NAT. CROAT. | VOL. 22 | No 1 | 111–134 | ZAGREB | June 30, 2013

original scientific paper / izvorni znanstveni rad

FLORA OF THE SEMINATURAL MARSHLAND SAVICA, PART OF THE (SUB)URBAN FLORA OF THE CITY OF ZAGREB (CROATIA)

Antun Alegro[1], Sandro Bogdanović[2], Ivana Rešetnik[1], Igor Boršić[3], Petra Cigić[4] & Toni Nikolić[1]

[1] University of Zagreb, Faculty of Science, Division of Biology, Department of Botany and Botanical Garden, Marulićev trg 20/II, HR-10000 Zagreb, Croatia (antun.alegro@biol.pmf.hr)

[2] University of Zagreb, Faculty of Agriculture, Department of Agricultural Botany, Svetošimunska 25, HR-10000 Zagreb, Croatia

[3] State Institute for Nature Protection, Trg Mažuranića 5, HR-10000 Zagreb, Croatia

[4] Ministry of Health, Directorate for Sanitary Inspection, Branimirova 183, HR-10000, Zagreb, Croatia

Alegro, A., Bogdanović, S., Rešetnik, I., Boršić, I., Cigić, P. & Nikolić, T.: Flora of the seminatural marshland Savica, part of the (sub)urban flora of the city of Zagreb (Croatia) Nat. Croat., Vol. 22, No. 1., 111–134, 2013, Zagreb.

The flora of Savica, a suburban part of the town Zagreb with remnants of alluvial forests and vegetation of still waters, was surveyed mainly during 2006 with some later additions. In total 289 vascular plant species and subspecies were recorded. Regarding the spectrum of chorological types the flora of Savica is similar to other areas of NW Croatia, but with higher ratio of Euro-Asiatic chorotypes (48.3%), adventive species (13.2%) and Mediterranean chorotypes (9.7%) as consequence of anthropogenic influence and the ruderalisation of habitats. The same process is reflected in its relatively high ratio of therophytes (19.1%). Indicators of anthropogenic changes show that the flora of Savica is more influenced by archaeophytes than by neophytes. Among them, 25 species (8.6%) are invasive alien species. The life-form spectrum is almost the same as for other areas of NW Croatia, suggesting that the flora has a structure well adapted to general climate of North-Western Croatia. A special value of the flora of Savica consists of stands of tree species representing the last remnants of alluvial forests along the Sava River, as well as hydrophytes and helophytes in and around small lakes.

Key words: biodiversity, urban flora, life-forms, chorological types, alien species

Alegro, A., Bogdanović, S., Rešetnik, I., Boršić, I., Cigić, P. & Nikolić, T.: Flora poluprirodne močvare Savica, suburbanog dijela grada Zagreba (Hrvatska). Nat. Croat., Vol. 22, No. 1., 111–134, 2013, Zagreb.

Flora Savice, suburbanog dijela grada Zagreba s ostacima poplavnih šuma i vegetacijom stajačica, istraživana je mahom 2006. s nekoliko kasnijih dodataka. Ukupno je zabilježeno 289 vrsta i podvrsta vaskularnog bilja. S obzirom na spektar horoloških tipova, flora Savice slična je nekim drugim područjima SZ Hrvatske s time da se s većom učestalošću ističu biljke eurazijskog elementa (48,3%), adventivne vrste (13,2%) i biljke mediteranskog elementa (9,7%), što je posljedica antropogenog utjecaja i posljedične ruderalizacije staništa. Taj proces se ogleda i u razmjerno visokom udjelu terofita (19,1%). Pokazatelji antropogene promjene pokazuju da je flora Savice više utjecana arheofitima nego neofitima. Među njima nalazi se 25 vrsta (8,6%) invazivnih stranih vrsta. Spektar životnih oblika gotovo je isti kao za druga područja SZ Hrvatske, što upućuje da je flora dobro prilagođena općoj klimi SZ Hrvatske. Osobita vrijednost flore Savice su sastojine drvenastih vrsta koje predstavljaju posljednje ostatke poplavne vegetacije uz rijeku Savu, kao i hidrofiti i helofiti prisutni u jezercima i oko njih.

Ključne riječi: biološka raznolikost, urbana flora, životni oblici, horološki tipovi, strane vrste

INTRODUCTION

Savica, a seminatural marshland area inside the administrative boundaries of the town of Zagreb, is an ideal test field to study the influence of urbanization on the changes in the composition of flora as consequence of habitat modification. Throughout habitat fragmentation, degradation and creation of new habitats with new ecological conditions the process of anthropization has strong influence on natural biodiversity resulting, at species level, in changes in species compositions and abundances. Anthropogenic pressure leads to changes in geographical-historical structure of the urban flora resulting in: (1) a flora with a structure divergent from that originally present (disturbance of natural floristic continuity in time), (2) a flora with a structure different from that present in extra-urban areas (disturbance of floristic continuity in space) and (3) in taxonomic, ecological and geographical uniformisation of floras in different urban areas (Witosławski & Bomanovska, 2009).

The floras of the urban areas in Croatia are very poorly known. Comprehensive data exists only for some towns in Dalmatia: Šibenik (Milović, 2000), Split (Ruščić, 2003; Jasprica *et al*., 2010), Zadar (Milović, 2008; Milović & Mitić, 2012), Omiš (Tafra, 2009; Tafra *et al*., 2012) and Dubrovnik (Jasprica *et al*., 2010), but for inland parts of Croatia they are very scarce and partial. Reports on the flora and vegetation of Zagreb and its surroundings are relatively numerous compared to the other cities in Croatia. The area along the Sava River near Zagreb has been extensively researched since the second half of the 19th century (Schlosser & Vukotinović, 1857, 1869; Gjurašin, 1923; Horvatić, 1931; Gospodarić, 1958; Horvatić & Gospodarić, 1959-60; Marković-Gospodarić, 1965; Marković, 1970, 1973, 1975, 1978; Topić & Šegulja, 1978; Lukač, 1988; Ilijanić *et al*., 1989; Smital *et al*., 1998; Nikolić & Fadljević, 1999; Hršak, 2002; Milović, 2004 and Mitić e*t al*., 2007), and the most recent study deals with the flora on the right bank of the Sava river in the area of Piškorovo and Konopljenka (Hudina *et al*., 2012).

On the other hand floristic data of the urban part of Zagreb are almost non-existent (an exception is a popular field guide Černicki (2006). Mapping of certain urban zones (Jarun, Maksimir, Savica) was conducted during 2006 within the frames of the project Countdown 2010 Zagreb (Nikolić *et al*., 2007; Anonymous, 2008).

The aim of this paper is to present he recent flora of Savica, to investigate the participation of archaeophytes and kenophytes in it, and their connection to historical, causal and functional factors.

MATERIAL AND METHODS

Study area

Savica (Fig. 1) is a complex of 12 small interconnected eutrophic lakes and surrounding habitats situated on the left river bank in the Sava plain (elevation between 110 and 125 m a. s. l.) on Neogene alluvial deposits. It is in the SE part of town Zagreb, ca 4 km from the town centre. The lakes are remnants of backwaters of the River Sava. They are spread on 30 ha, while the whole area has a surface of 75 ha. Habitats surrounding the lakes are strongly changed and degraded stands of previous floodplain forests. The lakes are now at a higher elevation than the Sava River and therefore without any communication with flowing water. They are fed with water only by precipitation and by cooling water from neighbouring thermal power plant/station.

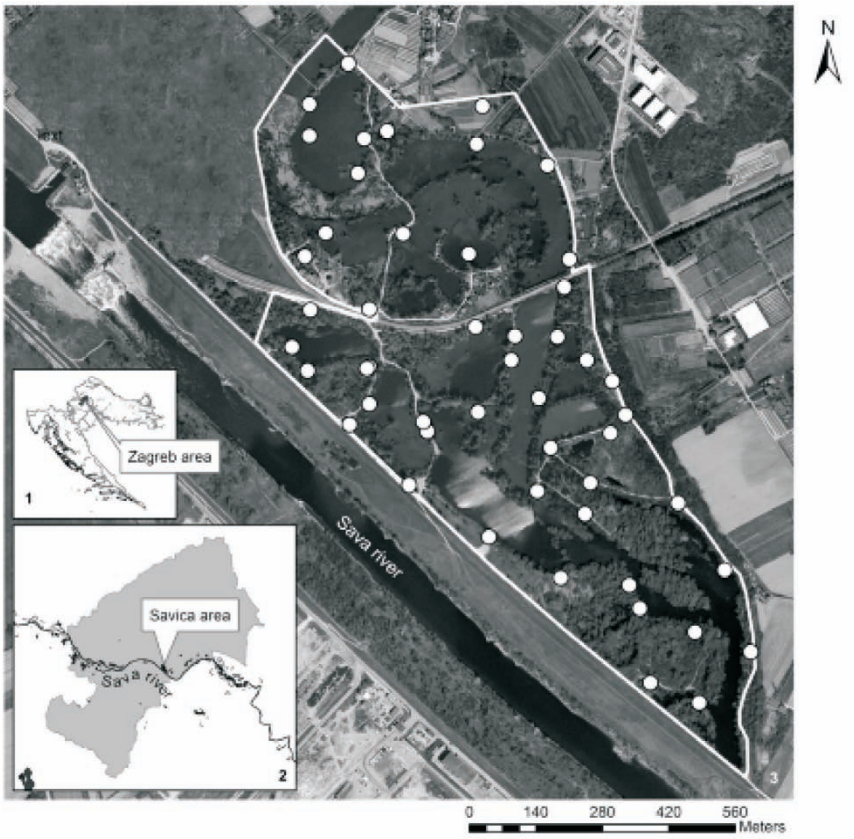

Fig. 1. Geographic position of the investigated area: 1/ area of the city of Zagreb in Croatia, 2/ Savica area inside Zagreb, 3/ Savica area – sampling localities are represented by white dots.

Historically, the area was part of huge lowland forests zone of pedunculate oak (ass. *Genisto elatae-Quercetum roboris* Horvat 1938 and *Carpino betuli-Quercetum roboris* (Anić 1959) Rauš 1971). Alongside the river and backwaters and on other habitats more strongly influenced by floods, with high groundwater and surface water remaining for longer periods, different types of forest communities with willows, alders and poplars (alliances *Salicion albae* Soó 1930 and *Alnion glutinosae* Malcuit 1929) developed (Vukelić, 2012).

Nowadays the area of Savica is without closed forest stands. It is characterised by a mosaic of more or less disturbed habitats around the lakes with single or small groups of trees and dense scrub between them. The most abundant tree species are white willow (*Salix alba*), black and white poplar (*Populus nigra* and *P. alba*), common alder (*Alnus glutinosa*) and black locust (*Robinia pseudoacacia*). The scrub consists mostly of *Cornus sanguinea*, *Prunus spinosa*, *Rosa canina*, *Crataegus monogyna*, *Corylus avellana*, *Sambucus nigra*, *Salix purpurea*, *Ligustrum vulgare* and some other species, all densely interwoven by *Rubus* spp., *Clematis vitalba* and in spots by *Thladiantha dubia*, discovered here for the first time in Croatia outside the Botanical Garden in Zagreb (Ilijanić *et al*., 1985; Alegro *et al*., 2010). This scrub belongs to the alliance *Carpino betuli-Prunion spinosae* (R. Tx. 1952)

H. E. Weber 1974 and to ass. *Cornetum sanguinei* Kaiser 1930. Loose stands of scrub, paths, open habitats and banks of lakes are overgrown by herbaceous species belonging mostly to the alliance *Senecion fluviatilis* R. Tx. 1950 (syn. *Convolvulion sepii* R. Tx. 1947). The most abundant species in this vegetation type are *Epilobium hirsutum*, *E. tetragonum*, *Urtica dioica*, *Calystegia sepium*, *Solidago gigantea*, *Bidens frondosa*, *Helianthus tuberosus*, *Impatiens glandulifera*, *Lysimachia vulgaris* and *L. punctata*. Regarding the water vegetation the most widespread is a community of spiked water milfoil and yellow water lily (ass. *Myriophyllo-Nupharetum luteae* (W. Koch 1926) Hueck 1931). Beside the spiked water milfoil in this community hornwort (*Ceratophyllum demersum*) is very abundant indicating eutrophy in the lakes. Near the banks, in shallow and still water, a community of duckweed has developed (ass. *Lemno-Spirodeletum polyrhizae* W. Koch 1954) with both of the two species abundantly present. In similar habitats there are sporadic occurrences of a community of floating heart (ass. *Nymphoidetum peltatae* Bellot 1951). Very important is the community of periodically flooded banks (*Nanociperion* W. Koch 1926) encompassing several *Cyperus* and *Carex* species. On the edges and banks of lakes, small patches of reed vegetation belonging to ass. *Phragmitetum australis* (Gams 1927) Schmale 1939 and ass. *Typhetum latifoliae* (Soó 1927) Now. 1930 are developed.

Nevertheless, the area of Savica is one of the last marshland habitats in the town Zagreb, and therefore protected as significant landscape (IUCN category V) with zoological reserve since 1991. In total, 174 bird species (data of Croatian Ornithological Society), 16 mammal species, six reptile species and four amphibian species have been recorded here (Tvrtković *et al*., 2007).

METHODS

The area of Savica was floristically studied in 2006, during the vegetation period. The specimens were identified directly in the field, or herbarized for subsequent identification, in 46 geocoded sampling spots (Fig. 1/3). Geocoding was done by GPS devices (Garmin eTrex Vista HCx). The historical records from literature were added to the field observation data.

Flora Europea (Tutin *et al*., 1964-1980, 1993) was mainly used to identify plant material, but some other floras were also employed (Oberdorfer, 2001; Martinčič *et al*., 2007; Fischer *et al*., 2008). The nomenclature used follows *Flora Croatica Database* (Nikolić 2012). Life-form, chorological type and origin (type and time of immigration) were attributed to each taxon of the check-list.

Raunkier's system of life-forms as presented by Ellenberg *et al.* (1991), Oberdorfer (2001), Landolt *et al*. (2010) was accepted:

p – Phanerophytes,
ch – Chamaephytes,
h – Hemicryptophytes,
t – Therophytes,
g – Geophytes,
hy – Hydrophytes.

Chorological types follow the system proposed by Horvatić (1963) and Horvatić *et al*. (1967-1968), but the affiliation of species to particular groups was revised and accorded to newer point of view (Simon *et al*., 1992; Oberdorfer, 2001; Ciocârlan, 2009 and especially Landolt *et al*., 2010). The chorological groups used in this paper are:

1. medit – Mediterranean (in broadest sense),
2. illyr-balk – Illyrian-Balkan,
3. S-europ – South-European,
4. atl – Atlantic,
5. E-europ-pont – East-European-Pontic,
6. SE-europ – Southern-East-European
7. C-europ – Central-European,
8. europ – European,
9. euro-asiat – Eurasiatic,
10. circ-holoart – Circumholarctic,
11. cosmop – Cosmopolites,
12. adv – Adventive species.

Spectra of life-forms and chorological types were compared with some other areas in North-Western Croatia characterized by mosaic, seminatural landscapes: Martinci in Hrvatsko zagorje (Martinko, 2009); Stupnik, a suburban area 10 km southwest from Zagreb (Mitić *et al*., 2007); Konjšćina in Hrvatsko zagorje (Stančić, 1994), Piškorovo and Konopljenka in suburban area on the south of Zagreb (Hudina *et al*., 2012) and Vukova Gorica on the edge of the Gorski kotar Region (Alegro *et al*., 2006).

Origin, i.e. type and time of immigration, was mainly accepted after Landolt *et al*. (2010), Pyšek *et al*. (2002) and Lauber & Wagner (1996), but with consideration of the specific circumstances of inland parts of Croatia. The terminology follows Kornaś (1981), Mirek (1981) and Jackowiak (1990). In brackets are quoted categories proposed by Mitić *et al*. (2008) as standards for national flora used in further text. The groups are:

Sp – spontaneophytes (native plants),
Ar – archaeophytes, established alien species introduced intentionally or unintentionally before 1500,
Kn – kenophytes (neophytes), alien species introduced intentionally or unintentionally after 1500, and
Df – diaphytes (non native casual plants), alien species not permanently established.

Indicators of anthropogenic changes in the flora were calculated after Jackowiak (1990, 2006) as follows:

1. Indicators of anthropization

1.1. IAn_t – indicator of total anthropization, $IAn_t=(An/(Sp + An))*100$;
1.2. IAn_p – indicator of permanent anthropization, $IAn_p=(Mt/(Sp + Mt)*100$;

2. Indicators of archaeophytization

2.1. IAr_t – indicator of total archaeophytization, $IAr_t=(Ar/(Sp + An)*100$;
2.2. IAr_p – indicator of permanent archaeophytization, $IAr_p=(Ar/(Sp + Mt)*100$;

3. Indicators of kenophytization

3.1. IKn_t – indicator of total kenophytization, $IKn_t=(Kn/(Sp + An)*100$;
3.2. IKn_p – indicator of permanent kenophytization, $IKn_p=(Kn/(Sp + Mt)*100$

4. IM – inicator of modernization, IM= (Kn/Mt)*100;

5. IF – indicator of fluctuation changes, IF=(Df/(Sp + An)*100;

where An is number of anthropophytes (alien species i.e. An=Ar + Kn + Df) and Mt is number of metaphytes (permanently established alien species, i.e. Mt=Ar + Kn).

Threat categories according to the *Red Book of Vascular Flora of Croatia* (Nikolić & Topić, 2005), legal protection statuses (Anonymous, 2009) and invasiveness of species (Boršić *et al*., 2008; Mitić *et al*., 2008) were also listed.

RESULTS

In the area of Savica 289 vascular plant species and subspecies belonging to 199 genera and 75 families were recorded (Tab 1). The most abundant families (Fig. 2) are Asteraceae (12.5%), Poaceae (11.8%), Lamiaceae (5.9%), Fabaceae (5.2%), Cyperaceae

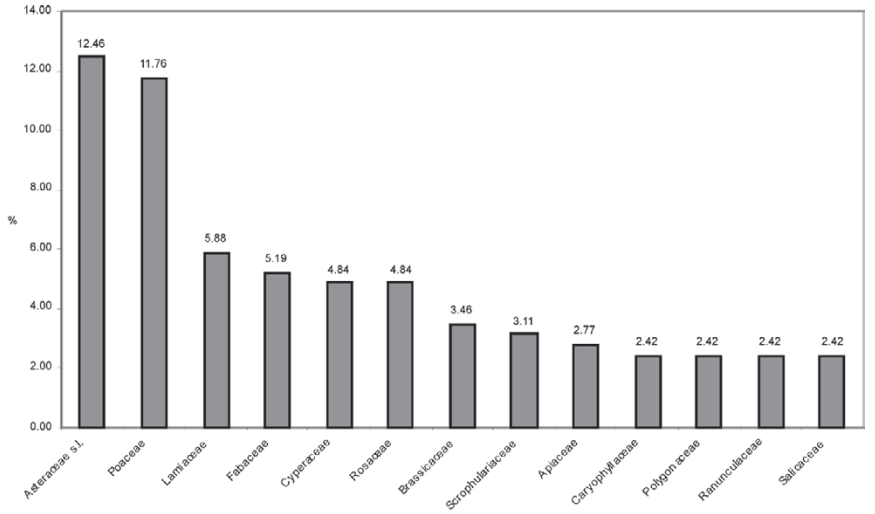

Fig. 2. The most abundant families in the flora of Savica.

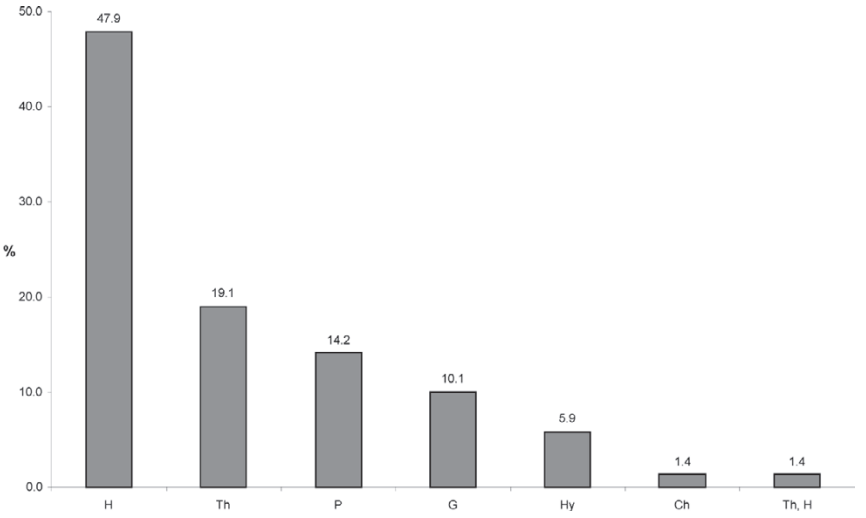

Fig. 3. Spectrum of life-forms for the flora of Savica.

Tab. 1. Vascular flora of Savica. O – origin (Sp- native plants, Ar- archaeophytes, Kn- neophytes, Df- non native casual plants), Ch – chorological types, LF – life forms, P – law protection status (P-protected, SP-strictly protected), IAS – invasive alien species.

	O	Ch	LF	P	IAS
Subclass Equisetidae					
Equisetaceae					
Equisetum arvense L.	Sp	10	g		
Equisetum pratense Ehrh.	Sp	10	g		
Equisetum ramosissimum Desf.	Sp	11	g		
Subclass Magnoliidae					
Amaranthaceae					
Amaranthus retroflexus L.	Kn	12	t		I
Apiaceae					
Aegopodium podagraria L.	Sp	9	h		
Angelica sylvestris L.	Sp	9	h		
Anthriscus sylvestris (L.) Hoffm.	Sp	9	h		
Berula erecta (Huds.) Coville	Sp	10	hy		
Daucus carota L.	Ar	1	h		
Hacquetia epipactis (Scop.) DC.	Sp	2	h		
Heracleum sphondylium L.	Sp	9	h		
Torilis arvensis (Huds.) Link	Ar	1	t		
Araliaceae					
Hedera helix L.	Sp	7	p		
Aristolochiaceae					
Aristolochia clematitis L.	Ar	1	h	P	
Asclepiadaceae					
Asclepias syriaca L.	Kn	12	g		I
Asteraceae					
Achillea millefolium L.	Sp	9	h		
Ambrosia artemisiifolia L.	Kn	12	t		I
Arctium lappa L.	Sp	9	h		
Arctium minus Bernh.	Sp	8	h		
Artemisia verlotiorum Lamotte	Kn	12	h		I
Artemisia vulgaris L.	Sp	9	h		
Bellis perennis L.	Sp	9	h		

Bidens frondosa L.	Kn	12	t		I
Centaurea jacea L.	Sp	9	h		
Centaurea nigrescens Willd.	Sp	5	h		
Centaurea rhenana Boreau	Sp	9	h		
Cichorium intybus L.	Ar	9	h		
Cirsium arvense (L.) Scop.	Sp	9	g		
Cirsium vulgare (Savi) Ten.	Sp	9	h		
Conyza canadensis (L.) Cronquist	Kn	12	t		I
Crepis biennis L.	Sp	7	h		
Erigeron annuus (L.) Pers.	Kn	12	h		I
Eupatorium cannabinum L.	Sp	9	h		
Galinsoga ciliata (Raf.) S.F.Blake	Kn	12	t		I
Galinsoga parviflora Cav.	Kn	12	t		I
Helianthus tuberosus L.	Kn	12	g		I
Lactuca serriola L.	Sp	9	h		
Lapsana communis L.	Sp	9	h		
Petasites hybridus (L.) P.Gaertn., B.Mey. et Schreb.	Sp	9	g		
Picris hieracioides L.	Sp	9	h		
Pulicaria dysenterica (L.) Bernh.	Ar	1	h	P	
Rudbeckia laciniata L.	Kn	12	h		I
Senecio erraticus Bertol.	Sp	3	h		
Senecio vulgaris L.	Ar	1	t		
Solidago gigantea Aiton	Kn	12	h	P	I
Sonchus asper (L.) Hill	Ar	9	t		
Sonchus oleraceus L.	Ar	9	t		
Tanacetum vulgare L.	Sp	9	h		
Taraxacum officinale Weber	Sp	10	h	P	
Tripleurospermum inodorum (L.) Sch. Bip.	Ar	9	t,h		
Tussilago farfara L.	Sp	9	h		
Balsaminaceae					
Impatiens glandulifera Royle	Kn	12	t		I
Impatiens parviflora DC.	Kn	12	t		I
Berberidaceae					
Berberis vulgaris L.	Sp	7	p	P	
Betulaceae					
Alnus glutinosa (L.) Gaertner	Sp	9	p		
Boraginaceae					
Myosotis scorpioides L.	Sp	9	h		
Pulmonaria officinalis L.	Sp	6	h		

Symphytum officinale L.	Sp	9	h	
Brassicaceae				
Alliaria petiolata (M. Bieb.) Cavara et Grande	Sp	9	h	P
Capsella bursa-pastoris (L.) Medik.	Ar	1	t	
Cardamine impatiens L.	Sp	9	h	
Diplotaxis muralis (L.) DC	Ar	1	t	
Erophila verna (L.) DC	Sp	9	t	
Lepidium ruderale L.	Ar	9	t	
Nasturtium officinale R. Br.	Sp	10	hy	P
Rorippa amphibia (L.) Besser	Sp	9	hy	
Rorippa sylvestris (L.) Besser	Sp	7	h	
Sinapis arvensis L.	Ar	1	t	
Cannabidaceae				
Humulus lupulus L.	Sp	9	h	
Caprifoliaceae				
Lonicera xylosteum L.	Sp	9	p	
Sambucus ebulus L.	Sp	1	h	
Sambucus nigra L.	Sp	8	p	
Viburnum lantana L.	Sp	9	p	
Viburnum opulus L.	Sp	9	p	
Caryophyllaceae				
Cerastium sylvaticum Waldst. et Kit.	Sp	5	h	
Cucubalus baccifer L.	Sp	9	h	
Saponaria officinalis L.	Sp	9	h	P
Silene dioica (L.) Clairv.	Sp	8	h	
Silene latifolia Poir. subsp. *alba* (Mill.) Greuter et Bourdet	Sp	1	h	
Silene vulgaris (Moench.) Garcke	Sp	7	h	
Stellaria media (L.) Vill.	Ar	1	t	
Celastraceae				
Euonymus europaeus L.	Sp	9	p	P
Ceratophyllaceae				
Ceratophyllum demersum L.	Sp	11	hy	
Chenopodiaceae				
Chenopodium album L.	Ar	9	t	
Convolvulaceae				

Calystegia sepium (L.) R. Br.	Sp	9	h		
Convolvulus arvensis L.	Ar	9	h		
Cornaceae					
Cornus sanguinea L.	Sp	8	p		
Corylaceae					
Corylus avellana L.	Sp	8	p		
Cucurbitaceae					
Echinocystis lobata (Michx.) Torr. et Gray	Kn	12	t		I
Thladiantha dubia Bunge	Kn	12	g		
Dipsacaceae					
Dipsacus fullonum L.	Ar	1	h		
Knautia arvensis (L.) Coult.	Sp	9	h		
Scabiosa columbaria L.	Sp	7	h		
Euphorbiaceae					
Euphorbia cyparissias L.	Sp	9	h		
Euphorbia esula L.	Sp	9	h		
Euphorbia helioscopia L.	Ar	1	t		
Fabaceae					
Coronilla varia L.	Sp	8	h		
Galega officinalis L.	Ar	1	h	P	
Lathyrus latifolius L.	Sp	3	h		
Lathyrus pratensis L.	Sp	9	h		
Lotus corniculatus L.	Sp	9	h		
Medicago falcata L.	Sp	9	h		
Medicago lupulina L.	Ar	1	t		
Medicago sativa L.	Ar	1	h		
Melilotus albus Medik.	Ar	9	h		
Melilotus officinalis (L.) Lam.	Ar	9	h		
Robinia pseudoacacia L.	Kn	12	p		I
Trifolium arvense L.	Ar	3	t		
Trifolium pratense L.	Sp	9	h		
Trifolium repens L.	Sp	9	h		
Vicia cracca L.	Sp	9	h		
Gentianaceae					
Nymphoides peltata (S. G. Gmelin) O. Kuntze	Sp	9	hy		

Geraniaceae				
Geranium robertianum L.	Sp	10	h	P
Haloragaceae				
Myriophyllum spicatum L.	Sp	10	hy	
Hypericaceae				
Hypericum perforatum L.	Sp	9	h	P
Junglandaceae				
Juglans regia L.	Ar	12	p	
Lamiaceae				
Ajuga reptans L.	Sp	9	h	
Ballota nigra L.	Ar	1	h	P
Galeopsis speciosa Mill.	Sp	5	t	
Glechoma hederacea L.	Sp	9	h	
Lamium maculatum L.	Sp	7	h	
Lamium orvala L.	Sp	2	h	
Lamium purpureum L.	Ar	1	t	
Lycopus europaeus L.	Sp	9	h	P
Mentha aquatica L.	Sp	9	hy	P
Mentha arvensis L.	Sp	10	h	
Mentha longifolia (L.) Huds.	Sp	9	h	
Prunella vulgaris L.	Sp	10	h	
Salvia pratensis L.	Sp	1	h	
Scutellaria galericulata L.	Sp	10	h	
Stachys palustris L.	Sp	10	g	
Thymus longicaulis C.Presl	Sp	6	ch	
Thymus pulegioides L.	Sp	9	ch	
Linaceae				
Linum bienne Mill.	Sp	1	h	
Lythraceae				
Lythrum salicaria L.	Sp	9	h	P
Malvaceae				
Althaea officinalis L.	Ar	12	h	P
Malva sylvestris L.	Ar	9	h	
Moraceae				
Morus alba L.	Ar	12	p	

Nympheaceae					
Nuphar lutea (L.) Sm. in Sibith. et Sm.	Sp	9	hy	P	
Onagraceae					
Circaea lutetiana L.	Sp	9	h		
Epilobium hirsutum L.	Sp	9	h		
Epilobium palustre L.	Sp	10	h		
Epilobium tetragonum L.	Sp	7	h		
Oenothera biennis L.	Kn	12	t		I
Oleaceae					
Ligustrum vulgare L.	Sp	9	p		
Oxalidaceae					
Oxalis corniculata L.	Kn	12	t		
Oxalis stricta L.	Kn	12	t		
Papaveraceae					
Chelidonium majus L.	Sp	9	h		
Plantaginaceae					
Plantago lanceolata L.	Sp	9	h		
Plantago major L.	Sp	9	h		
Plantago media L.	Sp	9	h		
Polygonaceae					
Fallopia convolvulus (L.) Á.Löve	Ar	1	t		
Polygonum aviculare L.	Sp	9	t		
Polygonum mite Schrank	Sp	7	t		
Polygonum persicaria L.	Sp	11	t		
Rumex crispus L.	Sp	9	h		
Rumex hydrolapathum Hudson	Sp	7	hy		
Rumex palustris Sm.	Sp	9	t,h		
Portulacaceae					
Portulaca oleracea L.	Ar	1	t		
Primulaceae					
Anagallis arvensis L.	Ar	1	t		
Lysimachia nummularia L.	Sp	8	h		
Lysimachia punctata L.	Sp	5	h		
Lysimachia vulgaris L.	Sp	9	h		

Primula vulgaris Huds.	Sp	10	h		
Ranunculaceae					
Clematis vitalba L.	Sp	7	p		
Ranunculus acris L.	Sp	9	h	P	
Ranunculus ficaria L.	Sp	7	h	P	
Ranunculus repens L.	Sp	9	h	P	
Ranunculus sardous Crantz	Ar	1	h	P	
Thalictrum lucidum L.	Sp	5	h	P	
Thalictrum minus L.	Sp	9	h	P	
Rhamnaceae					
Frangula alnus Mill.	Sp	9	p		
Rosaceae					
Agrimonia eupatoria L.	Sp	9	h	P	
Crataegus monogyna Jacq.	Sp	9	p	P	
Duchesnea indica (Andrews) Focke	Kn	12	h		I
Filipendula ulmaria (L.) Maxim.	Sp	9	h	P	
Malus domestica Borkh.	Df	12	p		
Potentilla reptans L.	Sp	9	h		
Prunus avium L.	Sp	9	p	P	
Prunus persica (L.) Batsch	Ar	12	p		
Prunus spinosa L.	Sp	9	p		
Rosa canina L.	Sp	9	p	P	
Rubus bifrons Vest ex Tratt.	Sp	7	p		
Rubus caesius L.	Sp	9	p		
Rubus idaeus L.	Sp	9	p		
Sanguisorba minor Scop.	Sp	7	h	P	
Rubiaceae					
Cruciata laevipes Opiz	Sp	7	h		
Galium aparine L.	Sp	9	t		
Galium mollugo L.	Sp	9	h		
Galium palustre L.	Sp	9	h		
Galium verum L.	Sp	9	h	P	
Salicaceae					
Populus alba L.	Sp	9	p		
Populus nigra L.	Sp	9	p		
Populus tremula L.	Sp	9	p	P	
Salix alba L.	Sp	9	p		
Salix cinerea L.	Sp	9	p		

Salix fragilis L.	Sp	9	p		
Salix purpurea L.	Sp	9	p		
Sapindaceae					
Acer campestre L.	Sp	9	p		
Acer negundo L.	Kn	12	p		I
Acer platanoides L.	Sp	7	p		
Acer pseudoplatanus L.	Sp	6	p		
Aesculus hippocastanum L.	Df	12	p		
Saxifragaceae					
Bergenia crassifolia (L.) Fritsch	Df	12	h		
Scrophulariaceae					
Chaenorhinum minus (L.) Lange	Ar	1	t		
Linaria vulgaris Mill.	Sp	9	g	P	
Odontites vulgaris Moench	Sp	9	t		
Rhinanthus minor L.	Sp	9	t		
Scrophularia nodosa L.	Sp	10	h	P	
Verbascum thapsus L.	Sp	9	t,h		
Veronica chamaedrys L.	Sp	9	ch		
Veronica persica Poir.	Kn	12	t		I
Veronica serpyllifolia L.	Sp	9	h		
Simaroubaceae					
Ailanthus altissima (Mill.) Swingle	Kn	12	p		I
Solanaceae					
Solanum dulcamara L.	Sp	9	ch	P	
Solanum nigrum L.	Sp	10	t	P	
Staphyleaceae					
Staphylea pinnata L.	Sp	9	p		
Ulmaceae					
Ulmus laevis Pall.	Sp	5	p		
Ulmus minor Miller	Sp	3	p		
Urticaceae					
Parietaria officinalis L.	Sp	3	h		
Urtica dioica L.	Sp	9	h		
Verbenaceae					

Verbena officinalis L.	Ar	1	t,h		
Violaceae					
Viola reichenbachiana Jord. ex Boreau	Sp	7	h		
Vitaceae					
Parthenocissus quinquefolia (L.) Planchon	Kn	12	p		I
Superorder Lilianae					
Alliaceae					
Allium carinatum L.	Sp	3	g		
Allium schoenoprasum L.	Sp	10	g		
Amaryllidaceae					
Galanthus nivalis L.	Sp	3	g	P	
Asparagaceae					
Asparagus tenuifolius Lam.	Sp	3	g	P	
Araceae					
Arum maculatum L.	Sp	7	g	P	
Alismataceae					
Alisma plantago-aquatica L.	Sp	9	hy		
Cyperaceae					
Carex elata All.	Sp	8	h		
Carex hirta L.	Sp	9	h		
Carex otrubae Podp.	Sp	9	h		
Carex pendula Huds.	Sp	9	h		
Carex pseudocyperus L.	Sp	10	hy		
Carex remota L.	Sp	10	h		
Carex spicata Huds.	Sp	9	h		
Carex sylvatica Huds.	Sp	9	h		
Carex vulpina L.	Sp	9	h		
Cyperus fuscus L.	Sp	9	t		
Cyperus glomeratus L.	Sp	9	hy	SP	
Cyperus serotinus Rottb.	Sp	9	g	SP	
Eleocharis palustris (L.) Roem. et Schult.	Sp	10	hy		
Scirpus sylvaticus L.	Sp	9	g		
Dioscoreaceae					

Tamus communis L.	Sp	3	g	P	
Iridaceae					
Iris pseudacorus L.	Sp	8	g	SP	
Juncaceae					
Juncus compressus Jacq.	Sp	9	g		
Juncus effusus L.	Sp	9	h		
Juncus inflexus L.	Sp	9	h		
Lemnaceae					
Lemna minor L.	Sp	10	hy		
Spirodela polyrhiza (L.) Schleiden	Sp	11	hy		
Orchidaceae					
Epipactis palustris (L.) Crantz	Sp	9	g	SP	
Poaceae					
Agrostis capillaris L.	Sp	9	h		
Agrostis stolonifera L.	Sp	9	h		
Brachypodium pinnatum (L.) P. Beauv.	Sp	9	h		
Brachypodium sylvaticum (Huds.) P. Beauv.	Sp	9	h		
Bromus hordeaceus L.	Ar	9	t		
Bromus sterilis L.	Ar	9	t		
Calamagrostis epigejos (L.) Roth	Sp	8	g		
Cynodon dactylon (L.) Pers.	Ar	11	g		
Dactylis glomerata L.	Sp	9	h		
Digitaria sanguinalis (L.) Scop.	Ar	9	t		
Echinochloa crus-galli (L.) P. Beauv.	Ar	12	t		
Eleusine indica (L.) Gaertn.	Kn	12	t		I
Elymus repens (L.) Gould	Sp	10	g		
Eragrostis minor Host	Ar	9	t		
Festuca pratensis Huds.	Sp	9	h		
Holcus lanatus L.	Sp	9	h		
Hordeum murinum L.	Ar	1	t		
Leersia oryzoides (L.) Sw.	Sp	9	g	P	
Lolium perenne L.	Sp	8	h		
Panicum capillare L.	Kn	12	t		I
Panicum miliaceum L.	Ar	9	t		
Phalaris arundinacea L.	Sp	11	g		
Phleum pratense L.	Sp	9	h		
Phragmites australis (Cav.) Trin. ex Steud.	Sp	11	hy		
Poa annua L.	Sp	9	t		

Poa compressa L.	Sp	9	h	
Poa nemoralis L.	Sp	10	h	
Poa pratensis L.	Sp	10	h	
Poa trivialis L.	Sp	10	h	
Setaria pumila (Poir.) Schult.	Ar	12	t	
Setaria verticillata (L.) P.Beauv.	Ar	11	t	
Setaria viridis (L.) P.Beauv.	Ar	1	t	
Sorghum halepense (L.) Pers.	Kn	12	g	I
Zea mays L.	Df	12	t	
Potamogetonaceae				
Potamogeton natans L.	Sp	11	hy	
Sparganiaceae				
Sparganium erectum L.	Sp	9	g	
Typhaceae				
Typha latifolia L.	Sp	10	g	

(4.8%) and Rosaceae (4.8%). The biggest genus is *Carex* with nine species, followed by *Poa* (5), then by *Acer*, *Galium* and *Salix* with four species each.

Regarding life-form spectrum (Fig. 3) almost the half of the recorded taxa (47.9%) are hemicryptophytes. Very significant is the relatively high ratio of therophytes (19.1%).

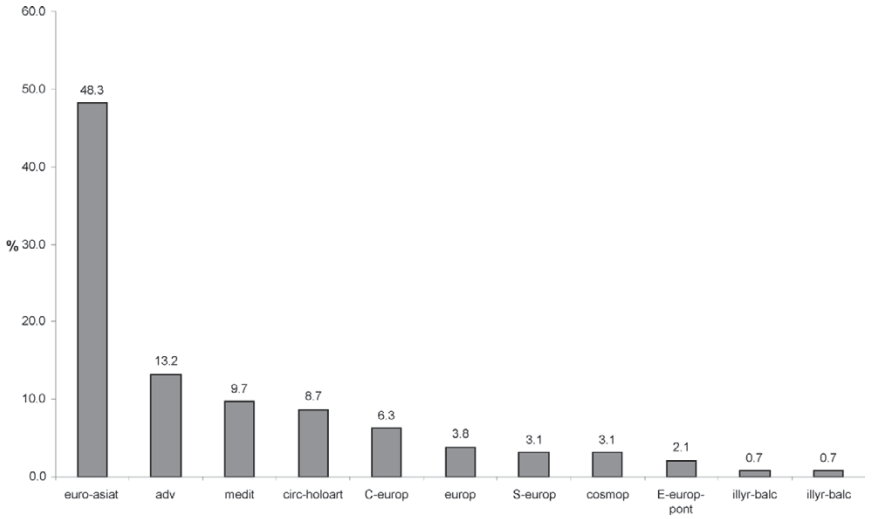

Fig. 4. Spectrum of chorological types for the flora of Savica.

Tab. 2. Comparative spectra of life-forms for some areas in NW Croatia with seminatural landscapes.

Life-forms (%)	Savica	Marinci	Stupnik	Konjšćina	Piškorovo and Konopljenka	Vukova Gorica
p	14.2	15.1	10.9	8.9	14.5	11.4
ch	1.4	2.7	3.1	5.0	3.1	4.0
h	47.9	52.1	49.6	45.0	48.1	52.3
g	10.1	13.7	10.0	13.9	10.8	13.5
th	19.1	16.1	24.0	24.0	22.2	13.5
hy	5.9	0.3	2.4	3.3	1.1	1.3
th, h	1.4	–	–	–	–	–

Tab. 3. Comparative spectra of chorological types for some areas in NW Croatia with seminatural landscapes. Some specific values for the flora of Savica are bolded.

chorotype (%)	Savica	Marinci	Stupnik	Konjšćina	Piškorovo and Konopljenka	Vukova Gorica
medit	**9.7**	1.0	2.0	1.0	1.4	1.5
illyr-balk	0.7	-	0.2	0.7	-	1.2
S-europ	**3.1**	7.6	9.0	9.4	9.1	11.3
atlantic	-	-	0.4	0.2	-	0.2
E-europ-pont	2.1	1.0	0.9	0.9	1.1	1.2
SE-europ	1.0	1.0	0.4	0.5	0.6	0.6
C-europ	6.3	3.8	4.2	2.9	3.1	4.8
europ	**3.8**	11.0	11.5	11.5	11.1	12.6
euro-asiat	**48.3**	34.8	32.5	33.2	30.1	31.9
circ-holoart	8.7	6.6	7.3	7.9	6.3	8.4
cosmop	3.1	25.2	27.7	26.4	27.0	23.1
adv	**13.2**	7.9	3.7	5.5	10.2	3.4

Water habitats enable the occurrence of 5.9% of hydrophytes. A small proportion of taxa (1.4%) can behave as therophytes or hemicryptophytes depending on local ecological conditions, first of all on the duration and severity of winters.

The phytogeographical spectrum is presented in Fig. 4. Almost the half of the recorded taxa (48.3%) belong to the Euro-Asiatic chorotype. A peculiar feature is that the second place belongs to adventive species, with arelatively high ratio of 13.2%. All other

Tab. 4. Indicators of anthropogenic changes in the flora of Savica.

Indicators of anthropization	%
IAn_t	27,78
IAn_p	26,76
Indicators of archaeophytization	
IAr_t	16,67
IAr_p	16,90
Indicators of kenophytization	
IKn_t	9,72
IKn_p	9,86
Indicator of modernization	
IM	36,84
Indicator of fluctuation changes	
IF	1,39

chorotypes are represented with less than 10% each. It is important to stress that Illyrian-Balkan chorotype is represented with only 0.7% i.e. with two species (*Hacquetia epipactis* and *Lamium orvala*). The Mediterranean chorotype has accounts for 9.7%, the circumholoarctic 8.7% and the Central-European for 6.3%, which all reflect different aspects of origin of the researched flora. Comparative spectra (Tab. 2) show that the flora of Savica is similar to other localities in North-Western Croatia regarding life-forms. In comparison to some other places in North-Western Croatia (Tab. 3) it is obvious that the flora of Savica has specific composition with higher ratios of Euro-Asiatic, adventive, and Mediterranean plants.

Indicators of anthropogenic changes (Tab. 4) show that the flora of Savica is more influenced by archaeophytes than by neophytes. Very similar values of total and permanent values of indices indicate that alien flora is well established, i.e. with only a small proportion of not-permanently-established species. This is confirmed by the low value of the indicator of fluctuating changes. The relatively high indicator of modernization (36.8%) is in accordance with the high proportion of adventive species (13.2%), both showing the vigorous anthropogenic influence on the flora of Savica.

Four species are quoted on the Red list: *Asparagus tenuifolius* (NT), *Cyperus glomeratus* (VU), *Cyperus serotinus* (VU) and *Leersia oryzoides* (NT). According to the Ordinance on Designating Wild Taxa Protected and Strictly Protected (Anonymous 2009) 44 taxa (15.2%) are legally protected and four of them (1.4%) are strictly protected. According to Boršić *et al.* (2008) and Mitić *et al.* (2008), 25 species (8.6%) are invasive alien species (IAS).

DISCUSSION

The flora of Savica counts 289 taxa, and the species-richest families are: Asteraceae and Poaceae with more than 10% of taxa; Lamiaceae, Fabaceae, Rosaceae and Cype-

raceae with more than 5%; Scrophulariaceae and Brassicaceae with more than 3%; and Apiaceae, Ranunculaceae and Salicaceae with more than 2%. This order of families in general reflects the order for entire national flora according to Nikolić (2012), with some exceptions as consequences of some specific characteristics of habitats of the area.

The first notes about Savica flora go back to 1954 and come from the ZA herbarium samples of *Zannichellia palustris* L. and *Potamogeton pectinatus* L. Neither of these taxa were confirmed recently. Only 25 taxa were mentioned previously in literature (Alegro *et al*. 2010).

The higher share of grasses indicates the presence of intensively influenced ruderal habitats, whereas the more abundant Cyperaceae and Salicaceae reflect the presence of water and alluvial habitats. A relatively high share of the Mediterranean element (9.7%) is also a consequence of the presence of highly disturbed habitats which support the occurrence of thermophilous but annual species. So, 16 of 28 Mediterranean species are therophytes, and even more important is that 24 of them are archaeophytes, which are not part of stable plant communities, but are pioneers on open habitats, where co-occurrence of other species is low (bare soil, edges of paths and gardens etc.). All these facts are reflected in high indicators of archaeophytization. A very similar trend is reflected in the composition of neophytes, where 15 of 28 species are also therophytes. However, the total number of archaeophytes is almost twice as high as number of neophytes (48 vs. 28). This is also visible from indicators of archaeophytization (16.7 and 16.9) and kenophytization (9.7 and 9.9). Similar values of total and permanent indicators suggest that both archaeophytes and neophytes are permanently established in local flora, with only a few occasional species. In general, therophytes are the dominant life-form among archaeophytes and neophytes, followed by hemicryptophytes, with only a few intentionally introduced phanerophytes (Ar: *Juglans regia* and Kn: *Robinia pseudoacacia*, *Acer negundo* and *Ailanthus altissima*). On the other hand, all the described facts can be seen in the high total share of adventive species (13.2 %), which is significantly higher than in other areas of NW Croatia, varying from 3.4-7.9 %.

The high ratio of Mediterranean species compared to other areas of NW Croatia (Stančić, 1994; Alegro *et al*., 2006; Mitić *et al*., 2007; Martinko, 2009; Hudina *et al*., 2012) is significant. This can be explained not only by the presence of the described suitable habitats, but also by the slightly different definition of the Mediterranean geoelement accepted here. As Mediterranean plants are treated also well established species in the local flora, historically originating from Mediterranean area, up to day not present in natural and seminatural plant communities, but only as ruderal and weed species.

Also significant in the researched flora is the higher share of Euro-Asiatic species (48.3%) (31.9-34.8%) and the lower share of European species (38% vs. 11.0-12.6%) in comparison to other areas. From all these facts it can be concluded that the flora of Savica very weakly reflects the phytogeographical position of the area, but it has more general character as a consequence of the great human impact and changed habitats. The peri-Pannonian position of the researched area is indicated only in the relatively high share of Central-European species (6.3%). However, the general, non-specific character of the flora is naturally supported by the presence of water habitats, i.e. hydrophytes, which mainly have broad areas of distribution without being restricted to narrowly defined phytogeographical areas. Disturbance of the area is also indicated by the no fewer than 25 invasive species, all kenophytes originating mainly from North America. On the other hand, the life-form spectrum is almost the same as for other areas compa-

red, suggesting that the flora of Savica has a structure well adapted to the general climate of North-Western Croatia.

A special value of the vegetation of Savica inheres in the stands of tree species (*Salix alba*, *Populus nigra*, *Alnus glutinosa*) representing the last remnants of alluvial vegetation along the Sava River and hydrophytes and helophytes in and around the lakes (i.e. *Nuphar lutea*, *Myriophyllum spicatum*, *Nymphoides peltata*, *Nasturtium officinale*, *Berula erecta*, *Rorippa amphibia*, *Lemna minor*, *Spirodella polyrhiza*, *Cyperus* spp. and some others) forming several communities.

ACKNOWLEDGEMENT

The field work was carried out in the framework of the international project ''Countdown towards 2010 in Zagreb: Community Involvement in Biodiversity Assessment'' funded by the Netherlands Ministry of Agriculture, Nature and Food Quality as part of the Support Scheme Action Plan BBI-Matra 2005–2008.

Received February 2, 2013

REFERENCES

Alegro, A., Marković, Lj., Antonić, O. & Bogdanović, S., 2006: Historical and functional aspects of plant biodiversity – an example on the flora of the Vukova Gorica region (Central Croatia). Candollea **61**, 135-166.

Alegro, A. L., Bogdanović, S., Rešetnik, I. & Boršić, I., 2010: *Thladiantha dubia* Bunge (Cucurbitaceae), new alien species in Croatian flora. Natura Croatica **19**, 281-286.

Anonymous, 2008: LAB Biodiversity report 2008: City of Zagreb. City Office for Strategic Planning and Development of the City, Zagreb.

Anonymous, 2009: Pravilnik o proglašavanju divljih svojti zaštićenim i strogo zaštićenim. Narodne novine **99/2009**.

Boršić, I., Milović, M., Dujmović, I., Bogdanović, S., Cigić, P., Rešetnik, I., Nikolić, T. & Mitić, B., 2008: Preliminary check-list of invasive alien plant species (IAS) in Croatia. Natura Croatica, **17**, 55-71.

Ciocârlan, V., 2009: Flora ilustrată a României – Pteridophyta et Spermatiphyta. Editura Ceres, Bucureşti.

Černicki, L., 2006: Samoniklo cvijeće grada Zagreba. Školska knjiga, Zagreb.

Ellenberg, H., Weber, H. E., Düll, R., Wirth, V., Werner, W. & Paulissen, D., 1991: Zeigwerte von Pflanzen in Mitteleuropa. Scripta Geobot. **18**, 1-248.

Fischer, M. A., Oswald, K. & Adler, W., 2008: Exkursionsflora für Österreich, Lichtenstein und Südtirol. 3. Aufl. Biologiezentrum der Oberösterreichischen Landesmuseen, Linz.

Gjurašin, S., 1923: Dodatak flori Zagrebačke okolice. Glasnik Hrv. prirodosl. društva **35**, 138-141.

Gospodarić, Lj., 1958: Novi prilog flori okolice Zagreba. Acta Bot. Croat. **17**, 151-157.

Horvatić, S., 1931: Bilješke o nekim manje poznatim biljkama iz hrvatske flore. Acta Bot. Inst. Bot. Univ. Zagreb **6**, 56-65.

Horvatić, S., 1963: Vegetacijska karta otoka Paga s općim pregledom vegetacijskih jedinica hrvatskog primorja. Prir. Istraž. Ser. Acta Biol. **4**, 1-187.

Horvatić, S., Ilijanić, Lj. & Marković-Gospodarić, Lj. 1967-68: Biljni pokrov okolice Senja. Senjski zbornik **3**, 298-323.

Horvatić, S. & Gospodarić, Lj., 1959-60: *Sporobolus vaginaeflorus* (Torr.) Wood u biljnom pokrovu Hrvatske. Acta Bot.Croat. **18-19**, 79-103.

Hršak, V., 2002: Taxonomic and chorologic revision of the *Polypodium vulgare* complex in Herbarium Croaticum and the Ivo and Marija Horvat Herbarium. Acta Bot. Croat. **61**, 45-49.

Hudina, T., Salkić, B., Rimac, A., Bogdanović, S. & Nikolić, T., 2012: Contribution to the urban flora of Zagreb (Croatia). Nat. Croat. **21**, 357-372.

Ilijanić, Lj., Topić, J., Šegulja, N., 1985: Meadow-succession experiment on the permanent plots in Botanical garden in Zagreb. In Schreiber, K.-F. (ed.), Sukzession auf Grünlandbrachen. Vorträge eines Symposiums der Arbeitsgruppe »Sukzessionforschung auf Dauerflächen« in der Internationalen Vereininug für Vegetationskunde (IVV) in Stuttgart-Hohenheim 1984. Padebron: Ferdinand Schöningh (Münsterische Geographische Arbeiten), 69-80.

Ilijanić, Lj., Hršak, V., Juričić, Ž. & Hršak, J., 1989: Influence of air pollution on the bark pH-values in the regions of Zagreb and Sisak. Acta Bot. Croat. **48**, 63-73.

Jackowiak, B., 1990: Antropogeniczne przemiany flory roślin naczyniowych Poznania. Wyd. Naukowe Uniwersytety A. Mickiewicza w Poznaniu, ser. Biol. **42**, 1-208.

Jackowiak, B., 2006: Methodological proposals for studies on the structure and dynamics of urban flora. Pol. Bot. Stud. **22**, 251-260.

Jasprica, N., Ruščić, M. & Lasić, A., 2010: Comparison of urban flora in Split, Dubrovnik and Mostar. Hrvatska misao (Sarajevo) **40** , 77-104.

Kornaś, J., 1981: Oddziaływanie człowieka na florę: mechanizmy i konsekwencje. Wiad. Bot. **25**, 165-182.

Landolt, E., Bäumler, B., Erhardt, A., Hegg, O., Klötzli, F., Lämmler, W., Nobis, M., Rudmann-Maurer, K., Schweingruber, F. H., Theurillat, J-P., Urmi, E., Vust, M. & Wohlgemuth, Th., 2010: Flora indicativa. Ökologische Zeigwerte und biologische Kennzeichen zur Flora der Schweiz und der Alpen. Editions des Conservatoire et Jardin botaniques de la Ville de Genève and Haupt Verlag, Bern-Stuttgart-Wien.

Lauber, K. & Wagner, G., 1996: Flora Helvetica. 2. Aufl. Paul Haupt Ver., Bern, Stuttgart, Wien.

Lukač, G., 1988: Neke značajke strukture sastojina *Solidago gigantea* i *Helianthus tuberosus* i njihove ornitocenose u sjeverozapadnoj Hrvatskoj. Acta Bot. Croat. **47**, 63-75.

Marković-Gospodarić, Lj., 1965: Prilog poznavanju ruderalne vegetacije kontinentalnih dijelova Hrvatske. Acta Bot. Croat. **24**, 91-136.

Marković, Lj., 1970: Prilozi neofitskoj flori savskih obala u Hrvatskoj. Acta Bot. Croat. **29**, 203-211.

Marković, Lj., 1973: *Sporobolus neglectus* Nash, nova adventivna vrsta Jugoslavije. Acta Bot. Croat. **32**, 237-242.

Marković, Lj., 1975: O vegetaciji sveze *Bidention tripartiti* u Hrvatskoj. Acta Bot. Croat. **34**, 103-120.

Marković, Lj., 1978: Travnjačka vegetacija sveze *Agropyro-Rumicion* u obalnom pojasu Save u Hrvatskoj. Acta Bot. Croat. **37**, 107-130.

Martinčič, A., Wraber, T., Jogan, N., Podobnik, A., Turk, B. & Vreš, B., 2007: Mala flora Slovenije. Tehniška založba Slovenije, Ljubljana.

Martinko, M., 2009: Flora šireg područja sela Martinci u Hrvatskom Zagorju. MSc Thesis. Faculty of Science. University of Zagreb, Zagreb.

Milović, M., 2000: Flora papratnjača i sjemenjača Šibenika i okolice. MSc Thesis. Division of Biology. Faculty of Science, University of Zagreb, Zagreb.

Milović, M., 2004: Naturalised species from the genus *Conyza* Less. (Asteraceae) in Croatia. Acta Bot. Croat. **63**, 147-170.

Milović, M., 2008: Urbana flora Zadra. PhD Thesis. Faculty of Science. University of Zagreb, Zagreb.

Milović, M. & Mitić, B., 2012: The urban flora of the city of Zadar (Dalmatia, Croatia). Nat. Croat. **21** , 65-100.

Mirek, Z., 1981: Problemy klasifikacji roślin synantropijnych. Wiad. Bot. **25**, 45-54.

Mitić, B., Kajfeš, A., Cigić, P. & Rešetnik, I., 2007: The flora of Stupnik and its surroundings (Northwest Croatia). Nat. Croat. **16**, 147-169.

Mitić, B., Boršić, I., Dujmović, I., Bogdanović, S., Milović, M., Cigić, P., Rešetnik, I. & Nikolić, T., 2008: Alien flora of Croatia: proposals for standards in terminology, criteria and related database. Nat. Croat. **17**, 73-90.

Nikolić, T. & Fadljević, D., 1999: Horsetails (class Sphenopsida) distribution in Croatia. Nat. Croat. **8**, 465-496.

Nikolić, T. & Topić, J. (eds.), 2005: Crvena knjiga vaskularne flore Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb.

Nikolić T., Rešetnik, I., Alegro, A., Cigić, P., Boršić, I. & Bogdanović, S., 2007: Inventarizacija flore. Prilog za izradu prostornog plana područja posebnih obilježja priobalje Save krajobraz uz Savu – savski park I. etapa – Savica. Gradski zavod za prostorno uređenje i Prirodoslovno-matematički fakultet Sveučilišta u Zagrebu, Zagreb.

Nikolić, T. (ed.), 2012: Flora Croatica Database. On-Line (http://hirc.botanic.hr/fcd). Botanical Department and Botanical Garden, Faculty of Science, University of Zagreb, Zagreb.

Oberdorfer, E., 2001: Pflanzensoziologische Exkursionsflora für Deutschland und angrenzende Gebiete. 8. Aufl. Ulmer Verl., Stuttgart (Hohenheim).

Pyšek, P., Sáldo, J. & Mandák, B., 2002: Catalogue of alian plants of the Czech Republic. Preslia **74**, 97-186.

Ruščić, M., 2003: Urbana flora Splita. MSc Thesis. Faculty of Science. University of Zagreb, Zagreb.

Schlosser, J. C. & Vukotinović, Lj., 1857: Syllabus florae Croaticae. Typis Dr. Ludovici Gaj, Zagreb.

Schlosser, J. C. & Vukotinović, Lj., 1869: Flora Croatica. Sumptibus et auspiciis academiae scientiarum et articum slavorum meridionalium, Zagreb.

Simon, T., Horánszky, A., Dobloyi, K., Szerdahelyi, T.& Horváth, F., 1992: A magyar edényes flóra értékelő táblázata. In: Simon, T. (ed.): A magyarországi edényes flóra határozója: 837-955. Nemzeti Tankönyvkiadó, Budapest.

Smital, A., Marković, Lj. & Ruščić, M., 1998: O širenju vrste *Artemisia verlotiorum* Lamotte u Hrvatskoj. Acta Bot. Croat. **55/56**, 53-63.

Stančić, Z., 1994: Prikaz i analiza flore okolice Konjšćine (Hrvatska). Acta Bot. Croat. **53**, 125-140.

Tafra, D., 2009: Vaskularna flora Omiša. MSc Thesis. Faculty of Forestry. University of Zagreb, Zagreb.

Tafra, D., Pandža, M. & Milović, M., 2012: Vascular flora of the town of Omiš. Nat. Croat. **21** , 301-334.

Topić, J. & Šegulja, N., 1978: Novo nalazište vrste *Eleusine indica* (L.) Gaertn. u Hrvatskoj. Acta Bot. Croat. **37**, 229-230.

Tvrtković, N., Vuković, M., Pavlinić, I., Šašić, M., Mihoci, I., Grbac, I. & Godec, Z., 2007: Inventarizacija odabrane faune Savice sa zonacijom prostora. Prilog za izradu Prostornog plana područja posebnih obilježja Priobalje Save (krajobraz uz Savu – Savski park). I. Etapa – Savica. Zoološki odjel Hrvatskog prirodoslovnog muzeja, Zagreb.

Tutin, T. G., Heywood, V. H., Burges, N. A., Valentine, D. H., Walters, S. M. & Webb D. A. (eds.), 1964-1980: Flora Europaea 1–5. Cambridge University Press, Cambridge.

Tutin, T. G., Burges, N. A., Chater, A. O., Edmondson, J. R., Heywood, V. H., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (eds.), 1993: Europaea 1, ed. 2. Cambridge University Press, Cambridge.

Vukelić, J., 2012: Šumska vegetacija Hrvatske. Faculty of Forestry, University of Zagreb and State Institute for Nature Protection, Zagreb.

Witosławski, P. & Bomanovska, A., 2009: Southern European species in the flora of towns in the central Poland. Bot. Serb. 33, 115-129.

SAŽETAK

Flora poluprirodne močvare Savica, suburbanog dijela grada Zagreba (Hrvatska)

A. Alegro, S. Bogdanović, I. Rešetnik, I. Boršić, P. Cigić & T. Nikolić

Flora Savice, suburbanog dijela grada Zagreba s ostacima poplavnih šuma i vegetacijom stajačica, istraživana je tokom vegetacijske sezone 2006. s nekoliko kasnijih dodataka. Istraživano područje čini sustav od 12 jezeraca s okolnim staništima. Ukupno je zabilježeno 289 vrsta i podvrsta vaskularnog bilja. Najzastupljenije porodice su Asteraceae (12.5 %), Poaceae (11.8 %), Lamiaceae (5.9 %), Fabaceae (5.2 %), Cyperaceae (4.8 %) i Rosaceae (4.8 %), a rodovi zastupljeni s najviše vrsta su: *Carex* (9), *Poa* (5), a zatim *Acer*, *Galium* i *Salix* svaki s po četiri vrste. S obzirom na spektar horoloških tipova, flora Savice slična je nekim drugim područjima SZ Hrvatske s time da se s većom učestalošću ističu biljke eurazijskog elementa (48.3%), adventivne vrste (13.2%) i biljke mediteranskog elementa (9.7%), što je posljedica antropogenog utjecaja i posljedične ruderalizacije staništa. Taj proces se ogleda i u razmjerno visokom udjelu terofita (19.1%). Pokazatelji

antropogene promjene pokazuju da je flora Savice više utjecana arheofitima nego neofitima. Među njima nalazi se 25 vrsta (8.6%) invazivnih stranih vrsta. Spektar životnih oblika gotovo je isti kao za druga područja SZ Hrvatske, što upućuje da je flora dobro prilagođena općoj klimi SZ Hrvatske. Osobita vrijednost flore Savice su sastojine drvenastih vrsta (*Salix alba*, *Populus nigra*, *Alnus glutinosa*), koje predstavljaju posljednje ostatke poplavne vegetacije uz rijeku Savu, kao i hidrofiti i helofiti prisutni u jezercima i oko njih (npr. *Nuphar lutea*, *Myriophyllum spicatum*, *Nymphoides peltata*, *Nasturtium officinale*, *Berula erecta*, *Rorippa amphibia*, *Lemna minor*, *Spirodella polyrhiza*, *Cyperus* spp. i dr.). Četiri vrste navedene su Crvenom popisu: *Asparagus tenuifolius* (NT), *Cyperus glomeratus* (VU), *Cyperus serotinus* (VU) and *Leersia oryzoides* (NT). Zakonom su zaštićene 44 vrste (15.2 %), a četiri od njih (1.4 %) su strogo zaštićene.