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The flora of the volcanic island of Brusnik (central Dalmatia, Croatia)

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Research into the vascular flora of the volcanic island of Brusnik was carried out in the period from 2000 to 2002. A total of 28 higher plant species was found, four of them being noted for the first time. Of the 41 taxa noted by previous authors, 24 were confirmed, but 17 were not.

According to analysis of life forms, the most numerous are *Therophyta* (13 species, 46.4%), followed by *Chamaephyta* (seven species, 25%), *Phanerophyta* (four species, 14.3%), *Hemicryptophyta* (three species, 10.7%) and *Geophyta* (one species, 3.6%).

After analysis of floral elements, autochthonous taxa are grouped into three categories: Mediterranean floral element (18 species, 66.6%), South European floral element (five species, 18.5%) and widespread plants (four species, 14.8%). Especially important plants in the flora of Brusnik are *Frankenia pulverulenta* L., a very rare species in the Croatian flora and the Illyrian-Adriatic endemic plants *Centaurea ragusina* L., *Limonium vestitum* (Salmon) Salmon subsp. *brusnicense* Trinajstić and *Senecio leucanthemifolius* Poir. var. *reichenbachii* Fiori. The results of our research show that the island of Brusnik belongs, in phytogeographical terms, to the Mediterranean zone proper of the Mediterranean region.

Key words: Flora, endemic plants, island, Brusnik, Dalmatia, Adriatic, Croatia

Introduction

The island of Brusnik, lat. *Melisello*, with the islands of Biševo, Svetac, Kamik and Jabuka, belongs to the Vis archipelago (Central Dalmatia, Croatia). It is about 4 km southeast of the island of Svetac (Sv. Andrija) and 30 km southwest of Komiža on the island of Vis (43´59´42˝ N, 15´47´55˝ E, MTB 2960/4). The island is 320 m long, with an average width of 205 m, and covers an area of 4.5 ha. With the islands of Jabuka and Kamik it is one of the smallest islands in archipelago.

The island of Brusnik has been protected since 1951 and the island of Jabuka since 1958, as monuments of nature. The basic phenomenon of these monuments is their rare and specific geological structure. The islands of Brusnik and Jabuka are the only volcanic islands in the Adriatic Sea. As well as their geological importance, these islands are prominent for the numbers of their endemic plant and animal species.

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The island of Brusnik was formed of eruptive rocks. Most parts of the island as well as the sea rocks on the island's eastern and western sides are made of conglomerates formed from the fragments of eruptive rocks glued with limestone bond. Only in the central part of the island are there high cliffs of massive diabases, and they are in some parts intersected with breaches that are filled with limestone sediment. The highest part of the island is 30 m above sea level. The hollow in the middle of the highest part splits it in two parts; the western part is wider than the eastern. In that hollow there is a small valley in the bottom of which is seawater. On the eastern coast there are bare reefs that slope sheer, while the western coast is rugged (TUĆAN 1950, 1953). The island of Brusnik got its name after the eruptive rocks that were used for the making of whetstone (»brus«) (CVITANIĆ 1968).

The area investigated is characterized by a typical Mediterranean climate. On the island there is no climatological station, so climatic data (only rainfall data) were taken from the neighbouring islands Svetac and Biševo for the period 1991–2001. During that period the average annual precipitation for Svetac was 535.72 mm and for Biševo it was 544.65 mm. The largest amounts of precipitation occur in November and December, and the lowest amounts occur in June and July, sometimes even without rain at all. The climate of Brusnik could be defined as arid, and that of Biševo and Svetac as semi-arid.

Floristically, Brusnik has been poorly explored, with the data on the flora of Brusnik being given by SPREITZENHOFER (1876), who described 11 species. A few years later, in 1882, professor of botany Bohuslav Jiruš examined the flora of the volcanic islands of Brusnik and Jabuka, but did not publish his results. The most significant contribution to the flora of Brusnik was given by GINZBERGER (1921) who published a list of 38 vascular plants and after that, the flora of Brusnik was not studied for a long period of time. Later, during the floristic and vegetational researches PAVLETIĆ (1970, 1983) recorded for the island the taxon *Senecio leucanthemifolius* Poir. var. *reichenbachii* Fiori, and TRINAJSTIĆ (1980, 1981, 1991) described an endemic subspecies, *Limonium vestitum* (Salmon) Salmon subsp. *brusnicense* Trinajstić. The endemic association with that taxon was described by PAVLETIĆ (1989) as *Crithmo-Limonietum vestiti* (TRINAJSTIĆ 1981) ZI. PAVLETIĆ 1989. Some new research into the association was described by PAVLETIĆ (1992). The latest records of flora and marine flora (algae) of the island of Svetac and Brusnik were given by LOVRIĆ and RAC (2002).

According to all previous literature data, for the island of Brusnik, 41 higher plant species have been recorded so far.

Materials and methods

Research into the vascular flora of the volcanic island of Brusnik (Fig. 1) was carried out in the period from 2000 to 2002 in all seasons. The taxa were determined using the following keys: FIORI (1923–1929, 1933), TUTIN et al. (1964–1980, 1993), TRINAJSTIĆ (1980, 1981), PIGNATTI (1982), DOMAC (1994), BURNIE (1995), BLAMEY and GREY-WILOSN (1998).

The names of taxa and nomenclatures have been adjusted to the Croatian Flora Checklist (NIKOLIĆ 1994, 1996, 1997, 2000, 2000a), except in the cases of *Limonium vestitum* (Salmon) Salmon subsp. *brusnicense* Trinajstić according to TRINAJSTIĆ (1980, 1981), and of *Senecio leucanthemifolius* Poir. var. *reichenbachii* Fiori according to FIORI (1923–1929). Families, genera, species and lower system units are listed in alphabetical order and

organized according to higher system units. When appropriate some comments are given. The herbarium specimens of collected plant taxa are deposited in the Herbarium of the Department of Botany, University of Zagreb (ZA).

Life forms are interpreted according to HORVAT (1949) and PIGNATTI (1982). Abbreviations are given in the brackets below the names of taxa that are noted by this research: **T** – Therophyta, **Ch** – Chamaephyta, **H** – Hemicryptophyta, **P** – Phanerophyta and **G** – Geophyta.

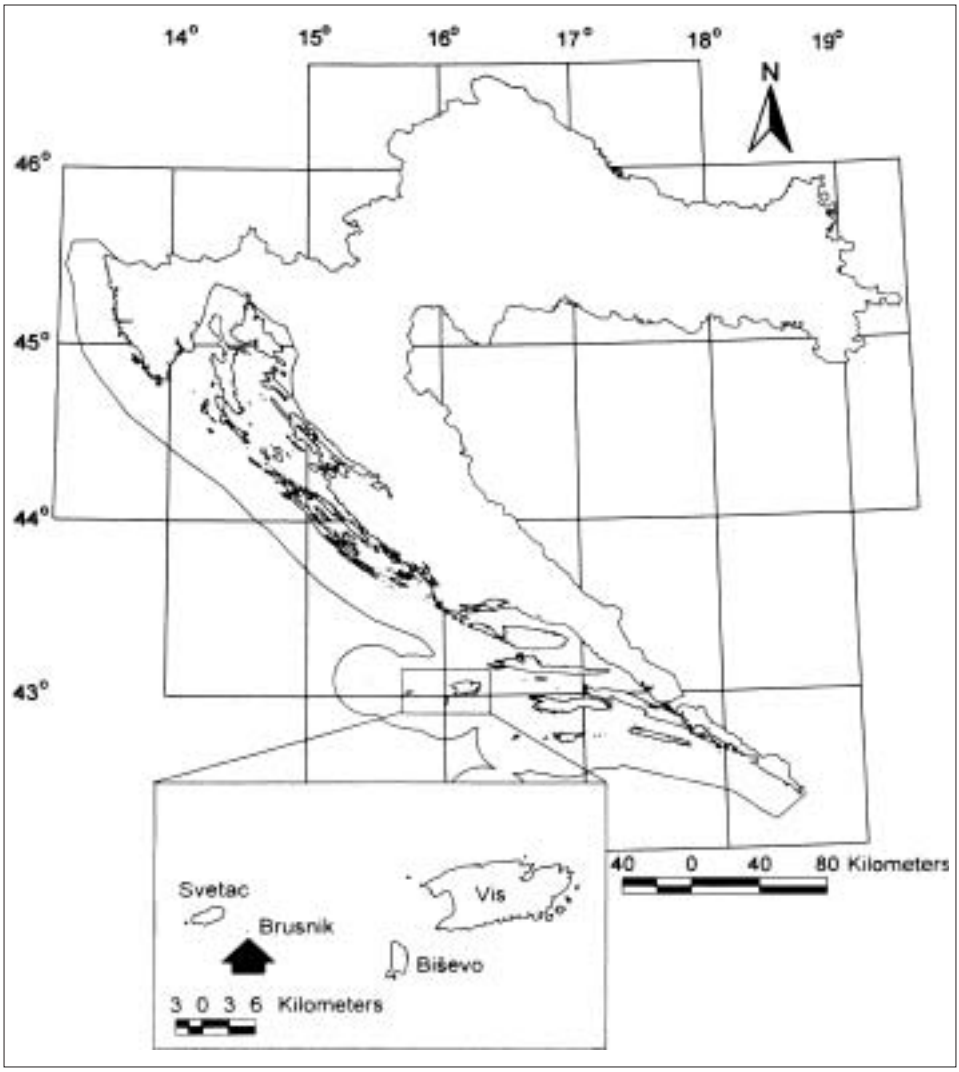

Fig. 1. The geographical position of the island of Brusnik

The division of the plants into floral elements and lower categories is done according to HORVATIĆ (1963), PAVLETIĆ (1974, 1975, 1978, 1979), HEĆIMOVIĆ (1981, 1982), REGULA-BEVILACQUA and ILIJANIĆ (1984). Abbreviations of floral elements, given below, are put in the brackets after the abbreviation for the life forms.

1) MEDITERRANEAN FLORAL ELEMENT
    a. Circum-Mediterranean plants – **CM**
    b. East Mediterranean plants – **EM**
    c. Illyrian Mediterranean plants
        1. Illyrian-Adriatic plants
            a. Illyrian-Adriatic endemic plants – **IAE**
    d. Mediterranean-Atlantic plants – **MA**
    e. Mediterranean-Pontic plants – **MP**
    f. European Mediterranean plants – **EUM**

2) SOUTH EUROPEAN FLORAL ELEMENT
    a. South European-Mediterranean plants – **SEUM**
    b. South European-Pontic plants – **SEUP**

3) WIDESPREAD PLANTS – **WSP**

Results and discussion

During this floristic research on the island of Brusnik a total of 28 higher plant species were found. Four of them, noted for the first time in this paper, are marked with ** (*Chenopodium vulvaria* L., *Prasium majus* L., *Tamarix africana* Poir. and *Umbilicus horizontalis* (Guss.) DC.). Among the previously noted taxa, 24 of them were confirmed. But 17 taxa marked with * findings were not confirmed, so it is to assumed that they are probably extinct on the island.

In the following floristic list, below the name of the taxon, after the abbreviations of life forms and floral elements, come the first two letters of the name of the recorder (Sp-SPREITZENHOFER 1876, Gi-GINZBERGER 1921, Pa-PAVLETIĆ 1970, 1983, 1992, Tr-TRINAJSTIĆ 1980, 1981, Lo-LOVRIĆ and RAC 2002).

Floristic list

SPERMATOPHYTA
Angiospermae
MAGNOLIOPSIDA

APIACEAE
Crithmum maritimum L.
(**Ch**, **MA**, Sp, Gi, Pa)

Daucus carota L. subsp. *hispanicus* (Gouan) Thell. *
(Sp, as *Daucus gingidium* L. var. *latilobus* Vis., Pa, as *D. gummifer* Lam. var. *hispanicus* (Gouan) Hayek, Lo, as *D. gummifer* All. and subsp. *mauritanicus* (L.) Onno)

ASTERACEAE

Centaurea ragusina L. subsp. *ragusina*
(**Ch**, **IAE**, Sp, Gi, Pa, Lo, as *C. ragusina* L. subsp. *padelini* (Ginzb.) Pevalek = *C. ragusina x C. lungensis* Ginzb.)

Inula crithmoides L. *
(Gi, Lo, as *I. crithmoides* L. subsp. *mediterranea* Kerg.)

Senecio leucanthemifolius Poir. var. *reichenbachii* Fiori
(**T**, **IAE,** Sp, as *Senecio aethnensis* Jahn, Gi, as *S. leucanthemifolius* Poir. var. *pinnatifidus* Fiori, but it wasn't that taxon according to Pa, Lo)

BORAGINACEAE

Heliotropium europaeum L.
(**T**, **MP**, Gi, as *H. europaeum* L. var. *tenuiflorum* Guss., Lo)

BRASSICACEAE

Cakile maritima Scop. *
(Gi, Lo, as *C. maritima* Scop. subsp. *aegyptica* (Willd.) Nyman)

Lobularia maritima (L.) Desv. *
(Sp, as *Koniga maritima* Br., Gi, Lo)

CAPPARIDACEAE

Capparis spinosa L.
(**T**, **CM**, Gi, as *Capparis rupestris* Sibth. et Sm., Pa)

CARYOPHYLLACEAE

Silene sedoides Poiret, also occurs *S. sedoides* Poiret f. *laxa* Hausskn.
(**T**, **CM**, Gi, Lo)

Silene vulgaris (Moench.) Garcke subsp. *angustifolia* Hayek
(**Ch**, **SEUM**, Sp, as *Silene cucubalus* Wild. var. *linarifolia*, Gi, as *Silene vulgaris* (Moench.) Garcke var. *reiseri* Maly)

CHENOPODIACEAE

Arthrocnemum macrostachyum (Moric.) C. Koch
(**Ch**, **SEUM**, Sp, as *Salicornia fruticosa* L., Gi, and Lo, as *A. glaucum* (Del.) Ung.-Sternb.)

Atriplex prostrata Boucher ex DC. in Lam. et DC.
(**T**, **WSP**, Gi, as *A. hastatum* L., Lo)

Chenopodium murale L.
(**T**, **WSP**, Gi, Lo)

Chenopodium vulvaria L. **
(**T**, **SEUM**)

*Halimione portulacoid*es (L.) Aellen *
(Gi, as *Atriplex portulacoides* L, Lo)

Suaeda verna J. F. Gmelin *
(Gi, as *S. fruticosa* Forsk., Lo)

CICHORIACEAE

Reichardia picroides (L.) Roth
(**H**, **CM**, Pa, Lo)

Sonchus oleraceus L.
(**T**, **WSP**, Gi, as *S. laevis* (L.) Gars.)

CRASSULACEAE

Sedum hispanicum L.
(**T**, **SEUP**, Gi, as *S. glaucum* Waldst. et Kit., Lo)

Sedum ochroleucum Chaix *
(Gi, Lo)

Umbilicus horizontalis (Guss.) DC. **
(**Ch**, **CM**)

FABACEAE

Lotus cytisoides L.
(**Ch**, **CM**, Sp, as *Lotus cytisoides* L. var. *prostratus* Jahn, Gi and Pa, as *L. allionii* Desv., Lo)

FRANKENIACEAE

Frankenia pulverulenta L.
(**T**, **CM**, Gi, Pa)

FUMARIACEAE

Fumaria flaballata Gaspar.
(**T**, **EM**, Gi, Lo)

LAMIACEAE

Prasium majus L. **
(**Ch**, **CM**)

MALVACEAE

Lavatera arborea L.
(**P**, **EUM**, Gi, Pa, Lo)

MORACEAE

Ficus carica L. *
(Gi, Lo)

PLANTAGINACEAE

Plantago coronopus L. *
(Gi, as *P. coronopus* L. var. *pusilla* Moris)

PLUMBAGINACEAE

Limonium cancellatum (Bernh. ex Bertol.) O. Kuntze
(Sp, Gi, as *Statice cancellata* Bernh.)
Ginzberger gave his collected material to Charles Edger Salmon for taxonomic revision because he noted some different characteristics that are not typical of *S. cancellata*. SALMON (1923) described those specimens as *Statice vestita* Salmon, so it is to be supposed that *L. cancellatum* (Bernh. ex Bertol.) O. Kuntze is not present in the flora of Brusnik)

Limonium vestitium (Salmon) Salmon subsp. *brusnicense* Trinajstić
(**H**, **IAE**, Tr, Pa, Lo, as *L. diomedeum* Brullo)

PORTULACACEAE

Portulaca oleracea L. subsp. *oleracea*
(**T**, **WSP**, Gi, as *Portulaca oleracea* L., Lo)

SOLANACEAE

Hyoscyamus albus L.
(**T**, **CM**, Gi, Lo)

TAMARICACEAE

Tamarix africana Poir. **
(**P**, Lo, as *Tamarix dalmatica* Baum, probably wrong determination)
This plant is not indigenous in the flora of Brusnik, because it was introduced by Komiža fishermen thirty years ago.

URTICACEAE

Parietaria judaica L.
(**H**, **SEUM**, Sp, as *P. diffusa* Mert. et Koch, Gi, Pa, Lo)

ZYGOPHYLLACEAE

Tribulus terrestris L. *
(Gi, as *T. orientalis* A. Kern., Lo)

LILIOPSIDA

LILIACEAE

Allium commutatum Guss.
(**G**, **CM**, Lo)

Asparagus acutifolius L.
(**P**, **CM**, Sp, Gi, Lo)

Smilax aspera L. *
(Gi, Lo)

POACEAE

Bromus madritensis L. *
(Gi, Lo)

Bromus rigidus Roth *
(Gi, as *B. villosus* Forsk. subsp. *maximus* Desf., Lo, as *B. villosus* Forsk.)

Desmazeria marina (L.) Druce
(**T**, **MA**, Gi, as *Catapodium loliaceum* (Huds.) Link f. *subramosum* Hack., Lo)

Hordeum marinum L. *
(Gi, Lo)

Lagurus ovatus L. *
(Gi, Lo)

Parapholis incurva (L.) C. E. Hubb. *
(Gi and Lo, as *Lepturus incurvatus* (L.) Trin.)

The analysis of the flora

The analysis of the life forms includes a total of 28 taxa. The results are shown by the spectrum of life forms (Fig. 2) and the results of the phytogeographical analysis are shown in table (Tab. 1).

The vascular flora of the island of Brusnik researched in the period from the year 2000 to 2002 includes 28 taxa, from 26 genera and 24 families.

Among them, four species were observed for the first time: *Chenopodium vulvaria* L., *Umbilicus horizontalis* (Guss.) DC., *Prasium majus* L. and *Tamarix africana* Pior.

Plant taxa recorded by LOVRIĆ and RAC (2002) that were not confirmed by this research are: *Atriplex arenaria* (Tin.) Woods (= *A. tornabenei* Tin.), *Elymus pycnanthus* (Gord.) Meld., *Hordeum leporinum* Link., *S. litoreum* Guss., *Sonchus glaucescens* Jord., *S. tenerrimus* L. Following plant species: *Capparis orientalis* Sibth. et Sm., *C. sicula* Duham. (= *C. ovata* auct.), *Chenopodium botryodes* Sm. (= *Ch. crassifolium* Horn.), *Lavatera bryonifolia* Lam. (= *L. unguiculata* Desf.), *Limonium diomedeum* Brullo, *Sedum orientale* Boiss. (= *S. dinaricum* M.G.), *Silene vulgaris* L. subsp. *suffrutescens* Grent et al. were not mentioned earlier for the flora of Croatia (NIKOLIĆ 1994, 1996, 1997, 2000, 2000a; HRŠAK 2001, http://www.ipni.org/index.html). Also, in the Herbarium of the Department of Botany, Faculty of science, University of Zagreb (ZA and ZAHO) there are no specimens of

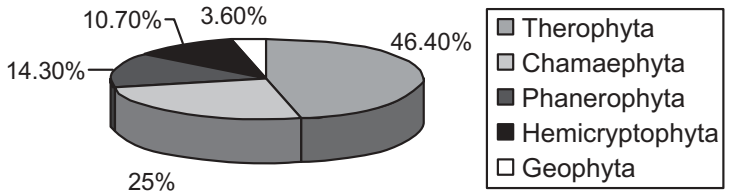

Fig. 2. Spectrum of life forms of Brusnik vascular flora

those taxa. Hence, we assume that these taxa are new to the Croatian flora, but without herbarium specimens we cannot prove their existence.

According to analysis of the life forms (Fig. 2), the most numerous plants on the island are *Therophyta* (13 species, 46.4%), followed by *Chamaephyta* (seven species, 25%), *Phanerophyta* (four species, 14.3%), *Hemicryptophyta* (three species, 10.7%) and *Geophyta* (one species, 3.6%). The domination of *Therophyta* (46.4%) indicates that the climate of this island is typically Mediterranean. On the other hand, the high percentage of *Chamaephyta* (25%) shows the dry and very hot conditions on the island, which are similar to the spectrum of the desert (cf. HORVAT 1949). The climate of Brusnik according to flora analyses could be defined as arid.

The phytogeographical analysis of the flora includes all autochthonous taxa, which are classified into three categories (Tab. 1). The greatest number of plants belong to the Mediterranean floral element (18 species, 66.6%), with a dominant Circum-Mediterranean plants (37%). Within Illyrian-Mediterranean plants there are three important Illyrian-Adriatic endemic plants (11.1%): *Centaurea ragusina* L., *Limonium vestitum* (Salmon) Salmon subsp. *brusnicense* Trinajstić and *Senecio leucanthemifolius* Poir. var. *reichenbachii* Fiori. After them come plants of the South European floral element (five species, 18.5%) and a group of widespread plants (four species, 14.8%). The last group of floral elements reveals an anthropogenic influence on the flora of Brusnik. The results of phytogeographical analysis show that the island of Brusnik belongs to the Mediterranean zone proper of the Mediterranean region (HORVATIĆ 1963).

Tab. 1. Analysis of floral elements in the flora of Brusnik

Floral element	Number of taxa and percentage
1. MEDITERRANEAN FLORAL ELEMENT	18 (66.6%)
A. Circum-Mediterranean plants – **CM**	10 (37%)
B. East Mediterranean plants – **EM**	1 (3.7%)
C. Illyrian Mediterranean plants	
1. Illyrian-Adriatic plants	
a. Illyrian-Adriatic endemic plants – **IAE**	3 (11.1%)
D. Mediterranean-Atlantic plants – **MA**	2 (7.4%)
E. Mediterranean-Pontic plants – **MP**	1 (3.7%)
F. European Mediterranean plants – **EUM**	1 (3.7%)
2. SOUTH EUROPEAN FLORAL ELEMENT	5 (18.5%)
A. South European-Mediterranean plants – **SEUM**	4 (14.8%)
B. South European-Pontic plants – **SEUP**	1 (3.7%)
3. WIDESPREAD PLANTS – **WSP**	4 (14.8%)

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