	*24.3*	*21.4*	52	43	8.5	6	*6.9*	*6.3*	17	13	2.5	2.8
FS	*31.8*	*17.8*	56	37	10	3	*8.2*	*6*	15	12	4	1

FD = Fânațul Domnesc; FS = Fânațul Sătesc; b.l. = basal leaf; med = average; min = minimum; max = maximum; L = lenght; w = width; V = vegetative; F = generative.

Table 5

Biometrical measurements of *Sanguisorba officinalis* inflorescences

Hay-meadow	L med. (cm)		L max. (cm)		L min. (cm)		w med. (cm)		w max. (cm)		w min. (cm)	
	I.1	I.2	I.1	I.2	I.1	I.2	I.1	I.2	I.1	I.2	I.1	I.2
FD	*1,78*	*1,45*	*2,8*	2,5	1	0,4	*0,94*	*0,92*	1,3	1,4	*0,6*	0,2
FS	*1,56*	*1,14*	*3,2*	2,5	0,5	0,3	*0,86*	*0,68*	1,5	1,3	*0,3*	0,2

FD = Fânațul Domnesc; FS = Fânațul Sătesc; L = lenght; w = width; max = maximum; min = minimum; med = average; I.1 = inflorescence of the highest branch; I.2 = inflorescence of the lowest branch;

Conclusions

The two subpopulations of *Sanguisorba officinalis* differ quite clearly in their size and average density but have a similar aggregated distribution pattern of dominance, i.e. of patches with *S. officinalis* occurence. Within the polygons which were delimitated to contain *S. officinalis* as opposed to the surrounding area, there are patches suitable for the growth of the Great Burnet as well as unsuitable stands. Again, there is a clear difference also here between FD and FS, with only a sixth of FD, but more than half of FS being favourable.

The differences between FD and FS as a suitable environment for *S. officinalis* could be caused through differences between the vegetation types, soil characteristics, the depth of underground water / stagnant moisture as well as actual and former land use, all these factors potentially being correlated also with each other. Interesting findings are expected through the comparison of the *S. officinalis* data with the population size and other parameters of two *Maculinea* butterfly species in the studied polygons.

Our findings about the biometrical features suggest that there could be significant differences between the subpopulations, for instance concerning the size of the basal leaves. Further studies should focus on the question if the phenological and/or genetical variability differ between the subpopulations.

Acknowledgements: We are deeply grateful to Professor Dr. Vasile Cristea for the discussion of our results and valuable comments. Furthermore, we would like to thank the working group of Professor Dr. Laszlo Rakosy for the fruitful collaboration and Gwyn Jones for his help during field work. Financial support for this research has been kindly provided by the German Federal Foundation for Environment (DBU, project nr. 27559).

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OBSERVAŢII ASUPRA STRUCTURII UNEI POPULAŢII DE *SANGUISORBA OFFICINALIS* DIN COMUNA DĂBÂCA (JUDEŢUL CLUJ, ROMÂNIA)

Rezumat: Lucrarea de faţă prezintă rezultatele unui studiu privind structura a două subpopulaţii de *Sanguisorba officinalis* (*Rosaceae*) desfăşurat în 2010 în comuna Dăbâca, judeţul Cluj, România. Cele două subpopulaţii sunt localizate în cadrul a două complexe de fânețe ce se diferenţiază prin modul de utilizare a terenului din trecut şi prin gradul de abandonare actual a acestuia. Fânețele studiate adăpostesc populaţii ale unor specii de fluturi rari din genul *Maculinea*, a căror plantă gazdă specifică este *S. officinalis*. Abandonarea practicilor de gospodărire agricolă tradiţională (cum ar fi cositul) şi intensificarea păşunatului ar putea avea efecte negative asupra

răspândirii fluturilor şi plantei lor gazdă; în acest sens, se impune elaborarea unor strategii de conservare pornind de la datele obținute prin intermediul studiilor populaționale. În acest studiu se compară cele două subpopulații de *S. officinalis* în ceea ce privește mărimea lor, densitatea indivizilor, principalele caracteristici morfometrice ale acestora, distribuția spațială şi corelația cu caracteristicile structurii vegetației. Rezultatele obținute arată că *S. officinalis* nu este răspândită în toată regiunea studiată şi doar în anumite zone, cu valori distincte în ceea ce privește suprafața ocupată în cele două fânețe. Acestea se pot datora unor factori abiotici diverşi (tipuri diferite de sol, gradul de umiditate a solurilor, adâncimea la care se află pânza de apă freatică, etc.), diferitelor tipuri de vegetație, precum şi istoriei folosinței terenurilor sau modului de utilizare actual al acestora. În vederea formulării unor măsuri pentru menținerea acestor populații la efective optime, astfel încât să se asigure, implicit, conservarea speciilor de fluturi periclitați, sunt necesare studii viitoare care să vizeze relația între caracteristicile populaționale ale *S. officinalis* şi factorii menționați anterior.

Cuvinte cheie: *Sanguisorba*, fâneață, mod de utilizare a terenului, mărimea populației, densitate, distribuție spațială, metoda morfometrică

Acta Horti Bot. Bucurest. **39**: 53–68
Bucureşti 2012

CONTRIBUTIONS TO THE KNOWLEDGE OF THE CORMOPHYTIC SHRUB VEGETATION FROM THE SUBALPINE LEVEL OF THE LATORIȚA HYDROGRAPHIC BASIN (VALCEA COUNTY, ROMANIA)

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Abstract: The results of the phytosociological research of the cormophytic shrub communities found in the structure of the vegetation layer from the subalpine level of the Latorița hydrographic basin are presented. The final set of results is completed by the identification and observation of five associations included in the class *Vaccinio-Piceetea* Br.–Bl. 1939: *Campanulo abietinae–Vaccinietum myrtilli* Boşcaiu 1971, *Rhododendro myrtifolii-Vaccinietum* (Borza 1959) Boşcaiu 1971, *Junipero-Bruckenthalietum spiculifoliae* Horvat 1936, *Vaccinio-Juniperetum communis* Kovács 1979, *Rhododendro myrtifolii-Pinetum mugi* Borza 1959 emend. Coldea 1986. Each association is characterised using as criteria the floristic element, life form and geo-element spectra.
Key words: *Vaccinio-Piceetea*, subalpine level, Latorița hydrographic basin, Southern Carpathians, Romania

Received 01 July 2012 *Revision accepted 28 September 2012*

Introduction

In the current paper there are presented the results of the coenologic research focused on the diversity of the cormophytic shrub communities found in the structure of the vegetation layer from the subalpine level of the Latorița hydrographyic basin. Thanks to the fact that this research work is the first of its kind in the area, the recorded results are completely new and original. The findings are closely linked to the previous floristic and chorological studies (Ștefureac et al. 1957, Buia et al. 1962, Pócs 1962, Anghel 2010, 2011, Anghel & Toma 2011), which they complete by emphasising the sociological value of species and their distribution in various phytocommunities.

In Latorița's limitrophe areas, previous botanical research was conducted by Ștefureac et al. (1957, 1962) (in the area Lotrului Valley), Păun & Popescu (1971) (in the area Oltețului Valley), Popescu (1974) (in the area Bistriței Vâlcii), Răduțoiu (2006) (in the area Cernei de Olteț Valley).

The results obtained are useful in the conservation management of the specific floristic diversity of the Latorița hydrographic basin.

Materials and methods

Investigated area. The river Latorița, tributary of the river Lotru, has a hydrographic basin of 195.40 km^2, bordered by the Parâng Mountains in the West, by Latoriței and Lotrului Mountains in the North, by Căpățânii Mountains and the Eastern peak of the Parâng Mountains in the South and East. The basin has a length (in aerial line) of about 29 km, oriented on the direction West-East. Altitude varies from between 520

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m at Gura Latoriței to 2185 m at Peak Galbenu (Figs 1, 2). Overall, the relief of the Latorița basin is greatly fragmented due to the development of a rich hydrographic network.

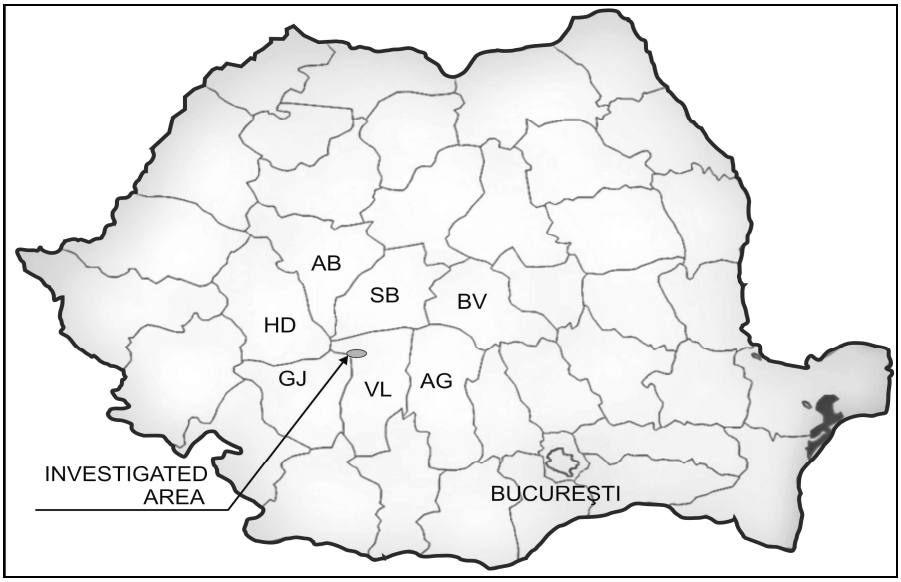

Fig. 1. Administrative map of Romania, pointing out the location of the Latorița hydrographic basin (compiled by D. Anghel)

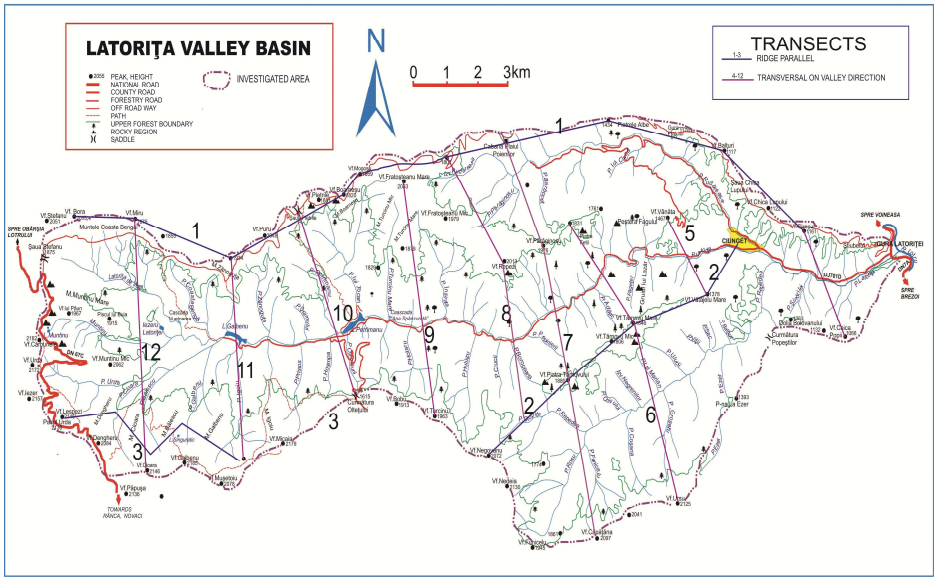

Fig. 2. Map of the Latorița hydrographic basin, with the 12 transects completed during the field research (compiled by D. Anghel)

The subalpine level stretches between 1750 and 2185 m altitude, extending over about 45% of the area of the basin; it has a wider spread on the peaks higher than 2000 m altitude, which are: Peak Galbenu (2185 m), Peak Cioara (2146 m), Peak Urda (2172 m), Peak Nedeia, (2130 m), Peak Negovanu (2072 m), Peak Muntinu Mic and Mare (2062 m), Peak Bora (2055 m), Peak Fratoşteanu Mare (2053 m) and Peak Ștefanu (2051 m).

The glacial relief is well represented in the region of the three tributary springs of the river Latorița (West Latorița, Muntinu and Urda), where each spring drains a glacial valley. On the northern slope of the Păpușa-Micaia Peak there are also glacial cirques, which stretch on a smaller area (Dengheru, Cioara, Bălescu, Galbenu, Igoiu and Pritos). There is one glacial cirque on the Eastern slope of the Fratoşteanu Mare Peak, where the glacial lake Negru is located.

The geological substrate of this vegetation level is diverse and includes granite, crystalline and ultrabasic (serpentinites) rocks, as well as limestone (Popescu et al. 2003), and the climate and the soil are typical for the peaks of the Southern Carpathians (Iancu 1970, Mândruț 2002).

Methodology. The procedures used in the phytocoenologic research were based on the methodology developed by the Central European Zurich-Montpellier school (Braun-Blanquet 1964), to which some subsequent amendments were added (Borza & Boşcaiu 1965, Boşcaiu 1971, Floyd & Anderson 1987, Bakker et al. 1996, Bohn et al. 2000, 2003).

The field research work started off with following the same transects completed in the taxonomic research (Fig. 2) and it consisted of the selection of the phtyocommunities and the collection of data regarding their vertical structure (by conducting relevees).

The selection of the phytocommunities was made using some key criteria, such as taxonomic diversity (establishing the specific composition), the abundance/ dominance and the degree of coverage of individuals of a plant species. The data recorded on the field also focused on sketching and photographing each of the analysed phytocommunities.

The timeframe for conducting the relevees varied according to the type of vegetation. In the vast majority of the cases, this process took place in the moment of maximum affirmation of the phenotype of each type of phytocoenosis. Overall, the capturing of the late-spring and the middle-summer aspects, offered conclusive images of the structure of the phytocoenoses.

The fundamental criterion taken into account for the identification of the coenotaxa was the species fidelity, abundance and dominance, in relation to certain ecological factors.

For the identification and classification of the cormophytic associations, there were used the works of both national authors (Coldea 1991, Coldea et al. 1997, Sanda et al. 2008) and international (Borhidi 1996, Mucina 1997, Weber et al. 2000, Rothmaler 2002).

The names of the taxa are consistent with the Flora Europaea (Tutin et al. 1996) and with www.theplantlist.org.

Results and discussion

The processing of the data collected during the field research through the implementation of 36 relevees, and the synthesis of the secondary data, have resulted in the identification in the structure of the vegetation layer of the subalpine level of the Latorița hydrographic basin of 5 associations of woody species belonging to four alliances, classified into three orders and one class, as below:

CL. VACCINIO-PICEETEA Br.– Bl. 1939
ORD. ATHYRIO-PICEETALIA Hadač 1962
AL. Rhododendro-Vaccinion Br.–Bl. ex G. Br.–Bl. & Br.–Bl. 1931
1. *Rhododendro myrtifolii-Vaccinietum myrtilli* (Borza 1959) Boşcaiu 1971
ORD. JUNIPERO-PINETALIA MUGI Boşcaiu 1971
AL. Pinion mugi Pawłowski 1928
2. *Rhododendro myrtifolii-Pinetum mugi* Borza 1959 emend. Coldea 1985
AL. Junipero-Bruckenthalion Horvat (Horvat 1949) Boşcaiu 1971
3. *Junipero-Bruckenthalietum* Horvat 1936
4. *Campanulo abietina-Vaccinietum myrtilli* Boşcaiu 1971
ORD. VACCINIO-JUNIPERETALIA Passarge & Hoffmann 1968
AL. Vaccinio-Juniperion communis Passarge & Hoffmann 1968
5. *Vaccinio-Juniperetum communis* Kovács 1979

For each association there were recorded: the current scientific name, the synonyms, the field distribution, the dynamic, a short taxonomic and ecological characterisation of the life forms and of the geographic elements, and a phytosociological table was compiled.

1. *Rhododendro myrtifolii-Vaccinietum* (Borza 1959) Boşcaiu 1971 (syn: *Rhodoretum kotschyi* auct. roman., *Rhodoreto-Juncetum trifidi* Resmeriță 1974) is included in the different classification systems of the habitat types: NATURA 2000: Alpine and Boreal heaths; EMERALD: 31.424 Carpathian Kotshy's alpenrose heaths; CORINE: 31.4 Alpine and Boreal heaths; PALAEARTIC HABITATS: 31.424 Carpathian Kotshy's alpenrose heaths; EUNIS: F2.224 Carpathian Kotschy's heaths; ROMANIAN HABITATS: R3104 South-eastern Carpathian Kotschy's heaths (*Rhododendron myrtifolium*) with bilberry (*Vaccinium myrtillus*) (Doniță et al. 2005). The association is fairly widespread and it covers vast areas on all the slopes of the subalpine level, where the *Pinus mugo* shrubs were cut, having mostly a secondary character.

The primary rhodoretums occupy small areas and vegetate on lithosols and on humic-silicate soils, shallow, with a reduced trophicity and a strong acid reaction to pH 4.5–5.2 (Sanda et al. 2008). In the floral composition of the rhodoretum there are well represented, alongside the characteristic species of the alliance *Rhododendro-Vaccinion* and for the order *Junipero-Pinetalia mugi*, the characteristic species for the order *Caricetalia curvulae*. The presence of the species of subalpine meadows as *Deschampsia flexuosa*, *Homogyne alpina, Soldanella hungarica* is due to excessive grazing in these areas (Table 1).

In the life forms spectrum, hemicryptophytes are dominant (73.68%), followed by phanerophyte, chamaephytes (10.53% each) and geophytes (5.26%). The geographic elements spectrum reveals the large share of Alpine elements (26.32%), followed by

Circumpolar elements (23.68%), Eurasian elements (18.42%) and Carpathian-Balkan elements (13.16%). The presence of Carpathian-Endemic elements (5.26%) offers a great conservative value to the phytocoenoses.

2. *Rhododendro myrtifolii-Pinetum mugi* Borza 1959 emend. Coldea 1985 (syn: *Pinetum mugi carpaticum* auct. roman., *Calamagrostio villosae-Pinetum mugi* Sanda et Popescu 2002) is included in the different classification systems of the habitat types: NATURA 2000: 4070* Bushes with *Pinus mugo* and *Rhododendron myrtifolium*; EMERALD: 31.4 Alpine and Boreal heaths; CORINE: does not have a correspondent; PALAEARTIC HABITATS: 31.561 Subalpine mountain pine scrub; EUNIS: F2.46 Carpathian *Pinus mugo* scrub F2.461+F2.462; ROMANIAN HABITATS: R3105 South-eastern Carpathian *Pinus mugo* heaths with alpenrose (*Rhododendron myrtifolium*) (Doniță et al. 2005). The association can be frequently found in the researched area, at the upper limit of the spruce forests, on humic-silicate, brown-ferifluvial soils, with a high percentage of organic matter and a strong acid reaction. Regarding physiognomy, the *Pinus mugo* heaths take the form of compact heaths of 2–2.5 meters long, to which, sometimes, alongside the characteristic and dominant species, *Pinus mugo*, there can also be found *Juniperus communis* var. *saxatilis* (syn. *Juniperus sibirica*), *Alnus alnobetula* and *Sorbus aucuparia*.

In the herbaceous-subshrub layer, the characteristic species *Rhododendron myrtifolium* is accompanied by numerous elements of the order *Vaccinio-Piceetalia* (*Vaccinium myrtillus, V. uliginosum, V. vitis-idaea, Homogyne alpina* etc.) (Table 2). The mosses layer is developed, consisting of *Sphagnum* sp., *Pleurozium schreberi, Polytrichum* sp. and *Dicranum scoparium*. The massive deforestation of the last years in Muntinu, Cioara, Dengheru and the pastoral activities has led to the secondary establishment of the associations *Potentillo ternatae-Festucetum airoidis* Boşcaiu 1971, *Violo declinatae-Nardetum strictae* Simon 1966.

The life forms spectrum consists of hemicryptophyte elements (67.57%), phanerophytes (16.22%), chamaephytes (13.51%) and geophytes (2.7%). The geographic elements are represented by Alpine-European species (35.14%), Circumpolar species (21.62%), Eurasian species (16.22%), Carpathian-Balkan species (13.51%), European and Central-European (5.41% each) and autochthonous species (2.7%).

3. *Junipero-Bruckenthalietum spiculifoliae* Horvat 1936 (syn: *Juniperetum intermediae* Nyárády 1956 n.n., *Bruckenthalietum spiculifoliae* Buia et al. 1962 p.p., *Bruckenthalia spiculifolia* with *Antennaria dioica* Şerbănescu 1961, *Nardus stricta* with *Bruckenthalia spiculifolia* Şerbănescu 1961) is included in the different classification system of the habitat types: NATURA 2000: 4060 Alpine and Boreal heaths; EMERALD: 31.46 *Bruckenthalia* heaths; CORINE: 31.46 *Bruckenthalia* heaths; PALAEARTIC HABITATS: 31.4632 Carpathian *Bruckenthalia* heaths; EUNIS: F2.2632 Carpathian *Bruckenthalia* heaths; ROMANIAN HABITATS: R3107 South-eastern Carpathian *Bruckenthalia spiculifolia* heaths with dwarf junipers (*Juniperus communis* var. *saxatilis*) (Doniță et al. 2005).

The mesophilic, microthermic and acidophilic phytocoenoses of this association, characteristic of subalpine heaths, develop on flat or inclined areas, with shallow or emerging, sunny and (slightly) acid soils. The heaths established by *Juniperus communis* s.l. have a coverage ranging from 80 to 100% and are tristratified. The upper

layer consists of the dominating and characteristic species *Juniperus communis* s.l., and very often there are also present individuals of *Pinus mugo* and *Picea abies*. The middle layer is composed of the characteristic species *Bruckenthalia spiculifolia* and of numerous other accompanying species: *Vaccinium myrtillus*, *V. vitis-idaea*, *Homogyne alpina*, *Deschampsia flexuosa*, *Campanula patula* subsp. *abietina*, *Rhododendron myrtifolium*, *Epilobium angustifolium* etc., whereas the lower layer is formed of mosses and some lichens (*Cetraria* sp., *Cladonia* sp.) (Table 3). Most often, these phtyocoenoses have a secondary character, developing on the areas of deforested spruce forests, and up to altitudes of between 1750 and 1900 meters.

Hemicryptophytes (75.76%), phanerophytes (15.15%), chamaephytes (6.06%) and geophytes (3.03%) make up the life forms spectrum. In the spectrum of the phyto-geographical elements, the Alpine-European (30.3%) and Eurasian elements (24.24%) are the dominant ones, followed by Circumpolar and Central-European elements (15.15% each). The smallest percentage is held by the Carpathian elements (3.03%), but this figure is significant, bearing in mind the investigated area, which requires an in-depth analysis in order ensure their efficient protection

4. *Campanulo abietinae-Vaccinietum myrtilli* Boşcaiu 1971 [syn: *Campanulo abietinae–Vaccinietum* (Buia et al. 1962) Boşcaiu 1971, *Vaccinietum myrtilli* Buia et al. 1962, *Junceto trifidi–Vaccinietum myrtilli* Resmeriță 1976, *Melampyro saxosi-Vaccinietum myrtilli* Coldea 1990] is included in the different classification systems of habitat types: NATURA 2000: Alpine and Boreal heaths; EMERALD: 31.4 Alpine and Boreal heaths; CORINE: 31.412 Alpine *Vaccinium* heaths; PALAEARTIC HABITATS 31.4122 Carpathian dwarf *Vaccinium* wind heaths; EUNIS: F2.2122 Carpathian dwarf (*Vaccinium*) wind heaths; ROMANIAN HABITATS: R3111 South-eastern Carpathian bilberry heaths (*Vaccinium myrtillus*) (Doniță et al. 2005). The association is spread at altitudes of between 1850 and 1950 m, on semi-sunny slopes, with a moderate inclination. The association was described for the first time on the Buia limitrophe area, and is established by circumpolar and boreal species, oligotrophic, acidophilous with varying hydric requirements (Buia et al. 1962). It is a secondary association, but it has great coenotic stability, developing on the areas of juniper and spruce deforestation, and it has a wide coverage (50–100%). The subshrub layer is constantly dominated by *Vaccinium myrtillus*, sometimes the species being monodominant. For this reason, the phytocommunities located at the lower altitudinal limit of the association have a monotonous aspect. Sometimes, a large number of elements of *Vaccinium vitis-idaea*, *V. uliginosum*, *Rhododendron myrtifolium*, *Juniperus communis* var. *saxatilis* can occur (Table 4).

The life forms spectrum emphasises the prevalence of hemicryptophytes (80.43%), chamaephytes (8.7%) and phanerophytes (6.52%). The spectrum of the floristic elements reflects the large share of European species (26.09%), Circumpolar species (23.91%), Eurasian species (21.74%), Carpathian-Balkan species (17.39%).

5. *Vaccinio-Juniperetum communis* Kovács 1979 (syn: *Campanulo abietinae – Juniperetum* Simon 1966, *Juniperetum nanae* Soó 1928, *Juniperetum sibiricae* Rațiu 1965, *Junipereto-Vaccinietum* Puşcaru et al. 1956) is included in the different classification systems of habitat types: NATURA 2000: 4060 Alpine and Boreal heaths; EMERALD: 31.46 *Bruckenthalia* heaths; CORINE: 31.46 *Bruckenthalia* heaths; PALAEARTIC HABITATS: 31.4632 Carpathian *Bruckenthalia* heaths; EUNIS:

F2.2632 Carpathian *Bruckenthalia* heaths; ROMANIAN HABITATS: R3108 South-eastern Carpathian dwarf juniper heaths (*Juniperus communis* var. *saxatilis*) (Doniță et al. 2005).

The phytocoenoses of this association extend into the areas of the subalpine level, sometimes going down into the upper montaine sublevel, at altitudes between 1750 and 1900 m, on moderately inclined slopes. Alongside the edifying and characteristic species represented by *Vaccinium myrtillus* and *Juniperus communis* s.l., numerous elements of the order *Vaccinio-Piceetea* are well represented (Table 5).

In the life forms spectrum, hemicryptophytes have a share of 76.47% of the total of species. Alongside these, there coexist phanerophytes (14.71%), chamaephytes (5.88%) and geophytes (2.94%). In the spectrum of phyto-geographical elements, the Alpine-European elements are dominant (26.47%), followed by Eurasian elements (23.53%), Carpathian-Balkan elements (20.59%) and Circumpolar elements (17.65%).

From the results obtained we concluded that on the subalpine level of the Latorița hydrographic basin, there can be found the main shrub and subshrub associations typical of this vegetation level, despite its fairly limited area.

From the comparative analysis of the floristic, life forms and geographic elements spectra of the associations found in the Latorița hydrographic basin with those of the habitats of the Romanian Carpathians (cited below), several similarities were noted, but also some peculiarities that are related to the impact of a number of local pedo-climatic factors.

The defining communities are those of *Pinus mugo*, belonging to the associations of *Rhododendro myrtifolii-Pinetum mugi* Borza 1959 emend. Coldea 1986, *Rhododendro myrtifolii-Vaccinietum* (Borza 1959) Boşcaiu 1971 and *Junipero-Bruckenthalietum spiculifoliae* Horvat 1936, which stretch over fairly large areas and are well preserved, comparing to the neighbouring areas (Popescu 1974, Răduțoiu 2006) and other places of the Romanian Carpathians (Coldea 1980, 1991, Coldea et al. 1997, Danci & Cristea 2009). This situation can be explained by the implementation of better, more effective management measures by the Forestry Department of Vâlcea County, and also by the existence of moderate grazing, due to smaller meadow areas. Nevertheless, the areas currently populated with junipers in the Latorița basin represent only 50–60% of that covered over a century ago (Boşcaiu 1975, Coldea 1980, Pânzaru 1983).

Conclusions

The description of the five shrub and subshrub associations brings a significant contribution to the knowledge and understanding of the vegetal layer of the subalpine level of the Latorița hydrographic basin. Given the conservation values of these phytocommunities, it is necessary to achieve a more efficient management that can ensure their ecological reconstruction and the expansion of the areas they occupy.

The action plan must make provisions for the regulation, monitoring and the control of the natural resources exploitation activities conducted in the area, as well as for the creation of a Red List of protected, endangered or on the verge of extinction plants. Furthermore, action is required for the creation of protected areas (for the areas hosting representative elements of interest in terms of flora, fauna, landscape, geology, geomorphology etc.), and for their monitoring and management, and for education and raising awareness among the public regarding the importance of nature conservation.

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CONTRIBUŢII LA CUNOAŞTEREA VEGETAŢIEI CORMOFITICE DIN ETAJUL SUBALPIN AL BAZINULUI HIDROGRAFIC LATORIŢA (JUDEŢUL VÂLCEA, ROMÂNIA)

Rezumat: Sunt prezentate rezultatele cercetărilor fitosociologice privind comunităţile arbustive şi subarbustive din structura covorului vegetal din etajul subalpin al bazinului hidrografic Latoriţa, finalizate prin identificarea şi caracterizarea a 5 asociaţii încadrate în clasa *Vaccinio-Pceetea* Br.– Bl. 1939 şi anume: *Campanulo abietinae-Vaccinietum myrtilli* Boşcaiu 1971; *Rhododendro myrtifolii-Vaccinietum* (Borza 1959) Boşcaiu 1971; *Junipero-Bruckenthalietum spiculifoliae* Horvat 1936; *Vaccinio-Juniperetum communis* Kovács 1979; *Rhododendro myrtifolii-Pinetum mugi* Borza 1959 emend. Coldea 1986. Fiecare asociaţie este caracterizată utilizând drept criterii spectrele floristice, ale bioformelor şi geoelementelor.

Cuvinte cheie: *Vaccinio-Piceetea*, etaj subalpin, bazinul hidrografic Latoriţa, Carpaţii Meridionali, România.

Table 1

Rhododendro myrtifolii-Vaccinietum (Borza 1959) Boşcaiu 1971 association

Life form	Geographic element	Number of relevee	1	2	3	4	5	6	7	8	9	10	K
		Altitude (m)	1850	1860	1860	1890	1910	1860	1840	1860	1930	1980	
		Exposure	E	E	N	E	E	E	E	E	E	N-E	
		Inclindation (degree)	25	15	20	45	45	45	30	30	50	30	
		Vegetation cover (%)	100	100	100	100	100	100	100	100	100	100	
		Researched area (m)	100	100	100	100	100	100	100	100	100	100	
Characteristic species													
Ph.	Carp.-Balc.	*Rhododendron myrtifolium*	3–4	4–5	2	4	3–4	4	4–5	4	4	3–5	V
Ch.	Circ. Arct.-Alp.	*Vaccinium uliginosum*	1	+	1	–	+	+	–	–	+	+	IV
		Rhododendro-Vaccinion											
Ch.	Cosm.	*Huperzia selago*	+	–	+	–	–	+	+	–	+	–	III
H.	Carp.-Balc.	*Soldanella hungarica*	–	+	–	–	+	–	–	+	–	+	II
H.	Circ.-Arct.-Alp.	*Carex atrata*	–	+	+	–	–	+	–	–	+	–	II
H.	Circ.-Arct.-Alp.	*Hieracium alpinum*	+	–	–	+	–	–	+	+	–	–	II
		Junipero-Pinetalia mugi* & *Vaccinio-Piceetalia											
H.	Carp.-Balc.	*Campanula patula* subsp. *abietina*	+	–	+	+	+	–	+	+	+	+	IV
Ph.	Centr.-Eur.-Mont.	*Pinus mugo*	+	–	+	+	+	–	+	+	–	–	III
Ph.	Arct.-Alp.	*Juniperus communis* var. *saxatilis*	–	+	+	+	–	+	+	+	–	–	III
Ch.(Ph.)	Circ.	*Vaccinium myrtillus*	1–2	–	1	+	1	–	1	–	+	–	III
Ch.(Ph.)	Circ.	*Vaccinium vitis-idaea*	+	+	–	–	+	–	+	–	+	–	III
H.	Alp. Eur.	*Homogyne alpina*	+	+	–	+	–	+	–	+	–	+	III
H.	Circ.	*Deschampsia flexuosa*	+	1	+	–	1	+	–	–	+	–	III
H.	Euras.	*Calamagrostis villosa*	–	–	–	+	–	+	–	+	–	+	II
		Caricetalia curvulae											
H.	Circ.-Arct.-Alp.	*Juncus trifidus*	–	+	+	+	–	1	+	–	1	–	IV
H.	Alp.-Carp.	*Pulsatilla alba*	+	–	–	+	+	–	–	+	+	+	III
H.	Alp.-Eur.	*Agrostis rupestris*	–	+	–	–	1–2	+	+	1	–	+	III
H.	Euras.-Arct.-Alp.	*Festuca supina*	+	–	+	–	–	–	+	–	+	–	II
H.	Alp.-Carp.	*Oreochloa disticha*	–	–	+	+	–	+	–	–	+	–	II
H.	Alp.-Eur.	*Avenula versicolor*	–	+	–	–	+	–	+	–	+	–	II

		Variae syntaxa											
H.	Alp.-Eur.	*Geum montanum*	+	+	+	+	–	+	–	+	+	+	IV
H.	Alp.-Eur.	*Ligusticum mutellina*	+	+	–	+	+	–	+	–	–	+	III
H.	Centr. Eur.	*Luzula luzuloides*	–	–	+	–	+	+	–	+	–	–	II
H.	Alp.-Eur.	*Soldanella pusilla*	+	–	–	+	–	–	+	–	–	+	II
H.	Circ.Arct.-Alp.Euram.	*Gnaphalium supinum*	–	+	–	–	+	–	–	+	–	+	II
H.	Cosm.	*Deschampsia cespitosa*	+	–	+	–	–	–	–	–	+	+	II
H.	Euras.	*Veratrum album*	–	+	–	–	+	–	+	+	–	–	II
H.	Euras.(Circ.)	*Nardus stricta*	–	+	1	–	–	+	–	–	+	–	II
Ph.(Ch.)	Carp.-Balc.	*Bruckenthalia spiculifolia*	+	–	–	1	–	–	1	–	–	1–2	II
G.	Alp. Carp.-Balc.	*Scorzonera rosea*	–	–	–	–	+	–	–	+	–	–	I

Species in only one relevee: H., Euras. Arct.-Alp.-Eur., *Hieracium aurantiacum* (1); G., Euras., *Lilium martagon* (2); H., End. Carp., *Campanula serrata* (3); H., Carp. Balc., *Sesleria coerulans* (4); H., Alp. Carp., *Hypochaeris uniflora* (6); H., Euras., *Leontodon autumnalis* (6); H., End. Carp. Rom., *Onobrychis montana* (6); H., Circ. Arct.-Alp., *Luzula alpinopilosa* (10). **Place and date of the relevees**: 1. Petrimanu (27.08.2009); 2. Zănoguţa (21.05.2011); 3. Dengheru (12.07.2009); 4. Cioara (30.07.2010); 5. Igoiu (05.07.2007); 6. Căldarea Galbenu (30.07.2010); 7. Pristos (20.08.2010); 8. Bălescu (17.08.2010); 9. Muntinu Mare (30.07.2010); 10. Muntinu Mic (25.07.2008).

Table 2

Rhododendro myrtifolii-Pinetum mugi Borza 1959 emend. Coldea 1985 association

		Number of relevee	1	2	3	4	5	6	7	8	9	10	
Life form	Geographic element	Altitude (m)	2010	1980	2010	2020	1980	1970	1980	1990	1980	1970	K
		Exposure	E	E	N	S	N	E	N	E	E	E	
		Inclination (degree)	10	45	30	25	30	45	15	45	45	45	
		Vegetation cover (%)	100	100	90	100	100	100	100	100	100	100	
		Researched area (m)	500	500	500	500	500	500	500	500	500	500	
Characteristic species													
Ph.	Centr.-Eur.-Mont.	*Pinus mugo*	4	5	3	4	5	5	4–5	4–5	5	5	V
Ph.	Carp.-Balc.	*Rhododendron myrtifolium*	1	+	2–3	1	+	+	1	+	+	+	V
		Junipero-Pinetalia mugi* & *Vaccinio-Piceetalia											
Ch.(Ph.)	Circ.	*Vaccinium myrtillus*	1	+	–	+	+	1	+	1	–	+	IV
H.	Carp-Balc.	*Campanula patula* subsp. *abietina*	–	+	+	+	–	+	+	+	+	+	IV
Ch.(Ph.)	Circ. Bor.	*Vaccinium uliginosum*	+	+	–	–	+	–	+	+	–	+	III
Ch.(Ph.)	Circ.	*Vaccinium vitis-idaea*	+	+	–	–	+	–	+	–	–	+	III
H.	Circ.	*Deschampsia flexuosa*	–	–	+	+	–	+	–	+	+	–	III
Ph.	Arct.-Alp.	*Juniperus communis* var. *saxatilis*	+	+	–	–	+	–	+	–	–	+	III
H.	Alp. Eur.	*Homogyne alpina*	+	–	+	–	–	–	+	–	+	–	II
		Variae syntaxa											
H.	Euras.(Circ.)	*Nardus stricta*	–	+	+	+	+	–	+	+	+	+	IV
H.	Carp.-Balc.	*Potentilla ternata*	+	–	+	+	–	+	–	+	+	+	IV
H.	Alp.-Eur.	*Geum montanum*	+	+	–	–	+	+	+	+	+	–	IV
G.	Alp. Carp.-Balc.	*Scorzonera rosea*	–	+	+	+	–	–	+	–	–	+	III
H.	Alp. Eur.	*Hieracicum villosum*	+	–	+	–	–	–	–	+	+	+	III
H.	Alp.-Carp.-Balc.	*Phyteuma confusum*	–	+	–	–	+	+	+	–	–	+	III
H.	Euras.	*Veratrum album*	–	+	–	+	–	+	–	+	–	–	II
H.	Alp.-Carp.-Balc.	*Soldanella major*	+	–	+	–	–	–	–	–	+	–	II
Ph.	Eur.	*Sorbus aucuparia*	–	+	–	–	+	–	–	+	–	–	II

H.	Circ.-Arct.-Alp.-Euram.	*Pedicularis verticillata*	–	–	–	+	+	–	–	–	–	+	II
H.	Alp.-Euras.-Arct.	*Gentiana verna*	–	+	–	+	–	–	–	+	–	–	II
H.	Alp. Eur.	*Centaurea nervosa*	–	–	–	+	–	+	–	–	–	+	II
Ch.(H.)	Euras.	*Antennaria dioica*	–	–	–	+	+	–	–	–	–	+	II
H.	Euras.	*Potentilla erecta*	+	–	–	–	–	–	+	–	+	–	II
H.	Circ. Alp.	*Phleum alpinum*	+	–	+	–	–	–	–	–	–	–	I
H.	Euras.	*Senecio ovatus*	–	–	–	–	–	+	–	+	–	–	I
H.	Alp.-Eur.	*Rumex alpinus*	–	–	–	+	–	–	–	–	–	+	I
H.	Alp.-Eur.	*Ligusticum mutellina*	–	+	–	–	–	–	–	+	–	–	I
H.	Centr. Eur.	*Luzula luzuloides*	+	–	–	–	+	–	–	–	–	–	I
H.	Euras.	*Hypericum maculatum*	–	–	+	+	–	–	–	–	–	–	I
H.	Carp.-Balc.-Anat.	*Plantago gentianoides*	–	–	–	–	–	–	–	+	+	–	I
H.	Alp.-Carp.-Balc.	*Achillea distans*	–	–	–	–	–	–	+	–	–	+	I
Brchs.	Circ.	*Sphagnum angustifolium*	+	–	–	–	+	–	–	–	–	–	I
Brchr.	Circ.	*Pleurozium schreberi*	–	+	–	–	–	+	–	–	–	–	I
Brch.	Cosm.	*Polytrichum commune*	–	–	–	–	–	+	–	+	–	–	I
Brchc.	Circ.	*Dicranum scoparium*	+	–	–	–	–	–	+	–.	–	–	I

Species in only one relevee: H., End. Carp., *Campanula serrata* (1); Ch., Circ. Arct.-Alp., *Vaccinium uliginosum* (4); H., Eur. (Mont.), *Cicerbita alpina* (6); H., Circ. Arct.-Alp.-Euram., *Bartsia alpina* (7); Ph., Alp.-Eur., *Alnus alnobetula* (8); Ph., Carp.-Balc.-Sudet., *Salix silesiaca* (10). **Place and date of the relevees**: 1. Bora (25.08.2007); 2. Căldarea Muntinu (25.07.2008); 3. şi 4. Muntinu Mic (25.07.2008); 5. Dengheru (12.07.2009); 6. Căldarea Cioara (30.07.2010); 7. Valea Cioara (30.07.2010); 8. Căldarea Bălescu (12.08.2011); 9. Igoiu (05.07.2007); 10. Pristos (05.07.2007).

Table 3

Junipero-Bruckenthalietum spiculifoliae Horvat 1936 association

		Number of relevee	1	2	3	4	5	
Life form	Geographic element	Altitude (m)	1750	1800	1850	1870	1840	K
		Exposure	S	V	E	E	N	
		Inclination (degree)	10	15	15	15	20	
		Vegetation cover (%)	80	90	100	100	90	
		Researched area (m)	100	100	100	100	100	
Characteristic species								
Ph.	Circ.	*Juniperus communis* s.l.	3–4	3	4–5	4–5	3–4	V
Ph.(Ch.)	Carp.-Balc.	*Bruckenthalia spiculifolia*	1	1	+	+	1	V
		Junipero-Bruckenthalion spiculifoliae						
H.	Carp.-Balc.	*Campanula patula* subsp. *abietina*	+	–	+	+	+	IV
H.	Carp.-Balc.	*Potentilla ternata*	–	+	+	+	1	IV
H.	End. Carp.	*Campanula serrata*	+	+	–	–	–	II
		Junipero-Pinetalia* & *Vaccinio-Piceetea						
Ch.(Ph.)	Circ.	*Vaccinium myrtillus*	1	–	+	–	1	III
Ph.	Centr.-Eur.-Mont.	*Pinus mugo*	+	1	–	+	–	III
Ch.(Ph.)	Circ.	*Vaccinium vitis-idaea*	+	+	–	+	–	III
H.	Alp. Eur.	*Homogyne alpina*	–	–	–	+	+	II
Ph.	Centr. Eur. şi N.	*Picea abies*	+	+	–	–	–	II
		Variae syntaxa						
Ph.	Carp.-Balc.	*Rhododendron myrtifolium*	+	+	–	+	1	IV
H.	Circ.	*Deschampsia flexuosa*	+	–	+	–	+	III
H.	Euras. (Circ.)	*Nardus stricta*	–	+	–	+	+	III
H.	Alp.-Carp.	*Aconitum tauricum*	+	–	+	–	–	II
H.	Alp.-Eur.	*Agrostis rupestris*	–	+	–	+	–	II
H.	Alp.-Eur.	*Geum montanum*	–	+	+	–	–	II
H.	Euras.	*Veratrum album*	+	–	–	+	–	II
H.	Alp.-Eur.	*Ligusticum mutellina*	–	–	+	–	+	II
H.	Centr.Eur.-Submedit.	*Senecio ovatus*	+	–	–	–	+	II
H.	Centr. Eur.	*Luzula luzuloides*	–	–	+	–	+	II
H.	Alp. Eur.	*Centaurea nervosa*	+	+	–	–	–	II
H.	Alp. Eur.	*Gentiana acaulis*	–	–	–	+	+	II
G.	Alp. Carp.-Balc.	*Scorzonera rosea*	+	–	–	+	–	II
H.	Euras.	*Hypericum maculatum*	–	+	+	–	–	II
H.	Alp.-Carp.-Balc.	*Phyteuma confusum*	–	–	+	–	+	II
H.	Circ.	*Gnaphalium sylvaticum*	+	–	–	+	–	II
H.	Circ.	*Epilobium angustifolium*	–	+	+	–	–	II
Fr.	Circ.- Arct.-Alp.	*Cetraria islandica*	–	–	+	+	–	II
Fr.	Circ.- Arct.-Alp.	*Cladonia rangiferina*	+	–	–	–	+	II

Species in only one relevee: H., Euras, *Potentilla erecta* (1); H., Euras., *Trifolium repens* (1); H., Alp.-Eur., *Avenula versicolor* (2); H., Centr. Eur.-Medit., *Carlina acaulis* (3); H., Euras.-Arct.-Alp.-Eur., *Hieracium aurantiacum* (4); H., Subarct.-Alp.-Euras., *Luzula sudetica* (5); H., Euras., *Trifolium pratense* (5). **Place and date of the relevees**: 1. Coasta Bengăi (09.07.2011); 2. Ştefanu (03. 08.2010); 3. Muntinu Mare (25.08.2008); 4. Bălescu (12.08.2011); 5. Dengheru (15.07.2011).

Table 4

Campanulo abietinae – Vaccinietum myrtilli Boşcaiu 1971 association

Life form	Geographic element	Number of relevee	1	2	3	4	5	6	K
		Altitude (m)	1850	1870	1945	1900	1850	1850	
		Exposure	V	N	N	N-E	N	E	
		Inclination (degree)	40	25	30	35	20	60	
		Vegetation cover (%)	50	95	80	65	85	100	
		Researched area (m)	100	100	100	100	100	100	
Characteristic species									
H.	Carp.-Balc.	*Campanula patula* subsp. *abietina*	+	+	+	+	+	+	V
Ch.(Ph.)	Circ.	*Vaccinium myrtillus*	3	4	3–4	3	3–4	4	V
		Junipero-Bruckenthalion & ***Vaccinio-Piceetea***							
Ph.	Carp.-Balc.	*Rhododendron myrtifolium*	1	+	1–2	+	1–2	+	V
Ch.(Ph.)	Circ.-Bor.	*Vaccinium uliginosum*	+	1	+	–	+	–	IV
Ch.(Ph.)	Circ.	*Vaccinium vitis-idaea*	–	+	–	+	–	+	III
Ph.	Arct.-Alp.	*Juniperus communis* var. *saxatilis*	1	–	–	–	–	1	II
H.	Alp.-Eur.	*Homogyne alpina*	–	+	–	+	–	–	II
Ph.	Centr.-Eur.-Mont.	*Pinus mugo*	+	–	–	–	–	1	II
		Caricion curvulae & ***Juncetea trifidi***							
H.	Alp. Eur.	*Geum montanum*	+	+	+	+	+	+	V
H.	Carp.-Balc.	*Potentilla ternata*	+	+	+	+	–	+	V
H.	Circ.-Arct.-Alp.	*Loiseleuria procumbes*	+	+	+	+	+	–	V
H.	Subarct.-Alp.-Euras.	*Luzula sudetica*	+	–	+	+	+	+	V
H.	Alp.-Carp.-Balc.	*Phyteuma confusum*	+	+	+	+	–	+	IV
H.	Carp.-Balc.	*Viola declinata*	+	+	–	+	+	–	IV
H.	Alp. Eur.	*Centaurea nervosa*	–	+	–	+	–	+	III
H.	Alp. Eur.	*Ligusticum mutellina*	+	–	+	–	+	–	III
H.	Circ.-Arct.-Alp.	*Luzula spicata*	–	+	+	+	–	–	III
H.	Alp.-Eur.	*Gentiana acaulis*	–	–	–	+	+	–	II
H.	Circ.-Arct.-Alp.	*Carex atrata*	+	–	–	+	–	–	II
H.	Circ.-Arct.-Alp.	*Juncus trifidus*	+	+	–	–	–	–	II
		Potentillo-Nardion & ***Nardetalia strictae***							
H.	Euras.(Circ.)	*Nardus stricta*	1	+	1	+	1	+	V
H.	Euras.-Arct.-Alp.	*Festuca airoides*	+	1	+	+	+	+	V
H.	Alp.- Eur.	*Agrostis rupestris*	1	+	+	+	+	+	V
Ch.(H.)	Euras.	*Antennaria dioica*	–	–	+	–	+	–	II
		Festuco saxatilis-Seslerion bielzii & ***Seslerietea albicantis***							
H.	Carp.-Balc.	*Sesleria bielzii*	+	–	+	–	+	–	III
H.	Circ.-Arct.-Alp.-Euram.	*Pedicularis verticillata*	+	–	+	–	+	–	III
H.	Alp.-Euras.-Arct.	*Gentiana verna*	–	+	+	–	–	–	II
H.	Alp.-Eur.	*Carex sempervirens*	–	–	1	–	+	–	II
		Variae syntaxa							
H.	Circ.-Arct.-Alp.-Euram.	*Bartsia alpina*	+	–	+	–	+	–	III
H.	Euras.	*Anthoxanthum odoratum*	–	–	+	+	–	–	II
H.	Alp.-Carp.	*Oreochloa disticha*	+	–	–	–	+	–	II
H.	Alp.-Eur.	*Trifolium pratense*	–	–	–	+	+	–	II
H.	Carp.-Balc.	*Trifolium repens*	–	–	+	–	+	–	II

Species in only one relevee: H., Alp. Eur., *Hieracium villosum* (1); H., Alp.-Eur., *Tanacetum alpinum* (1); G., Alp.-Carp.-Balc., *Scorzonera rosea* (2); H., Circ., *Deschampsia flexuosa* (3); H., Euras., *Potentilla erecta* (3); H., Alp.-Euras.-Arct., *Gentiana verna* (3); H., Circ. Alp., *Phleum alpinum* subsp. *commutatum* (4); T., Eur. Centr., *Euphrasia rostkoviana* (5); H., Euras., *Veratrum album* (6); H., Euras.Arct.-Alp.-Eur., *Hieracium aurantiacum* (6); H., Alp.-Carp., *Hypochaeris uniflora* (6); H., Eur., *Alchemilla vulgaris* (6); H., Alp. Eur., *Alnus alnobetula* (6). **Place and date of the relevees**: 1. Culmea Dengheru (30.07.2010); 2. Zănoguța (05.07.2008); 3. Puru (25.08.2009); 4. Petrimanu (27.08.2009); 5. Vf. Fratoşteanu (15.08.2008); 6. Cioara (30.07.2010).

Table 5

Vaccinio-Juniperetum communis Kovács 1979 association

		Number of relevee	1	2	3	4	5	
Life form	Geographic elements	Altitude (m)	1830	1860	1780	1810	1860	
		Exposure	S-E	S-E	N	S	S	K
		Inclination (degree)	20	15	10	20	15	
		Vegetation cover (%)	90	80	100	90	90	
		Researched area (m)	100	100	100	100	100	
Characteristic species								
Ph.	Circ.	*Juniperus communis*	4–5	1–2	4–5	4	3–4	V
Ch.(Ph.)	Circ.	*Vaccinium myrtillus*	+	3	+	+	1	V
		Junipero-Bruckenthalion spiculifoliae						
H.	Carp.-Balc.	*Campanula patula* subsp. *abietina*	+	–	+	+	+	IV
Ph.(Ch.)	Carp.-Balc.	*Bruckenthalia spiculifolia*	–	+	1	1	1–2	IV
H.	Carp.-Balc.	*Potentilla ternata*	+	–	+	–	+	III
		Junipero-Pinetalia & ***Vaccinio-Piceetea***						
Ch.(Ph.)	Circ.	*Vaccinium vitis-idaea*	+	+	–	+	–	III
Ph.	Centr.-Eur.-Mont.	*Pinus mugo*	+	+	–	+	–	III
H.	Alp. Eur.	*Homogyne alpina*	–	–	–	+	+	II
H.	End. Carp.	*Campanula serrata*	+	+	–	–	–	II
		Variae syntaxa						
H.	Euras.Arct.-Alp.	*Festuca supina*	+	+	+	+	+	V
Ph.	Carp.-Balc.	*Rhododendron myrtifolium*	1	+	–	+	+	IV
H.	Circ.	*Deschampsia flexuosa*	+	–	+	–	+	III
H.	Euras. (Circ.)	*Nardus stricta*	–	+	–	+	+	III
H.	Alp.-Carp.	*Aconitum tauricum*	+	–	+	–	–	II
H.	Alp.-Eur.	*Agrostis rupestris*	–	+	–	+	–	II
H.	Alp.-Eur.	*Geum montanum*	–	+	+	–	–	II
H.	Euras.	*Veratrum album*	+	–	–	+	–	II
H.	Alp.-Eur.	*Ligusticum mutellina*	–	–	+	–	+	II
H.	Centr.Eur.-Submedit.	*Senecio ovatus*	+	–	–	–	+	II
H.	Centr. Eur.	*Luzula luzuloides*	–	–	+	–	+	II
H.	Alp. Eur.	*Centaurea nervosa*	+	+	–	–	–	II
H.	Euras.	*Lotus corniculatus*	+	–	+	–	–	II
H.	Alp. Eur.	*Gentiana acaulis*	–	–	–	+	+	II
G.	Alp. Carp.-Balc.	*Scorzonera rosea*	+	–	–	+	–	II
H.	Euras.	*Hypericum maculatum*	–	+	+	–	–	II
H.	Alp.-Carp.-Balc.	*Phyteuma confusum*	–	–	+	–	+	II
H.	Circ.	*Gnaphalium sylvaticum*	+	–	–	+	–	II
H.	Euras.	*Potentilla erecta*	–	+	+	–	–	II

Species in only one relevee: H., Alp. Eur., *Carex sempervirens* (1); H., Alp.-Eur., *Avenula versicolor* (2); H., Euras.-Arct.-Alp.-Eur., *Hieracium aurantiacum* (3); Ph.(Ch.), Circ. Bor., *Vaccinium uliginosum* (3); H., Euras., *Trifolium pratense* (4); H., Carp.-Balc., *Viola declinata* (5).
Place and date of the relevees: 1. Petrimanu (17.07.2010); 2. Muntinu Mic (03. 08.2010); 3. Muntinu Mare (25.08.2008); 4. Cioara (19.08.2011); 5. Dengheru (15.07.2011).

Acta Horti Bot. Bucurest. **39**: 69–90
Bucureşti 2012

PRELIMINARY STUDY ON THE FLORA OF THE SNAGOV LAKE NATURAL RESERVE AND ITS SURROUNDINGS

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Abstract: The research conducted in the Snagov Lake Natural Reserve highlights a rich flora, with numerous species of conservation value, but also with allochthonous plant species which need special attention from the custodian of the protected area. No elements currently protected at European level were found: *Aldrovanda vesiculosa*, *Caldesia parnassifolia*, *Marsilea polycarpa*. For the first time, two vascular plants are reported for this area, *Cladium mariscus* s.l. and *Hordeum bulbosum*, and also eight avascular plants: *Fissidens taxifolius*, *Amblystegium serpens*, *Anomodon attenuatus*, *Brachythecium rutabulum*, *Hypnum cupressiforme*, *Leucodon sciuroides*, *Pterygoneurum ovatum*, *Porella platyphylla*.
Key words: bryophytes, rare plants, allochthonous plants, Snagov Lake, Romania

Received 01 August 2012 *Revision accepted 28 September 2012*

Introduction

Although located in the vicinity of Bucharest, an important university centre, the Snagov area has been the object of a rather limited number of botanical and forestry studies. The botanical studies of this area have so far primarily focused on identifying the vascular species and the phytocoenoses of the Snagov Lake, but no comprehensive study dealing with the floristic inventory of the area has yet been completed. The forestry studies have focused mostly on explaining the presence of beech in the plain area (Şerbănescu 1960).

The first data regarding the flora of the Snagov area belong to Panțu (1906) and contain references to two rare species, *Vallisneria spiralis* and *Wolffia arrhiza*, identified during a field trip in the area of the Snagov Monasterry in 1902. A few years later, Panțu (1908–1912) reports in his papers 75 other plant species, including some rare ones such as *Marsilea polycarpa* (syn. M. quadrifolia). Most references in terms of distribution are made for the Snagov Monasterry and the village Fundu. Zaharia Panțu later on also discovered *Aldrovanda vesiculosa* at "Gruiu, Ilfov County, at the edge of the Gruiu forest, in a lake, near the road". From Gruiu he also reports *Caldesia parnassifolia*, which was growing "in a small lake in the Gruiu forest, the place where it was first discovered by Carol Gutmann on the 28th of July 1915" (Panțu 1931).

In the Romanian Flora (Săvulescu 1952–1976) 46 plant species are mentioned for Snagov. These include, *Caldesia parnassifolia*, *Epipactis atrorubens*, *Epipactis palustris*, *Hippuris vulgaris*, *Marsilea polycarpa* (syn. M. quadrifolia), *Najas minor*, *Wolffia arrhiza*. Part of the data in the Romanian Flora is informed by Panțu's research (1908–1912). As far as *Aldrovanda vesiculosa* is concerned, it is mentioned that „it

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disappeared not long ago from the area Mrea Țigănești (r. Snagov)', without providing however a bibliographic reference.

In 1951 Țopa (cf. Țopa 1955a) discovered and published *Aldrovanda vesiculosa* from the area „Fundu village and Coada Cățelul (commune Turbați) and in V. Stubeului (commune Izvorani), all located in the surroundings of Snagov Lake (Reg. Bucureşti, r. Snagov)".

Țopa (1955b), in the Romanian Flora, mentions in regard to *Nelumbo nucifera* that in the spring of 1931 the first specimens were planted in the lakes of Snagov and Bucharest (Cişmigiu). The same information is noted for *Sagittaria latifolia*, with the addition that this plant can also be found in impressive groups at Ghermănești and Izvorani (Țopa 1966). These species were brought by the former House of Gardens in Bucharest (Țopa 1966).

Purcelean (1955) publishes a note regarding "Snagov Natural Reservation". He mentions that the reservation "stretches over an area of 957.70 ha in land and 180 ha covered by the eponymous lake". It is also noted that the structure of the forest consists of beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), hazel (*Corylus avellana*), fluffy ash (*Fraxinus pallisae*), but also rare species such as Caucasian beech (*Fagus orientalis*) and hybrid beech (*Fagus* × *taurica*). In terms of aquatic species he mentions *Aldrovanda vesiculosa*, *Sagittaria latifolia*, *Nelumbo nucifera*, *Nymphaea alba* (as *Castalia alba*) and *Nuphar luteum*.

In 1959 Ion Șerbănescu publishes "Research on the vegetation in the area of Bucharest" in which he presents a series of data, some concerning the phytocoenoses of the Snagov area. Thus, the vegetal associations identified on the Snagov Lake are: *Lemno minoris – Spirodeletum* Koch 1954, *Wolffietum arrhizae* Miyaki et J.Tüxen 1960, *Spirodelo-Aldrovandetum* Borhidi et Komlódi 1959 (Sanda et al. 2008).

Nedelcu (1976) notes from Snagov 115 aquatic and swamp species in the following vegetal associations: *Lemnetum minoris* (Oberd. 1957) Müller & Görs 1960, *Spirodeletum polyrhizae* W.Koch 1954, *Lemno-Salvinietum natantis* Miy. et Tx. 1960, *Wolffietum arrhizae* Miy. et Tx. 1960, *Hydrocharitetum morsus-ranae* Langendonck 1935, *Potametum crispi* Soó 1927, *Potametum lucentis* Hueck 1931, *Potameto-Vallisnerietum* Br.–Bl. 1931, *Nymphaeetum albo-luteae* Nowinski 1928, *Polygono-Potametum natantis* Soó 1964, *Scirpo-Phragmitetum* W.Koch 1926, *Bidentetum tripartiti* (W.Koch 1926) Libbert 1932, *Ranunculetum repentis* Knapp 1946. What is very interesting here is that, although the list of species is extensive, no data are provided for some rare plants such as *Aldrovanda vesiculosa*, *Marsilea polycarpa*, *Caldesia parnassifolia*, *Urtica kioviensis*, *Najas minor*, which were previously mentioned by other botanists researching that area.

In regard to bryophytes, the following species were mentioned from the area of Snagov: *Radula complanata*, *Frullania dilatata*, *Ricciocarpus natans*, *Riccia fluitans*, *Ceratodon purpureus*, *Orthotrichum affine* (Mohan 1988, 1990, 1998).

Due to the presence of some rare plants such as *Aldrovanda vesiculosa* and *Salvinia natans*, but also of some endangered habitats, Snagov Lake was identified as a special area for the protection and conservation of plants in Romania – IPA (Sârbu et al. 2007).

The main objectives of our study were the inventorying and characterisation of the flora of the Snagov Lake Natural Reserve (Rezervația Naturală Lacul Snagov – RNLS) and of its immediate surroundings, so that the data obtained can be used to compile the Management Plan of this protected area.

Material and methods

Investigated area. The Snagov Lake is situated in the North of Ilfov County, about 35 kilometers aways from Bucharest (Fig. 1). In terms of relief, the lake is located in the subunity Snagov Plain of the Romanian Plain. Snagov Lake is the most important important lagoon on the lower course of the River Ialomița, it covers an area of 187 km^2, its maximum length is 16.5 km, its maximum width is 400 m, and its maximum depth is 9 m. The climate in the area where the Snagov Lake is located is temperate continental, with excessive tendencies (very hot and dry summers and very cold winters).

According to Law 5/2000, an area of 100 hectars, located to the West of Snagov, and to the South of Siliștea Snagovului, was declared natural reservation. This corresponds to the category IV IUCN.

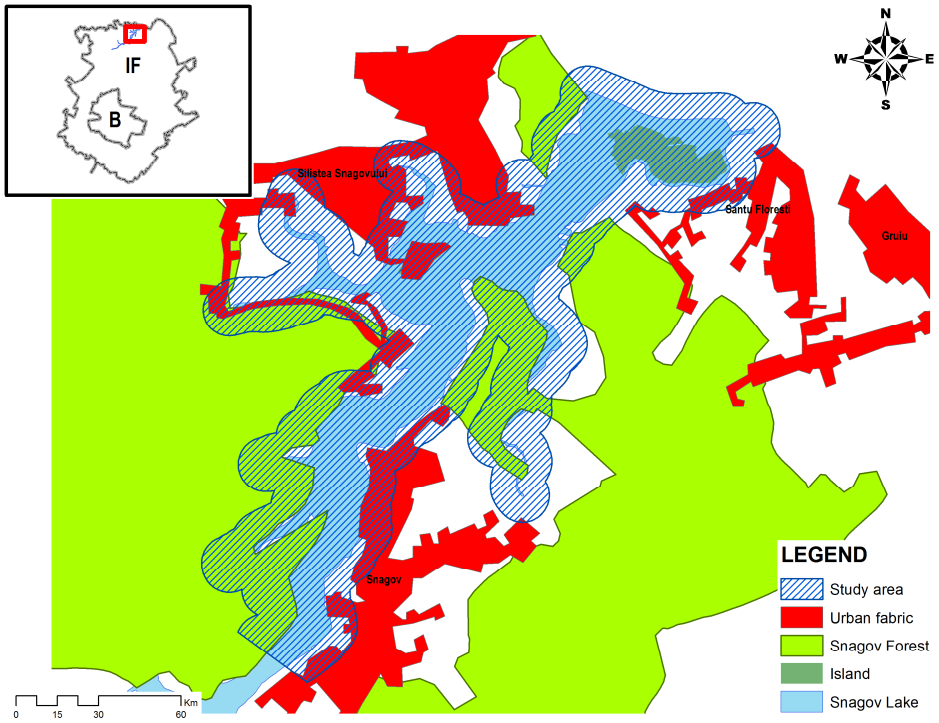

Fig. 1. Snagov Lake and its surroundings: B – Bucharest, IF – Ilfov County, red square – Snagov Lake (map compiled by Tiberiu Săhlean)

Research methods. The inventorying of the plant species was done on walking transects, so that an area as large as possible is covered. We mention here that on the edges of the lake, the inventorying was done on a width of up to 100 m, depending on the configuration of land and nearby roads.

The study visits for the complete inventorying of the local flora were conducted regularly (1–3 days / month during the vegetation period, from May 2011 to Aprilie 2012), so that all the stages of vegetation are observed and as many species as possible are recorded. For the taxa whose identify was difficult to determine on the field, 1–2 specimens were collected and subsequently identified in the laboratory. Furthermore, the Snagov area was thouroughly researched in order to identify the strictly protected plant species and the rare species, mentioned in the Red Book (Dihoru & Negrean 2009) and in the National Red List (Oltean et al. 1994). The data were collected in standard forms and stored electronically. The results obtained were organised in tables using Microsoft Excel, and presented graphically in charts and graphs. For each species there were noted and analysed the systematic classification, the geographic element, the life form and the ecological indicators, according to the Abstract of the cormophytes in Romania (Sanda & Popescu 1998). The definitions and comments suggested by Cristea et al. (2004) were taken into account for the interpretation of the data regarding the geographic elements and the life forms. Furthermore, for each species there was noted the degree of threat according to international and national documents (Bilz et al. 2011, Habitat Directive, Bern Convention, CITES Convention, OUG 57/2007, Dihoru & Negrean 2009, Oltean et al. 1994). The assessment of the invasiveness status was made using the definitions developed by Richardson et al. (2000).

For two of the taxa listed in RNLS no determination at specific level was conducted: *Carex* sp., *Sisymbrium* sp..

The nomenclature of the inventoried species is according to The Illustrated Flora of Romania (Ciocârlan 2009) and The Plant List (www.theplantlist.org).

Results and discussion

Using the data collected on field and the bibliographic resources dealing with the flora of the Snagov Lake and its surroundings, **14 bryophytes species** were listed (*Fissidens taxifolius* Hedw., *Amblystegium serpens* (Hedw.) Schimp., *Anomodon attenuatus* (Hedw.) Huebener, *Brachythecium rutabulum* (Hedw.) Schimp., *Hypnum cupressiforme* Hedw., *Leucodon sciuroides* (Hedw.) Schwägr., *Orthotrichum affine* Schrad. ex Brid., *Pterygoneurum ovatum* (Hedw.) Dixon, *Frullania dilatata* (L.) Dumort., *Porella platyphylla* (L.) Pfeiff., *Radula complanata* (L.) Dumort., *Ricciocarpos natans* (L.) Corda, *Riccia fluitans* L., *Ceratodon purpureus* (Hedw.) Brid.), as well as **460 species and subspecies of vascular plants** (Table 1).

Some of the species mentioned in the literature were not found on field during the research conducted in the period May 2011 – April 2012. Thus, the following bryophytes were not found: *Ricciocarpus natans*, *Riccia fluitans* and *Ceratodon purpureus*. It must be mentioned here that the first two species of bryophytes are aquatic. Of the vascular plants that have been reported for this area, 53 were not found (Table 1). Most of these plants are characteristic of aquatic ecosystems. The fact that some flora elements mentioned by previous authors were not found might be due to the

fact that older data referred to the Sangov area more broadly, whereas our research study was limited to a up to 100 metre-wide strip of land around the lake, and was more intensely conducted on the left side of the lake, which was more accessible. It is possible that subsequent research, on a larger area, will confirm the presence in the Snagov area of these plants. Three of the vascular plants that were not found during our study, *Aldrovanda vesiculosa*, *Caldesia parnassifolia* and *Marsilea polycarpa* (syn. M. quadrifolia), are of community interest (Directive 92/42/CEE). Another plant that was not found, *Elodea canadensis*, is allochthonous. The presence of his plant has not been recorded for the Snagov area in the last few years, and at national level it has been replaced in many aquatic ecosystems by *Elodea nuttallii* (Lițescu et al. 2005).

Out of the total of 460 vascular plant taxa found in RNLS and its surroundings, 410 are autochthonous species, spontaneous, and 50 species are allochthonous, cultivated, escaped from cultivation, naturalised or invasive.

Class distribution of the species of vascular plants in RNLS and its surroundings is the following: Equisetopsida – 3 taxa, Polypodiopsida – 3 taxa, Pinopsida – 4 taxa cultivated in the surroundings of the lake, Magnoliopsida – 351 taxa, Liliopsida – 99 taxa.

Regarding the family distribution of the autochthonous vascular plants in RNLS and its surroundings, it can be noted that most species belong to the families of Asteraceae (45 taxa – 10.9%), Poaceae (35 taxa – 8.5%), Lamiaceae (29 taxa – 7.0%), Fabaceae (23 taxa – 5.6%), Cyperaceae and Apiaceae (17 taxa each – 4.1%), Rosaceae (16 taxa – 3.9%), Plantaginaceae (14 taxa – 3.4%), Ranunculaceae and Brassicaceae (13 taxa – 3.2%), Polygonaceae (12 taxa – 2.9%) (Fig. 2). The other 62 families are represented by a small number of species, ranging from 1 to 9.

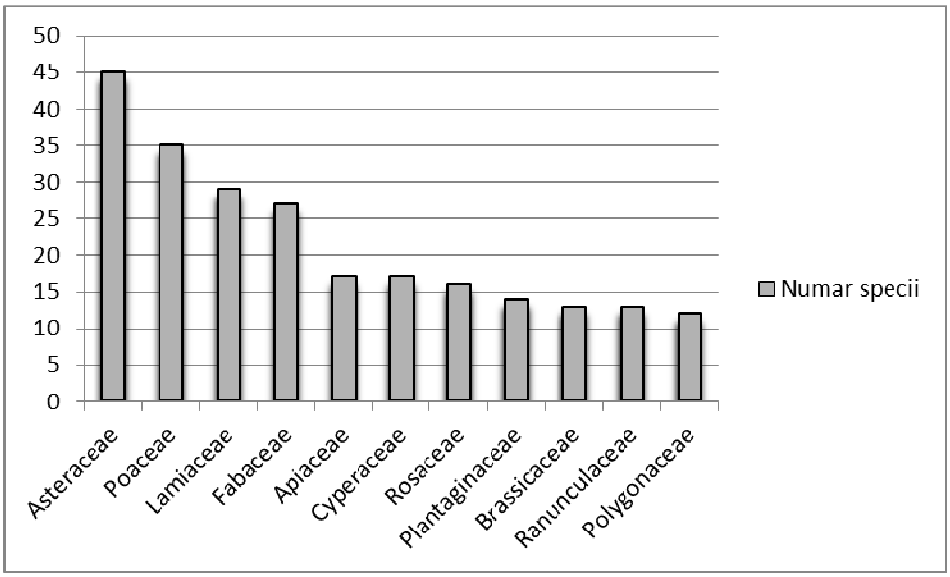

Fig. 2. Spectrum of the main plant families in RNLS and its surroundings

The dominating life forms in the flora of RNLS and its surroudings are represented by hemicryptophytes, with 165 taxa (39.9%). These are followed by: therophytes with 83 taxa (20.2%), helohydatophytes with 58 taxa (14.1%), geophytes with 39 taxa (9.5%), phanerophytes with 36 taxa (8.8%), biannual therophytes with 20 taxa (4.9%), chamaephytes with 7 taxa (1.7%) and nanophanerophytes with 4 taxa (0.9%) (Fig. 3).

Hemicryptophytes usually indicate a climate with a thermic and hydric deficit and the abundance of grass formations edified by perennial poaceaes (Cristea et al. 2004). In the case of the Snagov area, these hemicryptophytes are present especially in the meadow on the left side of the river (the former orchard of the Snagov palace), as well as on the edge of the forest, along roads. Therophytes, usually associated with a high degree of flora anthropisation, are present, as expected, especially in ruderal places (side of the road) and not so much in the forest. Helohydatophytes are typical of the aquatic and swamp formations of the Snagov area. Geophytes, usually characterised by a brief vegetation period, are present especially in the floristic composition of the Snagov forest which borders the lake. Among these, we mention: *Scilla bifolia*, *Galanthus nivalis*, *Polygonatum hirtum* (syn. P. latifolium), *Polygonatum odoratum*, *Convallaria majalis*, *Gagea lutea*, *Dioscorea communis*, *Platanthera bifolia*, *Neottia nidus-avis*, *Epipactis helleborine*, *Cephalanthera damasonium*. Phanerophytes are present in the lakeside forest formations.

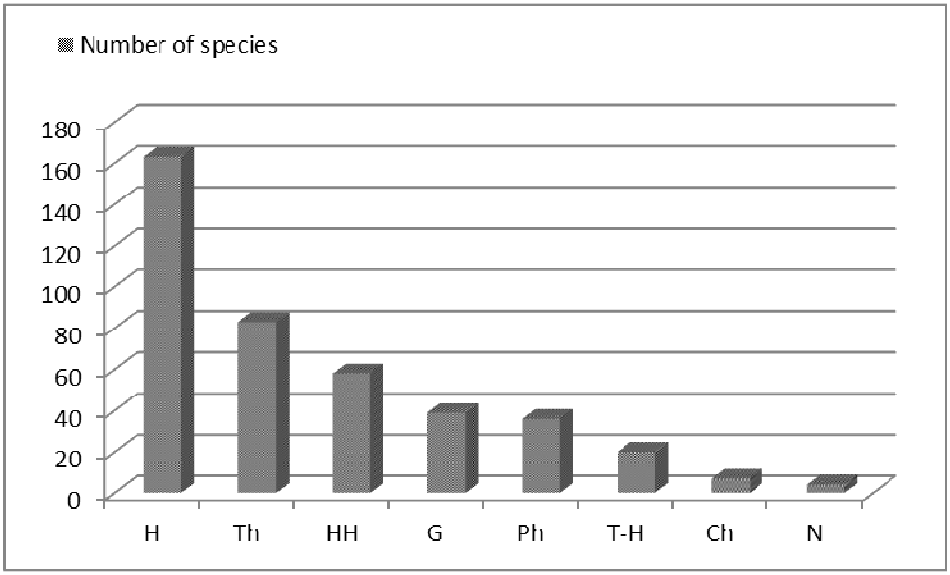

Fig. 3. Life forms spectrum in RNLS and its surroundings

The dominating geographic element is the Eurasian one, with 196 taxa (47.8%). Out of the Eurasian elements, we mention: *Achillea setacea*, *Bromus tectorum*, *Echinops sphaerocephalus*, *Elymus hispidus*, *Festuca valesiaca*, *Medicago sativa* subsp. *falcata*, *Nepeta nuda* subsp. *nuda*, *Potentilla recta*, *Thalictrum simplex*. These are present in small meadow areas on the left side of Snagov Lake. The European elements are represented by 58 taxa (14.1%), cosmopolitan elements with 56 taxa (13.6%), circumpolar with 30 taxa (7.3%), Central-European with 26 taxa (6.3%) and elements of Southern, South-Eastern and South-Western origin with a total of 44 taxa (10.7%) (Fig. 4). The European elements, typical of a temperate-moderate climate, and the Central-European ones, typical of the regions with a temperate-humid climate, are present especially on the lakeside forests of Snagov. Among these we note: *Quercus robur*, *Fagus sylvatica* and *Carpinus betulus* – the main components of tree layer, *Corylus avellana*, *Crataegus monogyna*, *Euonymus europaeus*, *Euonymus verucossus*, *Cornus sanguinea* subsp. *australis* – components of the shrub layer, as well as *Allium ursinum*, *Chaerophyllum temulum*, *Galanthus nivalis*, *Convallaria majalis*, *Corydalis solida*, *Corydalis cava*, *Melica uniflora*, *Mercurialis perennis*, *Cardamine bulbidera*, *Carex michellii*, *Isopyrum thalictroides*, *Lamium galeobdolon* and others – typical of the herbaceous layer. Among the European elements characteristic of the aquatic environment *Nymphaea alba* stands out. Cosmopolite species (ubiquiste) usually populate swamps, stagnant waters, ruderal and segetal places. In the case of the Snagov Lake, out of the 58 helohydatophyte species, 21 are cosmopolite. Among these, there are also some rare species, such as *Cladium mariscus* s.l., *Vallisneria spiralis*, but also some very common species such as *Phragmites australis*, *Lemna minor*, *Lemna trisulca*, *Typha latifolia*, *Typha angustifolia*, *Bolboschoenus maritimus*, *Schoenoplectus lacustris*. Among the cosmopolite species found in ruderal areas we mention: *Arabidopsis thaliana*, *Digitaria sanguinalis*, *Echinochloa crus-galli*, *Polygonum aviculare*, *Portulaca oleracea* s.l., *Setaria pumila*, *Sonchus oleraceus*. An important category of the Snagov flora is represented by the elements of Southern origin, which grow in milder climate conditions, with an estival hydric deficit: mediterranean, ponto-mediterranean, ponto-balkan. Among these we note: *Arum orientale*, *Asperula taurina* subsp. *leucanthera*, *Glechoma hirsuta*, *Polygonatum latifolium*, *Quercus cerris*, *Scutellaria altissima* – found in the forests on the left side of the lake, *Carthamus lanatus*, *Centaurium eryhtraea*, *Cynanchum acutum*, *Dipsacus fullonum*, *Hordeum bulbosum*, *Petrorhagia prolifera*, *Tragus racemosus* – found in the meadows on the left side of the lake, *Urtica kioviensis* – found in the tall herbs around the lake, in Coada Țigăniei. We also mention here some of the Atlantic-Mediterranean elements, whose genesis took place in a temperate-oceanic climate with high temperatures: *Dioscorea communis*, *Hedera helix*, *Crepis setosa*, *Wolffia arrhiza*.

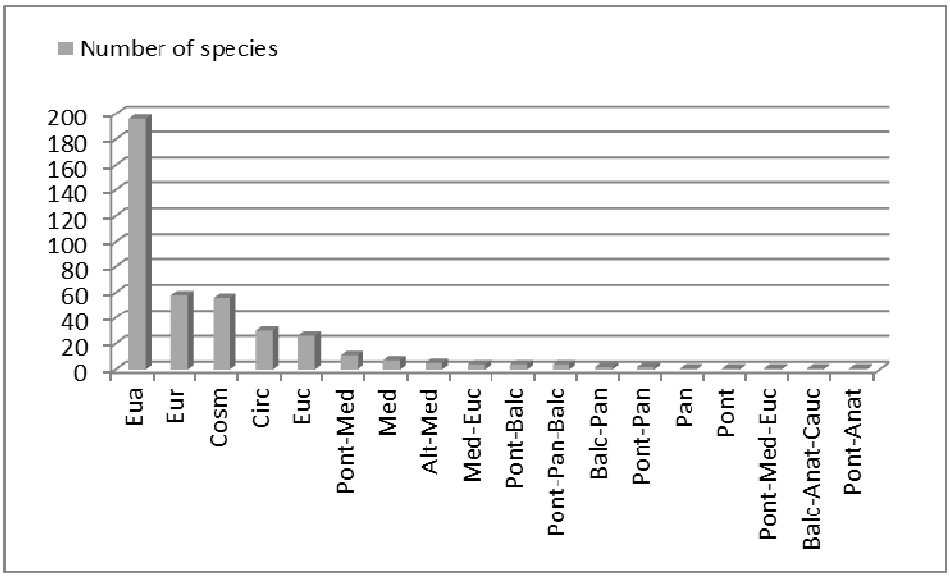

Fig. 4. Geographic elements spectrum in RNLS and its surroundings

The analysis of the ecological indices of the inventoried plants in RNLS and its surroundings reveals that the flora of this area is dominated by elements with medium requirements in terms of water and heat, and which prefer slightly to normal acid-neutrophil soils (Fig. 5).

In terms of the water factor, 74 species are hydrophytes and ultrahydrophytes, these species being aquatic plants that grow on permanently wet to submerged soils and that have under-water regenerative organs. Only 14 species are euryphytes, adapted to great humidity variations. Among these we mention: *Bromus hordeaceus*, *Elymus repens*, *Tragus racemosus*, *Carex hirta*. This aspect may gain a great deal of importance if the area becomes affected by aridity under the influence of global climate change and of the diminution of the hydric regime in the area due to the impact of anthropological activities. Such a development would lead to a loss of up to 20% of the local flora.

Concerning the requirements in terms of heat, we note the presence of several thermophilic elements (*Botriochloa ischaemum*, *Veronica orchidea*, *Festuca valesiaca*) typical of dry grasslands, installed nearby Snagov Palace, on the place of the former orchard.

In regard to the plants' preferences for the soil pH, we noticed the presence of a large number of euryionic elements (134 taxons), elements with wide ecological amplitude to soil reaction.

Some vegetal elements (*Aegopodium podagraria*, *Asperula odorata*, *Carex sylvatica*, *Geranium robertianum*, *Cardamine impatiens*, *Melica uniflora*, *Neottia nidus-avis*, *Salvia glutinosa*, *Sanicula europaea* etc.) from the forest on the left side of RNLS are typical of beech forests, which suggest their existence in the Snagov area in the geological past (before the last Ice Age). These beech forests disappeared as a result of the rise in climate aridity (Șerbănescu 1960).

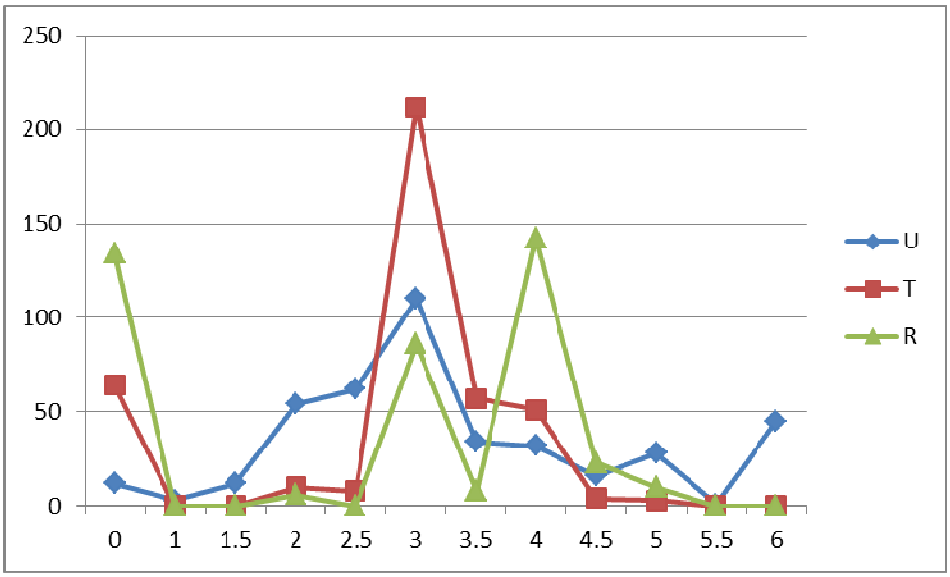

Fig. 5. Spectrum of the ecological forms in RNLS and its surroundings

The analysis of the floristic inventory in RNLS and its surroundings shows the fact that 105 taxons are listed in IUCN Red List 2011 (Bilz et al. 2011). A significant percentage of these are aquatic plants (67.6% – 71 taxa), many of them very frequent, but which require a great deal of attention due to the fact that aquatic habitats are currently under the threat of many factors with a negative impact. Of special interest is the species *Cladium mariscus* s.l., which has not been previously mentioned for the Snagov area, being nevertheless known form a nearby location, Căldăruşani Lake (Panţu 1908). This species is characteristic of habitat 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (Gafta & Mountford 2008), a priority at European level in terms of conservation

Another important category among the plants listed in IUCN Red List is represented by the wild relatives of some species cultivated for economic purposes (CWR). In the area of Snagov 27 such species are present. Among them: *Brassica nigra* (Black mustard), *Cichorium intybus* (Chicory), *Fragaria viridis* (Wild strawberry), *Daucus carota* subsp. *carota* (Wild carrot), *Hordeum murinum* (Wall barley), *Trifolium pratense* (Red clover). While these are not rare plants, they must be given increased attention due to the risk of genetic pollution caused by the cultivation of genetically modified plants (Bilz et al. 2011).

Of the species listed in the Habitats Directive, four are reported for the Snagov area:

Aldrovanda vesiculosa (Waterwheel plant) – listed in the Habitat Directive, annexes II and IV, The Bern Convention annex I, OUG 57/2007, annexes III and IV. The plant is considered Critically endangered (Dihoru & Negrean 2009) or Endangered (Oltean et al. 1994), Data Deficient (IUCN Red List 2011). For the conservation of this species it is

necessary to create a special and strictly protected area. This species was not found in the Snagov area during our studies.

Caldesia parnassifolia – listed in the Habitat Directive, annexes II and IV, The Bern Convention annex I, OUG 57/2007, annexes III and IV. The plant is considered Vulnerable/Rare (Oltean et al. 1994), Near Threatened (IUCN Red List 2011). For the conservation of this species it is necessary to create a special and strictly protected area. This species was not found in the Snagov area during our field research.

Marsilea polycarpa [syn. M. quadrifolia] (Four Leaf Clover) – listed in the Habitat Directive, annexes II and IV, The Bern Convention annex I, OUG 57/2007, annexes III and IV. The plant is considered Vulnerable (Oltean et al. 1994), Near Threatened (IUCN Red List 2011). For the conservation of this species it is necessary to create a special and strictly protected area. This species was not found in the Snagov area during our field research.

Galanthus nivalis (Snowdrop) – listated in the Habitat Directive, annex V, CITES Convention, annex II, OUG 57/2007, annex 5a. The plant is considered Near Threatened at international level (IUCN Red List 2011). The collection from nature of this species must be the subject of effective management measures. Only a small number of individuals were found in the forest, on the left side of the Snagov Lake.

Of the plants inventoried in RNLS and its surroundings, in annex I of the Bern Convention the following species are listed: *Aldrovanda vesiculosa*, *Caldesia parnassifolia*, *Marsilea polycarpa* (syn. M. quadrifolia), *Salvinia natans*.

In annex II of the CITES Convention there are listed, of the plants inventoried in RNLS and its surroundings, the following orchids: *Cephalanthera damasonium*, *Epipactis atrorubens*, *Epipactis helleborine*, *Epipactis palustris*, *Neottia nidus-avis*, *Platanthera bifolia*. To these, the snowdrop (*Galanthus nivalis*) must also be added. At national level, except for *Cephalanthera damasonium*, orchids are considered rare (Oltean et al. 1994).

Of the species mentioned in the National Red Book (Dihoru & Negrean 2009), in the floristic inventory of RNLS there are, alongside *Aldrovanda vesiculosa*, three other rare species of the RNLS flora, with various levels of threat: *Hordeum bulbosum* (Critically endangered), *Urtica kioviensis* (Vulnerable) and *Wolffia arrhiza* (Endangered). We mention that for *Hordeum bulbosum*, this reporting is the first one for Muntenia. As we only found one specimen of the plant, we consider that the presence of the species on the side of the Snagov Lake is accidental. The plant was previously known only in several localities in Oltenia and Dobrogea (Oprea 2005, Dihoru & Negrean 2009).

From the National Red List (Oltean et al. 1994), other than the species mentioned above, there are others, rare or with varying levels of threat: *Najas minor* – rare, *Utricularia vulgaris* – rare.

The inventory conducted in the Snagov area comprises 50 allochthonous species. Two of them, mentioned in the bibliographic sources, were not found in the researched area: *Elodea canadensis*, *Bidens frondosa*. The ones that were found can be grouped as follows:

(1) Cultivated plants – 11 taxa: *Acer saccharinum*, *Arundo donax*, *Catalpa bignonioides*, *Juglans regia*, *Pennisetum villosum*, *Pinus nigra* s.l., *Prunus domestica*, *Pseudotsuga menziesii*, *Salix babylonica*, *Salix babylonica* 'Tortuosa', *Taxodium distichum*. These plants require monitoring and removal if it is noticed that they escape cultivation.

(2) Subspontaneous plants (escaped from cultivation) – 9 taxa: *Cydonia oblonga*, *Fallopia aubertii*, *Helianthus annuus*, *Mahonia aquifolium*, *Portulaca grandiflora*, *Solanum tuberosum*, *Vitis vinifera*, *Medicago sativa* subsp. *sativa*, *Tanacetum parthenium*. Of these, special attention must be given to *Mahonia aquifolium*, a plant fairly frequent in the forest nearby the Astoria Complex, where it probably escaped from the previous nursery located on those grounds.

(3) Naturalised plants – 4 taxa: *Nelumbo nucifera*, *Nymphaea* × *marliacea*, *Quercus rubra* şi *Sagittaria latifolia*. *Nelumbo nucifera* may be considered naturalised according to the terminology suggested by Richardson et al. (2000), but according to the definition of invasive species from the Convention on Biological Diversity it can be considered invasive, as it has a negative impact on the habitats that it invades. *Nymphaea* × *marliacea* was cultivated for decorative purpose in front of several residence houses and it vegetates very well. *Quercus rubra* (Northern Red Oak) was cultivated for forest purposes, and it currently reproduces easily, without human intervention, being a frequent presence in the Snagov forest. *Sagittaria latifolia* was cultivated at the same time as *Nelumbo nucifera* in the Snagov Lake, but it has not multiplied to the point of affecting its habitat.

(4) Invasive plants – 24 taxa: *Acer negundo*, *Ailanthus altissima*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Amorpha fruticosa*, *Artemisia annua*, *Conyza canadensis*, *Cuscuta campestris*, *Dysphania botrys*, *Elaeagnus angustifolia*, *Erigeron annuus* subsp. *annuus*, *Fraxinus pennsylvanica*, *Galinsoga quadriradiata*, *Helianthus tuberosus*, *Lycium barbarum*, *Morus alba*, *Oxalis stricta*, *Parthenocissus inserta*, *Parthenocissus quinquefolia*, *Robinia pseudoacacia*, *Solidago canadensis*, *Sorghum halepense*, *Veronica persica*, *Xanthium strumarium*. Among the most widespread, with a visible impact on the vegetation of the area, we mention two species of Canadian vine: *Parthenocissus inserta* and *Parthenocissus quinquefolia*. Alongside these, on the lakesides of Snagov the autochthonous flora is challenged by *Amorpha fruticosa*, *Elaeagnus angustifolia*, *Acer negundo*, *Robinia pseudacacia*.

Conclusions

The Snagov Lake Natural Reserve and its adjacent areas host a rich flora, with numerous elements of conservation value both at national and European level, which would rend necessary extending the area of this reservation and even granting it the status of Special Area of Conservation. In terms of management activities particular attention should be paid to the elements that have an invasive character, threatening some habitats and autochthonous species.

It is necessary to further investigate this area with the purpose of confirming the presence of some species such as *Marsilea polycarpa* (syn. M. quadrifolia), *Aldrovanda vesiculosa* and *Caldesia parnassifolia*.

***Acknowledgments**:* The research study was conducted within the framework of the project "The Protected Natural Area Snagov Lake – Adequate management through the revision of Management Plan, base on scientific studies, information and raising awareness", POS MEDIU, contract no. 3/ 5 May 2011.

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STUDIU PRELIMINAR ASUPRA FLOREI DIN REZERVAŢIA NATURALĂ LACUL SNAGOV ŞI ÎMPREJURIMI

***Abstract*:** Cercetările efectuate în Rezervaţia Naturală Lacul Snagov evidenţiază o floră bogată, cu numeroase elemente de interes conservativ, dar şi specii de plante alohtone care necesită o atenţie deosebită din partea custodelui. Nu au fost regăsite unele elemente care în prezent sunt protejate la nivel european: *Aldrovanda vesiculosa, Caldesia parnassifolia, Marsilea polycarpa*. Pentru prima dată sunt raportate din această zonă două plante vasculare, *Cladium mariscus* şi *Hordeum bulbosum*, şi opt plante avasculare: *Fissidens taxifolius, Amblystegium serpens, Anomodon attenuatus, Brachythecium rutabulum, Hypnum cupressiforme, Leucodon sciuroides, Pterygoneurum ovatum, Porella platyphylla*.

***Cuvinte cheie*:** briofite, plante rare, plante alohtone, Lacul Snagov, Romania

Table 1

List of vascular plants from the Snagov Lake Natural Reserve and its surrounding areas

No.	Family	Scientific name	IUCN Red List 2011
1.	Malvaceae	Abutilon theophrasti Medik.	
2.	Sapindaceae	Acer campestre L.	
3.	Sapindaceae	Acer negundo L.	
4.	Sapindaceae	Acer platanoides L.	
5.	Sapindaceae	Acer saccharinum L.	
6.	Sapindaceae	Acer tataricum L.	
7.	Asteraceae	*Achillea aspleniifolia Vent.	
8.	Asteraceae	*Achillea millefolium L.	
9.	Asteraceae	Achillea setacea Waldst. & Kit.	
10.	Adoxaceae	Adoxa moschatellina L.	
11.	Apiaceae	Aegopodium podagraria L.	
12.	Rosaceae	Agrimonia eupatoria L.	
13.	Simaroubaceae	Ailanthus altissima (Mill.) Swingle	
14.	Lamiaceae	Ajuga genevensis L.	
15.	Droseraceae	*Aldrovanda vesiculosa L.	DD
16.	Alismataceae	Alisma lanceolatum With.	LC/Aqua
17.	Alismataceae	Alisma plantago-aquatica L.	LC/Aqua
18.	Brassicaceae	Alliaria petiolata (M.Bieb.) Cavara & Grande	
19.	Amaryllidaceae	Allium rotundum L.	
20.	Amaryllidaceae	Allium ursinum L. s.l.	
21.	Poaceae	*Alopecurus geniculatus L.	LC/Aqua
22.	Malvaceae	Althaea officinalis L.	
23.	Amaranthaceae	Amaranthus retroflexus L.	
24.	Asteraceae	Ambrosia artemisiifolia L.	
25.	Fabaceae	Amorpha fruticosa L.	
26.	Ranunculaceae	Anemone nemorosa L.	
27.	Ranunculaceae	Anemone ranunculoides L.	
28.	Asteraceae	Anthemis arvensis L.	
29.	Apiaceae	Anthriscus cerefolium (L.) Hoffm.	
30.	Apiaceae	Anthriscus sylvestris (L.) Hoffm.	
31.	Brassicaceae	Arabidopsis thaliana (L.) Heynh.	
32.	Asteraceae	Arctium lappa L.	
33.	Aristolochiaceae	Aristolochia clematitis L.	
34.	Asteraceae	Artemisia absinthium L.	
35.	Asteraceae	Artemisia annua L.	
36.	Asteraceae	Artemisia vulgaris L.	
37.	Araceae	Arum orientale M.Bieb.	
38.	Poaceae	Arundo donax L.	
39.	Aristolochiaceae	Asarum europaeum L.	
40.	Rubiaceae	Asperula taurina L. subsp. leucanthera (G.Beck) Hayek	
41.	Fabaceae	Astragalus cicer L.	
42.	Fabaceae	Astragalus glycyphyllos L.	
43.	Amaranthaceae	Atriplex tatarica L.	
44.	Poaceae	*Avena fatua L.	LC/CWR
45.	Lamiaceae	Ballota nigra L. subsp. nigra	
46.	Asteraceae	Bellis perennis L.	
47.	Apiaceae	*Berula erecta (Huds.) Coville [syn. Sium angustifolium L.]	LC/Aqua
48.	Asteraceae	*Bidens cernua L.	LC/Aqua
49.	Asteraceae	Bidens frondosa L.	
50.	Asteraceae	Bidens tripartita L.	LC/Aqua
51.	Cyperaceae	Bolboschoenus maritimus (L.) Palla	LC/Aqua
52.	Poaceae	Bothriochloa ischaemum (L.) Keng	

53.	Poaceae	Brachypodium pinnatum (L.) P.Beauv. s.l.	
54.	Poaceae	Brachypodium sylvaticum (Huds.) P.Beauv. s.l.	
55.	Brassicaceae	Brassica nigra (L.) K.Koch	LC/CWR
56.	Poaceae	Bromus hordeaceus L.	
57.	Poaceae	Bromus sterilis L.	
58.	Poaceae	Bromus tectorum L.	
59.	Boraginaceae	Buglossoides purpureocaerulea (L.) I.M.Johnst.	
60.	Butomaceae	Butomus umbellatus L.	LC/Aqua
61.	Poaceae	Calamagrostis epigeios (L.) Roth	
62.	Alismataceae	*Caldesia parnassifolia (L.) Parl.	NT/Aqua
63.	Convolvulaceae	Calystegia sepium (L.) R.Br.	
64.	Campanulaceae	Campanula persicifolia L. s.l.	
65.	Campanulaceae	Campanula rapunculoides L.	
66.	Brassicaceae	Capsella bursa-pastoris (L.) Medik.	
67.	Brassicaceae	Cardamine bulbifera (L.) Crantz	
68.	Brassicaceae	Cardamine impatiens L.	
69.	Asteraceae	Carduus acanthoides L.	
70.	Cyperaceae	Carex acutiformis Ehrh.	LC/Aqua
71.	Cyperaceae	*Carex cuprina (Sándor ex Heuff.) Nendtv. ex A.Kern. [syn. Carex otrubae Podp.]	
72.	Cyperaceae	Carex divulsa Stokes	
73.	Cyperaceae	Carex hirta L.	
74.	Cyperaceae	Carex michelii Host	
75.	Cyperaceae	Carex pairae F.W.Schultz	
76.	Cyperaceae	Carex pseudocyperus L.	LC/Aqua
77.	Cyperaceae	*Carex remota L.	
78.	Cyperaceae	Carex riparia Curtis	LC/Aqua
79.	Cyperaceae	Carex sp.	
80.	Cyperaceae	Carex sylvatica Huds.	
81.	Cyperaceae	Carex vulpina L.	
82.	Betulaceae	Carpinus betulus L.	
83.	Asteraceae	Carthamus lanatus L.	
84.	Bignoniaceae	Catalpa bignonioides Walter	
85.	Asteraceae	Centaurea phrygia L. s.l.	
86.	Asteraceae	Centaurea phrygia L. subsp. stenolepis (A.Kern.) Gugler [syn. Centaurea stenolepis A.Kern.]	
87.	Asteraceae	Centaurea scabiosa subsp. spinulosa (Spreng.) Arcang. [syn. Centaurea apiculata Ledeb. subsp. spinulosa (Rochel ex Spreng.) Dostál	
88.	Asteraceae	*Centaurea solstitialis L. s.l.	
89.	Gentianaceae	Centaurium erythraea Rafn	
90.	Orchidaceae	Cephalanthera damasonium (Mill.) Druce	LC
91.	Caprifoliaceae	Cephalaria transsylvanica (L.) Schrad. ex Roem. & Schult.	
92.	Ceratophyllaceae	Ceratophyllum demersum L.	LC/Aqua
93.	Ceratophyllaceae	*Ceratophyllum submersum L.	LC/Aqua
94.	Apiaceae	Chaerophyllum temulum L.	
95.	Lamiaceae	Chaiturus marrubiastrum (L.) Ehrh. ex Rchb. [syn. Leonurus marrubiastrum L.]	
96.	Papaveraceae	Chelidonium majus L.	
97.	Amaranthaceae	Chenopodium album L.	
98.	Amaranthaceae	*Chenopodium hybridum L.	
99.	Chenopodiaceae	Chenopodium strictum Roth	
100.	Asteraceae	Chondrilla juncea L.	
101.	Asteraceae	Cichorium intybus L.	LC/CWR
102.	Apiaceae	*Cicuta virosa L.	LC/Aqua
103.	Onagraceae	Circaea lutetiana L.	

104.	Asteraceae	Cirsium arvense (L.) Scop.	
105.	Asteraceae	Cirsium vulgare (Savi) Ten.	
106.	Cyperaceae	Cladium mariscus (L.) Pohl s.l.	LC/Aqua
107.	Ranunculaceae	Clematis vitalba L.	
108.	Lamiaceae	Clinopodium vulgare L.	
109.	Apiaceae	Conium maculatum L.	
110.	Asparagaceae	Convallaria majalis L.	
111.	Convolvulaceae	Convolvulus arvensis L.	
112.	Asteraceae	Conyza canadensis (L.) Cronquist	
113.	Cornaceae	Cornus mas L.	
114.	Cornaceae	Cornus sanguinea L. subsp. australis (C.A.Mey.) Jáv.	
115.	Fabaceae	Coronilla varia L.	
116.	Papaveraceae	Corydalis cava (L.) Schweigg. & Körte	
117.	Papaveraceae	Corydalis solida (L.) Clairv.	
118.	Betulaceae	Corylus avellana L.	
119.	Rosaceae	Crataegus monogyna Jacq.	
120.	Asteraceae	Crepis foetida L. subsp. rhoeadifolia (M.Bieb.) Čelak.	
121.	Asteraceae	Crepis setosa Haller f.	
122.	Convolvulaceae	Cuscuta campestris Yunck.	
123.	Rosaceae	Cydonia oblonga Mill.	
124.	Apocynaceae	Cynanchum acutum L.	
125.	Poaceae	Cynodon dactylon (L.) Pers.	
126.	Boraginaceae	Cynoglossum officinale L.	
127.	Cyperaceae	Cyperus fuscus L.	LC/Aqua
128.	Poaceae	Dactylis glomerata L. s.l.	
129.	Apiaceae	Daucus carota L. subsp. carota	LC/CWR
130.	Caryophyllaceae	Dianthus armeria L.	
131.	Plantaginaceae	*Digitalis lanata Ehrh.	
132.	Poaceae	Digitaria sanguinalis (L.) Scop.	
133.	Discoreaceae	Dioscorea communis (L.) Caddick & Wilkin [syn. Tamus communis L.]	
134.	Caprifoliaceae	Dipsacus fullonum L.	
135.	Caprifoliaceae	Dipsacus laciniatus L.	
136.	Amaranthaceae	Dysphania botrys (L.) Mosyakin & Clemants [syn. Chenopodium botrys L.]	
137.	Poaceae	Echinochloa crus-galli (L.) P.Beauv.	
138.	Asteraceae	Echinops sphaerocephalus L.	
139.	Boraginaceae	Echium vulgare L.	
140.	Elaeagnaceae	Elaeagnus angustifolia L.	
141.	Cyperaceae	*Eleocharis palustris (L.) Roem. & Schult.	LC/Aqua
142.	Hydrocharitaceae	*Elodea canadensis L.	
143.	Poaceae	Elymus hispidus (Opiz) Melderis s.l.	
144.	Poaceae	Elymus repens (L.) Gould s.l.	
145.	Onagraceae	Epilobium hirsutum L.	
146.	Onagraceae	*Epilobium parviflorum Schreb.	
147.	Onagraceae	*Epilobium tetragonum L. s.l. [syn. Epilobium adnatum Griseb.]	
148.	Onagraceae	Epilobium tetragonum L. subsp. lamyi (F.W.Schultz) Nyman	
149.	Orchidaceae	*Epipactis atrorubens (Hoffm.) Besser	LC
150.	Orchidaceae	Epipactis helleborine (L.) Crantz	LC
151.	Orchidaceae	*Epipactis palustris (L.) Crantz	LC
152.	Equisetaceae	Equisetum arvense L.	LC/Aqua
153.	Equisetaceae	Equisetum giganteum L. [syn. Equisetum ramosissimum Desf.]	
154.	Equisetaceae	Equisetum palustre L.	LC/Aqua

155.	Poaceae	Eragrostis minor Host	
156.	Asteraceae	Erigeron annuus (L.) Pers. subsp. annuus	
157.	Geraniaceae	Erodium cicutarium (L.) L'Hér.	
158.	Celastraceae	Euonymus europaeus L.	
159.	Celastraceae	Euonymus verrucosus Scop.	
160.	Asteraceae	Eupatorium cannabinum L. subsp. cannabinum	
161.	Euphorbiaceae	Euphorbia amygdaloides L.	
162.	Euphorbiaceae	Euphorbia cyparissias L.	
163.	Euphorbiaceae	*Euphorbia platyphyllos L.	
164.	Euphorbiaceae	Euphorbia stricta L.	
165.	Fagaceae	*Fagus orientalis Lipsky	
166.	Fagaceae	Fagus sylvatica L.	
167.	Fagaceae	*Fagus × taurica Popl.	
168.	Apiaceae	Falcaria vulgaris Bernh.	
169.	Polygonaceae	Fallopia aubertii (L.Henry) Holub	
170.	Polygonaceae	Fallopia convolvulus (L.) A.Löve	
171.	Poaceae	Festuca arundinacea Schreb. s.l.	
172.	Poaceae	Festuca valesiaca Schleich. ex Gaudin	
173.	Ranunculaceae	Ficaria verna Huds. s.l.	
174.	Asteraceae	Filago vulgaris Lam.	
175.	Rosaceae	Fragaria viridis (Duchesne) Weston	LC/CWR
176.	Oleaceae	Fraxinus angustifolia Vahl	
177.	Oleaceae	Fraxinus pallisae Wilmott	
178.	Oleaceae	Fraxinus pennsylvanica Marshall	
179.	Liliaceae	Gagea lutea (L.) Ker Gawl.	
180.	Amaryllidaceae	Galanthus nivalis L.	NT
181.	Fabaceae	Galega officinalis L.	
182.	Asteraceae	Galinsoga quadriradiata Cav.	
183.	Rubiaceae	Galium album subsp. pycnotrichum (Heinr.Braun) Krendl	
184.	Rubiaceae	Galium aparine L.	
185.	Rubiaceae	Galium humifusum M.Bieb.	
186.	Rubiaceae	Galium odoratum (L.) Scop.	
187.	Rubiaceae	*Galium palustre L.	
188.	Rubiaceae	Galium rubioides L.	
189.	Rubiaceae	Galium verum L. subsp. verum	
190.	Geraniaceae	Geranium phaeum L.	
191.	Geraniaceae	Geranium pusillum Burm.f.	
192.	Geraniaceae	Geranium robertianum L.	
193.	Rosaceae	Geum urbanum L.	
194.	Lamiaceae	Glechoma hederacea L.	
195.	Lamiaceae	Glechoma hirsuta Waldst. & Kit.	
196.	Poaceae	*Glyceria fluitans (L.) R.Br.	LC/Aqua
197.	Poaceae	*Glyceria maxima (Hartm.) Holmb.	LC/Aqua
198.	Araliaceae	Hedera helix L.	
199.	Asteraceae	Helianthus annuus L.	
200.	Asteraceae	Helianthus tuberosus L.	
201.	Apiaceae	Heracleum sphondylium L. s.l.	
202.	Malvaceae	Hibiscus trionum L.	
203.	Asteraceae	Hieracium lachenalii C.C.Gmel.	
204.	Plantaginaceae	*Hippuris vulgaris L.	LC/Aqua
205.	Poaceae	Hordeum bulbosum L. (one individual)	LC/CWR
206.	Poaceae	Hordeum murinum L.	LC/CWR
207.	Cannabaceae	Humulus lupulus L.	
208.	Hydrocharitaceae	Hydrocharis morsus-ranae L.	LC/Aqua
209.	Hypericaceae	Hypericum perforatum L.	
210.	Asteraceae	Inula britannica L.	

211.	Asteraceae	*Inula conyza (Griess.) DC.	
212.	Asteraceae	Inula salicina L. s.l.	
213.	Iridaceae	Iris pseudacorus L.	LC/Aqua
214.	Ranunculaceae	Isopyrum thalictroides L.	
215.	Asteraceae	Jacobaea erucifolia (L.) "P.Gaertn., B.Mey. & Schreb." [syn. Senecio erucifolius L.]	
216.	Juglandaceae	Juglans regia L.	
217.	Juncaceae	Juncus articulatus L.	LC/Aqua
218.	Juncaceae	Juncus compressus Jacq.	
219.	Juncaceae	*Juncus effusus L.	
220.	Juncaceae	Juncus inflexus L.	
221.	Asteraceae	Lactuca serriola L.	
222.	Lamiaceae	Lamium galeobdolon (L.) Crantz	
223.	Lamiaceae	Lamium maculatum (L.) L.	
224.	Lamiaceae	Lamium purpureum L.	
225.	Asteraceae	Lapsana communis L.	
226.	Orobanchaceae	Lathraea squamaria L.	
227.	Fabaceae	Lathyrus niger (L.) Bernh.	
228.	Fabaceae	Lathyrus pratensis L.	
229.	Fabaceae	Lathyrus sylvestris L.	LC/CWR
230.	Fabaceae	Lathyrus tuberosus L.	LC/CWR
231.	Fabaceae	Lathyrus venetus (Mill.) Wohlf.	
232.	Lemnaceae	Lemna minor L.	LC/Aqua
233.	Lemnaceae	Lemna trisulca L.	LC/Aqua
234.	Lamiaceae	*Leonurus cardiaca L.	
235.	Brassicaceae	Lepidium draba L. [syn. Cardaria draba (L.) Desv.]	
236.	Brassicaceae	Lepidium ruderale L.	LC/CWR
237.	Asteraceae	Leucanthemum vulgare (Vaill.) Lam.	
238.	Oleaceae	Ligustrum vulgare L.	
239.	Plantaginaceae	*Linaria genistifolia (L.) Mill. subsp. dalmatica (L.) Maire & Petitm.	
240.	Plantaginaceae	Linaria vulgaris Mill.	
241.	Boraginaceae	Lithospermum arvense L.	
242.	Poaceae	Lolium perenne L.	LC/CWR
243.	Loranthaceae	Loranthus europaeus Jacq.	
244.	Fabaceae	Lotus corniculatus L.	LC/CWR
245.	Solanaceae	Lycium barbarum L.	
246.	Lamiaceae	Lycopus europaeus L.	LC/Aqua
247.	Lamiaceae	*Lycopus exaltatus L.f.	LC/Aqua
248.	Primulaceae	Lysimachia nummularia L.	LC/Aqua
249.	Primulaceae	Lysimachia vulgaris L.	
250.	Lythraceae	Lythrum salicaria L.	LC/Aqua
251.	Berberidaceae	Mahonia aquifolium (Pursh) Nutt.	
252.	Malvaceae	Malva sylvestris L.	
253.	Malvaceae	Malva thuringiaca (L.) Vis. [syn. Lavathera thuringiaca L.]	
254.	Lamiaceae	Marrubium vulgare L.	
255.	Marsileaceae	*Marsilea polycarpa Hook. & Grev. [syn. Marsilea quadrifolia L.]	NT/Aqua
256.	Asteraceae	Matricaria perforata Mérat	
257.	Fabaceae	Medicago lupulina L.	LC/CWR
258.	Fabaceae	Medicago sativa L. subsp. falcata (L.) Arcang.	LC/CWR
259.	Fabaceae	Medicago sativa L. subsp. sativa	LC/CWR
260.	Orobanchaceae	*Melampyrum arvense L.	
261.	Poaceae	Melica uniflora Retz.	
262.	Fabaceae	Melilotus alba Medik.	LC/CWR

263.	Fabaceae	Melilotus officinalis (L.) Lam.	LC/CWR
264.	Lamiaceae	Melissa officinalis L.	
265.	Lamiaceae	*Mentha × dumetorum Schult.	
266.	Lamiaceae	Mentha aquatica L.	
267.	Lamiaceae	*Mentha arvensis L.	
268.	Lamiaceae	Mentha longifolia (L.) L.	
269.	Lamiaceae	Mentha pulegium L.	
270.	Euphorbiaceae	Mercurialis perennis L.	
271.	Caryophyllaceae	Moehringia trinervia (L.) Clairv.	
272.	Moraceae	Morus alba L.	
273.	Asteraceae	Mycelis muralis (L.) Dumort.	
274.	Boraginaceae	*Myosotis scorpioides L. [syn. Myosotis palustris (L.) Nath.]	LC/Aqua
275.	Caryophyllaceae	Myosoton aquaticum (L.) Moench	
276.	Haloragaceae	Myriophyllum spicatum L.	LC/Aqua
277.	Haloragaceae	*Myriophyllum verticillatum L.	LC/Aqua
278.	Hydrocharitaceae	*Najas marina L.	LC/Aqua
279.	Hydrocharitaceae	Najas minor All.	LC/Aqua
280.	Nelumbonaceae	Nelumbo nucifera Gaertn.	LC/Aqua
281.	Orchidaceae	Neottia nidus-avis (L.) Rich.	LC
282.	Lamiaceae	Nepeta cataria L.	
283.	Lamiaceae	Nepeta nuda L. subsp. nuda [syn. Nepeta pannonica L.]	
284.	Nymphaeaceae	Nuphar luteum (L.) Sibth. & Sm.	LC/Aqua
285.	Nymphaeaceae	Nymphaea × marliacea Wildsmith	
286.	Nymphaeaceae	Nymphaea alba L.	LC/Aqua
287.	Apiaceae	*Oenanthe aquatica (L.) Poir.	LC/Aqua
288.	Fabaceae	Ononis spinosa L.	
289.	Asteraceae	Onopordum acanthium L.	
290.	Oxalidaceae	Oxalis stricta L. [syn. Oxalis dillenii Jacq.]	
291.	Poaceae	*Panicularia plicata (Fr.) Scribn. & Merr. [syn. Glyceria plicata Fr.]	
292.	Papaveraceae	Papaver rhoeas L.	
293.	Urticaceae	Parietaria officinalis L.	
294.	Vitaceae	Parthenocissus inserta (A. Kerner) Fritsch	
295.	Vitaceae	Parthenocissus quinquefolia (L.) Planch.	
296.	Apiaceae	Pastinaca sativa L.	
297.	Poaceae	Pennisetum villosum Fresen.	
298.	Polygonaceae	Persicaria amphibia (L.) Delarbre [syn. Polygonum amphibium L.]	LC/Aqua
299.	Polygonaceae	Persicaria hydropiper (L.) Delarbre [syn. Polygonum hydropiper L.]	LC/Aqua
300.	Polygonaceae	Persicaria lapathifolia (L.) Delarbre [syn. Polygonum lapathifolium L.]	LC/Aqua
301.	Polygonaceae	Persicaria maculosa Gray [syn. Polygonum persicaria L.]	LC/Aqua
302.	Polygonaceae	*Persicaria minor (Huds.) Opiz [syn. Polygonum minus Huds.]	
303.	Polygonaceae	Persicaria mitis (Schrank) Holub [syn. Polygonum mite Schrank]	
304.	Caryophyllaceae	Petrorhagia prolifera (L.) P.W.Ball & Heywood [syn. Tunica prolifera (L.) Scop.]	
305.	Apiaceae	Peucedanum carvifolia Vill.	
306.	Poaceae	Phragmites australis (Cav.) Trin. ex Steud.	
307.	Solanaceae	Physalis alkekengi L.	
308.	Pinaceae	Picea abies (L.) H.Karst.	
309.	Pinaceae	Pinus nigra J.F.Arnold s.l.	
310.	Plantaginaceae	Plantago lanceolata L. s.l.	
311.	Plantaginaceae	Plantago major L. s.l.	

312.	Plantaginaceae	Plantago media L. s.l.	
313.	Orchidaceae	Platanthera bifolia (L.) Rich.	LC
314.	Poaceae	Poa angustifolia L.	
315.	Poaceae	*Poa annua L.	
316.	Poaceae	Poa nemoralis L.	
317.	Poaceae	*Poa palustris L.	
318.	Poaceae	*Poa pratensis L.	
319.	Poaceae	Poa sylvicola Guss.	
320.	Asparagaceae	Polygonatum (Bosc ex Poir.) Pursh [syn. P. latifolium (Jacq.) Desf.]	
321.	Asparagaceae	Polygonatum multiflorum (L.) All.	
322.	Asparagaceae	Polygonatum odoratum (Mill.) Druce	
323.	Polygonaceae	Polygonum aviculare L.	
324.	Salicaceae	Populus alba L.	
325.	Salicaceae	Populus canescens (Aiton) Sm.	
326.	Salicaceae	Populus nigra L.	
327.	Portulacaceae	Portulaca grandiflora Hook.	
328.	Portulacaceae	Portulaca oleracea L. subsp. oleracea	
329.	Potamogetonaceae	Potamogeton crispus L.	LC/Aqua
330.	Potamogetonaceae	Potamogeton lucens L.	LC/Aqua
331.	Potamogetonaceae	Potamogeton natans L.	LC/Aqua
332.	Potamogetonaceae	*Potamogeton perfoliatus L.	LC/Aqua
333.	Rosaceae	*Potentilla anserina L.	
334.	Rosaceae	Potentilla argentea L.	
335.	Rosaceae	Potentilla recta L.	
336.	Rosaceae	Potentilla reptans L.	
337.	Lamiaceae	Prunella vulgaris L.	
338.	Rosaceae	Prunus avium (L.) L.	LC/CWR
339.	Rosaceae	Prunus cerasifera Ehrh.	LC/CWR
340.	Rosaceae	Prunus domestica L.	
341.	Rosaceae	Prunus spinosa L.	LC/CWR
342.	Pinaceae	Pseudotsuga menziesii (Mirb.) Franco	
343.	Boraginaceae	Pulmonaria obscura Dumort.	
344.	Boraginaceae	Pulmonaria officinalis L.	
345.	Rosaceae	Pyrus pyraster (L.) Du Roi	
346.	Fagaceae	Quercus cerris L.	
347.	Fagaceae	Quercus robur L. subsp. pedunculiflora (K.Koch) Menitsky [syn. Quercus pedunculiflora K.Koch]	
348.	Fagaceae	Quercus robur L. subsp. robur	
349.	Fagaceae	Quercus rubra L.	
350.	Ranunculaceae	Ranunculus auricomus L.	
351.	Ranunculaceae	Ranunculus cassubicus L.	
352.	Ranunculaceae	*Ranunculus lingua L.	LC/Aqua
353.	Ranunculaceae	Ranunculus repens L.	LC/Aqua
354.	Ranunculaceae	Ranunculus rionii Lagger	LC/Aqua
355.	Ranunculaceae	Ranunculus sardous Crantz	
356.	Ranunculaceae	Ranunculus sceleratus L.	LC/Aqua
357.	Fabaceae	Robinia pseudoacacia L.	
358.	Brassicaceae	Rorippa amphibia (L.) Besser	LC/Aqua
359.	Brassicaceae	Rorippa austriaca (Crantz) Spach	LC/CWR
360.	Brassicaceae	Rorippa sylvestris (L.) Besser	LC/CWR
361.	Rosaceae	Rosa canina L. s.l.	
362.	Rosaceae	Rubus caesius L.	
363.	Polygonaceae	Rumex crispus L.	
364.	Polygonaceae	Rumex hydrolapathum Huds.	LC/Aqua
365.	Polygonaceae	Rumex patientia L. s.l.	

366.	Polygonaceae	Rumex sanguineus L.	
367.	Alismataceae	Sagittaria latifolia Willd.	
368.	Alismataceae	Sagittaria sagittifolia L.	LC/Aqua
369.	Salicaceae	Salix alba L.	
370.	Salicaceae	Salix babylonica L.	
371.	Salicaceae	Salix babylonica L. 'Tortuosum'	
372.	Salicaceae	Salix cinerea L.	
373.	Salicaceae	Salix purpurea L. s.l.	
374.	Lamiaceae	Salvia glutinosa L.	
375.	Lamiaceae	Salvia nemorosa L.	
376.	Lamiaceae	Salvia verticillata L.	
377.	Salviniaceae	Salvinia natans All.	LC/Aqua
378.	Caprifoliaceae	Sambucus ebulus L.	
379.	Caprifoliaceae	Sambucus nigra L.	
380.	Rosaceae	Sanguisorba minor Scop. s.l.	
381.	Apiaceae	Sanicula elata Buch.-Ham. ex D.Don [syn. Sanicula europaea L.]	
382.	Cyperaceae	Schoenoplectus lacustris (L.) Palla [syn. Scirpus lacustris L.]	LC/Aqua
383.	Asparagaceae	Scilla bifolia L.	
384.	Lamiaceae	Scutellaria altissima L.	
385.	Lamiaceae	Scutellaria galericulata L.	
386.	Saxifragaceae	Sedum maximum (L.) Suter	
387.	Poaceae	Setaria pumila (Poir.) Roem. & Schult.	
388.	Poaceae	Setaria viridis (L.) P.Beauv.	
389.	Caryophyllaceae	Silene baccifera (L.) Roth [syn. Cucubalus baccifer L.]	
390.	Caryophyllaceae	Silene latifolia Poir. subsp. alba (Mill.) Greuter & Burdet	
391.	Caryophyllaceae	Silene vulgaris (Moench) Garcke	
392.	Brassicaceae	Sisymbrium sp.	
393.	Apiaceae	*Sium latifolium L.	LC/Aqua
394.	Solanaceae	Solanum americanum Mill. [syn. Solanum nigrum L.]	
395.	Solanaceae	Solanum dulcamara L.	
396.	Solanaceae	Solanum tuberosum L.	
397.	Asteraceae	Solidago canadensis L.	
398.	Asteraceae	Sonchus arvensis L. s.l.	
399.	Asteraceae	Sonchus asper (L.) Hill s.l.	
400.	Asteraceae	Sonchus oleraceus L.	
401.	Rosaceae	Sorbus torminalis (L.) Crantz	
402.	Poaceae	Sorghum halepense (L.) Pers.	
403.	Typhaceae	Sparganium erectum L. subsp. neglectum (Beeby) K.Richt.	LC/Aqua
404.	Lemnaceae	Spirodela polyrrhiza (L.) Schleid.	LC/Aqua
405.	Lamiaceae	Stachys palustris L.	
406.	Lamiaceae	Stachys sylvatica L.	
407.	Caryophyllaceae	Stellaria media (L.) Vill. s.l.	
408.	Potamogetonaceae	*Stuckenia pectinata (L.) Börner [syn. Potamogeton pectinatus L.]	
409.	Boraginaceae	Symphytum officinale L.	
410.	Tamaricaceae	Tamarix ramosissima Ledeb.	
411.	Asteraceae	Tanacetum corymbosum (L.) Sch.Bip.	
412.	Asteraceae	Tanacetum parthenium (L.) Sch.Bip.	
413.	Asteraceae	Tanacetum vulgare L.	
414.	Asteraceae	Taraxacum officinale Webb	
415.	Taxodiaceae	Taxodium distichum (L.) Rich.	
416.	Ranunculaceae	Thalictrum simplex L.	
417.	Polypodiaceae	Thelypteris palustris (A.Gray) Schott	
418.	Brassicaceae	Thlaspi perfoliatum L.	
419.	Tiliaceae	Tilia tomentosa Moench	

420.	Apiaceae	Tordylium maximum L.	
421.	Apiaceae	Torilis arvensis (Huds.) Link	
422.	Asteraceae	Tragopogon dubius Scop.	
423.	Poaceae	Tragus racemosus (L.) All.	
424.	Fabaceae	Trifolium alpestre L.	LC/CWR
425.	Fabaceae	Trifolium arvense L. s.l.	LC/CWR
426.	Fabaceae	Trifolium campestre Schreb.	
427.	Fabaceae	Trifolium fragiferum L. s.l.	
428.	Fabaceae	Trifolium pratense L. s.l.	LC/CWR
429.	Fabaceae	Trifolium repens L. s.l.	LC/CWR
430.	Asteraceae	Tussilago farfara L.	
431.	Typhaceae	Typha angustifolia L.	LC/Aqua
432.	Typhaceae	Typha latifolia L.	LC/Aqua
433.	Ulmaceae	Ulmus minor Mill.	
434.	Urticaceae	Urtica dioica L.	LC/Aqua
435.	Urticaceae	Urtica kioviensis Rogow.	LC/Aqua
436.	Urticaceae	*Urtica urens L.	
437.	Lentibulariaceae	Utricularia vulgaris L.	LC/Aqua
438.	Hydrocharitaceae	Vallisneria spiralis L.	LC/Aqua
439.	Scrophulariaceae	Verbascum nigrum L. s.l.	
440.	Scrophulariaceae	Verbascum speciosum Schrad. subsp. speciosum	
441.	Verbenaceae	Verbena officinalis L.	
442.	Plantaginaceae	*Veronica anagallis-aquatica L.	LC/Aqua
443.	Plantaginaceae	Veronica chamaedrys L. s.l.	
444.	Plantaginaceae	Veronica hederifolia L. s.l.	
445.	Plantaginaceae	Veronica officinalis L.	
446.	Plantaginaceae	Veronica orchidea Crantz	
447.	Plantaginaceae	Veronica persica Poir.	
448.	Plantaginaceae	Veronica serpyllifolia L. s.l.	
449.	Plantaginaceae	Veronica teucrium L.	
450.	Caprifoliaceae	Viburnum opulus L.	
451.	Fabaceae	Vicia cracca L.	
452.	Fabaceae	Vicia hirsuta (L.) Gray	
453.	Apocynaceae	Vinca minor L.	
454.	Violaceae	Viola odorata L.	
455.	Violaceae	Viola reichenbachiana Jord. ex Boreau	
456.	Violaceae	Viola suavis M.Bieb.	
457.	Vitaceae	Vitis vinifera L. s.l.	
458.	Lemnaceae	Wolffia arrhiza (L.) Horkel ex Wimm.	LC/Aqua
459.	Asteraceae	Xanthium strumarium L.	
460.	Asteraceae	Xeranthemum foetidum Moench	

Note: the species marked with * were not found during the research conducted between 2011–2012.

Acta Horti Bot. Bucurest. **39**: 91–94
Bucureşti 2012

PIETRIŞ HILL (TULCEA HILLS) – A NEW SITE FOR *HEDYSARUM GRANDIFLORUM*

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Abstract: In the current paper the presence of the taxa *Hedysarum grandiflorum* Pall. subsp. *grandiflorum* is reported for the Southern ridge of Tulcea Hills, more precisely for the area of Pietriș Hill, and an inventory of the flora and the vegetal associations of the area is compiled.
Key words: *Hedysarum grandiflorum* Pall. subsp. *grandiflorum*, Pietriș Hill, Dobrogea, Romania

Received 02 October 2012 *Revision accepted 06 November 2012*

Introduction

Tulcea Hills spread along the Danube River from Tulcea to Dunavăț. To the West they are bounded by the Niculițel Plateau, along the valley of the river Telița, and to the South the same valley separates the Nălbant – Mihail Kogălniceanu corridor. The Eastern limit of Tulcea Hills is formed by Ostrovul Dranov and by Lake Razim (Coteț & Popovici 1972). Pietriș Hill is part of the South-Eastern branch of Tulcea Hills, which also includes Agighiol and Stânca Mare Hills, and it consists of two small hills separated by a valley. The maximum height is of about 160 m, and in the aforementioned valley the altitudinal minimum is of about 30 m. According to the geological map, the substrate is composed of limestone with ammonites, schists and quartzite sandstones (Mutihac et al. 2007). The soils are brown and leached brown of xerophile forests and shiblak (Popovici et al. 1984).

Pietriș Hill was studied in terms of flora and vegetation during the period 2005–2009 (Chifu & Țupu 2009, Țupu 2009a,b).

So far the literature mentions the species *Hedysarum grandiflorum* Pall. in only one place, namely the Natural Reserve Alah-Bair Hill in Constanța County (Panțu & Solacolu 1924, Nyárády 1957, Dihoru & Negrean 2009).

The main objective of this study is to provide a characterisation of the second site of *Hedysarum grandiflorum* – a rare species of the Romanian flora.

Material and methods

The floristic research on Tulcea Hills was conducted from the spring of 2005 until the summer of 2009. The study started off with a geographical delimitation of the researched area, followed by the harvesting of the botanical material, its herborising and identification. In June 2007 we identified several specimens of *Hedysarum grandiflorum* Pall. subsp. *grandiflorum* on one of the relief units of Tulcea Hills, namely on Pietriș Hill. The species was found again on the same spot in June 2009 and

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in May 2010. A herbaria sheet is deposited at the Herbarium of the Botanical Garden of Cluj-Napoca [CL 661.646].

The taxonomic nomenclature is according to Ciocârlan (2009), and the sozological classification was made upon consulting the Red Lists of Romania (Dihoru & Dihoru 1994, Boşcaiu et al. 1994, Oltean et al. 1994) and the Red Book (Dihoru & Negrean 2009). The phytosociological identification and classification of the main vegetal associations found in the researched area were made according to Sanda & Arcuş (1999).

Results and discussion

The research work conducted at Pietriş Hill led to the identification of 116 species of cormophytes. In terms of ferns, the species *Asplenium ruta-muraria* L. was identified. The Magnoliophyta division is represented the best, by 30 families of the class Magnoliatae and 3 families of the class Liliatae. As far as dicotyledons are concerned, the best represented families are Asteraceae, Lamiaceae, Brassicaceae, Scrophulariaceae etc.; in terms of monocotyledons, the family with most representatives is *Poaceae*. Among these, 13 taxa are rare, being included in the Red Lists of Romania under different sozological categories: *Adonis flammea* Jacq. – Rare (Dihoru & Dihoru 1994), *Adonis vernalis* L. – Vulnerable (Dihoru & Dihoru 1994), *Androsace maxima* L. – Indeterminate (Boşcaiu et al. 1994), *Asparagus verticillatus* L. – Rare (Oltean et al. 1994), *Bombycilaena erecta* (L.) Smolj. – Rare / Vulnerable (Boscaiu et al. 1994), *Dianthus nardiformis* Janka – Vulnerable / Rare (Oltean et al. 1994), *Festuca callieri* (Hack. ex St. Yves) Markgraf – Rare (Oltean et al. 1994), *Koeleria lobata* (M. Bieb.) Roem. et Schult. – Rare (Oltean et al. 1994), *Salvia aethiopis* L. – Endangered / Rare (Oltean et al. 1994), *Salvia nutans* L. – Rare / not endangered(Oltean et al. 1994), *Scutellaria orientalis* L. var. *pinnatifida* Rchb. – Rare (Oltean et al. 1994), *Tanacetum millefolium* (L.) Tzvelev – Rare (Oltean et al. 1994), *Thymus zygioides* Griseb. – Rare (Oltean et al. 1994).

In regard to the vegetation, it was observed that the most developed associations, which also have the highest degree of coverage, are the xerophile meadows of the class *Festuco – Brometea*: *Agropyro pectinatae-Tanacetum millefoliae* (Şerbănescu 1970) Chifu, Ţupu 2009, *Cynodonti – Poëtum angustifoliae* Rapaics ex Soó1957, *Stipo ucrainicae – Festucetum valesiacae* Dihoru 1970, *Festucetum callieri* Şerbănescu 1965 apud Dihoru 1970, *Koelerio lobatae – Thymetum zygioides* Burduja et Horeanu 1976, *Sedo hillebrandtii – Polytrichetum piliferi* Horeanu et Mihai 1974; out of the forest associations of the class *Quercetea pubescentis*, the association *Paeonio peregrinae – Carpinetum orientalis* Doniţă 1970 is the only one present.

The species *Hedysarum grandiflorum* Pall. was identified on only one of the small hills of Pietriş Hill, at an altitude of 145 m, on the slope with an Western exposure and an inclination of 30°. The coordinates of the site with *Hedysarum grandiflorum* are: 45°03′44″ N and 28°48′ 59″ E. The population is much smaller than the one identified at Alah-Bair Hill, in Constanţa County. The few individuals of the species found at Pietriş Hill correspond, from a phenotypical point of view, to the descriptions made in the literature (Nyárády 1957). They have a strong root, the rhizome is ramified, and the leaves are rosulate, long petiolate, with elliptical folioles on the back and with thick,

grey, hairy folioles on the edges. The stem is scapiform, erect, hairy sericeous, and it ends with a raceme that is dense in the beginning, with yellow flowers.

Hedysarum grandiflorum is part of the association *Festucetum callieri* Şerbănescu 1965 apud Dihoru 1970, which has a 70% coverage of the herbaceous layer. The abundance-dominance index is 3 for *Festuca callieri* (Hack.) Markgr. and 1 for *Teucrium chamaedrys* L.. The other species forming the association are accompanying, and are noted with (+): *Achillea nobilis* L. subsp. *neilreichii* (A.Kern.) Velen, *Adonis vernalis* L. *Agropyron cristatum* (L.) Gaertn. subsp. *pectinatum* (M.Bieb.) Tzvelev, *Agropyron ponticum* Nevski, *Ajuga chamaephytis* (L.) Schreber, *Allium sphaerocephalon* L., *Androsace maxima* L., *Crataegus monogyna* Jacq., *Crepis foetida* L. subsp. *rhoaedifolia* (Bieb.) Čelak, *Digitalis lanata* Ehrh., *Dichanthium ischaemum* (L.) Roberty, *Dianthus nardiformis* Janka, *Echinops ruthenicus* (Fisch.) M.Bieb., *Eryngium campestre* L., *Euphorbia glareosa* Pall. ex M.Bieb. subsp. *dobrogensis* (Prodan) Ciocârlan, *Festuca valesiaca* Schleich., *Koeleria lobata* (M.Bieb.) Roem. & Schult, *Kohlrauschia prolifera* (L.) Kunth, *Marrubium peregrinum* L., *Onosma visianii* G.C.Clementi, *Ornithogalum orthophyllum* Ten. subsp. *kochii* (Parl.) Zahar., *Paeonia peregrina* Miller, *Papaver rhoeas* L., *Poa angustifolia* L., *Salvia nutans* L., *Sanguisorba minor* Scop., *Senecio vernalis* Waldst. & Kit., *Siderites montana* L., *Stipa ucrainica* P.Smirnov, *Tanacetum millefolium* (L.) Tzvelev, *Taraxacum serotinum* (Waldst. & Kit.) Poiret, *Teucrium polium* L., *Thymus zygioides* Griseb., *Verbascum banaticum* Schrad., *Vinca herbacea* Waldst. & Kit., *Viola arvensis* Murray.

The site with *Hedysarum grandiflorum* is subject to intense degradation due to excessive sheep and goat grazing. Another important factor with a negative impact is the building of a wind farm, in May 2010, 15 metres away from the place where *Hedysarum grandiflorum* was identified.

Conclusions

The research conducted to date on the area of Pietriş Hill, highlights the existence of 116 cormophyte species, of which 13 are rare and included in the Red Lists of Romania under different levels of threat. The flora of Pietriş Hill comprises xeric, heliophile species, which prefer a substrate with a neutral or basic pH. The flora of this area includes primarily Eurasian and Pontic species, typical of the xerophile, rocky, Dobrogean meadow habitats. Among these species, we identified *Hedysarum grandiflorum* subsp. *grandiflorum*, a rare and critically endangered species, previously reported from only one (other) place in Romania.

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DEALUL PIETRIŞ (DEALURILE TULCEI) – UN NOU SIT PENTRU *HEDYSARUM GRANDIFLORUM*

Abstract: Este semnalată prezenţa taxonului *Hedysarum grandiflorum* Pall. subsp. *grandiflorum* pe coama sudică a Dealurilor Tulcei, mai exact pe dealul Pietriş, şi se realizează un inventar al florei şi al asociaţiilor vegetale din zonă.

Cuvinte cheie: *Hedysarum grandiflorum* Pall. subsp. *grandiflorum*, Dealul Pietriş, Dobrogea, România

Acta Horti Bot. Bucurest. **39**: 95–100
Bucureşti 2012

SPECIES OF *GALEGA ORIENTALIS, POLYGONUM SACHALINENSE, SILPHIUM PERFOLIATUM* AND THEIR AGROBIOLOGICAL PECULIARITIES IN REPUBLIC MOLDOVA'S CONDITIONS

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Abstract: The *Galega orientalis* 'Speranța', *Silphium perfoliatum* 'Vital', *Polygonum sachalinense* 'Gigant' growth and development, their productivity, and chemical content of the species fresh mass were studied. Their productivity in the third year of vegetation exceeds 70–100 t/ha of fresh mass. Chemical composition constitutes: raw protein (most essential aminoacids) 3.20–4.93%, mineral substances 2.04–2.41%, carotene 10–37 mg, vitamin C 136–316 mg, and 0.16–0.23 nutritive units/1 kg fresh mass. They can be cultivated on the same field for more than 20 years. They are resistant to frost and cold, but have an average resistance to drought. Due to longevity, high and constant productivity, the species are used to produce feed for livestock and poultry, as bee plants obtaining of 100–200 kg/ha honey, and as energy plants for biogas production and pellets. The investigated species contribute to the improvement of polluted, degraded and eroded soils.
Key words: *Galega orientalis*, *Silphium perfoliatum*, *Polygonum sachalinense*, fodder, honey, energy plants

Received 11 March 2011 *Revision accepted 07 November 2012*

Introduction

The study, improvement and implementation of introduced species with multiple values are dictated by the demand and supply of Moldova's national economy. About 140,000 hectares of agricultural land are degraded, and for this reason the species can not be used for traditional crop cultivation. The problem of providing by forage for livestock and poultry year-round has remained a very current one. Due to an unbalanced ratio to vegetable protein, food consumption increases by 20–25%. A lack of perennial crops with high protein content, drought resistance and excess moisture has been observed. There are only few crops resistant to cold, which begins early and late ends the vegetation. There are no researched and implemented species with high energy potential for bioenergy production. The area cultivated with herbaceous honey plants is significantly reduced. The Botanical Garden (Institute) of A.S.M.'s collection of fodder plants counts near 260 species and varieties. Scientific investigations performed in the last 60 years have been focused on improving and implementing new species, and new forms and varieties, and cultivation technologies have been developed (Teleuță 2010). The introduction of certain perennial herbaceous plant species has played a significant role in solving the aforementioned problem. These species are: *Galega orientalis* Lam. from Caucasus, *Silphium perfoliatum* L. originating from North America, *Polygonum sachalinense* Fr.Schmidt from Far East. They were recorded and introduced in the Botanical Garden's fodder plants collection over more than 30 years ago.

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Material and methods

In our study we used as a biological material the perennial herbaceous plant species *Galega orientalis* Lam. 'Speranța', *Silphium perfoliatum* L. 'Vital', *Polygonum sachalinense* Fr.Schmidt 'Gigant'. The cultivars of these species were created and cultivated in the Botanical Garden (Institute) of ASM. We conducted scientific research concerning the plant growth and development, their productivity by methodical instructions (Novoselov 1983, Ivanov1985), and the chemical composition (Ermakov 1987).

Results and discussion

Goat's-rue, *Galega orientalis* Lam.

The autochthonous cultivar 'Speranța' is an herbaceous perennial plant, it reaches a height of 155–175 cm, its pivoting root system, branching strong, penetrates to a depth of 50–135 cm, and initiates an intensive development in early spring using soil moisture accumulated during autumn-winter, which positively influences the stability of the harvest. Thus, in early May, the plants reach a height of 70 cm and provide a harvest of 30–33 t/ha, compared with 3–6 t/ha of alfalfa and clover, the total annual harvest being of around 60–80 t/ha of fresh mass, compared with 30–35 t/ha of alfalfa. Seed production is 3–6 q/ha. High capacity of vegetation recovering after mowing, until late October – early November, when is recorded a temperature of – 3 – 5°C. This culture contributes to solving the problem of seasonal providing of the livestock and poultry with high quality feed.

The autochthonous cultivar 'Speranța' is characterized by a high leaf degree, reaching 60% in the first mowing of the total mass, leaves do not shake after drying, fact which allows the production of hay and silage of a higher quality compared to production obtained from alfalfa and clover.

Analyzing forage nutritive value indices, the green mass, harvested in bud stage, contains up to 70.0% water, 4.93% raw protein, 1.1% raw fats, 10.47% raw fiber, 2.04% minerals and 11,35% extractive free-nitrate substances; 1 kg of fresh nutrients contains 0.23 units, 2.86 MDJ for livestock, 29.9% dries substances, 49.34 g raw protein, 37.49 g digestible protein, 11.06 g raw fats, 104.65 g raw fiber, 20.42 g minerals, 37 mg% carotene, 310 mg% vitamin C, up to 216 g protein from a feed unit were established. Digestibility is represented in the following percentages: 53–76% dries substances, 80% protein, 69% cellulose, 50% fats. It is a honey plant providing a harvest of 200 kg/ha.

At the end of exploitation, the *Galega orientalis* farm plantations accumulate in soil an amount of organic nitrogen biologically equivalent to 2 tons/ha of saltpeter. It has curative properties in the treatment of cardiovascular diseases, diabetes, and it is used for stimulating the secretion of milk etc. (Vavilov & Kondratiev 1975, Uteush 1991, Iaroshevich et al. 1991, Kshnikatkina 2001, Pikun 2011).

It is propagated by seed, the sowing norm being 1.8 to 2.0 million seed or 16 kg/ha.

Cup plant, *Silphium perfoliatum L.*

It is a perennial herbaceous plant, usually growing and developing on fertile soils well supplied with water, in the plains, on the rivers and reservoirs, irrigation canals, parks and beehives (Vavilov & Kondratiev 1975, Uteush 1991, Abramov 1992). It shows a high resistance to cold and frost, and supports moderate drought and heat. Cup plant serves as fodder, honey, decorative plant, and for technique culture. It is a

biological source for the preparation of medicines, plant growth stimulants, and it is also used as raw material for thermo-energy. The species is propagated by seeds and vegetatively as well (fragments of rhizomes, seedling). The plants are sown in late fall or early spring by stratified seeds, the sowing norm being 10 kg/ha at the depth of 1.5 to 2.0 cm; after sowing the soil compaction is practiced. Seedlings appear in spring, after 15 days, when the soil temperature at a depth of 4–5 cm reaches 6–8 °C. In the first year of vegetation it forms a rosette, develops strong roots and rhizomes. In subsequent years the vegetation begins in early spring, developing a tubular square stems; in early May it reaches a height of 45–65 cm, and at the end of the vegetation grows up to 250–370 cm of 3–4 cm thick. On the stem, there are formed 22–24 cordiform leaves, with a length of 20–35 cm and the wide of 14–22 cm, rough, serrated, opposite arranged on the stem forming a cup, effectively collecting the atmospheric precipitations (rainfall). The root system is well developed, branched, penetrating to a depth of 2.5 m, which facilitates the provision with water and nutrients, improves soil physical and chemical properties.

In the second year of growing, plants bloom in mid-July to August; flowers are grouped in composed inflorescences, arranged by 20 to 30, with a diameter of 3–5 cm; a flower produces nectar from 0.3 to 0.4 mg of sugar, ensuring the yield of 150–220 kg/ha of honey. After harvesting in the bud stage, the plants grow back, and at the end of September reach again the shoot-flowering stage. Fruits (achenes) are spread with the aid of wind. Seed yield constitutes 290–450 kg/ha.

Cup plant, the autochthonous 'Vital' is a forage plant, used in the mass production of natural fresh green forage, for the preparation of silage and vitaminous flour for livestock and poultry. In the period of shoot phase, the harvest of fresh mass reached 72–128 t/ha, the leaves constituting more than 55%. The chemical composition of the natural forage is the following: 78.90% water, 3.20% raw protein, 0.51% raw fats, 7.15% raw fiber, 2.36% minerals, 7.87% of extractive substances extractive free-nitrate substances; 1 kg of natural forage content: 0.16 nutrient units, 1.92 MDJ exchange energy for cattle, 21.47 g digestible protein, 4.58 g calcium, 0.46 g phosphorus, 9.70 mg carotene; 1 nutritive unit is provided with 134.19 g digestible protein.

Cup plant extracts are used to treat wheat seeds, contributing to the increase of yields to 2.4 – 3.7 qs/ha, of the gluten content by 1.3 to 1.4% (Davidiants 2006).

As a medicinal plant, it is used to treat arthritis, bleeding, diarrhea, and it has antibacterial properties (Kowalski & Kedzia 2007, Kowalski 2007, 2009). In Germany, *Silphium perfoliatum* biomass is used to produce biogas (about 500 m^3 gas/one tone of raw material). The obtained gas contains up to 70% methane. The pellets have a higher energy capacity than that of the willow (Majtkowski 2009).

Giant knotweed, *Polygonum sachalinense* Fr.Schmidt (syn. *Fallopia sachalinensis, Reynoutria sachalinensis*)

It is a perennial plant, herbaceous, with repent rhizomes. The stem is erect, tubular, vigorous, and achieves 300 cm height, but often reaches over 500 cm height; the stem diameter at the base is 3.2 to 5.0 cm, green or brown. The tubulate stems, with 20–26 internodes, resemble bamboo. Leaves are dark green, acute, cordiform or rounded at the base, 15–30 cm length, 7–25 cm width, with slightly wavy edges, glabrous, glossy on the top, in dorsal part sometimes hair-covering, arranged on the short petiole. Flowers are bisexual or female, small, 0.5 cm diameter, white or creamy-white, grouped in panicle-shaped (thyrsiform) inflorescence, with the length of 20 cm. It

blooms in August–September, for a period of 40–45 days. Seeds are trigonal achenes, brown, non fertile in Moldova's conditions. In the soil, the plant develops a strong network of rhizomes, growing mainly horizontal, but may reach 2 m in depth, 2/3 of the plant is in the soil mass. Rhizomes reach up to 10 cm of thick.

Based on the findings of our research it was established that, given Moldova's conditions, *Polygonum sachalinense* can only be multiplied vegetatively, by rhizomes or cuttings; the planting is carried out in well-treated soil, late fall or early springs. The vegetation of plants begins in late February – early March, when air temperature is positive; vegetation ends in late fall, when the temperatures are negative. Plant height, after 20 days of vegetation, reaches 1.5 m, in mid-June – 3.1 to 3.6 m; in flowering period the height of plants exceeds 3.7 to 4.6 m. The flowering phase begins after 135 – 150 days of vegetation, but the plant does not form fertile seeds. Giant knotweed has high resistance to winter conditions; it can often be affected by spring frosts, but it recoveres quickly. During our research, plants were not affected by atmospheric drought and heat, disease and pests.

The autochthonous cultivar 'Gigant', in a fresh state, is a good fodder for cattle, sheep and goats. Furthermore, the biomass can be used as silage and protein fortified (vitaminized) flour. Plants are harvested in bud stage (June), the harvest being of around 57 tons/fresh mass or 18.7 tons/dry weight in the first years of the plantation; after 20 years of exploitation it exceeds 100 tons/fresh mass. Natural forage content: 72.30% water, 3.67% raw protein, 0.67% raw fats, raw fiber 9.11%, minerals 2.41%, 11.83% extractive substances free-nitrate. One kilogram of naturally feed nutrients contain: 0.21 units, 2.45 MDJ for cattle, 27.70 g dry weight, 36.70 g raw protein, 22.27 g digestible protein, 6.73 g raw fats, 91.13 g raw fiber, 24.10 g mineral substances (of which, 3.99 g calcium, 0.42 g phosphorus), 35.90 mg carotene. In early spring, mixed with roughage forage the plant is used as animal feed. The plant is used as food and as a camouflage for animals and wild birds (pheasants).

Based on previous scientific investigation, it was established that the extracts from Giant knotweed can be used for the production of plant protection means (phytosanitary measures), and to control diseases and pests (Regalia, MILSANA 13) of agricultural crops. Authors from Belarus, Japan, Russia, have identified *Polygonum sachalinense* as a source for the pharmaceutical industry (Inoe et al. 1992, Melinkova et al., 2002); concomitantly, others (Gagieva et al. 2000, Basharin et al. 2002, Tsukiev et al. 2004) have observed the plant's high capacity of extracting from soil heavy metal, salts, and converting them into inoffensive substances.

It is a tardy honey plant, in the autumn 65–120 kg/ha of honey being harvested.

Polygonum sachalinense is a decorative species; the plants are used as camouflage near walls or margins of the gardens, falling to decorate gardens being alone. It can be used as a substitute for asparagus; the shoots are edible in early spring, being used in the preparation of various dishes and drinks.

Polygonum sachalinense biomass is used in the production of cellulose, also as pellets in Germany, Poland, Russia, Belarus and other countries too. The pellets produced from *Giant knotweed* stems exceed willow and poplar index on "energy capacity". Our research showed that the yield of dry mass of these plants is higher than that of willow and poplar, and harvesting technology does not require application of special equipment.

Conclusions

In the first year of vegetation, the species studied had a slow growth, but in the subsequent years, growth and development were intensive, beginning in early spring ensured the production of the first natural forage.

Their productivity in the third year of vegetation exceeded 70–100 t/ha of fresh mass. Chemical composition was: raw protein (most essential amino acids) 3.20–4.93%, mineral substances 2.04–2.41%, carotene 10–37 mg, vitamin C 136–316 mg, and 0.16–0.23 nutritive units/1 kg fresh mass. On the same field, the plants can be cultivated for over than 20 years. They are resistant to frost and cold, but have an average resistance to drought. Due to their longevity, high and constant productivity, the species are utilized to produce feed for livestock and poultry, as bee plants obtaining of 100–200 kg/ha honey, and as energy plants for biogas production and pellets. The investigated species improve the polluted, degraded and eroded soils where they grow, by enhancing the physical and chemical properties of soil.

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PARTICULARITĂȚILE AGROBIOLOGICE ALE SPECIILOR *GALEGA ORIENTALIS, POLYGONUM SACHALINENSE, SILPHIUM PERFOLIATUM* ÎN CONDIȚIILE REPUBLICII MOLDOVA

***Abstract*:** S-a cercetat creşterea şi dezvoltarea, productivitatea şi compoziția chimică a masei proaspete a speciilor: *Galega orientalis*, soiul 'Speranța', *Silphium perfoliatum*, soiul 'Vital', *Polygonum sachalinense*, soiul 'Gigant' create în cadrul Grădinii Botanice. Productivitatea speciilor în al treilea an de vegetație constituie 70–100 t/ha de masă proaspătă. Compoziția chimică: proteină brută (majoritatea aminoacizilor esențiali) 3,20–4,93%, substanțe minerale 2,04–2,41%, carotină 10–37 mg, vitamina C 136–316 mg, 0,16–0,23 unități nutritive/1 kg de masă proaspătă. Pe acelaşi teren se pot menține mai mult de 20 ani. Sunt rezistente la ger şi frig, dar manifestă rezistență medie la secetă. Datorită longevității, productivității înalte şi constante, speciile se folosesc la producerea nutrețurilor pentru animale şi păsări; ca plante melifere, 100–200 kg/ha miere de albine; ca plante energetice pentru producerea biogazului şi peletelor. Plantele contribuie la ameliorarea solurilor poluate, degradate şi erodate, îmbunătățind proprietățile fizico-chimice ale solului.

Cuvinte cheie: *Galega orientalis*, *Polygonum sachalinense*, *Silphium perfoliatum*, plante furajere, melifere, energetice

Acta Horti Bot. Bucurest. **39**: 101–103
Bucureşti 2012

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Two copies of the manuscript (one in Romanian and the other in English) should be submitted before the 28th of February 2013, electronically as MS-Word file, as well as printed to conf. dr. Paulina Anastasiu, Faculty of Biology, University of Bucharest, Intr. Portocalelor no. 1–3, sector 6, Bucharest – 060101, Romania, e-mail: anastasiup@yahoo.com.

The paper should be of maximum 10 pages edited according to the journal's requirements. The critical reviews should not exceed one page. Authors are expected to cover the cost of supplementary pages as well as the colour reproductions.

The title of the paper should be informative and as short as possible. Write the title centred, with bold capitals, size font 10, Times New Roman. Use *italics* only for the plant names and do not add the authority to species names in the title.

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The abstract should be written as a single paragraph and should not exceed 200 words, font size 9, Times New Roman, justify. Do not include authority in the names of taxa.

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The text of paper must be typed using 10 Times New Roman, one spaced, justify, on A4 format with the next margins: top 57 mm, bottom 50 mm, left 45 mm, right 40 mm. First line of each paragraph should be at 10 mm. It is recommended to divide the text into: **Introduction**, **Material and methods**, **Results and discussion**, **Conclusions**, **Acknowledgements** and **References**. The critical reviews and commemorative papers are exempt from this rule. Write all main headings in bold.

Scientific plant names should be given in italics. The author's name should be written in normal print at least once, when mentioned for the first time in the text or in a table, and should be omitted subsequently. They should be abbreviated according to *Authors of Plant Names*, Royal Botanic Gardens, Kew (Brummitt & Powell 1992). After the first mention, the generic name should be abbreviated to its initial, except where its use causes confusion.

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2. FRIDAY J.B., OKANO D. 2006. Thespesia populnea. *Species profiles for Pacific Island Agroforestry*. [Online] Available at www.traditionaltree.org (accesed 9th of July, 2011)

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