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1st Croatian Botanical Symposium

s međunarodnim sudjelovanjem

with international participation

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PREDGOVOR

Prvi hrvatski botanički simpozij s međunarodnim sudjelovanjem (1. HBS) osmišljen je kao središnji znanstveno-stručni skup botaničara Hrvatske i susjednih zemalja, a organizira ga Hrvatsko botaničko društvo (HBoD). Društvo je osnovano 18. studenoga 2002. godine, s ciljem rada na napretku i unapređenju botaničkih znanosti na popularnoj, stručnoj, nastavnoj i znanstvenoj razini.

Stoga je i cilj Prvog hrvatskog botaničkog simpozija promicanje suradnje i razmjene znanstvenih i stručnih informacija s područja botanike između botaničara i stručnjaka srodnih struka, te potencijalnih korisnika botaničkih podataka, kako iz Hrvatske tako i iz susjednih europskih zemalja, ali i šire. Iako je glavna tema simpozija Flora i vegetacija Hrvatske i susjednih područja, raduje da ima i veliki broj priloga iz drugih botaničkih disciplina. Stotinjak stručnjaka koji će izložiti svoje znanstvene i stručne spoznaje u 30-ak usmenih i 70-ak posterskih priopćenja pokazuje opravdanost organiziranja ovakvog skupa. Ovaj broj je značajno nadmašio naša nadanja kada smo započeli s organizacijom simpozija, a posebno veseli da osim iz Hrvatske sudionici dolaze iz sljedećih zemalja: Austrije, Bosne i Hercegovine, Bugarske, Mađarske, Makedonije, Nje-

PREFACE

The 1st Croatian Botanical Symposium with international participation (1. HBS), was thought out as a central scientific-expert meeting of the botanists of Croatia and the neighbouring countries, and is organised by Croatian Botanical Society (HBoD). The Society was founded on November 18th, 2002, with the objective of promoting the advancement and improvement of botanical sciences on popular, expert, educational and scientific levels.

Thus the objective of the 1st Croatian Botanical Symposium is the promotion of cooperation and the exchange of expert information within the field of botany between botanists and experts of the related disciplines and the potential users of botanical data from Croatia and the neighbouring European states, as well as others. Although the main topic of the Symposium is the flora and vegetation of Croatia and neighbouring territories, it is exciting that there is a large number of works from other botanical disciplines. Around a hundred experts that will present their scientific and expert findings through about thirty oral and seventy poster presentations justifies the organisation of such an event. This number has greatly exceeded our expectations when we first begun the preparation work for the Symposium and it is particularly exciting that, beside the participants

mačke, Slovačke, Slovenije, Srbije i Crne Gore i Velike Britanije. Razmjena ideja i iskustava između sudionika simpozija sigurno će pridonijeti boljoj suradnji i budućem napretku svih botaničkih disciplina.

Prvi hrvatski botanički simpozij prvi je ovakav skup u povijesti hrvatske botanike uopće, te predstavlja značajan korak za razvoj naše botanike. Očekujemo da će ovaj simpozij pokazati nužnost uporabe podataka i dostignuća iz područja botanike, posebno u smislu zaštite biološke raznolikosti i primjene botanike u provođenju projekata održivog razvoja hrvatske privrede, te se nadamo i planiramo da održavanje ovakvog skupa postane tradicijom.

Organizacijski odbor Prvog hrvatskog botaničkog simpozija zahvaljuje na potpori u organizaciji svim pokroviteljima, sponzorima i ostalim osobama koje su se na bilo koji način uključile i podržale ovaj skup i njegovo održavanje.

Božena Mitić
Predsjednica Organizacijskog odbora 1. HBS-a

from Croatia, there are participants from the following countries: Austria, Bosnia and Herzegovina, Bulgaria, Hungary, Macedonia, Germany, Slovak republic, Slovenia, Serbia and Montenegro and Great Britain. The exchange of ideas and experiences between the participants will certainly improve the co-operation and the future progress of all botanical disciplines.

The 1st Croatian Botanical Symposium is the first of its kind in the history of Croatian botany, and represents a significant step forward for the development of our botany. We expect that this symposium will emphasise the necessity for the use of data and achievements from the field of botany, particularly in the sense of the protection of the biological diversity and the application of botany in the implementation of projects of sustainable development of Croatian trade, and we hope and plan that this kind of symposium will become a tradition.

The organising committee of the 1st Croatian Botanical Symposium would like to thank all the sponsors and other persons who in any way contributed to the organisation and realisation of this Symposium.

Božena Mitić
The President of the
Organising committee of the
1st Croatian Botanical
Symposium

Organizacija

Hrvatsko botaničko društvo
(HBoD)

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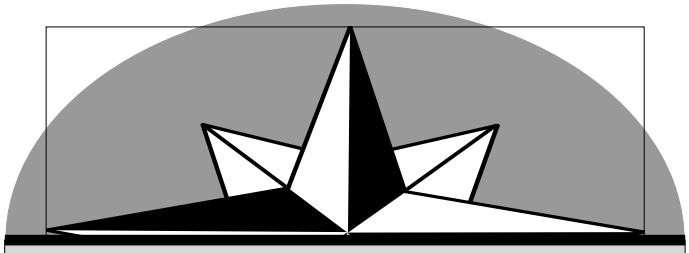

PLENARNA PREDAVANJA

PLENARY LECTURES

THE EURO+MED PLANTBASE PROJECT: PAST AND FUTURE

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The Euro+Med PlantBase project aims to provide an on-line, up-to-date and critically evaluated taxonomy for the vascular plants of the European and Mediterranean regions. It will ultimately be a rich resource of information for approximately one-eighth of all vascular plant species for a wide variety of users, including national and international authorities, conservationists, environmental legislators, agronomists, etc. A key component of the Euro+Med PlantBase project is the use of the *Flora Europaea* mechanism of regional co-operative taxonomic revisions with a network of collaborators in all the countries and territories of the Euro+Med area. Software has been developed to allow the database to be edited over the Internet. The revisionary process will result in an agreed 'taxonomic core' comprising basic taxonomic, ecological and distribution data. This will be linked to 'beads', providing further information on a range of topics including conservation, cytology and additional detailed distributional data, etc., and to other relevant databases such as the *Atlas Florae Europaea* database. At the end of the first EU-sponsored phase, a synonymic checklist of European plants is planned together with taxonomic treatments of a number of taxa and a working list of plants of the entire Euro+Med area. This will be used to establish future priorities for taxonomic revision work. All outputs will be accessible on-line. Further funds are presently being sought that will continue this process and develop the system for further novel uses in the field.

PLANT DISTRIBUTION MAPPING IN CENTRAL EUROPE – RESULTS, CHALLENGES, AND REGIONAL EXAMPLES OF DATA EVALUATION

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"Mapping the Flora of Central Europe" was initiated about 1965 as a scheme based on cooperation of botanists from several Central European countries. The plan was, and is, to prepare a comprehensive Distribution Atlas of the vascular plant flora of as many Central European countries as possible, based on appropriate field exploration and other available sources, and offering a rather detailed scale of grid resolution: squares of 10' longitude × 6' latitude, i.e. approximately 12 × 11 km, which for regional purposes mostly are subdivided into still smaller units (e.g. quadrants of 5' × 3'). Later on, the original scheme got welcomed counterparts by corresponding neighbouring projects, which will allow to treat an even wider territory within one joint Atlas. Though the advancement of the regional floristic mapping projects involved is still unequal, there exists already a large, coherent territory with a good coverage of data. On the other hand, to fill remaining gaps is still an important challenge.

Within the framework of regional projects, computerized databases were primarily installed as a tool for efficient data handling and map production. In the meanwhile these databases have proved also to be a mighty basis for manifold lines of data analysis. Published and current work, executed in various countries, includes visual as well as computer generated comparison and grouping of plant distribution patterns, division and grouping of spatial landscape units, elucidation of correlations of plant distributions with environmental and geohistorical factors, analysis of spatial patterns of ecological indicator values and of other attributes of species, etc., and promises valuable results also in the future.

FLORA HRVATSKE – DANAS I SUTRA

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Flora Hrvatske izrazito je bogata. S više od 5500 svojti i preko 300 endema i velikim brojem vrsta po jedinici površine jedan je od europskih centara florističke raznolikosti. Naličje bogatstva je njegova slaba dokumentiranost, manjak analitičke flore, nedostatak suvremene ekskurzijske flore, atlasa rasprostranjenosti, oskudan profesionalni kadar, malen broj poznavalaca amatera i dr. Potraživanja za podacima su iz dana u dan sve veća i veća, njihova akumulacija spora, a uzročnici ugroženosti i nestanka pojednih svojti i staništa neumolivo pritišću. Kako zadovoljiti svjetske znanstvene standarde u poznavanju nacionalnog florističkog bogatstva? Kako znanje pravilno upotrijebiti u praktične svrhe? Što smo dosada napravili? Što tek kanimo napraviti? Kakvi su ciljevi i koliko su daleko, te kakva je potencijalna uloga Hrvatskog botaničkog društva? Mnoštvo ptanja, ..., a odgovori?

FLORA CROATICA – TODAY AND TOMORROW

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Flora of Croatia is clearly rich. With more than 5500 taxa, over 300 endemic taxa, large number of species per square unit, it is one of the European centres of floristic diversity. Back side of richness, is faintly documentation, lack of analitical flora, insufficiency of modern excursion flora, shortcoming in distribution knowledge, tenuous professional staff, small number of proficient amateurs, etc. Demands on florsitic data are from day to day bigger, theirs back up slow, and in the same time causes of threats and vanishing of respective taxa and habitats unpitying weigh down. How to satisfy world scientific standards in national floristic richness knowledge? Where to use knowledge properly in practically? What we a already done? What we plan to do? What are the targets, and how do we get there? What is the potential role of Criatian Botanical Society? Lot of questions, ..., and replies?

FLORISTIČKA ISTRAŽIVANJA

FLORISTIC RESEARCH

FLORA VUKOVE GORICE

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Vukova Gorica smještena je u zapadnom dijelu Karlovačke županije, na razmeđi središnje i gorske Hrvatske, uz granicu s Republikom Slovenijom. Istraživano područje omeđeno je rijekom Kupom na sjeveru i sjeverozapadu, riječkom i Lujzinskom cestom na jugu i jugoistoku, te prati obalu rijeke Kupe u duljini od 5 km. Širina područja je na svim dijelovima manja od 1 km tako da ukupna površina iznosi 2,5 km². Obuhvaća sela Johi, Glavica, Vukova Gorica i Gornje Prilišće. Istraživano područje prema Koppenovoj klimatskoj razdiobi pripada u područje umjerene C klime, te se nalazi na "crti kontinentalnosti", tj. granici između kontinentalnog i maritimnog godišnjeg hoda padalina. Geološku podlogu čine jurski vapnenci, dolomiti jure i krede, te aluvijalni nanosi na dijelovima obale Kupe.

Floristički je područje istraživano od 1996. do 2004. godine. Ukupno je pronađeno 530

THE FLORA OF VUKOVA GORICA

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Vukova Gorica is located in the western part of Karlovac county, on the meeting point between Central Croatia and the region of Gorski Kotar, alongside the border to the Republic of Slovenia. The researched area is bordered by the Kupa river on the north and northwest, the "Riječka" and "Lujzinska" roads on the south and southeast and it is spread along the Kupa river in the total length od 5 km. The width of the area does not exceed 1km. The total surface of the area is 2.5 km². The area includes villages Johi, Glavica, Vukova Gorica and Gornje Prilišće. According to the climate classification by Koppen it belongs to the temprate C climate and is situated on the "continentality line" i.e. on the boundary between continental and maritime annual precipitation regime. Geological basis is composed by Jurassic limestone, Jurassic and Cretaceous dolomits and aluvial deposits on some parts of the Kupa bank.

svojti višeg bilja iz 96 porodica. Najzastupljenije porodice su *Asteraceae* s. l. (10,8%) , *Poaceae* (8,4%), *Fabaceae* (6,5%), *Lamiaceae* (5,9%) i *Rosaceae* (4,2%). U spektru životnih oblika prevladavaju hemikriptofiti (52,3%), slijede geofiti i terofiti (s po 13,5%), fanerofiti (11,4%), hamefiti (4%), hidrofiti (1,3%), a ostatak (4%) čine biljke s više mogućih načina prezimljivanja. Fitogeografska analiza pokazala je da eurazijskom flornom elementu pripada 31,86% svojti, biljke široke rasprostranjenosti čine 22,3%, biljke europskog flornog elementa 12,59%, biljke južnoeuropskog flornog elementa 11,25%, a biljke cirkumholoarktičke rasprostranjenosti 8,4%. Mediteranski florni element zastupljen je s 1,53%, a ilirsko-balkanski sa svega 1,15%. Na "Crvenom popisu ugroženih biljaka i životinja Hrvatske" nalaze se ukupno 22 vrste (VU 6, NT 9, DD 7).

Velika floristička raznolikost istraživanog područja može se tumačiti specifičnim geografskim položajem, raznolikošću staništa (suhi, svježi i vlažni travnjaci, šikare, brdske šume bukve, šume hrasta kitnjaka i običnog graba, vlažna staništa i galerijske šume uz Kupu, poljoprivredne kulture i ruderalna staništa) i ekstenzivnim utjecajem čovjeka.

The area has been floristicaly researched in the period between 1996. and 2004. In the mentioned period 530 taxa of higher plants from 96 families were found. The most abundant families are *Asteraceae* s.l. (10.8%), *Poaceae* (8.4%), *Fabaceae* (6.5%), *Lamiaceae* (5.9%) and *Rosaceae* (4,2%). In the life form spectrum hemicriptophyta are dominant (52.3%) followed by geophyta and therophyta (each 13.5%), phanerophyta (11.4%), chamaephyta (4%), hydrophyta (1.3%) and plants with several possible life forms (4%). Phytogeographical analysis has showed that Euroasiatic element encompasses 31.86% of taxa, widespread taxa encompasses 22.3%, Southeuropean plants 11.25% and Circumholoarctic plants 8.4%. Mediterranean plants are represented with 1.53% and Illyrian-Balcan plants with only 1.15%. On the "Red List of Threatened Plants and Animals of Croatia" 22 taxa are listed (VU 6, NT 9 and DD 7).

The great floristical diversity of researched area can be explained with specific gegraphical position, habitat diversity (dry, fresh and moist grasslands, scrubs, mountain beech forest, oak-hornbeam forest, damp habitats, agricultural and ruderal habitats) and extensive human influence.

THE RARE AND ENDANGERED FLORISTIC SPECIES OF THE NATURAL PARK OF HUTOVO BLATO

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The Hutovo Blato wetland, one of the most important parts of the Neretva river delta in Bosnia and Herzegovina, was evaluated as a natural park in 1995 and intentions are to list in the Ramsar Convention as an internationally protected wetland. The area of the park covers 74 km^2 and belongs to the Submediterranean vegetation zone. The aquatic and the terrestrial types of ecosystems predominate in the park. During the last investigated, the project LIFE was found more then 600 floristic species. This investigation was carried out during 2003/2004 and 28 rare and endangered floristic species were found.

NOVA VRSTA GLOGA U FLORI BOSNE I HERCEGOVINE (*Crataegus microphylla* K.Koch subsp. *malýana* Christensen & Janjić)

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Rod *Crataegus* se odlikuje velikom polimorfnošću oblika uzrokovanom čestom hibridizacijom, introgresijom i apomiksijom. Najnovija istraživanja roda *Crataegus* na području Bosne i Hercegovine ukazala su na postojanje četiri autohtone vrste glogova: *C.laevigata*, *C.monogyna*, *C.rhipidophylla* i *C.microphylla*. Posljednje dvije vrste tek su nedavno registrirane. U ovome radu su iznesene osnovne morfološke, ekološke i horološke karakteristike endemične bosanskohercegovačke podvrste *C.microphylla* subsp. *malýana*, koja dolazi na zapadnoj granici areala ove vrste.

NEW HAWTHORN SPECIES IN THE FLORA OF BOSNIA AND HERZEGOVINA (*Crataegus microphylla* K.Koch subsp. *malýana* Christensen & Janjić)

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Genus *Crataegus* exhibits outstanding polymorphism of forms caused by often interspecific hybridisation, introgression and apomyxis. Recent investigations of *Crataegus* indicate the existence of four indigenous hawthorns: *C.laevigata*, *C.monogyna*, *C.rhipidophylla* and *C.microphylla*. The last two species have been recently registered for Bosnia and Herzegovina. In this paper we present results of morphological, ecological and horological features of endemic subspecies *C.microphylla* subsp. *malýana* inhabiting western areal of the species.

THE FLORA OF ISTRIA: *JUNCACEAE*

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Investigation into the flora of Istria was carried out and a check-list, keys and distribution maps for the family *Juncaceae* were prepared. According to the check-list, the family *Juncaceae* participated with two genera (*Juncus* and *Luzula*) and 26 plant taxa (species, subspecies and varieties).

The genus *Juncus* is represented by the following 20 taxa (17 species and 3 subspecies): *Juncus acutiflorus* Ehrh. ex Hoffm., *J. acutus* L. subsp. a*cutus*, *J. ambiguus* Guss., *J. articulatus* L., *J. atratus* Krock., *J. bufonius* L., *J. capitatus* Weigel, *J. compressus* Jacq., *J. conglomeratus* L., *J. depauperatus* Ten., *J. effusus* L., *J. gerardii* Loisel. subsp. *gerardii*, *J. hybridus* Brot., *J. inflexus* L., *J. littoralis* C.A.Mey. subsp. *tommasinii* (Parl.) Arcang., *J. maritimus* Lam., *J. minutulus* Krecz. & Gontsch., *J. subnodulosus* Schrank, *J. tenageia* L.f. and *J. tenuis* Willd.

The genus *Luzula* has shown the presence of 6 taxa (3 species, 1 subspecies and 2 varieties): *Luzula campestris* (L.) DC., *L. forsteri* (Sm.) DC., *L. luzuloides* (Lam.) Dandy & Wilmott subsp. *luzuloides*, *L. multiflora* (Ehrh. ex Retz.) Lej. var. *multiflora*, *L. multiflora* (Ehrh. ex Retz.) Lej. var. *pallescens* Hoppe ex Sturm and *L. pilosa* (L.) Willd.

SCHOENUS NIGRICANS PASTURES IN ISTRIA

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We have studied the vegetation structure and phytocoenological composition of different pasture complexes in Istria (Croatia). Characteristic zonations along a predominant moisture gradient were observed. Interestingly, at summer-dry localities tussock-forming plants of *Schoenus nigricans* L. (*Cyperaceae*) were found. These structurally very heterogenous plant communities dominated by *Schoenus nigricans* are syntaxonomically hard to delineate. Therefore, we utilised the varying clonal growth strategy of *Schoenus nigricans* for the classification of these Istrian pastures.

FLORA OTOKA SILBE (SJEVERNA DALMACIJA, HRVATSKA)

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Otok Silba pripada skupini sjevernodalmatinskih otoka. Površine je oko 15 km^2, a najviši vrh otoka je 80 metara nad morem. Zbog svog karakterističnog položaja pružanja (sjeverozapad-jugoistok) i smještaja, izložen je utjecaju vjetrova bure i juga. Otok je floristički nedovoljno istražen, jer su prethodna istraživanja bila povremena i kratkotrajna. Naša istraživanja flore trajala su tri godine (2001-2004) i obuhvaćala su sve vegetacijske sezone, tako da su dala cjelovitiji i potpuniji prikaz florne raznolikosti ovog sjevernodalmatinskog otoka. Prema našim istraživanjima na otoku

THE FLORA OF THE ISLAND OF SILBA (NORTH DALMATIA, CROATIA)

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The island of Silba belongs to the group of north Dalmatian islands. The surface of the island is 15 km^2 and the highest part is 80 m above the sea level. Because of the characteristic geographical position and stretching (northwest – southeast), the island is exposed to the influence of the winds Bura and Jugo. Floristically the island is inadequately explored, because previous researches were periodical and transitory. Our researches of the vascular flora were carried out in the period of three years (2001-2004) and comprised all vegetational seasons, so they resulted in a more com-

Silbi je zabilježeno novih 145 biljnih svojti, te ukupno s prijašnjim istraživanjima broj svojti iznosi 514, što predstavlja izuzetno veliki broj s obzirom na malu površinu otoka. Na otoku su zabilježene sljedeće endemične svojte: *Iris illyrica* Tomm., *Viola adriatica* Freyn, *Vincetoxicum hirundinaria* Medik. subsp. *adriaticum* (Beck) Markgr., *Goniolimon dalmaticum* (C.Presl.) Reichb. f., *Anthyllis vulneraria* L. subsp. *rubiflora* (DC.) Arcang. i *Asplenium hybridum* (Milde) Bange, što ujedno predstavlja i novo nalazište te vrste izvan Kvarnerskog arhipelaga. Zaštićene vrste u flori otoka Silbe prema Zakonu o zaštiti okoliša su *Anacamptis pyramidalis* (L.) Rich. i *Cephalanthera longifolia* (L.) Fritsch. Također su zabilježene i sljedeće rijetke vrste: *Briza minor* L. i *Thymelaea hirsuta* (L.) Endl., a ugrožene svojte su *Blackstonia perfoliata* (L.) Huds. subsp. *serotina* (Koch ex Rchb.) Vollm., *Glaucium flavum* Crantz, *Carex divisa* Huds. i *Elymus pycnanthus* (Godr.) Melderis. Od zanimljivih neofitskih vrsta prisutne su npr. *Bidens bipinnata* L., *Datura stramonium* L., *Ailanthus altissima* (Mill.) Swingle i *Oxalis pes-caprae* L.

plete data about the floral diversity of this north Dalmatian island. According to these researches, new 145 plant taxa were recorded, and with all previous records, a total of 514 plant taxa have been recorded. Taking into consideration a small surface of the island, that is a significant number of taxa. Following endemic taxa were recorded on the island: *Iris illyrica* Tomm., *Viola adriatica* Freyn, *Vincetoxicum hirundinaria* Medik. subsp. *adriaticum* (Beck) Markgr., *Goniolimon dalmaticum* (C.Presl.) Reichb. f., *Anthyllis vulneraria* L. subsp. *rubiflora* (DC.) Arcang. and *Asplenium hybridum* (Milde) Bange, that represent a new finding of this species outside the area of the Kvarner archipelago. Protected species in the flora of Silba according to the Nature Conservation Law are *Anacamptis pyramidalis* (L.) Rich. and *Cephalanthera longifolia* (L.) Fritsch. Also the following rare species were recorded: *Briza minor* L., *Thymelaea hirsuta* (L.) Endl. and endangered species: *Blackstonia perfoliata* (L.) Huds. subsp. *serotina* (Koch ex Rchb.) Vollm., *Glaucium flavum* Crantz, *Carex divisa* Huds. and *Elymus pycnanthus* (Godr.) Melderis. Among some interesting neophyte species on the island were registered: *Bidens bipinnata* L., *Datura stramonium* L., *Ailanthus altissima* (Mill.) Swingle and *Oxalis pes-caprae* L.

NICOTIANA GLAUCA GRAHAM (*SOLANACEAE*) NOVA ADVENTIVNA VRSTA U FLORI HRVATSKE

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Rod *Nicotiana* L. (*Solanaceae*) u flori Hrvatske zastupljen je s dvije jednogodišnje zeljaste vrste, *N. rustica* L. i *N. tabacum* L. Novootkrivena vrsta *N. glauca* Graham je drvenasta trajnica s golim sivozelenim listovima. Za vrijeme floristićkih istraživanja otoka Visa, tijekom 2002. godine, naišli smo na desetak povećih grmova vrste *N. glauca* u neposrednoj blizini napuštenog dijela tvornice ribljih konzervi «Neptun» u Komiži. Sudeći prema visini i stanju tih grmova došli smo do zaključka da je vrsta već duže vrijeme prisutna u flori Hrvatske. Vrsta autohtono potječe iz Južne Amerike (Argentina i Bolivija), te se kao kultivar naturalizirala i proširila širom mediteranskih zemalja (Španjolska, Portugal, Francuska, Italija, Sicilija, Korzika, Sardinija, Grčka i Kreta). Pregledavajući herbarske zbirke Botaničkog zavoda ZA i

NICOTIANA GLAUCA GRAHAM (*SOLANACEAE*) A NEW ADVENTIVE SPECIES IN THE FLORA OF CROATIA

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In Croatian flora the genus *Nicotiana* L. (*Solanaceae*) is represented by two annual herbs species, *N. rustica* L. and *N. tabacum* L. Newly discovered species *N. glauca* Graham is a woody perennial with glabrous, glaucous leaves. In the year 2002, during the floristical investigations of the island of Vis, we found approximately ten bigger shrubs of *N. glauca* near the abandoned part of the fish factory in Komiža. Taking into consideration the height and condition of those shrubs, we assumed that this species has been present in Croatian flora for a longer period of time. The species is autochthonous in the South America (Argentina and Bolivia), but is cultivated and naturalized around the Mediterranean region (Spain, Portugal, France, Italy, Sicily, Corsica, Sardinia, Greece and Crete). Examining the Herbarium of the Department of

ZAHO, pronašli smo jedan herbarijski primjerak kojeg je sabrao Hećimović 1977. god. na otoku Lokrumu. Prema dosadašnjim podacima, zajedno s otokom Visom, to su jedina dva nalazišta ove adventivne vrste u flori Hrvatske.

Botany ZA and ZAHO we have found one herbarium sheet that was collected by Hećimović in 1977 from the island of Lokrum. Hitherto, according to the data from Lokrum and with the finding on the island of Vis, these are the only two known localities of this adventive species in the flora of Croatia.

PRILOG FLORI EPIFITSKIH ORHIDEJA PRIRODNOG REZERVATA »LA MONTAÑA DEL OCASO« (QUINDÍO, KOLUMBIJA)

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Pretpostavlja se da na svijetu postoji otprilike 20 000 – 35 000 vrsta orhideja, od čega je približno 70% epifitskih. S obzirom na broj svojti orhideja Kolumbija se smatra jednom od najbogatijih zemalja na svijetu. Ondje je prisutno 3 000 – 3 500 svojti orhideja što iznosi 10-15% svih vrsta orhideja svijeta. U prirodnom rezervatu »La Montaña del Ocaso« (Quimbaya, Quindío) dosadašnjim istraživanjima zabilježeno je ukupno 30 vrsta orhideja, od čega je 28 epifitskih. Ekološkim istraživanjima epifitskih orhideja provedenim od kolovoza do studenog 2002. godine na tom području

CONTRIBUTION TO THE EPIPHYTIC ORCHID FLORA OF THE NATURE RESERVE »LA MONTAÑA DEL OCASO« (QUINDÍO, COLOMBIA)

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It is assumed that there are approximately 20,000 – 35,000 orchid species in the world, out of which around 70% are epiphytic. According to the number of orchid species, Colombia is considered one of the richest countries in the world. There exist 3,000 – 3,500 orchid species which account for as much as 10-15% of all orchid species. Out of 30 orchid species recorded for the nature reserve »La Montaña del Ocaso« (Quimbaya, Quindío) in previous investigations, 28 are epiphytic. During the ecological research of the epiphytic orchids in this area between August and November 2002, 17 species

potvrđeno je 17 vrsta te je zabilježeno još šest vrsta novih za to područje. Tri od njih su u potpunosti određene: *Epidendrum coronatum* Ruiz & Pav., *E. imatophyllum* Lindl. i *Jacquiniella globosa* (Jacq.) Schltr., a zbog otežane determinacije ostale tri svojte nisu određene pa se u ovom priopćenju navode kao: cf. *Campylocentrum*, cf. *Epidendrum* te cf. *Masdevallia*. Ukupan broj vrsta orhideja u tom prirodnom rezervatu zasada iznosi 36, a budući da floristička istraživanja još uvijek traju, taj će se broj zasigurno povećati.

were confirmed and six were newly recorded. Three of them that were determined are: *Epidendrum coronatum* Ruiz & Pav., *E. imatophyllum* Lindl. and *Jacquiniella globosa* (Jacq.) Schltr. On the other hand, three other newly recorded orchid species could not be determined and are here presented as: cf. *Campylocentrum*, cf. *Epidendrum* and cf. *Masdevallia*. Total number of orchid species in this nature reserve is 36 for now, but it will surely increase in the future due to the continuing floristic research.

RASPROSTRANJENOST RODA *IMPATIENS* L. (*BALSAMINACEAE*) U PARKU PRIRODE MEDVEDNICA, HRVATSKA

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Analizom rezultata dosadašnjih floristićkih istraživanja utvrđene su četiri vrste roda *Impatiens* na Medvednici: *Impatiens balfourii* Hooker f., *I. glandulifera* Royle, *I. noli-tangere* L. i *I. parviflora* DC.
Podaci o rasprostranjenosti potječu iz tri izvora: terenskih istraživanja (66,2%), literature (26 %) i herbarija (7,8%). Od ukupnog broja korooloških podataka njih 57 (74 %) bilo je geokodirano. Najveći dio podataka iz literature i herbara stariji je od 50 godina. Kartiranjem rasprostranjenosti obavljenim na temelju osnovnih jedinica srednjoeuropske mreže (MTB) za kartiranje flore, upotrebom 1/64 osnovnih polja, izrađene su

THE DISTRIBUTION OF THE GENUS *IMPATIENS* L. (*BALSAMINACEAE*) IN MEDVEDNICA NATURE PARK, CROATIA

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The flora research in Medvednica Nature Park has shown presence of four species of the genus *Impatiens*: *Impatiens balfourii* Hooker f., *I. glandulifera* Royle, *I. noli-tangere* L. and *I. parviflora* DC.
Data on taxa distribution within the Nature Park were collected from three sources: field observations (66.2%), literature (26 %) and herbaria (7.8%). Among chorological data 57 were geocoded (74%). The majority of literature and herbaria data are more than 50 years old. Distribution mapping was done by using the basic units of the Central European grid (MTB) for flora mapping with the application of MTB 1/64 basic units.

karte rasprostranjenosti za navedene vrste. Podaci o rasprostranjenosti vrsta *Impatiens balfourii* Hooker f., *I. glandulifera* Royle i *I. parviflora* DC. gotovo isključivo su rezultat nedavnih floristički istraživanja (1997-1998. god.), dok manji dio podataka za vrstu *I. noli-tangere* L. potječe i iz druga dva izvora. Najšire rasprostranjena vrsta je *I. noli-tangere*.

U slučaju pojačanog antropogenog utjecaja na prirodnu vegetaciju u budućnosti se može očekivati daljnje širenje ovih (i drugih) neofitskih vrsta.

Distribution maps were done for mentioned species.

Data distribution of the species *I. balfourii, I. glandulifera* and *I. parviflora* are exclusively a result of the recent floristic research (1997-1998). A small number of the data for the species *I. noli-tangere* come from literature and herbarium data. The species *I. noli-tangere* is the most widespread in the Park.

In the future, if the antropogenic influence in the area of Nature Park increases, further distribution of these (and other) neophytes can be expected.

BOTANICAL RESEARCH OF THE VASCULAR PLANTS OF SLOVAKIA

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Botanical research in Slovakia has a long tradition. Among the most important historical works were Lumnitzer's *Flora Posoniensis* (1791), Endlicher's *Flora Posoniensis* (1830), Reuss's *Května Slovenska* (1853) and Holuby's *Flora des Trencsiner Comitates* (1888). Later on, other botanists contributed significantly to the botanical research in Slovakia, especially Jávorka, Domin, Podpěra, Silinger, Dostál and Futák.

Recently more than 4000 taxa of vascular plants have been listed from the territory of Slovakia. Our research work has been targeted at the basic taxonomical and chorological research of autochthonous (native) and alochthonous (naturalised, non-native, casual aliens, frequently cultivated, cultural and expected) species, aiming at deepening our knowledge on diversity, ecological claims and chorology. All the relevant studies have been carrying out in the framework of a series of projects, presented in the published volumes of the edition *Flóra Slovenska*. Since 1966–2004 10 volumes were published. The latest one (*Flóra Slovenska – V/4*), issued in 2002, covers the orders *Papaverales* and *Capparales*. At the moment the orders *Juglandales, Betulales, Fagales, Platanales, Salicales* and *Urticales*, along with the orders *Cistales, Violales, Cucurbitales* and *Campanulales* are being worked out to be published as 2 further volumes.

Invaluable aspect of the project "*Flóra Slovenska*" is a close co-operation of the team with European botanists that has a long-term tradition and provides a great help in floristic and taxonomical research in respective countries.

RASPROSTRANJENOST IMELICE (*ARCEUTHOBIUM OXYCEDRI* (DC.) M. BIEB.) U HRVATSKOJ

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Imelica, *Arceuthobium oxycedri* (DC.) M. Bieb., poluparazitska je, epifitska, vazdazelena i dvodomna kritosjemenjača, čiji su domaćini vrste iz porodice *Cupressaceae*. U Hrvatskoj je zabilježena samo na šmriki, *Juniperus oxycedrus* L. Imelica je rasprostranjena u južnoj Europi, sjevernoj Africi, preko Male Azije do Himalaje. Za Hrvatsku se u literaturi navode šira geografska područja, kao npr. Istra i Dalmacija, ili je navedeno samo "Hrvatska". Podaci o rasprostranjenosti ove vrste kod nas datiraju s kraja 19. i iz prve polovice 20. stoljeća.

Sustavnim prikupljanjem podataka na terenu, odnosno pregledom biljaka domaćina izrađena je karta sadašnjega stanja rasprostranjenosti *A. oxycedri* u Hrvatskoj. Rezultati istraživanja pokazuju da je imelica rasprostranjena duž cijele naše jadranske obale, od Istre do južne Dalmacije, uz obalu i na otocima. Rasprostranjenost je mozaična.

DISTRIBUTION OF JUNIPER DWARF MISTLETOE (*ARCEUTHOBIUM OXYCEDRI* (DC.) M. BIEB.) IN CROATIA

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Juniper dwarf mistletoe, *Arceuthobium oxycedri* (DC.) M. Bieb., is a semiparasitic, epiphytic, evergreen dioecious angiosperm, whose hosts are species of the *Cupressaceae* family. In Croatia it has been observed only on the prickly juniper tree, *Juniperus oxycedrus* L. Juniper dwarf mistletoe is spread in southern Europe, northern Africa, via Asia Minor to the Himalayas. For Croatia broader geographical areas are mentioned in the literature, like Istria and Dalmatia, or only "Croatia" is mentioned. The data about the distribution of this species in Croatia date back to the end of the 19th and the first half of the 20th century.

Based on systematic data collection from the field, i.e. through the investigation of hosts, a map of the present state of distribution of *A. oxycedri* in Croatia has been made. The results of the investigation show that juniper dwarf mistletoe is spread along the whole of the Adriatic coast, from Istria to south Dalmatia, along the coast and on the islands. The distribution is mosaic.

NOVA NALAZIŠTA VRSTE *ADIANTUM CAPILUS-VENERIS* L. U HRVATSKOJ

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Navode se nova, kao i do sada poznata nalazišta tercijarnog relikta, *Adiantum capilus-veneris* L. u Hrvatskoj. Jedno novo, oskudno nalazište nalazi se uz vodotok na Gospinom otoku u Solinu, a više novih, bogatijih nalazišta nalazi se u Splitu; jedno uz katedralu sv. Duje, gdje raste u sastavu vegetacije starih zidova. Druga nalazišta nalaze se uz izvore vode u Duilovu, neposredno uz morsku obalu. Ta nalazišta neophodno je zaštititi, budući da bi se izgradnjom planirane prometnice zatrpala ta nalazišta. U radu je obavljena i fitocenološka analiza spomenutih nalazišta.

NEW LOCALITIES OF THE SPECIES *ADIANTUM CAPILUS-VENERIS* L. IN CROATIA

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The paper provides new, as well as already known, localities of the Tertiary relict - *Adiantum capilus-veneris* L. in Croatia. One new, meagerly, location is found alongside the stream on Gospin otok at Solin while more richer, new ones can be found in Split. One is next to the Cathedral of Sveti Dujam where it grows among the old-wall vegetation. The second one spreads near springwater in Duilovo, close to the sea-shore. This locality needs urgent protection, since any road-construction (planned) could burry the location. Also, phytocenological analysis of these locations will be presented in this paper.

PRELIMINARY RESEARCHES OF THE NEOPHYTES ON THE AREA BETWEEN SAMOBOR AND ZAGREB

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Preliminary results of floristic researches on three localities (the Bregana border crossing, the Sava river bank, and the railroad) on which the adventive plants (newcomers) are very successful are presented. We tried to find out their presence within the whole flora. We were interested in the biology of the neophyte plants, so we analysed phytogeography, the presence of plant species within the biotope, its frequency according to the type of biotope, and similarity in number of species related to the biotope (Sorensen's coefficient of similarity).

Results showed up that adventive plants were present in 17% of total number of species. On all the locations the class of Dicotyledonae was dominant amongst the total number of neophyte species. By means of phytogeographic analysis we found out that on our localities the most widespread were plants of the broad area of growth, followed by Eurasian and European plant species. The highest number of species was found at the Bregana border crossing. The highest similarity in number of plant species was observed in between the Sava river bank near Podsused and the Bregana border crossing and was 24.56%. The lowest similarity was found in

KARTIRANJE RASPROSTRANJENOSTI NEKI BILJNIH SVOJTI U MEĐIMURJU

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Slaba zastupljenost ili čak potpun nedostatak podataka (čak i u Crvenoj knjizi) o nizu svojti za području Međimurja bio je poticaj za rad s učenicima u školama koji mogu dati svoj doprinos kartiranju rasprostranjenosti biljnih svojti i njihovom flornom istraživanju. Na području donjeg Međimurja u šumskoj zajednici hrasta lužnjaka i običnog graba (as. C*arpino betuli-Quercetum roboris* Rauš 1969.) istraživanjem od 1998. do 2003. godine određeno je deset vrsta proljetnica: visibaba (*Galanthus nivalis L.),* zlatica (*Ranunculus ficaria L.*), plućnjak (*Pulmonaria officinalis L.*), procjepak (*Scilla bifolia L.*), šupaljka *(Corydalis cava Sw.),* bijela šumarica (*Anemone nemorosa L.*), žuta šumarica (*Anemone ranunculoides L.*), baloče (*Gagea*

THE CARTOGRAPHY AND THE EXTENT OF SOME TYPES OF FLORA SPECIES IN MEĐIMURJE

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The lack of information about flora species in Međimurje (even in the Red Book) have stimulated us to start work with our students. We have started to explore the extent of flora species. We researched oak and hornbeam woods (*as. Carpino betuli – Quercetum roboris, Rauš 1969.*) in lower Međimurje from 1998 to 2003 and we analyzed ten species of spring flowers: *Galanthus nivalis* L., *Ranunculus ficaria* L., *Pulmonaria offincinalis* L., *Scilla bifolia* L., *Corydalis cava* Sw., *Anemone nemorosa* L., *Anemone ranunculoides* L., *Gagea lutea* L., *Crocus albiflorus* Kit., *Crocus neapolitanus* (Ker.-Gawl.) Mord.et Lois.) We have also determined the number of those species, their spread and the kind of societies. Through years of research we have noticed

lutea L.), bijeli šafran *(Crocus albiflorus Kit.)* i ljubičasti šafran *(Crocus neapolitanus (Ker-Gawl.) Mord. et Lois.),* te je praćena njihova brojnost, pokrovnost i socijalnost. U odnosu na početnu godinu istraživanja brojnost vrsta se mijenjala, a neke su i potpuno nestale s pojedinih staništa. Na odabranim mjestima praćeni su i abiotički čimbenici (pH tla, karakter humusa, količina kalcija u tlu, temperatura), za koje se pokazalo da utječu na brojnost i raznolikost vrsta. Od vrsta koje u Crvenoj knjizi nisu zabilježene za područje Međimurja kartirana su 4 staništa drijemovca (*Leucojum vernum* L.), označenog kao osjetljiva vrsta (V), dok je brojnost ugrožene vrste (E), kockavice (*Fritillaria meleagris* L.) praćena tri godine na tri lokaliteta. Ove godine provedena je anketa među učenicima gimnazije i na taj način prikupljeni su podaci prema kojima je kartirano čak 15 njenih lokaliteta. Svi lokaliteti vezani su uz rijeku Muru, dok uz Dravu nije nađen ni jedan. Kartirana su i tri staništa kebrača (*Myricaria germanica* (L.) Desv.) ugrožene vrste (E) i glacijalnog relikta i to na području od Preloga do Legrada.

that the number of species is changeable. Some of the plants have completely disappeared. On some locations we collected facts about abiotic indicators which are connected to the number and the difference of species such as pH soil, the kind of humus, quantity of the calcium in the soil, temperature. Four new locations of *Leucojum vernum* L. (known as a very delicate species), which were not recorded in the Red Book before, have been put on our maps. We observed endangered species named *Fritillaria meleagris* L. and we still investigate its number on those three locations. Recently, we have made a poll among our students and collected more information about *Fritillaria meleagris* L., and 15 new locations have been drawn in our maps. We have found *Fritillaria meleagris* L. by the river Mura, but not in the Drava region. We have been searching for the endangered *Myricaria germanica* ((L.) Desv.), and found it on three locations between Prelog and Legrad, so we have inserted those locations in our maps.

NOVI PODATCI O FLORI REPUBLIKE MAKEDONIJE

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U ovom priopćenju prezentiraju se novi podaci o horologiji 5 vrsta, od kojih je jedna nova za floru Makedonije (*Solanum sisymbrifolium* Lam.), dok se za ostale 4 [*Thesium macedonicum* Heyndr., *Silene gallica* L., *Tozia alpina* L. subsp. *carpathica* (Wolosz.) Dostal, and *Calycocorsus stipitatus* (Jacq.) Rauschert.] navode novi lokaliteti koji će biti prikazani na horološkoj mapi.

NEW DATA REGARDING THE FLORA IN REPUBLIC OF MACEDONIA

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In this contribution are presented new data regarding the horology of 5 species, out of which one was until now not known in the Macedonian flora (*Solanum sisymbrifolium* Lam.) whereas for the other 4 [*Thesium macedonicum* Heyndr., *Silene gallica* L., *Tozia alpina* L. subsp. *carpathica* (Wolosz.) Dostal, and *Calycocorsus stipitatus* (Jacq.) Rauschert.] also other localities are quoted and presented in distribution maps.

RASPROSTRANJENOST PREDSTAVNIKA RODA *EDRAIANTHUS* DC. U HRVATSKOJ FLORI

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Rod *Edraianthus* DC. se sastoji od 14 vrsta, većinom rasprostranjenih na Balkanskom poluotoku (jedna vrsta živi na sjevernom Kavkazu). Vrste roda *Edraianthus* DC. organizirane su u dva velika agregata: *graminifolius* i *pumilio*, dok četiri vrste stoje zasebno.

Od tih 14 vrsta šest vrsta živi u Hrvatskoj; od toga su oba agregata prisutna u flori Hrvatske. Agregat *graminifolius* obuhvaća tri vrste i dvije podvrste dok agregat *pumilio* obuhvaća dvije vrste a vrsta *Edraianthus serpyllifolius* stoji zasebno.

Glavni predmet ovog rada je prikaz rasprostranjenosti predstavnika roda *Edraianthus* DC. na području Hrvatske. Dva su predstavnika roda *Edraianthus* DC. (*E. dinari-*

THE DISTRIBUTION OF REPRESENTATIVES OF THE GENUS *EDRAIANTHUS* DC. IN THE CROATIAN FLORA

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The genus *Edraianthus DC* consists of 14 species, most of them distributed in the Balkan peninsula (one of the species living in the northern Caucasus). Species of *Edraianthus* DC are organised into two large aggregates: *graminifolius* and *pumilio,* while four of the species are freestanding.

Of these 14 species, six live in Croatia, and of this, both aggregates are to be found in the flora of Croatia. The aggregate *graminifolius* embraces three species and two subspecies, while the aggregate *pumilio* covers two species; the species *Edraianthus serpyllifolius* stands by itself.

The main subject of this paper is an account of the distribution of representatives of the genus *Edraianthus* DC in Croatia.

cus, *E. pumilio* i *E. serpyllifolius*) u Hrvatskoj vrlo uske rasprostranjenosti, dok su ostali šireg (*E. graminifolius i E. tenuifolius*) rasprostranjenja.

Rasprostranjenost roda *Edraianthus* DC. u Hrvatskoj je prikazana na preglednim kartama odgovarajućeg razmjera.

Three representatives of the genus *Edraianthus* DC (*E. dinaricus*, *E. pumilio* and *E. serpyllifolius*) have a very narrow distribution, while the others have a somewhat wider area of distribution (*E. graminifolius* and *E. tenuifolius*).

The distribution of the genus *Edraianthus* DC in Croatia is depicted in easily readable maps of appropriate scales.

EKOLOŠKO - FITOGEOGRAFSKE KARAKTERISTIKE KOROVSKE FLORE MIRIJEVA

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Korovska flora Mirijeva, kao i ostalih beogradskih naselja, nije sistematski proučavana. Međutim, postoji velika potreba za ovakvim istraživanjima zato što ona imaju višestruki naučni i praktični značaj, jer trebaju poslužiti kao osnova za izbor racionalnih mera suzbijanja korova. Cilj ovoga rada bio je da se korovska flora na području Mirijeva prikaže sa florističkog, ekološkog , fitogeografskog aspekta i da se na taj način "mreža" proučenih urbanih cjelina Srbije proširi do nivoa kada su moguće različite komparativne analize. Prikupljanje biljnog materijala obavljeno je istraživanjem na terenu u periodu od travnja 2000. do listopada 2003. godine u usjevima (pšenica, kukukruz, šećerna repa, suncokret, soja, lucerka, povrće: krumpir, grašak, grah, crni i bijeli luk, kupus, kelj, karfiol, paradajz, paprika, mrkva, peršin, celer), višegodišnjim zasadima (voćnjaci i vinogradi), livadama i pašnjacima na području beogradskog

ECOLOGICAL – PHYTOGRAPHIC CHARACTERISTICS OF WEED FLORA OF MIRIJEVO

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Weed flora of the Mirijevo region as of other Belgrade peripheral settlements has not been systematically studied. But, there is a great need for such studying because they have manifold scientific and practical significance, for they should serve for as the basis for the choice for rational measures of warding off the weed. The purpose of this work was to research the region of Mirijevo for weed flora from floral, ecological and phytogeographical aspect and to, in that way, exaond «the network» of studied urban entities of Serbia up to the level where different comparative analyses are possible. The collecting of herbal material was performed with the research on the terrain in the period from April 2000 until October 2003 in the crops (wheat, corn, sugar beet, sunflower, soybean, lucern, the vegetables: potatoes, peas, onion and garlic, cabbage, cauliflower, tomatoes, peppers, carrots, parsley, celery), many-year implantations

naselja Mirijevo. Na istraživanom području utvrđeno je 228 vrsta vaskularnih biljaka iz 159 rodova i 44 familije. Klasi *Dicotyledones* pripada 188 vrsta iz 132 rodova i 39 familije, a klasi *Monocotyledones* 39 vrste iz 26 roda i 4 porodice. Analizom zastupljenosti životnih formi biljaka u korovskoj flori Mirijeva ustanovljen je hemikriptofitsko-terofitski karakter (109:78). Analiza ekoloških indeksa za 5 osnovnih ekoloških faktora potvrđuje dominantnost biljaka koje preferiraju umjereno vlažna staništa, neutralne do slabo bazne reakcije, srednje bogata mineralnim materijama, poluotvorenog do otvorenog karaktera, mezofilna do termofilna u pogledu temperaturnog režima. Fitogeografskom analizom utvrđeno je prisustvo 135 različitih flornih elemenata, grupiranih u 7 osnovnih areal tipova. Najbrojnija je grupa koja pripada holarktičkom areal tipu.

(fruit-gardens and vineyards), meadows and pastures in the region of Belgrade peripheral settlement Mirijevo. In the research region 228 species of vascular plants have been ascertained, sorted out into 159 rows and 44 families. The class *Dicotyledones* has 188 species out of 132 genuses and 39 genera, and the class *Monocotyledones* 39 species out of 26 genuses and 4 families. With the analysis of the existence of living forms of herbs in weed flora of the Mirijevo region, hemicriptophyte/terophyte character has been ascertained (109:78). The analysis of ecological indexes for 5 basic ecological factors confirms the domination of the plants which prefer moderate humid places, neutral up to weak base reactions, medium rich with mineral materials, of semi-open to open character, and mesophyl to thermophyl regarding temperature regime. With phytogeographical analysis, it has been ascertained that there is the presence of 135 different floral elements grouped into 7 basic area types. The most numerous was the group which belongs to holarctic area type.

FITOGEOGRAFSKE KARAKTERISTIKE KOROVSKE FLORE SRBIJE

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U radu se daje pregled korovske flore Srbije. Korovska flora Srbije je izuzetno bogata i raznovrsna. Većina korova nije usko specijalizirana, već se javlja u okviru više korovskih kategorija, odnosno na različitim staništima. To pokazuje da korovi imaju široku ekološku valencu za veći broj faktora. U Srbiji se nalazi ukupno 968 vrsta korova, iz 375 rodova i 80 familija.

Fitogeografskom analizom korovske flore Srbije utvrđeno je prisustvo 402 različita florna elementa, koji su grupirani u 7 različitih arealnih tipova, tj. u 17 različitih arealnih grupa.

Klasifikacija flornih elemenata u osnovne arealne tipove i arealne grupe izvršena je na formacijskom principu floristično-vegetacijske biljnogeografske rejonizacije područja Srbije koju daje Stevanović (1992).

PHYTOGEOGRAPHIC CHARACTERISTICS OF THE WEED FLORA IN SERBIA

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Weed flora in Serbia is characterized by high diversity, comprising a total of 968 species classified into 375 genera and 80 families. Many weed species are not strictly specialized and occur in two or more weed categories. Most species have broad ecological amplitude regarding various ecological factors.

The phytogeographic analysis of weed flora in Serbia revealed the presence of 402 different floristic elements, which were included into seven basic area types, i.e. 17 different area groups.

The classification of floristic elements into basic area types was made according to the formative principle of floristic-vegetation phytogeographic regionalization of Serbia (Stevanović 1992).

The most numerous is a group of 507 spe-

Kao najbrojnija izdvaja se grupa vrsta holarktičkog arealnog tipa sa 507 vrsta, čiji areali zahvaćaju više ili manje široka područja sjeverne Zemljine hemisfere. Najveći broj vrsta unutar ovog arealnog tipa pripada različitim grupama Europsko-zapadnoazijskog (51,51%) i Europskog (26,81%) rasprostranjenja.

Na drugom mjestu se nalazi arealni tip Mediteransko-kontinentalnih vrsta sa ukupno 140 predstavnika. Glavni dio ovog arealnog tipa nalazi se u mediteranskom području odakle se pružaju više ili manje duboko u kontinentalna (meridionalno-submeridionalna) područja Europe i Azije. Na trećem i četvrtom mjestu po brojnosti u arealnom spektru nalazi se kozmopolitski arealni tip sa 129 vrsta i adventivni arealni tip sa 101 vrstom.

cies of the Holartic area type, whose areas cover comparatively large regions of Earth's northern hemisphere. Regarding species number and abundance, most prominent are species of the European-West-Asian (51.51%) and Eurasian (26.81%) distribution, which constitute a chorological core of the weed flora in Serbia.

Ranking second is the area type that includes a group of 140 predominantly xerothermic species of transitional Mediterranean-Continental distribution. Most of this area coincides with the Mediterranean region but it spreads more or less deep into the continental (meridional-submeridional) regions of Europe and Asia. The weed flora as a whole and that of the Serbia region in particular, is characterized by high participation of Cosmopolitan 129 species and Adventive's 101 species, which rank third and fourth most numerous regarding the basic area types.

The area spectrum of the total weed flora, as well as chorological spectra of particular weed communities in the region of Serbia, are characterized by the dominance of the species of wide area in whose distribution an important role (directly or indirectly) is played by the man.

THE VASCULAR FLORA OF THE ARCHITECTURAL RESERVE NEBET TEPE IN THE CITY OF PLOVDIV (BULGARIA)

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The flora of the Architectural Reserve Nebet Tepe in the city of Plovdiv was studied in the period 1998-2003. The number of vascular plants growing spontaneously on and around the Byzantian walls and on the pavements is more than 100. The fortification wall was 1650 m long. Nowadays fragments of the wall, one to five meters high, are present in some places. The flora is analysed with respect to the local distribution of the taxa, their chorology, life form and geoelement characteristics. The flora contains a relatively high proportion of ruderals and weeds. The therophytes and hemicryptophytes constitute the largest group. The following families are distinguished by the greatest number of species: *Fabaceae* (11), *Poaceae* (10), *Asteraceae* (8), *Scrophulariaceae* (7), *Brassicaceae* (6), e.t.c. The species *Cerastium tauricum* Spreng. and *Melica ciliata* L. are recorded for the first time for the flora of the floristic region Thracian plain. The results are compared with other European and Mediterranean wall floras.

RASPROSTRANJENOST RODA *DAPHNE* L. (*THYMELAEACEAE*) U PARKU PRIRODE MEDVEDNICA, HRVATSKA

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U svrhu izrade florističke karte Parka prirode Medvednica sabrani su postojeći podaci o rasprostranjenosti roda *Daphne* iz literaturnih i herbarskih izvora. Također su izvršena i terenska istraživanja. Zabilježene su tri vrste: *Daphne blagayana* Freyer, *Daphne laureola* L. i *Daphne mezereum* L. Ukupno je zabilježeno 159 lokaliteta od kojih je 124 (78%) lokaliteta bilo moguće geokodirati. Za vrste *D. laureola* i *D. mezereum* nalazišta su utvrđena iz sva tri izvora podataka, dok je za vrstu *D. blagayana* pronađen samo jedan literaturni podatak. Na temelju geokodiranih podataka prikazana je rasprostranjenost vrsta kartama uz uporabu srednjeeuropske mreže

THE DISTRIBUTION OF THE GENUS *DAPHNE* L. (*THYMELAEACEAE*) IN MEDVEDNICA NATURE PARK, CROATIA

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In order to build the floristic map of Medvednica Nature Park already existing data on the distribution of the genus *Daphne* was collected from literature and herbarium sources. Also, field observations were conducted. Three species were recorded: *Daphne blagayana* Freyer, *Daphne laureola* L. and *Daphne mezereum* L. The total of 159 data of findings was recorded for all three species and 124 (78%) localities were geocoded. For the species *D. laureola* and *D. mezereum* localities were noted from all three data sources, while the data of presence of *D. blagayana* on Mt. Medvednica came from only one literature reference. On the basis of geocoded data, the distribution

za kartiranje flore (MTB). Vrste *D. laureola* i *D. mezereum* bile su česte u istraživanom području: *D. laureola* je prisutna u 41, a *D. mezereum* u 54 od ukupno 135 osnovnih polja. Sve zabilježene vrste prema IUCN kategorijama spadaju među ugrožene i nisko rizične vrste, a *D. blagayana* i *D. laureola* su zaštićene zakonom.

of the species is shown on maps using a Central European grid for floristic mapping (MTB). The species *D. laureola* and *D. mezerum* were frequent in research area: *D. laureola* was found in 41 and *D. mezereum* in 54 out of total 135 basic units. All recorded species have the IUCN status of endangered or low risk species and *D. blagayana* and *D. laureola* are protected by the Nature Conservation Law.

NEW AND "NEW" TAXA IN THE FLORA OF SLOVENIA SINCE 1999

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In the last 5 years two important monographs dealing with flora of Slovenia have been published. Mala flora Slovenije (Martinčič & al., 1999) is the revised edition of the only Slovenian determination key and critical flora, whereas the Materials for the Atlas of Flora of Slovenia (Jogan et al. 2001) are the most complete cartographic compilation of floristic data from the territory of Slovenia.

In this two monographs, a relatively high number of taxa can be found in only one of them and in addition to that in the last years quite a number of taxa were discovered which were completely overlooked by both mentioned monographs.

So altogether there is about 200 taxa which need critical reconsideration and these new or »new« taxa can be grouped as follows:

1. recently discovered neophytes (e.g. *Pistia stratiotes*)
2. overlooked taxa with already published data on occurrence in Slovenia (e.g. *Fumana ericoides*)
3. overlooked taxa due to taxonomic confusion (e.g. *Ruppia cirrhosa*)
4. ephemeral taxa with only few old records (e.g. *Sicyos angulatus*)
5. "new taxa" because of the mistakes in Mala flora Slovenie (e.g. *Gymnocarpium robertianum*)
6. hybrids, not covered by Mala flora Slovenije (e.g. *Anemone x pittonii*)
7. overlooked naturalized garden escapes (e.g. *Berberis thunbergii*)
8. recently discovered taxa as result of taxonomic revisions (e.g. *Epilobium obscurum*)

ISTRAŽIVANJA NEOFITA NA SPLITSKOM PODRUČJU

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Pojačanom urbanizacijom na splitskom području sve više dolazi do potiskivanja autohtone flore i širenja urbane flore.

Na splitskom području sve se više udomaćuju neke neofitske vrste, koje potječu sa različitih kontinenata.

U istraživanoj flori Splita neofiti predstavljaju oko 8%, pokazujući daljnji trend širenja i naturaliziranja u prirodnim i antropogenim zajednicama.

Napravljen je popis neofitskih vrsta, utvrđeno je njihovo podrijetlo, tipovi staništa i nalazišta.

THE INVESTIGATIONS OF THE NEOFITIC SPECIES IN THE SPLIT AREA

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The intesification of urbanisation in the Split area causes a displacing of the autochthonous flora and spreading of the urban flora.

In the Split area more and more are settling down some floral species or neofitic species, which are of origin from different continents.

In the investigated flora of Split the neofitic species represent about 8 %, showing a further trend of spreading and naturalization in structure of the natural and anthropogenic communities.

A list of neofitic species has been made and their range, origin, habitats and localities.

O DOSADAŠNJIM ISTRAŽIVANJIMA FLORE I VEGETACIJE OTOKA BRAČA

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Otok Brač veličinom je treći jadranski otok, površine 394,5 km^2 .

Poznato je više radova o istraživanjima flore i šumske vegetacije otoka Brača.

Otok u potpunosti nije istražen, tako i nema kompletne flore otoka.

Potrebno je utvrditi i objediniti dosada istražene i zapisane vrste i nastaviti s daljnjim istraživanjima.

ABOUT THE PREVIOUS RESEARCH OF THE FLORA AND VEGETATION OF THE ISLAND OF BRAČ

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The island of Brač is the third largest Adriatic island, having the surface area of 394.5 m^2.

Several studies about the research of the Brač flora and wood vegetation have been made so far.

The island has not been fully explored, that is why the complete list of the island flora does not exist.

It is necessary to establish and unite the previously explored and listed species and to resume the detailed investigation.

FERNS AND FLOWERING PLANTS DESCRIBED FROM THE TERRITORY OF SLOVAKIA

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Slovakia is both from the viewpoint of history and plantlife diversity of Europe an important part of the Carpathian and Pannonian region. Many taxa (approx. 1000) of various systematic categories were described from this small territory. At present the historic and recent data on these taxa should be completed and their botanical status revised in accordance with new taxonomic knowledge.

The aim of our project is to prepare a complete list of taxa i.e. species (incl. apomictic ones), infraspecific taxa and hybrids, *locus classicus* of which is situated on the territory of Slovakia, to compile information on the type material (correct names, synonyms, nomina nuda), to collect digital forms of the sheets concerned, as well as the precise information on protologes (incl. *locus classicus*) and to create a functional database.

There is a fruitful collaboration with many important botanical institutions and their herbaria BRA, SAV, SLO, TNP in Slovakia and neighbouring countries: PR, PRC (Praha), BRNU, BRNM (Brno), BP (Budapest), KRA, KRAM (Kraków) etc.

The results of the project will be utilized for further taxonomic - nomenclatural studies as well as for territorial conservation of the plantlife diversity of Slovakia and the Eurasian continent as a whole.

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HEMEROCALLIS LILIOASPHODELUS L. U HRVATSKOJ

Jasenka Topić i Ljudevit Ilijanić

Botanički zavod s botaničkim vrtom, Biološki odsjek, PMF, Sveučilište u Zagrebu, Hrvatska, e-mail: jtopic@yahoo.com

Vrsta *Hemerocallis lilioasphodelus* L. (*Liliaceae*) bilježe za hrvatsku floru Schlosser i Vukotinović (1869), i to za lokalitete između Bratine i Velike Jamničke, nakon čega o njoj nema novih podataka. Tragom činjenice da je ta vrsta u Europi ograničene rasprostranjenosti na području Austrije, sjeverne Italije, Slovenije i Hrvatske, te da je u svim tim zemljama izuzetno rijetka i ugrožena, istražili smo njena moguća staništa. Pronašli smo je na nekima od prethodno zabilježenih lokaliteta, na geografski vrlo ograničenom prostoru. Njezina su staništa vlažni travnjaci koji se kose jedanput godišnje ili neredovito, te sastojine visokih šaševa. U svim slučajevima tlo je mokro, natopljeno podvirnom vodom, a dio godine voda se nalazi i na površini tla. Ovdje će se prikazati neke ekološke i vegetacijske značajke ove u Europi i Hrvatskoj rijetke i ugrožene biljne vrste.

HEMEROCALLIS LILIOASPHODELUS L. IN CROATIA

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The species *Hemerocallis lilioasphodelus* L. (*Liliaceae*) was noted for Croatian flora by Schlosser and Vukotinović (1869) on the localities between the villages of Bratina and Velika Jamnička. Afterwards, there was no new data about the species. Following that data and the fact that this species has restricted area in Europe, being distributed in Austria, Slovenia, northeastern Italy and Croatia, and is very rare and endangered everywhere, we have surveyed potential localities in Croatia. We have found *Hemerocallis lilioasphodelus* on very restricted area, on some of the previously noted localities. Its habitats are wet grasslands, mown once a year or irregularly, and stands of high sedges. The soil is always wet, and the part of the year has surface water. Some ecological and vegetational characteristics of this, in Europe and in Croatia, rare and endangered plant species will be presented here.

REDISCOVERY OF *SPIRAEA CRENATA* IN HUNGARY

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Spiraea crenata L. is a planar–collin Eurasian–cool-continental steppe species, the area border of which extends westwards to Hungary. Once it lived in the foreground of Mátra Mountain (periphery of Gyöngyös) and on the Great Plains (Heves, Pusztavacs, Tatárszentgyörgy) within oak forests of sandy soil. It has been considered to be extinct in Hungary since the 1960's.

I have found the plant in 2000 in the cemetery of Pusztamonostor (45 km south of Gyöngyös and 65 km west of Heves) on the grave of a young man killed in the war in 1944. The plant forms a dense sprout colony of about 20–30 cm wide around the lying gravestone, is regularly pruned therefore flowers and fruits are only seldom seen on it. On the basis of my publication, colleagues of the competent Hortobány National Park visited the cemetery in 2003, but in lack of correct localization they did not recognize the plant around the gravestone. However, in parts of the old cemetery, becoming densely shrubby, in more than 50 m distance in two opposite directions from the specimen living around the gravestone, two further specimens have been found. Within the boundries of the cemetery these thickets are in contact with vegetation types containing protected grassland plants (*Amygdalus nana, Iris variegata, Vinca herbacea*), and valuable habitat indicator species (*Vinca minor, Ficaria verna, Stellaria graminea*). The presence of these plants and the fact that this part of the cemetery (there are no graves in these spots) is relatively protected from drastic human disturbing effects let me conclude, that in the Pusztamonostor cemetery remains of original (not cultivated) populations of *Spiraea crenata* thrive.

As I found this specimen, it would be worthy to search thoroughly cemeteries near its former habitats, supposing that in the protection of them it remained elsewhere also.

ECHINOCYSTIS LOBATA (MICHX) TORREY & GRAY IN SERBIA

Olga Vasić

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The areas of primary distribution of *Echinocystis lobata* are the eastern parts of North America. The initial localities and formation of secondary area in Europe are result of combination of direct and indirect anthropogenous influence. Due to its esthetic characteristics this species was introduced deliberately in Europe, and it was primarily grown as a decorative plant. Very soon it began to spread subspontaneously outside of the areas controlled by humans, and in wetland and flood areas it entered the autochthonous vegetation. According to Tutin (1968), the species is naturalized in the central and southeastern Europe. In Serbia it was recorded for the first time in Novi Sad in 1966 (Šajinović 1976). During the following years it was recorded on about 15 more localities in Vojvodina, and also in two localities in Eastern Serbia. The recent studies show that *E. lobata* is in process of intensive spread in Balkan part of Serbia as well, and this is documented with numerous new records. This species grows on shores of both small and large rivers, and in certain places it almost completely overgrows the autochthonous willows and poplars.

PRILOG FLORI OTOKA ŠOLTE

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U dostupnoj literaturi do sada je za floru otoka Šolte zabilježeno 267 vrsta vaskularnih biljaka.

Tijekom 2001. god. u više navrata posjetili smo ovaj otok (Rogač, Grohote, Maslenica, uvala Tatinja) i za njega zabilježili novih 65 vrsta vaskularnih biljaka. Za floru ovoga otoka ukupno je zabilježeno 332 vrste vaskularnih biljaka, a istraživanje se nastavlja.

AN ENCLOSURE TO FLORA OF THE ISLAND OF ŠOLTA

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In available literature, there has been noted down 267 species of vascular plants, for the island of Šolta until now.

During the year 2001, we have visited this island several times (Rogač, Grohote, Maslenica, cove Tatinja) and noted down 65 species of vascular plants. For the flora of this island it has been noted down a total of 332 species of vascular plants, and the research continues.

FLORISTIČKE PROMJENE U OKOLICI SAMOBORA U PERIODU 1964-2001

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U nizinskom području između Samobora i Svete Nedjelje sustavna floristička i vegetacijska istraživanja provedena su 1964. godine (Hudek, 1964), nakon čega nema nikakvih podataka o flori i vegetaciji tog područja.

Stoga je cilj našeg rada bio ponovno istražiti floru navedenog područja i ustanoviti da li i u kojoj je mjeri došlo do promjena u floističkom sastavu. Floristička istraživanja nizinskog područja između Samobora i Svete Nedjelje provedena su tijekom vegetacijskih sezona 2001. i 2002. godine. Rezultati ukazuju na značajnije promjene staništa i flore u navedenom periodu. Usporedbom sadašnjeg stanja flore sa

FLORISTIC CHANGES IN THE SURROUNDINGS OF SAMOBOR IN THE PERIOD 1964-2001

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In the lowland area between Samobor and Sveta Nedjelja the systematic floristic and vegetation researches were realized in 1964 (Hudek 1964), and after that there is no information from this area.

That is why the object of our study was to research again the flora from this mentioned area, to establish if there is any change and to find out the proportions in floristic structure. Floristic researches of the lowland area between Samobor and Sveta Nedjelja were done during the vegetation periods of the years 2001 and 2002. The results of these researches indicate on more characteristic modifications of natural habitats and flora in the mentioned period. If we

stanjem iz 1964. godine utvrđene su promjene u floističkom sastavu, u smislu povećanja broja livadnih, ruderalnih, kultiviranih i adventivnih vrsta (za 41,98%), te smanjenja broja močvarnih vrsta (za 55,66%).

Analizom indikatorskih vrijednosti utvrđen je pad vlažnosti staništa za prosječno 10,03%, te porast obogaćivanja tla dušikom za 12,53%.

Analizom životnih oblika utvrđen je smanjeni udio hemikriptofita (za 15,67%), a značajan porast terofita (za 149,21%).

Uzrok promjenama su djelomično izmijenjeni ekološki činioci zbog izvršenih melioracijskih radova, a djelomično sve veći utjecaj urbanizacije na rubnim dijelovima tih staništa.

compare the floristic condition in 1964 and in the present, the modifications of the flora have been established, the number of some plants growing on meadow, ruderal plants, cultivated plants and adventitious plants have been increased (for 41.98%), but wet taxa have been reduced (for 55.66%).

According to the analysis of the indicative values, the humidity of natural habitat has decreased on average 10.03% while the enrichment of the ground by nitrogen has increased by 12.53%.

By the analysis of the life forms the reduced part of the Hemicryptophyta has been established (for 15.67%) and the significant increase of the Therophyta (for 2.5 time, respectively 149.21%).

The reason of these modifications is caused partly by modified ecological factors because of performable land - improvement works, and partly by growing influence of the urbanization on the marginal parts of these natural habitats.

ORIGANUM VULGARE L. SUBSP. *PRISMATICUM* ARCANG. (*LAMIACEAE*) NOVA SVOJTA U FLORI HRVATSKE

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Prema Indeksu flore Hrvatske rod *Origanum* L. (*Lamiaceae*) zastupljen je u hrvatskoj flori s tri svojte (*O. majorana* L., *O. heracleoticum* L. i *O. vulgare* L. subsp. *vulgare*). Tijekom floristićkih istraživanja Parka prirode Papuk pronđeno je nekoliko primjeraka biljke koja je kasnije određena kao *Origanum vu-lgare* L. subsp. *prismaticum* Arcang. Pri-mjerci su sabrani u rujnu 2003. godine u blizini umjetnog Orahovačkog jezera, unutar granica Parka prirode. Svojta je raspro-stranjena na području Austrije, Češke, Slovačke, Njemačke, Švicarske, Mađarske i Italije, a u flori Hrvatske do sada nije bila zabilježena.

ORIGANUM VULGARE SUBSP. *PRISMATICUM* ARCANG. (*LAMIACEAE*) A NEW TAXA IN THE FLORA OF CROATIA

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According to the Checklist of Croatian flora the genus *Origanum* is represented in the flora of Croatia with three taxa (*O. majorana* L., *O. heracleoticum* L. and *O. vulgare* L. subsp. *vulgare*). During the floristical investigations of Natural park Papuk several plants later identified as *Origanum vulgare* L. subsp. *prismaticum* Arcang were found. These plants were collected in September 2003. near the artificial Lake of Orahovica, in the Natural park. The taxa is distributed in Austria, Czech Republic, Slovakia, Germany, Switzerland, Hungary and Italy, but was never recorded in Croatian flora.

ORHIDEJE RTA KAMENJAK

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Rt Kamenjak smješten je na samom jugu istarskog poluotoka. Proteže se južnije od Premanture u duljini od oko 2700 m. Zbog razvedenosti obale širok je između 400 i 1300 m, a najviši vrh nalazi se na 40 m nadmorske visine. Osim najsjevernije granice sa svih je strana okružen morem, što ima veliki utjecaj na tamošnje klimatske prilike. Rt Kamenjak proglašen je zaštićenim krajolikom na temelju Zakona o zaštiti prirode iz 1994. godine. Tijekom proljeća i jeseni 2003. godine te ponovo proljeća 2004. godine obavili smo istraživanje orhideja na prostoru Rta Kamenjak, s ciljem nadopune postojećeg popisa vrsta i izrade karata njihove rasprostranjenosti. Prema dosadašnjim literaturnim i herbarskim podacima na Kamenjaku je zabilježeno 27 vrsta orhideja i 3 hibrida. Tijekom istraživanja spomenutog područja potvrdili smo 15 vrsta i 2 hibrida. Budući da je istraživanje još u tijeku pretpostavlja se da će se broj zabil-

ORCHIDS OF CAPE KAMENJAK

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Cape Kamenjak is situated on the very south of the Istrian peninsula. It spreads from the village of Premantura to the southernmost cape, about 2700 m toward the sea. The area is between 400 and 1300 m wide, and it's highest part is about 40 m above the sea level. Kamenjak is surrounded by sea with the exception of it's northernmost part, therefore it has specific climate conditions. Cape Kamenjak is protected as a valuable landscape since 1994. We investigated orchid species of the area in the period of spring and autumn of 2003, as well as spring of 2004, in order to complete the list of present species and make maps of their distribution. According to literature and herbarium data there are 27 orchid species present on Kamenjak so far, as well as 3 hybrids. During our research we recorded 15 species and 2 hybrids. Since the research is still in the process it is to be assumed that there will be a greater number

ježenih vrsta povećati. Pojedine vrste su zakonom zaštićene, a zabilježena su i dva endema (*Serapias istriaca* M. L. Perko i *Serapias* x *pulae* M. L. Perko). Upravo zbog različitih kategorija ugroženosti kojima pripada većina vrsta ove porodice istraživanje njihovih areala čini se izuzetno značajnim.

of recorded species in the end. Some of the species are protected by law and there are also two endemic orchid taxa recorded for the area (*Serapias istriaca* M. L. Perko and *Serapias* x *pulae* M. L. Perko). Most of these species belong to some category of endangerement, therefore it is extremely important to make further investigations of their distribution.

ROD *CROCUS L.* U FLORI PLANINE SVILAJE

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Za planinu Svilaju, Neorić UTM XJ23, potvrđuje se nalaz vrste *Crocus waldenii* Hoppe et Fürnrohr, koja na staništu dolazi u tri forme: f. *waldenii*, f. *bicolor* Pavletić Zi. Et Trinajstić i f. *lutescens* Pulević.

Lokalitet f. *lutescens* je najzapadniji i najjužniji nalaz ove forme u Hrvatskoj.

Na istom staništu pronađena je populacija *Crocus thommasinianus* Herbert, što je i najzapadniji nalaz ove vrste u Hrvatskoj.

THE GENUS CROCUS L. IN FLORA OF SVILAJA MOUNTAIN

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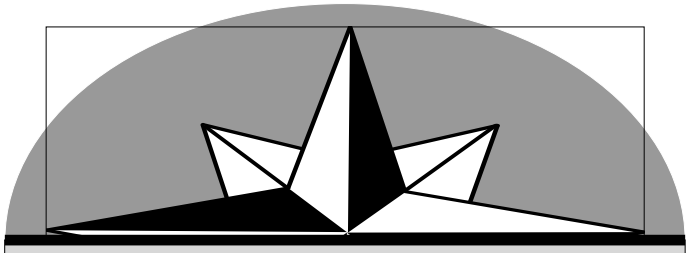
It is certified that *Crocus weldenii* Hoppe et Furnrohr, species which appears in three forms: f. *weldenii*, f. *bicolor* Pavletić Zi. et Trinajstić and f. *lutescens* Pulević in its natural habitat is found in the Svilaja mountain.

The habitat of *lutescens* form is the most western and the most southern habitat of this form in Croatia.

At the same place there has been found the population of Crocus thommasinianus Herbert, which is the most western habitat of this species in Croatia.



VEGETACIJA I EKOLOGIJA

VEGETATION AND ECOLOGY

VRSTE REDA *QUERCETALIA PUBESCENTIS* BR.-BL. (1931) 1932 U ŠUMSKOJ VEGETACIJI POŽEŠKOGA GORJA

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Rad predstavlja dio sveukupnih sinekološko-vegetacijskih istraživanja šumske vegetacije Požeške i Babje gore. Istraživano područje kao južni dio slavonskoga gorja predstavlja izuzetno vrijedan objekt u vegetacijskoj slici Republike Hrvatske, do sada neadekvatno istraženo, opisano i vrednovano. Ovim istraživanjima ustanovljeno je veliko bogatstvo i raznolikost biljnih vrsta i šumskih zajednica, što je rezultat položaja na granici vrlo raznolikih utjecaja (sa zapada alpskoga, s juga dinarskoga i sa sjevera i istoka puno aridnijega - panonskoga). Pri tome se posebna pažnja posvetila prisutnosti vrsta reda *Quercetalia pubescentis* u šumskoj vegetaciji požeškoga gorja, budući da one predstavljaju posebnost i rijetkost u kontinentalnim šumskim ekosustavima.

SPECIES FROM THE ORDER *QUERCETALIA PUBESCENTIS* BR.-BL. (1931) 1932 IN THE FOREST VEGETATION OF THE POŽEGA MOUNTAINS

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The paper is a component part of a comprehensive synecological-vegetational study of the forest vegetation of Požeška and Babja Gora. The investigated area represents the southern part of the Slavonian mountain range. It is an exceptionally valuable site in the vegetational picture of the Republic of Croatia, which is yet to be studied, described and evaluated in an adequate manner. The research confirmed the outstanding wealth and diversity of plant species and forest communities that result from their position on the boundary of highly diverse influences (the Alpine influence from the west, the Dinaric one from the south and the much more arid one from the Pannonian plain). Special focus was placed on the presence of the species from the order *Quercetalia pubescentis* in

Analizom flornoga sastava šumskih zajednica istraživanoga područja ustanovljena je vrlo značajna prisutnost termofilnih elemenata reda *Quercetalia pubescentis* u gotovo svim šumskim zajednicama. Većina zajednica je prvi put ustanovljena i opisana na istraživanome području, kao i neke važne vrste reda *Quercetalia pubescentis*, kao što je oskorušina mukinja (*Sorbus domestica* L.). Zajednica s najvećim brojem vrsta reda *Quercetalia pubescentis* je termofilna šuma hrasta kitnjaka i crnoga grahora (*Lathyro-Quercetum petraeae* Ht. (1938) 1958). Ona sistematski pripada redu *Q. pubescentis* i prvi put je opisana na istraživanome području. Zauzima najtoplije, pretežito južne položaje u gornjim dijelovima padina i hrptova, većih nagiba (30-35˚) i plićih tala. Od ukupno 109 vrsta prevladavaju termofilne vrste reda *Quercetalia pubescentis*, osobito *Fraxinus ornus, Sorbus torminalis, Cornus mas, Ligustrum vulgare, Lathyrus niger, Carex flacca, Dactylis glomerata, Viola hirta, Calamintha clinopodium, Mellitis melyssophyllum* i dr. Zajednica je po postanku i razvitku znatno bliža sastojinama na Kalniku (Vukelić 1991) nego što je to slučaj sa sastojinama koje su opisali Šugar (1972) na Samoborskom gorju i Regula-Bevilacqua (1978) na Strahinjščici. Vrste reda *Quercetalia pubescentis* vrlo značajno su prisutne i u acidotermofilnoj šumi hrasta kitnjaka s runjikom (*Hieracio racemosi-Quercetum petraeae* /Vukelić 1990/ 1991) i šumi hrasta kitnjaka s

the forest vegetation of the Požega mountains, since they represent a unique and rare feature in continental forest ecosystems.

The analysis of the floral composition of the forest communities in the studied area has confirmed a very significant presence of thermophilic elements from the order *Quercetalia pubescentis* in almost all forest communities. Most of these communities were detected and described in the studied area for the first time, together with some important species of the order *Quercetalia pubescentis*, such as the service tree (*Sorbus domestica* L.). A community with the highest number of species of the order *Quercetalia pubescentis* is a thermophilic forest of sessile oak and black pea (*Lathyro-Quercetum petraeae* Ht. (1938) 1958). Systematically, it belongs to the order *Q. pubescentis* and was described in the study area for the first time. This community takes up the warmest, predominantly southern positions in the upper parts of slopes and ridges with higher inclinations (30-35°) and shallower soils. Of a total of 109 species, the dominant ones include those from the order *Quercetalia pubescentis, especially Fraxinus ornus, Sorbus torminalis, Cornus mas, Ligustrum vulgare, Lathyrus niger, Carex flacca, Dactylis glomerata, Viola hirta, Calamintha clinopodium, Mellitis melyssophyllum* and others. In terms of origin and development, the community is much closer to the stands

vlasuljom (*Festuco drymeiae-Quercetum petraeae* /Jank. 1968/ Hruška 1974), te u puno manjem broju u zajednicama hrasta kitnjaka i pitomoga kestena (*Querco-Castaneetum sativae* Ht.1938), ilirskoj šumi hrasta kitnjaka i običnoga graba (*Epimedio-Carpinetum betuli* /Ht. 1938/ Borh 1963), šumi hrasta kitnjaka i običnoga graba s vlasuljom (*Festuco drymeiae-Carpinetum betuli* Vukelić /1990/ 1991) i bukovim zajednicama. Također su za svaku zajednicu posebno i ukupno određivani spektar bioloških oblika, spektar flornih geoelemenata i srednje ekoindikatorske vrijednosti prema Ellenbergovoj skali (1974). Rezultati rada uvelike proširuju spoznaje o broju, raširenosti i važnosti vrsta reda *Quercetalia pubescentis* u šumskim ekosustavima panonskoga gorja, te time nadopunjuju vegetacijsku sliku Republike Hrvatske i šireg područja.

on Kalnik (Vukelić 1991) than to the stands on Samoborsko Gorje described by Šugar (1972) and those on Strahinjščica described by Regula-Bevilacqua (1978). Species of the order *Quercetalia pubescentis* are also significantly present in the acidothermophilic forest of sessile oak with hawkweed (*Hieracio racemosi-Quercetum petraeae* /Vukelić 1990/ 1991) and in the forest of sessile oak with fescue (*Festuco drymeiae-Quercetum petraeae* /Jank. 1968/ Hruška 1974), and to a much smaller measure in the communities of sessile oak and sweet chestnut (*Querco-Castaneetum sativae* Ht. 1938), the Illyrian forest of sessile oak and common hornbeam (*Epimedio-Carpinetum betuli* /Ht. 1938/ Borh 1963), the forest of sessile oak and common hornbeam with fescue (Festuco drymeiae-Carpinetum betuli Vukelić /1990/ 1991) and beech communities. The spectre of biological forms, the spectre of floral geoelements and the mean ecoindicator value according to the Ellenberg scale (1974) were also determined for each community individually and accumulatively. The results of this work broaden the perceptions of the number, distribution and importance of the species of the order *Quercetalia pubescentis* in forest ecosystems of Pannonian montane area and complement the vegetational picture of the Republic of Croatia and of a wider area.

PRIKAZ UGROŽENOSTI ŠUMA U REPUBLICI HRVATSKOJ U FUNKCIONALNOJ OVISNOSTI O ZAGAĐENJU TALA OLOVOM ATMOSFERSKOG PORIJEKLA

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Poznato je da onečišćenje tla pozitivno korelira sa količinom oborina. Visoke koncentracije olova u tlima područja hrvatskog krša, donesenog zračnim strujama, javljaju se na oštroj geomorfološkoj granici duž koje mediteranski tip klime naglo prelazi u hladni kontinentalni, na visinama iznad 900 m. Detaljna proučavanja raspodjele olova Pb

EVALUATION OF FOREST ECOSYSTEM STRESS IN CROATIA AS A FUNCTION OF REGIONAL ATMOSPHERIC LEAD POLLUTION

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It is well known that soil pollution are directly linked to the amount of precipitation. Atmospherically introduced high lead concentrations in soils of Croatian karst occur along the sharp geomorphological boundary along which the Mediterranean climate abruptly changes into a cold continental climate and at altitudes above 900 m. Detailed

u profilima tla pokazala su da se koncentracije olova u udaljenim područjima penju i do 200 $mgkg^{-1}$ u gornjih 4 cm profila tla. Korištenjem omjera Pb/Sc dobivenog tijekom osnovnog geokemijskog kartiranja površinskog dijela profila tla u Hrvatskoj na 1088 lokacija procijenjen je prostorni rizik taloženja kiselih tvari u geomorfološki vrlo različitim područjima. Empirijski model koji se temelji na neuronskoj mreži povezao je količinu atmosferom donesenog olova (izračunatog postupkom normalizacije Pb/Sc kojim se odvaja olovo antropogenog porijekla od litogenog olova), veličinu i tip šumskog pokrivača, digitalni visinski model sa izvedenicama i srednju godišnju količinu oborina. Korelacija modela bila je vrlo visoka (R>0,85). Otkriveno je da predočeni model, koji povezuje geokemiju tla sa stupnjem oštećenja šuma predstavlja prikladno sredstvo za procjenu rizika zakiseljavanja površina atmosferskim putem.

studies of Pb distribution in soil profiles showed concentrations of lead in remote regions up to 200 $mgkg^{-1}$ in the upper 4 cm of the soil profiles. With the application of the Pb/Sc ratio obtained during the geochemical baseline mapping of the topsoil cover in Croatia at 1088 sampling sites, the spatial risk of acid deposition in areas of high geomorphic variability was evaluated. The empirical model built on the neural networks related the amount of atmospherically introduced Pb (calculated from the Pb/Sc normalization variable which separates the anthropogenically introduced Pb from lithogenic lead), extent and type of forest cover, digital elevation model with its variations as well as the mean annual precipitation. The correlation model was very high (R>0.85). The presented model, which links soil geochemistry with precipitation and degree of forest damage, was found to be an suitable tool for evaluation of the spatial acidification risk.

CRATAEGUS NIGRA WALDST. ET KIT. DOMINATED COMMUNITY IN THE FLOODED DANUBE RIVER AREA IN CROATIA

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The paper deals with a community dominated by *Crataegus nigra* and developed along the Danube River branches. The community has been classified into the association *Euphorbio palustris-Crataegetum nigrae* ass. nova (*Alno-Quercion roboris*, *Populetalia albae*, *Querco-Fagetea*). The community forms the edge of the pedunculate oak community *Genisto elatae-Quercetum roboris* and poplar trees community *Populetum nigrae-albae*. These sites are temporarily flooded, however, they are elevated above the normal water level so that organic material is swept away and deposited only to a limited extent. It is there where the processes of pedogenesis already start.

EKOLOŠKO – FITOCENOLOŠKE ZNAČAJKE ASOCIJACIJE *ABIETI-FAGETUM "PANNONICUM"* RAUŠ 1969 NA MEDVEDNICI

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Asocijacija *Abieti-Fagetum "pannonicum"* Rauš 1969 ima nevažeće ime i dvojben geobotanički i fitocenološki položaj. Edifikatorske vrste ove zajednice su jela (*Abies alba* Mill.) i bukva (*Fagus sylvatica* L.), a kao karakteristična vrsta prisutan je gorski javor (*Acer pseudoplatanus* L.). Kako bi se ustanovio floristički sastav bukovo-jelovih šuma na Medvednici te ispitala ovisnost flornog sastava o različitim stanišnim čimbenicima tijekom 2000. i 2001. godine istraživana je flora na 12 ploha (površine 50x50 m) središnjeg profila Medvednice. Na svakoj plohi prikupljeni su podaci o na-

ECOLOGICAL AND PHYTOSOCIOLOGICAL CHARACTERISTICS OF ASSOCIATION *ABIETI-FAGETUM "PANNONICUM"* RAUŠ 1969 ON MT. MEDVEDNICA

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Association *Abieti-Fagetum "pannonicum"* Rauš 1969 has an invalid name and still undefined position in geobotanical and phytosociological sense. Edificatory species of this association are silver fir (*Abies alba* Mill.) and beech (*Fagus sylvatica* L.), while the characteristic species is great maple (*Acer pseudoplatanus* L.). In order to determine the floristic structure of silver fir and beech forests on Mt. Medvednica and their dependence on different habitat factors, flora of 12 plots (50x50 m) on central Medvednica was investigated in 2000 and 2001. Floristic data as well as data on altitude,

dmorskoj visini, nagibu, ekspoziciji, zatvorenosti sklopa krošnji, kiselosti tla te geografskoj koordinati središta. Dvanaest istraživanih ploha smješteno je u visinskom rasponu od 600 do 950 metara nadmorske visine, na dosta nagnutim terenima (raspon od 21 do 39 stupnjeva) kisele reakcije tla (srednja vrijednost aktualnog aciditeta iznosi 5,07). Najčešća orijentacija ploha je sjeverozapadna, a zatvorenost sklopa krošnji varira od 50 do 90 posto. Na temelju višestrukog obilaska ploha napravljen je popis flore i fitocenološke snimke. Zabilježeno je ukupno 119 svojti vaskularne flore, čiji spektar životnih oblika odražava klimu umjerenog područja kojoj Medvednica i pripada. Među zabilježenim svojtama jedna je svojta subendemična, tri su osjetljive, a šest ih je zaštićeno Zakonom o zaštiti prirode.

Na istraživanim plohama vrsta *Sorbus aucuparia* L. dosta je zastupljena, što dovodi u pitanje njen status kao razlikovne vrste dinarskih bukovo-jelovih šuma, kako je do sada zabilježeno u literaturi. Kao razlikovne vrste panonskih bukovo-jelovih šuma navode se *Festuca drymeja* Mert. Koch, *Carex pilosa* Scop. i *Luzula luzuloides* (Lam.) Dandy et Wilmott, no vrsta *Carex pilosa* Scop. nije zabilježena ovim istraživanjem.

U svrhu ispitivanja sličnosti ploha s obzirom na biljne svojte podaci su statistički obrađeni *cluster* analizom. Floristički sastav istraživanih ploha najviše je uvjetovan

inclination and exposition of the investigated plots, their soil acidity, canopy closure and their geographical position were gathered. Twelve investigated plots are situated in range from 600 to 950 meters altitude, on relatively steep surface (21 to 39 degrees) with acid soil reaction (average acidity being 5.07). The plots are mostly northwest exposed, while the canopy closure fits between 50 to 90 percent. On the whole, 119 taxa of vascular plants were recorded; one of them being subendemic and three vulnerable. Six species are protected by the Nature Protection Act. The life form analysis confirmed that Medvednica's flora belongs to the moderate continental climate.

Species *Sorbus aucuparia* L. was recorded with a high percent of share, which questions its status as a differential species for the dinaric silver fir and beech forests. Species *Festuca drymeja* Mert. Koch, *Carex pilosa* Scop. and *Luzula luzuloides* (Lam.) Dandy et Wilmott are mentioned in the literature as the differential species for the pannonic silver fir and beech forests, but in this research the species *Carex pilosa* Scop. has not been recorded.

In order to compare the plots by their flora, the floristic data was analysed using cluster analysis. Floristic structure of the plots was mainly influenced by soil acidity. The most similar plots regarding floristic structure were plots with low soil acidity, big inclination and rather large canopy closure. Plots

kiselošću podloge. Najveću sličnost s obzirom na sastav flore pokazuju plohe niskog aktualnog aciditeta, velikog nagiba i relativno velike zatvorenosti sklopa krošnji. Plohe s najvećim brojem vrsta su manjeg nagiba i zatvorenosti sklopa krošnji te vrijednosti aktualnog aciditeta iznad 5.

with the highest number of species were the plots with higher soil acidity, smaller inclination and smaller canopy closure.

PRELIMINARNA ANALIZA KRETANJA VUKA PRAĆENOG GPS TEHNOLOGIJOM U ODNOSU NA STANIŠTA, NADMORSKU VISINU I SMJER NAGIBA TERENA

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U ovom radu prikazani su preliminarni rezultati kretanja vuka obilježenog GPS ogrlicom s ciljem utvrđivanja zastupljenosti i tipova staništa kojima se vuk kretao prvih

PRELIMINARY ANALYSIS OF WOLF'S MOVEMENT TRACKED BY THE GPS TECHNOLOGY IN RELATION TO HABITATS, ALTITUDE AND INCLINATION

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The purpose of this study was to analyze preliminary results and to determine the frequency and types of habitats used by the wolf marked with GPS collar. The wolf was

18 dana nakon obilježavanja. Vuk je obilježen na Jelovcu iznad Krasna u Lici. U navedenom razdoblju prikupljena su 202 zemljopisna položaja vuka i utvrđeno je da se vuk kretao područjem površine 156 km^2. Na toj površini određeno je 11 tipova staništa, a njihova zastupljenost je: dinarske bukovo-jelove šume (30,4%), mezofilne i neutrofilne čiste bukove šume (29,8%), mozaici kultiviranih površina (20,5%), subatlantski mezofilni travnjaci i brdske livade (7,2%), pretplaninske bukove šume (4,0%), europske suhe vrištine i travnjaci trave tvrdače (3,7%), submediteranski i epimediteranski suhi travnjaci (3,1%), aktivna seoska područja (0,9%), jugoistočnoalpsko - ilirske termofilne bukove šume (0,2%), vode stajaćice (0,2%), te smrekove šume (0,1%). Zabilježeni položaji vuka utvrđeni su na 9 tipova staništa osim staništa smrekove šume i voda stajaćica. Najviše zabilježenih zemljopisnih položaja vuka utvrđeno je na staništima mezofilne i neutrofilne čiste bukove šume (44,1%) i subatlantskim mezofilnim travnjacima i brdskim livadama (33,7%) koja su i najzastupljenija na tom području. Među najmanje korištenim staništima posebno se ističu mozaici kultiviranih površina (2,5%) i submediteranski i epimediteranski suhi travnjaci (0,5%). Raspodjela kretanja vuka s obzirom na nadmorsku visinu je: 41,09% (400 - 600 m), 26,73%, (1000 - 1200 m), 19,80% (600 - 800 m), 10,89% (> 1200 m), 1,49% (800 - 1000 m). Izvršena je i analiza kretanja vuka s obzirom na smjer nagiba

captured and marked in Jelovac above village Krasno in Lika region. In the first 18 days after the marking, 202 GPS coordinates were collected. The area of wolf's movement was 156 square kilometers and 11 different types of habitats were determined. They participate by following percentages: dinaric beech and fir forests (30.4%), mesophyllous and neutrophilous beech forests (29.8%), mosaics of cultivated areas (20.5%), subatlantic messophyllous grasslands and mountain meadows (7.2%), submountain beech forests (4.0%), european dry heaths and mat-grass swards (3.7%), submediterranean and epimediterranean dry grasslands (3.1%), active village areas (0.9%), south-eastern Alpine - Illyrian thermophilous beech forest (0.2%), dead waters (0.2%), and fir forests (0.1%). Wolf's positions were registrated on nine types of habitats, but not in the fir forests and dead waters habitats. Most frequently used types of habitats were mesophyllous and neutrophilous beech forests and subatlantic messophyllous grasslands and mountain meadows, which are also the most represented on this area. Mosaics of cultivated areas and submediterranean and epimediterranean dry meadows were emphasized as the most infrequent used habitats. Distribution of the wolf's movement in relation to altitude was: 41.09% (400 - 600 m), 26.73%, (1000 - 1200 m), 19.80% (600 - 800 m), 10.89% (> 1200 m), 1.49% (800 - 1000 m). Also, an analysis of wolf's movements in relation to the inclination of the terrain was

terena te je utvrđeno da su zastupljeniji smjerovi SW (39,8%) i NE (31,3%), dok su manje zastupljeni smjerovi NW (16,4%) i SE (12,4%). Takva distribucija vrlo je vjerojatno uvjetovana geomorfološkim značajkama toga područja, odnosno smjerom pružanja Dinarida (NW – SE). Iako preliminarne, provedene analize upućuju na to da se praćeni vuk najčešće zadržavao u staništu mezofilne i neutrofilne čiste bukove šume, a izbjegavao stanište mozaika kultiviranih površina.

made, and the most frequent determined directions were SW (39.8%) and NE (31.3%), while NW (16.4%) and SE (12.4%) were less represented. This distribution probably is caused by geomorphological characteristics of that area, i.e. to the direction of spreading of the Dinarids (NW – SE). Results of preliminary analyses pointed out that the tracked wolf the most frequently used mesophyllous and neutrophilous beech forests but avoided a cultivated areas habitat.

VEGETACIJSKA KARTA PARKA PRIRODE "ŽUMBERAK - SAMOBORSKO GORJE" (MPK 2,25 HA)

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Tijekom 2003. godine izrađena je vegetacijska karta Parka prirode "Žumberak – Samoborsko gorje" s minimalnom površinom kartiranja od 2,25 ha (22500 m^2). Kartiranje je napravljeno korištenjem satelitske snimke Landsat ETM+ iz 2000. godine i terenskim uzorkovanjem. Pri odabranom prostornom razlučenju na terenu je identificirano i pridruženo poligonima dobivenim obradom satelitske snimke ukupno 17 klasa. Od toga 13 klasa označava biljne asocijacije ili njihove kombinacije, a četiri klase različite tipove zemljišnog pokrova (nasadi crnogorica, seoski mozaični krajolici, naselja i kamenolomi). U ukupnoj površini Parka prirode (344 km^2) najzastupljenija je šuma bukve i velike mrtve koprive (38,4 %).

VEGETATION MAP OF NATURE PARK "ŽUMBERAK – SAMOBORSKO GORJE" (MMU 2.25 HA)

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Vegetation map of Nature Park "Žumberak – Samoborsko gorje" with minimum mapping unit of 2.25 ha (22500 m^2) was created during year 2003. Combination of Landsat ETM+ satellite image (acquired in year 2000) and field sampling were used as a mapping method. Given the constraints of minimum mapping unit chosen, 17 classes were identified in the field and designated to corresponding polygons created by classification of satellite image. Thirteen classes were plant communities or their combinations, while remaining four denoted various types of land cover (coniferous plantations, mixed rural landscapes, settlements and quarries). In overall area of the Nature Park (344 km^2) most frequent was *Lamio orvalae*

Od nešumskih zajednica najzastupljenija je livadna zajednica uspravnog ovsika i srednjeg trputca (7,9 %). Na temelju ovog istraživanja pod šumskom vegetacijom nalazi se čak 77,3 % površine Parka prirode, što je znatno povećanje u odnosu na ranije zabilježenu površinu (61 %). Analiza površina kartiranih klasa pokazala je da je područje Parka prirode izrazito mozaično. Gotovo četvrtina kartiranih poligona ima površinu jednaku ili neznatno veću od minimalne površine kartiranja (2,25 ha), dok više od tri četvrtine poligona ima površinu jednaku ili manju od 9 ha (odgovara kvadratu dimenzija 300 x 300 metara). Ovakav prostorni raspored zajednica, uz stalnu depopulaciju, pogoduje daljnjoj sukcesiji ka šumskim zajednicama a time i smanjenju ukupne biološke raznolikosti. Potrebna su dodatna ciljana kartiranja finijih prostornih razlučenja na pojedinim dijelovima Parka kao i složene prostorne analize prisutnog biljnog pokrova koji će omogućiti izradu plana upravljanja koji bi zaustavio trend zaraštavanja livada i smanjivanja biološke raznolikosti na području Parka prirode.

– *Fagetum* forest (38.4% of total area), while most frequent non-forest community was *Bromo – Plantaginetum mediae* (7.9%). According to this research, as much as 77.3% of Park area is covered with forests, that is significant increase comparing to old data of 61% of forests. Analyses of mapped polygons showed that almost quarter of all polygons has its area equal to, or just little bigger than the minimum mapping unit, while more than three quarters of all polygons have their area smaller or equal to 9 ha (corresponds to 300 x 300 meters square). Such extreme mosaic landscape structure with constant depopulation of Park area enables further natural forestation of park and decrease in biodiversity. Additional targeted mapping on finer spatial resolution with complex spatial analyses of present land cover will enable creation of management plan that will stop those trends.

PRILOG POZNAVANJU EKOLOGIJE I RASPROSTRANJENOSTI VRSTE *GENTIANA CRUCIATA* L. NA PODRUČJU PARKA PRIRODE "ŽUMBERAK - SAMOBORSKO GORJE", HRVATSKA

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Gentiana cruciata L. je vrsta koja je širokog rasprostranjenja na europskom i zapadnoazijskom području. U Hrvatskoj nema status ugroženosti. Prema raspoloživim podacima do 2003. godine smatrana je rijetkom na području Parka prirode "Žumberak – Samoborsko gorje", zbog čega smo prilikom izrade vegetacijske karte Parka prirode obratili posebnu pozornost na njeno eventualno opažanje prilikom terenskog rada. Zabilježili smo 17 lokaliteta u visinskom rasponu od 290 do 868 metara nadmorske visine, na blago nagnutim terenima (prosječna vrijednost zabilježenih nagiba iznosi sedam stupnjeva) različitih orijentacija od kojih je nešto češća jugoistočna orijentacija terena. Uz spomenute

A CONTRIBUTION TO THE KNOWLEDGE OF ECOLOGY AND DISTRIBUTION OF *GENTIANA CRUCIATA* L. IN NATURE PARK "ŽUMBERAK – SAMOBORSKO GORJE", CROATIA

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Gentiana cruciata L. is widely distributed species in Europe and western part of Asia. In Croatia, it has not been considered endangered. According to the existing data, it was considered rare in Nature Park "Žumberak – Samoborsko gorje". For this reason, we put emphasys on its observation during our mapping of vegetation of Nature park. We observed 17 localities in altitudinal range from 290 to 868 meters, on moderately steep terrain (mean slope equal to seven degrees) on various aspects with southeast aspect being slightly more frequent. In addition to already mentioned ecological factors, using the GIS environment, we associated the corresponding NDVI values calculated from LANDSAT ETM+ satel-

okolišne čimbenike, koristeći GIS okruženje, pridružili smo lokalitetima i vrijednosti NDVI indeksa izračunatog iz LANDSAT ETM+ satelitske snimke te odredili zone Parka prirode s okolišnim uvjetima koji pogoduju ekološkim zahtjevima vrste. S obzirom na prostorni raspored lokaliteta vrsta je široko rasprostranjena na području Parka prirode. Međutim, opaženi broj jedinki na lokalitetima je u pravilu malen što uz njenu vezanost za travnjačku zajednicu *Bromo-Plantaginetum mediae* čije površine zarastavaju, dovodi u pitanje budućnost i opstanak populacije. Vezanost razvojnog ciklusa ugrožene vrste leptira *Maculinea rebeli* uz vrstu *Gentiana cruciata* dodatno naglašava potrebu boljeg poznavanja njene ekologije i sačuvanja na prostoru Parka prirode "Žumberak – Samoborsko gorje".

lite image to the *Gentiana* localities and determined zones of the Nature Park that satisfies ecological requirements of the species. According to the spatial distribution of observed localities, the species is widely distributed in the Nature Park. However, observed number of specimens was mostly small, that together with species relation to the *Bromo-Plantaginetum mediae* association, that is slowly disappearing as a result of the natural forestation, arise the question of population viability and survival in the future. Dependence of the endangered butterfly *Maculinea rebeli* on *Gentiana* as the host plant for complete life cycle, additionally arise necessity of better knowledge of ecology and preservation of *Gentiana cruciata* in Nature Park "Žumberak – Samoborsko gorje".

VEGETACIJA PODRUČJA SUNGERSKOG LUGA U GORSKOM KOTARU

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Vegetacijska istraživanja Sungerskog luga i okolice (780-830 m n.v.) provedena su u srpnju 2001. g., te od svibnja do listopada 2002. g. Fitocenološke snimke napravljene su na 31 sastojini primjenom metode kombinirane procjene abundancije i pokrovnosti, te je ustanovljena sistematska pripadnost i određen floristički sastav utvrđenih biljnih zajednica. Zapažena je velika raznolikost biljnih zajednica u vegetaciji istraživanog područja. Utvrđeno je 9 asocijacija te nekoliko biljnih zajednica koje pripadaju dvjema svezama: as. *Blechno-Abietetum*, as. *Abieti-Fagetum*; as. *Telekietum speciosae*; as. *Arrhenatheretum elatioris*, as. *Alchemillo-Trisetetum,* as. *Festuco-Agrostetum*, as. *Bromo-Plantaginetum,* as. *Genisto-Callunetum,* as. *Arnico-Nardetum*; močvarna vegetacija sveze *Magnocaricion,* te cretna vegetacija prijelaznog tipa - razred *Scheuchzerio-Caricetea fuscae,* sveza *Rynchosporion albae*. Utvrđene su i sastojine u prijelaznom

VEGETATION OF THE SUNGERSKI LUG REGION IN GORSKI KOTAR (NW CROATIA)

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Vegetational research in the Sungerski lug (Gorski kotar) and its vicinity (780 - 830 m ASL) was carried out in July 2001. and from May to October 2002. Phytocenological records were made on 31 stands whose floristic composition was established. Relatively high diversity of plant communities was noticed in vegetation of the investigated area. Nine associations were defined and few plant communities belonging to two alliances: as. Abieti-*Fagetum,* as. *Blechno-Abietetum*; as. *Telekietum speciosae*; as. *Arrhenatheretum elatioris*, as. *Bromo-Plantaginetum*, as. *Alchemillo-Trisetetum*, as. *Festuco-Agrostetum*, as. *Arnico-Nardetum*, as. *Genisto-Callunetum*; swamp vegetation of alliance *Magnocaricion*; and bog vegetation of alliance *Rynchosporion albae,* class *Scheuchzerio-Caricetea fuscae*. Some transitional stages were found in vegetational development of the area. Predominating community in the Sungerski

stadiju nekih biljnih zajednica tog područja. Na području Sungerskog luga prevladava šumska zajednica jele i rebrače (as. *Blechno-Abietetum*) unutar koje je posebno značajna cretna vegetacija zbog svoje rijetkosti i ugroženosti, te zbog prisutnosti rijetkih i ugroženih vrsta hrvatske flore. Uz mahove tresetare (*Sphagnum spp.*) koji prevladavaju ovo je važno stanište (jedno od posljednjih) za vrstu *Calla palustris*, te za dvije ugrožene vrste šaša roda *Carex.* Cretna vegetacija je fragmentarno razvijena u različitim fazama sukcesije prema okolnoj šumskoj zajednici. Ukupno su zabilježene 324 vrste viših biljaka. Od toga ih 17 ima poseban status: 1 kritično ugrožena, 2 ugrožene, 5 endemičnih, 5 osjetljivih, 2 rijetke i 3 zaštićene vrste.

lug region is as. *Blechno-Abietetum.* Bog vegetation in it is specially important because of its rareness and endangered status, as well as because of the presence of endangered and rare species of Croatian flora. Besides species of order *Sphagnum spp.*, this is important habitat (one of the latest) for the species *Calla palustris* and for two endangered species of order *Carex.* Bog vegetation is fragmentary developed in succession toward surrounding forest community. Altogether 324 species of vascular plants were recorded; 17 of them are specially classified as: critically endangered (1), endangered (2), vulnerable (5), endemic (5), rare (2) and protected (3) species.

CONTRIBUTION TO THE KNOWLEDGE OF THE ASSOCIATION *BAZZANIO-ABIETETUM* M. WRABER 1958

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On the basis of phytocoenological and ecological investigations in the western and central part of the pre-Alpine area of Slovenia, the association *Bazzanio-Abietetum* was divided into four subassociations; *B.-A. typicum*, *B.-A. deschampsietosum flexuosae, B.-A. gentianetosum asclepiadeae*, *B.-A. sphagnetosum*, and three variants; *B.-A. typicum* var. *Homogyne alpina*, *B.-A. sphagnetosum* var. *Picea abies* and *B.-A. sphagnetosum* var. *Pinus sylvestris*.

ODNOS FLORNOGA SASTAVA I NEKIH SVOJSTAVA TALA I STANIŠTA U ŠUMAMA PITOMOG KESTENA (*CASTANEA SATIVA* MILL.) NA MEDVEDNICI

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Šume pitomog kestena (*Castanea sativa* Mill) u okviru šumskih resursa Hrvatske predstavljaju važan segment, kako u gospodarskom tako i u sociološko-krajobraznom aspektu. Njihov značaj je posebno naglašen u blizini većih urbanih sredina, kao što je slučaj s Medvednicom u blizini Zagreba. Iako je njihova vrijednost značajna, tim se šumama godinama nije pridavao veći značaj, kako s floističkog tako i s pedoekološkog aspekta.

U radu je istraživan florni sastav u različitim šumskim zajednicama, u kojima se pojavljuje pitomi kesten na Medvednici. Na osnovi flornoga sastava šume pitomog kestena svrstane su u tri glavne, jasno odvojene skupine.

FLORISTIC DATA AND SOME SOIL AND STAND CHARACTERISTICS RELATIONSHIP IN SWEET CHESTNUT FORESTS (*CASTANEA SATIVA* MILL) ON MEDVEDNICA MOUNTAIN

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Sweet chestnut forests represent an important segment in Croatian forest resource, regarding economic, but also social and landscaping role. Their value is especially important near urban centers, which is a case with Medvednica Mountain near Zagreb. Nevertheless, no important floristical and ecological investigations were performed in these forests since many years.

In this work we investigated floristic data in different forest communities with sweet chestnut on Medvednica Mountain. On the basis of floristic data, sweet chestnut forests are divided in three clearly different groups.

On the location of sample-plots, where phytosociological survey was made (Braun-Blanquet classic method), soil samples

Na lokacijama na kojima je obavljeno fitocenološko snimanje (po klasičnoj metodi Braun-Blanqueta) uzeti su uzorci organskog i mineralnog sloja tala kojima je analiziran pH (u vodi i KCl), humus, dušik, fosfor i kalij te mehanički sastav. Također su zabilježena ektomorfološka svojstva staništa.

Za svaku skupinu, odnosno (sub) asocijaciju, uspoređen je florni sastav s karakteristikama tala i staništa pomoću statističkih alata i GIS-a.

(organic and mineral) were also taken. Organic matter, soil pH value in H_2O, soil pH value in KCl, total nitrogen, phosphorus and potassium were measured as well as the texture. Some ectomorphological stand characteristics were also measured and recorded.

For each group, (sub) community, floristic data set was compared with soil and stand characteristics by statistical and GIS tools.

FOREST VEGETATION ON GUČEVO MOUNTAIN (WESTERN SERBIA)

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Gučevo mountain is located in Western Serbia, near the towns of Loznica and Zvornik. The mountain is elongated in west-east direction. According to Stevanović (1992), Gučevo belongs to a transitional zone between Illyrian subregion and west-Moesian province of Balkan subregion. Moreover, this mountain is exposed to significant influence of Pannonian floristic province. Therefore, this area may be considered as a broad ecotone, with diverse floristic elements. We recorded 583 species in different types of black hornbeam, oak and beech forests. Applying a set of classification and ordination methods, we described different vegetation types. Using the Canonical Correspondence Analysis, we related forest vegetation to different environmental factors. In this article we also analyzed syntaxonomic position of investigated forests.

FLORA I VEGETACIJA PODRUČJA REČICE U GORSKOM KOTARU

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Lokalitet Rečice (UTM VL53) je udolina na oko 900 m nadmorske visine. Nalazi se u pojasu bukovih i jelovih šuma (*Abieti – Fagetum*), no zbog temperaturne inverzije na rubnom je dijelu uskim pojasom zastupljena pretpalninska šuma smreke (*Picetum croaticum subalpinum* Horv. 1950). Na malenom prostoru Rečica zbog mikroreljefa i vodnog režima prisutna je raznolika vegetacija, uglavnom travnjaci, visoke zeleni te močvarna i cretna vegetacija. Od do sada zabilježenih zajednica potrebno je spomenuti *Nardetum strictae* Horv. 1930, *Carici – Blysmetum compressi* Eggl. 1933 i *Bromo – Plantaginetum* Horv. (1931) 1949, dok ostale primijećene zajednice nisu još detaljno fitocenološki obrađene. Rečice su

FLORISTIC AND PHYTOCENOLOGIC CHARACTERISTICS OF REČICA, GORSKI KOTAR (CROATIA)

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Rečice locality (UTM VL53) is a valley at about 900 m above sea. Although in *Abieti - Fagetum* zone, Rečice is characterized with local thermal inversion and is therefore surrounded with a ring of *Picetum croaticum subalpinum* Horv. 1950 wood. On a very small area vegetation differs a lot due to microrelief and water regime. There are many different plant communities present – mostly meadows, tall herbs, and also swamp and moor vegetation. Preliminary studies showed presence of *Nardetum strictae* Horv. 1930, *Carici – Blysmetum compressi* Eggl. 1933 and *Bromo – Plantaginetum* Horv. (1931) 1949 communities, while other communities are not phytosociologically defined so far. Rečice is a habitat of

stanište rijetkih i ugroženih biljnih vrsta, n. pr. *Eriophorum angustifolium* Honck., *Eleocharis quiqueflora* (F.X. Hartmann) O. Schwarz, *Equisetum hyemale* L.

Fitocenološka i ekološka (aciditet tla) istraživanja Rečica vršena su tijekom vegetacijske sezone 2004. godine.

many rare and endagered species, e.g. *Eriophorum angustifolium* Honck., *Eleocharis quiqueflora* (F.X. Hartmann) O. Schwarz, *Equisetum hyemale* L.

Plant community studies correlated with some ecological (ground acidity) studies were done through vegetation season of 2004.

KOROVNA I RUDERALNA VEGETACIJA RAZREDA *CHENOPODIETEA* BR.-BL. 1952 U ŠIROJ OKOLICI ŠIBENIKA

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Razredu Chenopodietea pripadaju zajednice korova okopavina i ruderalne vegetacije. Vegetaciji tog razreda u eumediteranu pripada red Chenopodietalia (OBERDORFER 1994). U okviru tog reda HORVATIĆ (1963) I OBERDORFER (1994) luče tri sveze koje su nazočne u korovnoj i ruderalnoj vegetaciji šire okolice Šibenika: Sveza Diplotaxidion Br.-Bl. (1931) 1936 s asocijacijom Tribulo-Amaranthetum Hodak 1962 (zajednica korova okopavina). Sveza Chenopodion muralis Br.-Bl. (1931) 1936 s asocijacijama Chenopodietum muralis Br.-Bl. et Maire 1924 i Lavateretum arboreae Br.-Bl. et Molinier 1935, te sveza Hordeion Br.-Bl. (1931) 1947 s asocijacijama Hordeetum leporine Br.-Bl. 1936 u obliku subasocijacija hordeetosum leporini ("typicum") I chamomilletosum H-ić 1963 i Scolymo-Marrubietum incani H-ić et Hodak 1965. Vegetacija razreda Chenopodietea slabo je

WEEDS AND RUDERAL VEGETATION OF THE *CHENOPODIETEA* CLASS IN THE AREA OF ŠIBENIK

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Group of weeds and ruderal vegetation belong to the Chenopodietea class. The Chenopodietalia order belongs to the vegetation of the same class within the eumediterran. Within this order, HORVATIĆ (1963) and OBERDORFER (1994) differ three lines of relation, existing in both weeds and ruderal vegetation in the area of Šibenik: The alliance of Diplotaxidion Br.-Bl. (1931) 1936 with the Tribulo-Amaranthetum Hodak 1962 associations (the associations of the weeds neighbouring cultivaded soil). The alliance of Chenopodion muralis Br.-Bl. (1931) 1936 with Chenopodietum muralis Br.-Bl. et Maire 1924 and Lavateretum arboreae Br.-Bl. et Molinier 1935 associations. The alliance of Hordeion Br.-Bl. (1931) 1947 with the Hordeetum leporine Br.-Bl. 1936 associations in the forms of hordeetosum leporini ("typicum") and chamomilletosum H-ić 1963 subassocia-

poznata s područja Srednje Dalmacije.

Na istraživanom području obilno su nazočne zajednice korova okopavina po vrtovima, vinogradima i krumpirištima (as. Tribulo-Amaranthetum), a od ruderalne vegetacije as. Hordeetum leporine, koja obrasta slabo nitrofilne veće zapuštene površine u obliku gustih, uskih pruga uz rubove putova, ograda i kuća. Izrazito nitrofilne asocijacije Chenopodietum muralis, Scolymo-Marrubietum incani i Lavateretum arboreae dosta su rijetke na istraživanom području. U zajednicama razreda Chenopodietea nazočan je veliki broj vrsta, a od životnih oblika prevladavaju terofiti. Svoj optimum razvoja zajednice postižu krajem proljeća i tijekom ljeta.

tions and Scolymo-Marrubietum incani H-ić et Hodak 1965 associations. The vegetation of Chenopodietea class in the Central Dalmatia area is poorly explored.

Groups of weeds neighbouring cultivated soil in gardens, vineyards and potato fields (ass. Tribulo-Amaranthetum) are profusely spread over the area. As for the Hordeetum leporini association of the ruderal vegetation, it can be found overgrowing neglected low-nitrogen surfaces, in thick, narrow stripes by fences, houses and paths. Associations of Chenopodietum muralis, Scolymo-Marrubietum incani and Lavateretum arboreae particulary rich in nitrogen are quite rare in the area. Within the groups of Chenopodietea class there is a large number of species and the predominant life forms are Therophyta. These groups reach their development optimum in late spring and during summer.

PEAT-BOG VEGETATION OF VLASINA PLATEAU IN SOUTHEASTERN SERBIA

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The results of thirteen years old research of peat-bog vegetation in the Vlasina plateau and surrounding mountains of Vlasina are presented in this paper. Peat-bog vegetation represents the basic characteristic of Vlasina plateau. It looks like mosaic of different peat-bog plants subordinated to the class *Scheuchzerio-Caricetea fuscae*. Peat-bog vegetation is divided into two orders - *Caricetalia fuscae* and *Scheuchzerietalia palustris*. Plant communities of low sedges with two alliances - *Caricion canescentis-nigrae* and *Carici-Nardion* - belong to the order *Caricetalia fuscae*. Vegetation where mosses of genus *Sphagnum* are dominant consist of two alliances - *Rhynchosporion albae* and *Salici-Betulion pubescentis*. The appearance of new alliantia - *Carici-Nardion* and *Salici-Betulion pubescentis* - fills a gap between peat-bogs and climax (plagioclimax) vegetation in the syngenetics series.

EKOLOŠKE ZNAČAJKE ŽUPANIJSKOG KANALA

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Ovaj prilog rezultat je rada na projektu «Revitalizacija močvarnih staništa» u sklopu UNDP/GEF Dunavskog regionalnog projekta (član 1.4) koji Prirodoslovno društvo «Drava» provodi u suradnji s World Wide Fund for Natur (WWF) i Virovitičko-podravskom županijom.

Rijeka Drava je u središnjoj Hrvatskoj rubna i najčešće granična tekućica. Glavne pritoke dobiva s desne strane: Rostrug, Lendava, Ođenica i Županijski kanal. U sklopu Tvornice šećera «Viro» u Virovitici sagrađen je pročistač otpadnih voda, pa se na taj način smanjuje opterećenje otpadnih voda koje se preko Županijskog kanala ulijevaju u rijeku Dravu. Županijski kanal je ukupne dužine oko 35 km, s početkom zapadno od naselja Turanovac i ušćem sjeveroistočno od naselja Kapinci.

U istraživanom području tijekom ljetnog

ECOLOGICAL FEATURES OF THE COUNTY CANAL

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This work is the result of working on the revitalisation study of wetland habitats, under the auspice of UNDP, within the Danube Regional Project 1.4 Component. This study was carried out by the Natural History Society "Drava", in co-operation with the WWF Danube Carpathian Programme and the authorities of Virovitica-podravska County.

The River Drava, on the northern margins of Croatia, constitutes the border with Hungary. The main tributaries enter from the right bank: the Rostrug, Lendava, Ođenica and the County canal. A water purifying system was built as a part of the "Viro" sugar factory, thus pollution is reduced in any water that enters the Drava through the County canal via this location. This canal is 35 km long, and begins its course west of Turanovac village, joining the Drava northeast of Kapinci.

During the summer period of 2003 in the study area were found 93 species of vascular

perioda 2003. god. ustanovljeno je 93 vrsta biljaka pripadnika vaskularne flore. 52.68 % - 49 vrsta je vezano za močvarna i vodena staništa, Većina tih biljaka je zabilježena u Županijskom kanalu. Prema IUCN – u dvije vrste su osjetljive: Sagittaria sagittifolia L. – obična strelica i Glyceria fiuitans (L.) R.Br. – pirevina, dok je Cyperus glomeratus L. – šilj rijetka vrsta .

Na istraživanom području uz Županijski kanal i rijeku Dravu još uvijek nalazimo raznolika staništa - od močvarnih i vodenih (trščaci i zajednice vodenih biljaka) do ostataka šuma i šumaraka. Veći udio oranica ukazuje da su dosad izvršeni zahvati pogodovali isušivanju tla, ali postoji relativno velik postotak vodenih površina koje povećavaju bioraznolikost područja.

Analizom vode utvrđeno je da se voda pročišćava prirodnim putem kada teče kroz pojas vodene i močvarne vegetacije u Županijskom kanalu. Zalihe pitke vode se smanjuju jer je uočen pad podzemnih voda u zadnjih šest godina..Ovo područje pokazuje sve karakteristike bitne za početak revitalizacije čime bi se još više unaprijedila bioraznolikost područja i smanjilo onečišćenje vodotoka unosom hranjivih tvari s okolnih poljoprivrednih površina. Samo cjelokupna zaštita ekosustava rijeke Drave omogućava i zaštitu podzemnih voda.

plants. 52.68 % of all plant species present (49 species) are connected to wetland and water habitats, the majority of these species are found in the County canal. According to IUCN (IUCN, 1983) two species are vulnerable: Sagittaria sagittifolia L., arrowhead; and Glyceria fliutans (L.) R.Br., water manna-grass, while Cyperus glomeratus L., nutsedge, is a rare species.

In the study area, near the County canal and the Drava River, it is still possible to find a diversity of habitats - from wetland and water habitats (reeds and water plant communities) to forest remnants. The majority of the agricultural land shows a drying-out of the soil, resulting from melioration works, but a relatively large percentage of water habitats has survived which enhances the area's biodiversity.

The chemical analyses of water showed that it is being purified naturally when it flows through the water-plants and marsh vegetation of the County canal. However reserves of drinking water are decreasing because of the fall of groundwater levels over the last 6 years.

This area shows all of the main features that are necessary prerequisites for the wetland rehabilitation and revitalisation project, resulting in enhanced biodiversity and a decrease in the pollution of the canal. This pollution comes from the nearby fields and also as waste-water from the villages. Only the total protection of the Drava River ecosystem can protect the quality of the groundwater.

SYNTAXONOMIC DIVERSITY AS AN INDICATOR OF ECOLOGICAL DIVERSITY CASE STUDY OF VRANICA MT. IN THE CENTRAL BOSNIA

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Syntaxonomic diversity (SD) represents number of plant communities (syntax) in certain area and in certain time period. Plant communities (phytocoenoses) in this context include organised systems of populations of various coexisting plant species inhabiting same or similar habitat in the function of time. SD is one of the best indicators of the state and potential carrying capacity of every ecosystem and attribute of total ecological diversity. In general, level of syntaxonomic diversity indicates habitat heterogenity and diversity. This could have significant importance in the categorisation of habitat values, and in accordance with EUNIS criteria. The results presented in this paper indicate without any doubt high natural values of mountain range Vranica in Bosnia and Herzegovina. One of the best proofs is extremely high level of syntaxonomic diversity. In this area covering just 50 km^2, vegetation is differentiated into 9 formations, 27 classes, 44 orders, 73 alliances and 165 associations. This is 82% of all classes, 73% of all orders, 65% of all alliances, and 53% of all associations of vegetation in Bosnia and Herzegovina, or 34% of all classes in vegetation diversity in Europe. Going from the level of class to the level of order, the number of syntaxa increases for 61%, from order to alliance for 60%, and from alliance to association for 44.24% (average 55%). SD index is a very high and it is 0.33. This means that on every three km^2 comes one new syntaxa.

RAZVOJ VEGETACIJE U OBALNOM PODRUČJU HRVATSKE TIJEKOM POSTGLACIJALA

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Usporedni pregled razvoja vegetacije analiziranih lokaliteta u obalnom području Hrvatske pokazuje da su to područje na početku postglacijalnog razdoblja (predboreal-boreal, mezolitik) prekrivale miješane listopadne šume u kojima je prevladavao hrast. Na početku atlantske faze (mezolitik-neolitik) te su šume imale termofilni karakter i prevladavao je hrast tipa *Quercus pubescens*, miješan s drugim tipovima termofilnog listopadnog drveća. Sredinom atlantske faze submediteranske drvenaste svojte zamjenjuje vazdazelena vegetacija u kojoj prevladavaju svojte poput *Phillyrea, Pistacia* i *Juniperus*, a submediteranski tip vegetacije povlači se u unutrašnji obalni pojas. Krajem atlantika ponovno dolazi do promjene vegetacije i prevlast preuzima eumediteranski vazdazeleni hrast crnika (*Quercus ilex*). Može se zaključiti da je krajem atlantika i početkom subboreala u

DEVELOPMENT OF THE VEGETATION IN MEDITERRANEAN REGION OF CROATIA DURING POSTGLACIAL PERIOD

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Comparative review of the development of the vegetation of analyzed localities in the coastal area of Croatia shows that at the beginning of the Postglacial period (Preboreal – Boreal, Mesolithic), the coastal area of Croatia was covered in mixed deciduous forests in which oak dominated. At the beginning of the Atlantic phase (Mesolithic – Neolithic) these forests had thermophilous character and the oak type *Quercus pubescens* was prevalent, mixed with other types of thermophilous deciduous trees. In the middle of Atlantic phase, submediterranean woody taxa were replaced with evergreen vegetation in which taxa such as *Phillyrea, Pistacia* and *Juniperus* are prevalent, and submediterranean type of vegetation withdraws to the inland part of the coastal area. At the end of the Atlantic changes in the vegetation occur again and the domination is taken by the eumediterranean evergreen Holm oak

osnovnim crtama utemeljen današnji tip potencijalne prirodne vegetacije na hrvatskom dijelu jadranske obale, koji čine eumediteranski prsten s pretežnim hrastom crnikom, nešto širi u južnom dijelu, nešto uži u sjevernom dijelu, na koji se prema unutrašnjosti nastavlja submediteranski tip šuma s karakterizirajućim hrastom meduncem.

Antropogeni utjecaj na vegetaciju obalnog područja prisutan je već u eneolitiku i početkom brončanog doba. Nesumnjivo su se prastanovnici bavili stočarstvom i ratarstvom i to se odražavalo na prirodnu vegetaciju, ali je teško reći u kojoj mjeri. Sigurni i nedvojbeni znakovi antropogenog utjecaja potječu iz antičkog razdoblja, kada su značajno porasle ratarska i druge aktivnosti što je dovelo do pretvaranja većih površina šuma u ratarske površine, makiju i pašnjake. Nakon tog razdoblja izmjenjuju se povremene faze regeneracije i ponovne devastacije prirodne vegetacije.

(*Quercus ilex*). It can be concluded that at the end of Atlantic and at the beginning of the Subboreal the today's type of the potential natural vegetation on the Croatian part of the Adriatic coast was established in the basic elements, and it is made of the eumediterranean ring with the dominating Holm oak, which is wider in the southern part and somewhat thinner in the northern part, and followed in the inland with the submediterranean type of forest with the characteristic Downy oak (*Quercus pubescens*).

Anthropogenic influence on the vegetation of the coastal area is present as early as Eneolithic and the beginning of the Bronze Age. Without the doubt the early inhabitants were into cattle breeding and agriculture and that was reflected onto the natural vegetation, but it is hard to say in which amount. Certain and doubtless signs of anthropogenic influence come from Antique period, when agricultural and other activities have significantly grown, which resulted in devastation of bigger forest surfaces into agricultural surfaces, macchias and pastures. After that period temporary phases of regeneration and repeated devastation of natural vegetation are interchangeable.

OENANTHO SILAIFOLIAE-ALOPECURETUM PRATENSIS, NOVA ASOCIJACIJA TRAVNJAČKE VEGETACIJE U HRVATSKOJ

Zvjezdana Stančić

Nova asocijacija s vrstom *Alopecurus pratensis* utvrđena je na veoma vlažnim staništima sjeverozapadne Hrvatske, te je opisana pod nazivom *Oenantho silaifoliae-Alopecuretum pratensis*, unutar reda *Molinietalia* i razreda *Molinio-Arrhenatheretea*. Razvija se u mikrodepresijama terena u dolinama potoka i rijeka. Povremene poplave obskrbljuju asocijaciju na prirodan način s dovoljnom količinom vlage i hranjivih tvari. Tla na staništu zajednice su duboka i zbijena. Prema teksturi pripadaju u skupinu glina i ilovača. Kemijske analize tla su pokazale da se radi o nekarbonatnim tlima ili pak o tlima s malom količinom karbonata, umjereno kisele reakcije, s velikim udjelom humusa.

U flornom sastavu asocijacije dolaze brojne vrste veoma vlažnih livadnih staništa reda *Molinietalia* i razreda *Phragmitetea*. Mnoge od tih vrsta su rijetke i zaštićene, tako da je zajednica veoma vrijedna i sa stanovišta

OENANTHO SILAIFOLIAE-ALOPECURETUM PRATENSIS, A NEW ASSOCIATION OF GRASSLAND VEGETATION IN CROATIA

Zvjezdana Stančić

A new plant community with the species *Alopecurus pratensis* was found in the region of northwest Croatia on very moist habitats, and is described under the name ass. *Oenantho silaifoliae-Alopecuretum pratensis*, belonging to the order *Molinietalia* and to the class *Molinio-Arrhenatheretea*. Preferably, this community can be found in terrain microdepressions of stream and river valleys. Occasional floods provide the association by constraining its utilization in a natural way (sufficient quantity of moisture and nutrients). The community prefers deep and compact soils dominated texturally by clay and loam. Chemical analyses of the soil have shown that it is non-carbonate or low-carbonate soil with a moderately acidic reaction and a high humus content.

In the floristic composition of the association there are numerous species of very wet meadows of the order *Molinietalia* and the class *Phragmitetea*. In particular, many of

zaštite prirode.

U Srednjoj Europi se livade s vrstom *Alopecurus pratensis* u najvećoj mjeri razvijaju na vlažnim staništima reda *Arrhenatheretalia*, pod utjecajem intenzivnog gospodarenja s četiri do šest otkosa godišnje i čestog gnojenja. Suprotno tome, u sjeverozapadnoj Hrvatskoj se livade vrste *Alopecurus pratensis* razvijaju na vlažnim, poplavnim staništima reda *Molinietalia*, pod utjecajem poluekstenzivnog gospodarenja s dva do tri otkosa godišnje.

Sve poznate zajednice u kojima prevladava vrsta *Alopecurus pratensis,* bez obzira na način gospodarenja, odlikuju se malim prosječnim brojem vrsta. To se može tumačiti razvojnom strategijom vrste *Alopecurus pratensis* koja pokazuje brz rast izdanaka u visinu rano početkom sezone. Zbog toga u flornom sastavu takvih zajednica može opstati samo mali broj vrsta dobro prilagođenih gustoj i visokoj strukturi tog tipa livadne vegetacije.

those species are very rare. Thus this community is very valuable also from the view of nature conservation.

In Central Europe, meadows with *Alopecurus pratensis* mostly are developed on moist habitats belonging to the order *Arrhenatheretalia,* generally managed intensively (mown four to six times per year, and frequently fertilised). In contrast, in Northwest Croatia *Alopecurus pratensis* meadows develop on moist habitats of the order *Molinietalia*, less intensively managed (mown two or three times per year).

All known communities dominated by *Alopecurus pratensis* feature a small average number of species, regardless of the land use mode. One explanation is the developmental strategy of *Alopecurus pratensis*, which shows rapid growth in height of flowering shoots combined with densely tillering from the base of last years flowering shoots early in the season. Thus, only a small number of species, well adapted to the dense and high structure of this kind of meadow vegetation, can survive in such communities.

EKOLOŠKA KLASIFIKACIJA TRAVNJAČKE VEGETACIJE RAZREDA *MOLINIO-ARRHENATHERETEA* SJEVEROZAPADNE HRVATSKE

Zvjezdana Stančić i Gerhard Karrer

Travnjačka vegetacija razreda *Molinio-Arrhenatheretea* s područja sjeverozapadne Hrvatske je klasificirana na osnovi 450 fitocenoloških snimaka. Primjenom aglomerativne metode (WARD-algoritam) dobiveno je sedam skupina:

1. *Bromus erectus – Arrhenatherum elatius* skupina,
2. *Arrhenatherum elatius* skupina,
3. *Crepis biennis – Arrhenatherum elatius* skupina,
4. *Luzula campestris – Holcus lanatus* skupina,
5. *Deschampsia cespitosa – Betonica*
6. *officinalis* skupina,
7. *Equisetum palustre* skupina,
8. *Oenanthe silaifolia – Alopecurus pratensis* skupina.

Za svaku skupinu su određene dijagnostičke, stalne i pretežne vrste pomoću programa JUICE.

ECOLOGICAL CLASSIFICATION OF THE GRASSLAND VEGETATION OF THE CLASS *MOLINIO-ARRHENATHERETEA* IN NORTHWEST CROATIA

Zvjezdana Stančić and Gerhard Karrer

Grassland vegetation of the class *Molinio-Arrhenatheretea* from Northwest Croatia has been classified on the basis of 450 relevés. An agglomerative cluster technique (WARD-algorithm) gave seven clusters (called groups):

1. *Bromus erectus – Arrhenatherum elatius* group,
2. *Arrhenatherum elatius* group,
3. *Crepis biennis – Arrhenatherum elatius* group,
4. *Luzula campestris – Holcus lanatus* group,
5. *Deschampsia cespitosa – Betonica officinalis* group,
6. *Equisetum palustre* group,
7. *Oenanthe silaifolia – Alopecurus pratensis* group.

The diagnostic, constant and dominant species were determined for each group or cluster by use of the respective calculations in JUICE.

Rezultati klasifikacije se u najvećoj mjeri poklapaju s tradicionalnom sintaksonomskom podjelom. Svaka skupina odgovara jednoj ili većem broju već otprije poznatih zajednica. Prve četiri skupine pripadaju redu *Arrhenatheretalia*, a preostale tri redu *Molinietalia*.

Skupina *Arrhenatherum elatius*, skupina *Crepis biennis – Arrhenatherum elatius* i skupina *Luzula campestris – Holcus lanatus* obuhvaćaju najveći broj fitocenoloških snimaka i predstavljaju najjače antropogeno utjecane travnjake istraživanog područja. Antropogeni utjecaj se očituje u dominaciji biljaka široke rasprostranjenosti te u značajnom udjelu korovnih biljaka, ruderalnih biljaka i neofita.

Za ekološku karakterizaciju skupina korišeni su mjereni parametri staništa kao što su pH, udio karbonata i udio humusa. Kao indirektni pokazatelji uvjeta staništa korišteni su i ekološki indeksi prema ELLENBERG-u. Ekološke razlike između skupina ispitane su pomoću različitih ordinacijskih tehnika. Rezultati analiza pokazuju da se skupina u najvećoj mjeri razlikuju s obzirom na vlažnost staništa, udio karbonata u tlu, reakciju tla i udio hranjivih tvari, a znatno manje s obzirom na ostale faktore.

The results of classification for the greatest part match the categories of the traditional syntaxonomic system. Thus, each group corresponds to one or more communities described previously. The first four groups belong to the order *Arrhenatheretalia*, and the last three groups to the order *Molinietalia*.

The *Arrhenatherum elatius* group, the *Crepis biennis – Arrhenatherum elatius* group and the *Luzula campestris – Holcus lanatus* group encompass the largest number of relevés in the dataset and represent the most intensively managed grassland types of the investigated area. Anthropogenic impacts are manifested in the domination of wide spread plant species and the presence of a considerable number of weeds, ruderals and not native species.

Several site characters were measured and used to characterize the above groups ecologically. The relevance of measured variables like pH, carbonate content and humus content for the differentiation of the clusters was analysed by different ordination techniques. Some additional ecological implications were detected indirectly by use of ecological indicator values following ELLENBERG. The results showed that the groups differ mainly in water balance, in carbonate content of the soil, soil acidity and soil nutrient content, but to a lesser extent with respect to other factors.

SOME NOVELTIES IN THE FLORA AND VEGETATION OF MT. SNEŽNIK (NORTH-WESTERN PART OF THE LIBURNIAN KARST)

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Some floristical and vegetational novelties of the flora and vegetation of Mt. Snežnik worth to notice are discussed. *Scabiosa graminifolia, Potentilla clusiana* and *Seseli gouanii* are recorded for the first time on the Snežnik plateau; one new association and a phytocoenon are also described: *Scabioso silenifoliae-Dryadetum octopetalae* ass. nova and phytocoenon with *Scabiosa silenifolia*. First results of mapping of flora and vegetation of the Snežnik plateau are also presented.

UGROŽENA STANIŠTA I UGROŽENA FLORA PARKA PRIRODE «ŽUMBERAK-SAMOBORSKO GORJE»

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Park prirode "Žumberak-Samoborsko gorje" nalazi se u zapadnom dijelu središnje Hrvatske. Najveći dio zauzima Žumberačko gorje, geografski jedinstven planinski masiv, koji obuhvaća i Samoborsko gorje. Tijekom vegetacijske sezone 2002. i 2003. godine na području Parka provedena su istraživanja kako bi se dobio uvid u što realnije stanje brojnosti, rasprostranjenosti te ugroženosti pojedinih biljnih vrsta i njihovih staništa. Istraživanjem su bila obuhvaćena ona staništa na kojima su se zbog određenih specifičnosti navedene vrste mogle očekivati. Bilježena je nazočnost biljaka, većina je fotografirana, a samo su neke prikupljane kao referentni materijal. Za dokumentaciju postojećeg stanja osjetljivih staništa i procjene ugroženosti izrađene su vegetacijske snimke. Neke su snimke uspoređene s već postojećim, izrađenima prije nekoliko godina. Na temelju kvalitativne i kvantita-

ENDANGERED HABITATS AND ENDANGERED FLORA OF THE «ŽUMBERAK–SAMOBORSKO GORJE» NATURE PARK

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The «Žumberak – Samoborsko gorje» Nature Park is situated in the western part of Central Croatia. Its biggest part consists of the Žumberak hills, a geographycally compact mountain massive which also encompasses the Samobor hills. During the vegetation period of 2002 and 2003 the research was conducted in the Park area in order to establish the number, distribution, and the state of endangerment for certain plant species and their habitats as accurately as possible. The research included habitats where these species were supposed to grow due to their very specific characteristics. The presence of plants was recorded, most of them were photographed, and only some of them were collected as a reference material. Vegetation records were made for documenting the present state of vulnerable habitats and estimation of endangerment. Some of the records were compared with the existing

tivne promjene floističkog sastava procijenjena je ugroženost staništa.

Utvrđen je znatan broj biljnih svojti sa statusom te 5 endemičnih i 17 zakonom zaštićenih. Također su izdvojene vrste koje su na istraživanom području rijetke: hrvatska perunika (*Iris croatica*), zimska preslica (*Equisetum hyemale*), planinski božur (*Paeonia mascula*), kasubijski žabnjak (*Ranunculus cassubicus*), lovor krestušac (*Polygala chamaebuxsus*), crveni likovac (*Daphne cneorum*), blagajev likovac (*Daphne blagayana*) itd.

Ustanovljeno je kako na području Parka postoje mnoga prirodna staništa koja za sada nisu ugrožena. Neka su vrijedna zaštite zbog značajnog ili jedinstvenog floističkog sastava. Negativnim antropogenim utjecajem ugrožena su samo vlažna i zamočvarena staništa u blizini naselja kao i staništa na kojima se sabiru biljke u ljekovite svrhe. Najugroženija staništa na području Parka su upravo ona koja su antropogeno uvjetovana. To su različiti tipovi travnjaka koji su ugroženi isključivo nedostatnim utjecajem čovjeka, što je posljedica iseljavanja i napuštanja tradicionalnog seoskog načina života. Takva će staništa postupno nestajati u prirodnom procesu sukcesije koji će rezultirati nestankom brojnih vrsta, a time i znatnim osiromašenjem floističke raznolikosti ovog područja.

ones, made a few years ago. The habitat endangerment was estimated on the basis of the qualitative and quantitative changes in the floristic composition.

We recorded the considerable amount of plant taxa which are listed in the Red Book of plant species of the Republic of Croatia, as well as 5 endemic taxa and 17 taxa protected by Law. We also made a list of rare species of this area: *Iris croatica, Equisetum hyemale, Paeonia mascula, Ranunculus cassubicus, Polygala chamaebuxsus, Daphne cneorum, Daphne blagayana* etc.

Many natural habitats were established in the Park which are still not endangered. Some of them are worth protecting because of the important or unique floristic composition. Only wet and swampy habitats near human settlements and habitats on which medicinal plants grow are endangered by the negative anthropogenic influence. The most endangered habitats in the Park are especially the anthropogenic habitats: different types of grasslands are endangered by the lack of human activities, which is a consequence of depopulation and abandonment of traditional rural way of life. These habitats will eventually disappear in the natural process of succession, which will result in losing many species, and in decline of floristic diversity of this area.

FLORA AND VEGETATION OF LAKES BAJERSKO (CROATIA) AND KLIVNIK (SLOVENIA)

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Flora and vegetation of two man made lakes are compared – water reservoirs Bajersko jezero (Fužine, Croatia), dump constructed in 1954, and Klivnik (Harije, Slovenia), constructed in 1986. Majority of field research were done in the years 2002 and 2003; some data were collected in the nineties of previous century in the framework of investigations of aquatic and semi-aquatic flora of Slovenian and neighbouring countries. Main characteristics of both lakes are oscillating water level, deposits of clay and organic sediments on the bottom and similar geological bedrock.

In both lakes 120 vascular aquatic and marsh plant species were recorded: 83 species in the Bajersko jezero and 97 species in the Klivnik. Lakes share 50 % of species.

13 species require priority conservation measures (recorded in lake Klivnik = K, Bajersko lake = B): 7 are listed on Croatian Red List (*Carex vesicaria* - B, *Cyperus fuscus*- K, B, *Cyperus michelianus* - K, *Eleocharis carniolica* - B, *Eleocharis ovata* - K, *Limosella aquatica* - K, *Peplis portula* - B), 12 on Slovene Red List (*Bolboschoenus maritimus* - K, *Carex vesicaria* - B, *Ceratophyllum demersum* - K, *Cyperus fuscus* - K, B, *Cyperus michelianus* - K, *Eleocharis carniolica* - B, *Equisetum fluviatile* - K, B, *Gratiola officinalis* - K, B, *Limosella aquatica* - K, *Ludwigia palustris* - K, *Peplis portula* - B, *Typha shuttleworthii* - B), 1 on Annexes II and IV of the Habitats Directive (*Eleocharis carniolica* - B) and 1 on the Bern Convention (*Typha shuttleworthii* - B).

Aquatic floating or rooted vegetation is missing. The main reason is unstable water level. Water level fluctuation and drying of the lake bottom in late summer cause growing of

communities of the class *Isoëto-Nanojuncetea* Br.-Bl. et Tx. ex. Westhoff, Dijk et Passhier 1946. This typical therophyte vegetation consists of prevailing annual plants from families *Cyperaceae, Caryophyllaceae, Scrophulariaceae,* and others. In Klivnik lake communities *Lindernio-Eleocharidetum* Pietsch 1973, *Cypero-Limoselletum aquaticae* (Oberdorfer 1957) Korneck 1960, *Cypero-Plantaginetum intermediae* Seliškar 1995, *Dichostylido michelianae-Gnaphalietum uliginosae* Timaár 1947 were found, and in Bajersko lake *Peplido-Juncetum tenuis* ass. nova. and *Spergulario arvensis-Plantaginetum intermediae* ass. nova. Successive vegetation in both lakes belongs to the class *Bidentetea tripartiti* R. Tx. et al in R. Tx. 1950. In permanently wet habitats communities of class *Phragmiti-Magnocaricetea* Klika in Klika et Novák 1941 were found and from *Molinio-Arrhenatheretea* R. Tx. 1937 em. R. Tx. 1970 community *Scirpetum sylvatici* Rałski 1931.

Occurrence of relatively high proportion of threatened species and communities is an important reason for further monitoring and conservation of both lakes.

MEADOWS WITH *GLADIOLUS ILLYRICUS* ON THE ČEPIĆKO POLJE (ISTRIA, CROATIA)

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Stands with dominant *Gladiolus illyricus* Koch were examined according to standard Central European method. These stands were found in shallow hollows within non-improved meadows on alluvial soils on the Čepićko polje. This area is very specific, as it has characteristics of Karstic polje and of Dinaric region, but this area is also on the edge of flysch part of the Istrian peninsula. The biggest influences on the floristic composition have the soil characteristics and specific water regime, respectively. In rainy periods the water temporarily stagnates in hollows due to low permeability of the soil what enables the thriving of hygrophilous species. In the summer the soil remain dried-up for months, what favours the species of dry-grasslands. So the site-conditions are specific and transitional in several aspects (bedrock, soil, water regime, climate, phytogeographical areas).

Similar communities were also described: *Molinio-Gladioletum* Horvat (1931) 1962 from the montane belt in Gorski kotar in Dinaric region (transitional position between *Molinietalia* and class *Festuco-Brometea*) and *Gladiolo palustris-Molinietum arundinaceae* Poldini & Feoli Chiapella 1993 from the lowland and montane belt of NE Italy (classified into the class *Festuco-Brometea*). In the studied stands the characteristic species of the class *Molinio-Arrhenatheretea* predominate, but the proportion of the characters of the class *Festuco-Brometea* is significant. So unlike the mentioned two associations, this can be classified into class *Molinio-Arrhenatheretea* but the transitional position is also evident in floristic composition.

Since the management has been too extensive, these meadows have been overgrowing with shrubs, but they should be protected as one of the characteristics of the unique area.

DISTRIBUTION AND COENOLOGICAL CHARACTERISTIC OF *IRIS SPURIA* L. SPECIES IN SLOVAKIA

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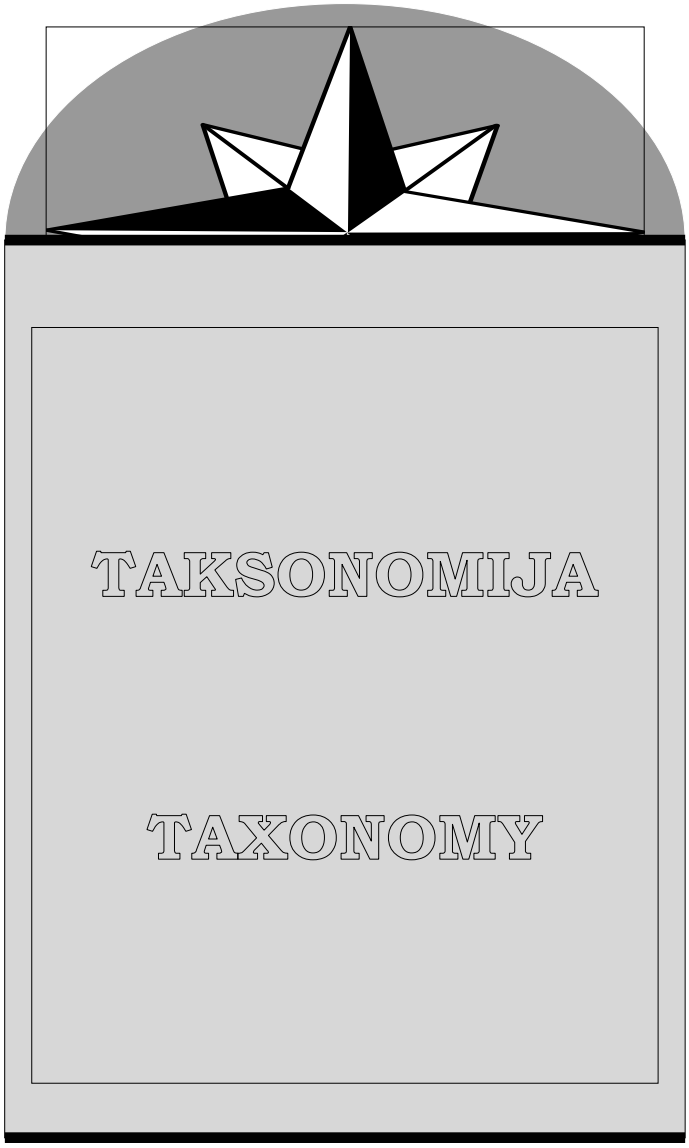
Iris spuria L., one of the aggregate taxa, is distributed in submeriodional Europe with a distinctive area in Northern, Western, Central and South-Eastern Europe. According to Flora Europaea it occurs in Slovakia, Czech Republic, Hungary, Austria, Northern Romania, Northern Greece, Germany, France, Denmark, Eastern England and Southern Sweden (TUTIN et al. 1980). According to MEUSEL, JÄGER, et WEINERT (1965) its main area is situated in Pannonia. In such a great area *Iris spuria* occurs in various meadow communities.

In Slovakia the geophytic *Iris spuria* L. occurs in meadow communities on fluvial landscape along great rivers, on the aluvium of the Nitra downstream and Danube on North from Komárno and on the aluvium of the Hron river downstream. Due to intensive argiculture management in lowlands it has died out in most of localities and at present it belongs to critically endangered taxones (FERÁKOVÁ, MAGLOCKÝ et MARHOLD 2001). The phytocoenological research and soil analyses have been realized at six recent sites – PR Komočín, PR Pohrebište, NPR Kamenínske slanisko, grounded canal in Komjatice, meadows in the surroundings of Chľaba and Malé Kosihy. The species seems to be connected with unmanaged subhalophilous communities of (*Caricion gracilis* NEUHÄUSL 1959), *Cnidion venosi* BAL.-TUL. 1965, (*Molinion coeruleae* W. KOCH 1926) and *Mesobromion* (BR.-BL. et MOOR 1938) KNAPP 1942 ex OBERD. (1950)1957 alliances on the soil subtypes of stagnic Fluvisols, salic Mollic Fluvisols, Haplic Solonchaks. *Iris spuria* tolerates synantropisation, partial drainage. It is sensitive to regular mowing. In future overgrowing by shrubs has to be solved.



TAKSONOMIJA

TAXONOMY

QUANTITATIVE KARYOLOGICAL STUDY OF *LUZULA CAMPESTRIS - MULTIFLORA COMPLEX* IN SLOVENIA

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The *Luzula campestris - multiflora* group is the most variable and taxonomically diverse group within the genus. It displays a wide range of chromosome numbers due to polyploidization and chromosome fragmentation (agmatoploidy).

In order to obtain all the taxa present in Slovenia, plants and seeds were systematically collected all over the territory. Genome size and chromosome number were measured for five species belonging to this group. Root tips of young seedlings were fixed in 4% formaldehyde and post-fixed in 3:1 methanol - acetic acid (MAA). DNA was stained with the Feulgen reaction after hydrolysis in 5N HCl for 90 min at 20°C. Genome size (C-value) was measured with interphase-peak DNA image cytometry, using *Pisum sativum* as the calibration standard (2C-value = 8.84 pg DNA). In the same slide chromosome number was determined.

The estimated 2C-value and chromosome number were 0,95 pg for *Luzula campestris* (2n = 12 full size chromosomes, AL - type), 2,71 pg for *Luzula multiflora* (2n = 36 AL), 2,09 pg for *Luzula divulgata* (2n = 24 AL) and 2,14 pg for *Luzula alpina* (2n = 12 AL + 24 BL, half size chromosomes). In most of the alpine samples, the estimated 2C-value was 0,99 pg and the chromosome number 2n = 24 BL. The taxon will be determined in further morphological studies.

According to the prediction of agmatoploid origin, DNA amount is the same in diploid (12 AL) and agmatotetraploid (24 BL) samples. DNA amount of partial agmatoploid (12 AL+24 BL) equals the DNA amount in tetraploid samples. In case of true polyploidy, the DNA

amount of the diploid doubles in true tetraploid and triples in hexaploid samples. In the present karyological study, *Luzula sudetica, Luzula pallidula* and the true tetraploid of *Luzula multiflora*, also reported for Slovenia, were not confirmed.

PROCJENA NEKIH MORFOLOŠKIH ZNAČAJKI MUNIKE (*PINUS HELDREICHII* CHRIST.) U DIJELU AREALA

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Munika (*Pinus heldreichii* Christ.) je tercijarni relikt i endemična vrsta europske flore. Zemljopisno udaljene, neujednačeno raspoređene, prirodne populacije munike u zemljama Balkanskoga i Apeninskoga poluotoka predstavljaju genetičke specifikume u laganom nestajanju. Cilj ovoga rada bio je procijeniti promjenjivost nekih morfoloških značajki češera i sjemena u pet prirodnih populacija munike s Balkanskoga poluotoka. Rezultati su pokazali malu međupopulacijsku promjenjivost istraživanih značajki. S obzirom na istraživane značajke populacije se diferenciraju po geografskom principu. Dobiveni rezultati se podudaraju s razultatima ranijih kariotipskih istraživanja provedenih u istim populacijama.

ESTIMATE OF SOME MORPHOLOGICAL TRAITS OF THE *PINUS HELDREICHII* CHRIST. IN A PART OF THE RANGE

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Pinus heldreichii Christ. is a tertiary relict and an endemic species of the European flora. Geographically distant, disjointedly ordered natural populations of whitebark pine in the Balkans and the Apennine peninsula, represent genetically specific phenomena which are slowly disappearing. The goal of this paper is to estimate the variability of some morphological traits of cone and seeds in five natural populations of whitebark pine from the Balkan peninsula. The results have shown the inter-population variability of the researched traits. Taking into consideration the researched traits, populations are differentiated geographically. Obtained results coincide with the results of earlier cytogenetic researches conducted within the same populations.

MORFOLOŠKO-ANATOMSKA OBILJEŽJA VELECVJETNOG ROŠCA - *CERASTIUM GRANDIFLORUM* WALDST. & KIT.

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Cerastium grandiflorum Waldst. & Kit. (= *Cerastium nodosum* Buschm.), velecvjetni rožac, endemična je vrsta Dinarskog područja iz porodice *Caryophyllaceae* (1). To je višegodišnja biljka koja raste u rahlim busenovima, a gotovo u potpunosti je obrasla sivim pustenastim dlakama. Listovi su joj usko linealni, slabo mesnati, šiljastog vrha. Uspravne jednogodišnje cvjetne stabljike nose na sebi nasuprotne listove i 7-15 cvjetova koji čine paštitac. Peteljke cvjetova su 1-4 cm dugačke i nisu žljezdaste. Bra-

MORPHOLOGICAL AND ANATOMICAL CHARACTERISTICS OF SHOWY CHICKWEED - *CERASTIUM GRANDIFLORUM* WALDST. & KIT.

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Cerastium grandiflorum Waldst. & Kit. (= *Cerastium nodosum* Buschm.) is an endemic species of Dinaric Karst belonging to the family *Caryophyllaceae* (1). That is a perennial which grows in loose sods and it is densely white to greyish-tomentose. The leaves are linear, slightly carnose, with pointy apices. Annual stems are conspicuously vertical, carrying opposite leaves and 7-15 flowers which form a cyme. Peduncles are 1-4 cm long and are not glandular. Bracts are ovate to broadly lanceolate with

kteje su ovalne do široko lancetaste sa suhim rubovima. Čaška se sastoji od 6-8 mm dugih gotovo tupih lapova. Latinski pridjev "grandiflorum", velecvjetni, u nazivu vrste odnosi se na vjenčić koji se sastoji od 5 velikih bijelih latica koje su gotovo tri puta duže od lapova. Prašnika ima 10, dok je tučak samo jedan, pustenaste plodnice. Plod je uspravni tobolac koji se otvara pomoću zubaca. Sjemenke su brojne, plosnate, crne. Biljka cvate od svibnja do srpnja (1-3). Kemijskim ispitivanjima navedene biljne vrste utvrđena je prisutnost aminokiselina, trjeslovina i flavonoida (4). Anatomskim ispitivanjima utvrđeno je da je primarna građa stabljike na prerezu okruglasta. Epidermu čini niz zaobljenih stanica, dok su od epidermskih tvorevina prisutni različiti oblici dlaka. Njihovom analizom utvrđene su jednostanične, višestanične, glavičaste i dlake T-oblika. Na epidermu se nastavlja sklerenhimska hipoderma te višeslojni parenhim primarne kore. Floem i ksilem se razvijaju u obliku koncentričnog kruga u primarnoj kori odnosno središnjem valjku. Traheje primarnog ksilema su spiralne, prstenaste i mrežaste. Parenhimske stanice srčike se tijekom rasta stabljike razgrađuju, pa središte postaje šuplje. Usporedbom dobivenih podataka ustanovljeno je da velecvjetni rožac ne pokazuje značajnija odstupanja u građi od drugih predstavnika roda *Cerastium*.

scarious margins. The calyx is formed by 6-8 mm long, nearly subobtuse sepals. The Latin term “grandiflorum” has it´s orgin in size of the flowers, namely, corolla consists of 5 white petals which are almost three times longer then the sepals. There are ten stamens, pistil is only one with tomentose ovary. Fruit is a straight capsule, tomentose at the base, which opens with teeth. There are many seeds which are flat and black. The flowering time is from May to July (1-3). Chemical investigations of above mentioned plant showed the presence of aminoacids, tannins and flavonoids (4). Anatomical investigations indicated that the primary shape of the stem is round on cross-section. Epidermis is formed of round-shaped cells, and different hairs are present on the epidermal surface. Analysis of the hairs showed the presence of unicellular and multicellular, stalked and T-shaped together. Beneath the epidermis lies sclerenchymatous hypodermis and multi-layered parenchyma of the primary cortex. Phloem and xylem are developed in a concentric ring in primary cortex, that is, in the central cylinder. Vessels are annulate, spiral and reticular. Parenchymatous cells in the middle of the central cylinder are usually disintegrated during the growth of stem, so the center becomes hollow. Analysis of the given data showed that the structure of the showy chickweed does not differ significantly from the same of other members of the genus *Cerastium.*

PROBLEMS IN CROATIAN *CROCUS*: *CROCUS VERNUS* AGG.

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The latest revision of the genus *Crocus* was by Brian Mathew in 1982. Since then less than a hand full of new species and subspecies where described. Despite this fact there are still three problematic species aggregates: *C. vernus* agg., *C. biflorus-chrysanthus* agg. and *C. sieberi-veluchensis* agg.

C. vernus agg. consists of four clades: the may be basal southern *C. „sarplaninae“*, the eastern *C. heuffelianus* clade (4 species/subspecies), the western *C. albiflorus* clade (4 species/subspecies) and *C. tommasinianus* also belonging here.

Totally there are 10 recognisable species. As they – besides *C. tommasinianus* – were lumped into one to three species, chorology and hybridisation or introgression are poorly known. In Croatia 4 species certainly occur. They are *C. exiguus* (*C. vittatus*, Heuffelianus clade), *C. albiflorus*, *C. purpureus* (*C. napolitanus* – both Albiflorus clade) and *C. tommasinianus*. *C. vernus* s.str. is cultivated, *C. „sarplaninae“* may occur in the south. Hybrids are known between *C. exiguus* and *C. albiflorus* in Croatia, between *C. albiflorus* and *C. purpureus* and between *C. vernus* and *C. tommasinianus* elsewhere. There may be problems to distinguish *C. albiflorus* from *C. purpureus* and it is unknown whether introgression occurs in natural habitats and subspecific rank would be more suitable or the two are clearly separated species.

For all species in the aggregate more detailed information on chorology and hybridisation is needed on the basis of the morphological characters provided by the author.

OPTIMISTI U LOVU NA NEUHVATLJIVO: IZVJEŠĆE O NAPRETKU I PRIKAZ POSTIGNUĆA EVOLUCIJSKIH I KLASIFIKACIJSKIH ISTRAŽIVANJA PORODICE *CAMPANULACEAE*

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Porodica zvončića (*Campanulaceae*) s taksonomskog je stajališta oduvijek smatrana veoma složenom: zapanjujuću raznovrsnost duguje fenotipskoj plastičnosti, ontogenetičkoj promjenjivosti te čestoj pojavi poliploidije. Na otocima i u planinama pojavili su se i poneki jedinstveni oblici zvončića, dajući priliku za istraživanje adaptivne radijacije i molekularne evolucije te velike skupine biljaka.

Klasifikacija porodice gradi se na čvrstim temeljima od 1960-ih. Najnovija molekularna istraživanja pokazuju da su najstarije podjele porodice (A. de Candolle) i

THE OPTIMISTIC IN PURSUIT OF THE ELUSIVE: A PROGRESS REPORT AND REVIEW OF EVOLUTIONARY AND CLASSIFICATION STUDIES OF THE CAMPANULACEAE

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The Campanulaceae has always been considered difficult from a taxonomic point of view. Variation is complex due to phenotypic plasticity, ontogenetic variation, and polyploidy. Several unique forms occur on islands and mountains, offering opportunities for the study of adaptive radiation and molecular evolution.

Classification of the family began on a firmer basis in the 1960s. Recent molecular investigations have shown that the division of the family into two major groups by Alphonse de Candolle, and the subdivision of *Campanula* by E. Boissier is

roda *Campanula* (Boissier) na po dvije velike skupine temeljno ispravne. Položaj zvončića unutar reda *Campanulales* također je prilično jasan, iako sama porodica i nema jasnih okvira (neki autori još uvijek smatraju i *Lobeliaceae* potporodicom *Campanulaceae*). Na višoj razini filogenetičke analize molekularna istraživanja danas su nezaobilazna, ali će ona nastaviti igrati značajnu ulogu i u novoj procjeni porodice zvončića na razini rodova i vrsta. Nejezgrini markeri, kao što je *mat*K, jasno podupiru najnovije *ITS* nalaze. Ipak, buduća molekularna istraživanja svakako trebaju biti vrednovana unutar dobro poznatih i široko prihvaćenih ideja o citološkim, morfološkim, ekološkim i biogeografskim odnosima unutar porodice, jer svaka nova klasifikacija mora biti prvenstveno svrsishodna iz perspektive korisnika. Stoga istraživanja polena, morfologije, ekologije i biogeografije i dalje trebaju igrati najvažnije uloge u definiranju opsega roda.

Istančanije analize filogenetičkih odnosa neophodne su unutar platikodonoidnih i valenbergioidnih svojti. Mnogi otočni valenbergioidi kritično su ugroženi i zahtijevaju žurnu zaštitu. Trenutačno su istraživanja unutar porodice koncentrirana na filogeniju i biologiju vrsta južnoafričkih *fynbos*-zajednica, dok su kod kampanuloida usmjerena na razjašnjavanje filogenije velikih i slabo uređenih rodova *Campanula* i

fundamentally correct. The position of the Campanulaceae within the Campanulales is fairly clear, although some authors include the lobelias as a subfamily of the Campanulaceae. At this deep level in phylogenetic analyses, molecular work is paramount, but it will also continue to play a prominent role for the reassessment of the Campanulaceae at the generic and infra-generic levels. Non-nuclear markers such as matK broadly support the recent ITS findings. However, future molecular research needs to be evaluated within a framework of generally accepted ideas of the cytological, morphological, ecological, and biogeographical relations within the family, while reclassification must be expedient from the user's point of view. Pollen studies, morphology, ecology and biogeography still have major roles to play in the refinement of generic limits.

More refined analyses of phylogenetic relationships within the platycodonoid and wahlenbergioid taxa are required. Many of the island wahlenbergioids are critically endangered and require urgent conservation. Current research is concentrated on the phylogeny and biology of the South African fynbos species, while, for the campanuloids it is aimed at elucidating the phylogeny of large genera such as *Campanula* and *Adenophora*. However, the Mediterranean area has a number of oligotypic and monotypic genera

Adenophora. Osobito se sredozemno područje ističe velikim brojem oligotipskih i monotipskih rodova, koji vjerojatno kriju i ključ evolucije kampanuloida uopće. Tim svojtama treba dati prioritet u istraživanjima porodice *Campanulaceae*.

that may offer clues about the evolution of the campanuloids in general, and research priorities should also be given to these taxa.

HELIOSPERMA INSULARE TRINAJSTIĆ (CARYOPHYLLACEAE, *SILENEAE*), A NEGLECTED SPECIES FROM THE ISLAND MLJET (CROATIA)

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Heliosperma insulare Trinajstić is one of about 15 species belonging to the genus *Heliosperma* (Rchb.) Rchb. (= *Ixoca* Raf.). Most of the taxa are endemic to relatively small areas of the Balkan peninsula, which is also the case of *H. insulare*. It was described in 1979 from the Veliki Grad mountain on the Mljet island in the southern Adriatic (Croatia), but was later ignored both by the Croatian excursion flora (Domac 1994) and the Index Florae Croaticae (1994).

We recollected *H. insulare* at the Mljet locality in 2003, and have included it in a molecular taxonomic study of *Heliosperma*. The nuclear ribosomal internal transcribed spacer (ITS) sequences and intron sequences of the chloroplast gene *rps*16 were used to examine the phylogenetic relationships among the taxa.

In both cases, *H. insulare* is positioned in the clade consisting of all *Heliosperma* taxa except *H. quadrifidum* (L.) Griseb. Interspecific relationships within the clade are poorly resolved in the case of ITS, while in the case of *rps*16 intron, *H. insulare* is grouped together with geographically related populations of other taxa, the closest being *H. tommasinii* (Vis.) Rchb. from the mainland (Montenegro). Habitually, *H. insulare* is similar to other *Heliosperma* taxa from lower altitudes, like *H. veselskyi* Janka from Slovenia, Austria and Italy, *H. retzdorffianum* K. Maly from Bosnia and Herzegowina and Serbia and to *H. tommasinii*. Distinguishing characters are mostly floral and are here used to examine

the relationships of *H. insulare* to the habitually most similar taxa.

Besides the importance of *H. insulare* in resolving interspecific relationships within the genus, the species is also important from the nature conservation point of view, since the population on Mljet is the only one known and therefore worth protecting.

USPOREDNA MORFOMETRIJA CVJETOVA AGREGATA *CAMPANULA* WALDSTEINIANA I ROTUNDIFOLIA (*CAMPANULACEAE*)

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Rod zvončića (*Campanula* L.) obuhvaća oko 400 vrsta rasprostranjenih sjevernom polutkom, a zbog velike složenosti dodatno se dijeli na mnogobrojne srodstvene skupine. Jedan od najvećih takvih agregata čini heterofilna *C. rotundifolia* L. sa svojim srodnicima, koje na području Euroazije obuhvaćaju oko 50 vrsta, od čega u jugoistočnoj Europi oko 20. Mali, izofiloidni agregat *C. waldsteiniana* - *C. tommasiniana* rasprostranjenošću je vezan uz masiv hrvatskih planina Velebita i Učke, ali nije bliže srodan s vrstama subsekcije Isophylla s.str. istog areala. Kako se te dvije blisko srodne vrste međusobno značajno razlikuju oblikom vjenčića, što je u biljnom svijetu vrlo rijetko, pokušali smo metodama usporedne morfometrije utvrditi postoji li značajna sličnost cvjetnih karakteristika s vrstama agregata Rotundifolia.

COMPARATIVE FLORAL MORPHOMETRY OF *CAMPANULA* WALDSTEINIANA AND ROTUNDIFOLIA (*CAMPANULACEAE*) AGGREGATES

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Genus *Campanula* L. comprises approx. 400 species in the Northern hemisphere, divided into numerous smaller groups or aggregates. One of the largest such aggregates is composed of heterophyllous and highly polymorphous *C. rotundifolia* L. and its relatives, which in the Euro-Asian region comprises 50 species, out of which in South-East Europe approx. 20. Small, "isophylloid" aggregate *C. waldsteiniana* - *C. tommasiniana* inhabits the Croatian mountains of Velebit and Učka, respectively, but it is not closely related to the isophyllous taxa s. str. of the same distribution. As closely related *C. waldsteiniana* and *C. tommasiniana* are separate by their corolla shape, which is very rare in the plant world, our intention was to compare the floral morphology of that aggregate with the rotundifolious taxa.

Materijal za morfometrijsku analizu, cvjetovi 14 vrsta roda *Campanula* iz agregata Waldsteiniana i Rotundifolia, te Isophylla i Pyramidalis (kontrola), prikupljeni su na 30 odvojenih lokaliteta s područja prirodne rasprostranjenosti vrsta. Svakom od ukupno 410 cvjetova računalno je izmjereno devet morfoloških varijabli, te podaci obrađeni multivarijatnim metodama statističke analize. Ukupnom razlikovanju mjerenih vrsta roda *Campanula* u najvećoj mjeri pridonosi dužina filamenata prašnika i režnjeva simpetalnih vjenčića, a za većinu je vrsta utvrđena i značajna unutarpopulacijska raznovrsnost. Testiran je i mogući utjecaj vremena sabiranja uzorka na mjerene varijable cvijeta, koji se nije pokazao značajnim, dok su tri mjerena svojstva pokazala statistički značajnu korelaciju s geografskim položajem lokaliteta sabiranja. Oblikom vjenčića znatno se razlikuju izofilne vrste, kojima je slična *C. waldsteiniana*, dok se *C. tommasiniana* približava reliktnim vrstama agregata Rotundifolia, *C. hercegovina* i *C. cespitosa*. Rezultati morfometrijske analize, koji ukazuju na intermedijarni položaj agregata Waldsteiniana (između Isophylla i Heterophylla), slažu se i s najnovijim rezultatima molekularnih istraživanja provedenih na istom uzorku.

Material for the morphometric analysis, flowers of 14 Campanula species of the Waldsteiniana and Rotundifolia, and Isophylla and Pyramidalis (control) aggregates, were collected in 30 disjunctive localities in the area of taxa's natural distribution. To each of 410 flowers 9 morphometric variables were measured, and the data analysed using multivariate statistical methods. The most prominent variables in evaluation of interspecific flower variability are the length of the filaments and the length of the free corolla lobes, and there is significant intrapopulational variability for most of the investigated taxa. We also tested a possible correlation of the sampling time to the morphological variables, which showed less significant, while three variables showed significant correlations with the geographic locality of the sampled population. Isophyllous taxa are well distinguished by their corolla shape, to which resembles *C. waldsteiniana*, while is *C. tommasiniana* closer to the relict heterophyllous taxa, *C. hercegovina* and *C. cespitosa*. Results of the morphometric analyses, showing intermediate position of Waldsteiniana aggregate (between Isophylla and Heterophylla), are concurrent with the recent molecular results conducted on the same sample.

GENUS *DIMERELLA* (*COENOGONIACEAE*, LICHENIZED ASCOMYCOTA) IN SLOVAKIA

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The genus *Dimerella*, covering up to 25 species world-wide, was studied to clarify its occurrence in Slovakia. The work based on literature review, revision of collections (BRA, SAV, W, BP, PRC, PR, herb. Vězda, herb. Pišút) and field work, brings an evidence of 2 species growing in the territory – *Dimerella pineti* and *D. lutea,* which is supplemented by distributional maps.

As for *Dimerella pineti*, first voucher specimens and published data date back to the second half of the 19th century (by Lojka and Hazslinszky). The entries of 20th century are occasional (by e. g. Zahlbruckner, Szatala, Suza, Vězda, Pišút) to such an extent, that the species was regarded rare, then even listed along with the species indicating naturality of montane forests. The investigation shows, that the lichen is widely distributed all over Slovakia, mainly on tree bases, stumps or mossy soil in forests.

For the first time the sub-oceanic lichen *Dimerella lutea* is recorded from Slovakia. Its historical occurrence in Vihorlat Mts. supports the specimen by J. Nádvorník of 1932 discovered in Budapest. Simultaneously, it was currently observed in Eastern Carpathians (Bukovské vrchy Mts.) in 2002. Following its ecological requirements it is evident, that it is confined to humid, well preserved forest biotopes. Within the studied territory the species is not overlooked, but extremely rare, which is the grounds to include it in the Red list of lichens of Slovakia within the category critically endangered.

SRODSTVENI ODNOSI NEKOLIKO OKOJADRANSKIH SKUPINA ZVONČIĆA (*CAMPANULA* L., CAMPANULACEAE) TEMELJENI NA OSOBINAMA KLOROPLASTNE DNA

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Do danas je zabilježeno oko 400 vrsta zvončića (rod *Campanula*) koje nastanjuju sjevernu Zemljinu polutku. Na Sredozemlju, središtu njihova razvitka, moguće je razlikovati oko 250 vrsta. Mnogi autori u posljednja dva stoljeća pokušali su razviti pogodnu klasifikaciju toga velikog roda, ali ni jedan klasifikacijski sustav nije se pokazao zadovoljavajućim. Cilj ovoga istraživanja bio je rasvjetljavanje taksonomske problematika male, ali morfološki i kariološki dobro karakterizirane skupine jadranskog područja, poznate kao skupina *Isophylla*. Ovim se radom također željelo odrediti klasifikacijski položaj endemičnih hrvatskih vrsta *C.*

RELATIONSHIPS AMONG SEVERAL AMPHI-ADRIATIC *CAMPANULA* GROUPS (CAMPANULACEAE) ACCORDING TO THEIR CHLOROPLAST DNA CHARACTERISTICS

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There are about 400 *Campanula* species in the world. The centre of species diversity is in Mediterranean area where about 250 species occur. Many authors during the last two centuries have tried to develop a suitable classification of this large genus but none of these systems have been suitable up to now. The main research interest of this study was the taxonomy of small but morphologically and karyologically well characterized group of the Adriatic region, called the *Isophylla* group, as well as classification position of Croatian endemical species *C. waldstainiana* and *C. tommasiniana.* Restriction site variation of PCR-amplified cp DNA region between the trnT and trnF genes in the large single-copy region was

waldstainiana i *C. tommasiniana*. Raznolikost restrikcijskih fragmenata PCR umnoženog DNA niza između trnT i trnF gena, unutar velike jedinstvene regije kloroplastne DNA, analizirana je u 16 vrsta roda *Campanula*. Prema osobinama kloroplastne DNA sve istraživane svojte oblikovale su dvije osnovne skupine. Prva dobro odvojena skupina sastojala se je od vrsta *C. istriaca*, *C. fenestrellata*, *C. poscharskyana*, *C. portenschlagiana*, *C. garganica* i *C. reatina*, koja odgovara prije opisanoj podskupini *Garganica* /2n=34/ izofilnih zvončića. Druga dobro odvojena skupina je još dodatno podijeljena u nekoliko podskupina: *C. isophylla* i *C. fragilis* (poznata do sada kao *Fragilis* skupina /2n=32/ izofilnih zvončića) smještena je vrlo blizu heterofilnim zvončićima *C. velebitica* i *C. justiniana*, dok je *C. pyramidalis* zajedno sa *C. versicolor, C. waldstainiana* i *C. tommasiniana* (poznati kao *Pyramidalis* i *Waldsteiniana* agregati) formirala odvojenu podskupinu koja bi se mogla opisati kao prijelazna skupina između heterofilnih i izofilnih zvončića.

analyzed in 16 *Campanula* taxa. All investigated campanulas formed two main groups of taxa. The first group that consists of *C. istriaca*, *C. fenestrellata*, *C. poscharskyana*, *C. portenschlagiana*, *C. garganica* and *C. reatina* was clearly separated. This group is congruent with the formerly described *Garganica* group /2n=34/ of the isophyllous campanulas. The second group is divided in several subgroups: *C. isophylla* and *C. fragilis* (formerly known as the *Fragilis* group /2n=32/ of isophyllous campanulas) are placed very close to the heterophyllous *C. velebitica* and *C. justiniana*, while *C. pyramidalis*, together with *C. versicolor, C. waldsteiniana* and *C. tommasiniana* (known as *Pyramidalis* and *Waldsteiniana* aggregates) form a separate subgroup that can be described as a transitional group between heterophyllous and isophyllous *Campanula* taxa.

ENDEMIČNE VRSTE RODA *IRIS* L. (IRIDACEAE) U HRVATSKOJ

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Ovim radom prikazujemo zastupljenost i areal endemičnih vrsta roda *Iris* L. u Hrvatskoj. Metodama komparativne taksonomije živih biljaka iz cijele Hrvatske, herbarijskih primjeraka (iz zbirki ZA, ZAHO, LJU, WU, W, BP, BU and PAD), terenskim istraživanjima i analizom brojnih literaturnih podataka ustanovili smo da je u Hrvatskoj flori prisutno pet endemičnih vrsta roda *Iris*: *I. adriatica* Trinajstić ex Mitić, *I. croatica* I. Horvat et M. Horvat, *I. illyrica* Tomm., *I. pseudopallida* Trinajstić i *I. rotschildii* Degen. *I adriatica* i *I. rotschildii* su stenoendemične, a ostale vrste su subendemične. Prikazani su rezultati nomenklaturne revizije, taksonomski problemi i horologija hrvatskih endemičnih perunika.

ENDEMIC SPECIES OF THE GENUS *IRIS* L. (IRIDACEAE) IN CROATIA

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We have defined the identity and distribution of endemic species of the genus *Iris* L. in Croatia. By the methods of comparative taxonomy of living plants from the entire Croatia, herbarium specimens (from the collections ZA, ZAHO, LJU, WU, W, BP, BU and PAD), by field-work research and analysis of the numerous literature data we have established that in Croatia five endemic species of the genus *Iris* exist: *I. adriatica* Trinajstić ex Mitić, *I. croatica* I. Horvat et M. Horvat, *I. illyrica* Tomm., *I. pseudopallida* Trinajstić and *I. rotschildii* Degen. *I adriatica* and *I. rotschildii* are stenoendems and the others are subendems. The results concerning the revision of the nomenclature, taxonomic problems and the chorology of Croatian endemic irises are presented.

PHYLOGENY AND TAXONOMY OF *PHYTEUMA* (CAMPANULACEAE)

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The European endemic *Phyteuma* comprises ca. 20 species morphologically well characterised by their peculiar flower morphology suggesting monophyly of this group. In order to investigate the phylogenetic relationships of *Phyteuma* to other genera as well as those within *Phyteuma* we conducted molecular phylogenetic analyses using data from the nuclear ITS and the plastid *trnL-F*-region (intron and spacer). Both markers congruently suggest a monotypic *Physoplexis*, an endemic of the southeastern Alps, as closest relative of *Phyteuma*. While the clade of *Phyteuma* plus *Physoplexis* is statistically strongly supported, the separation of *Phyteuma* from *Physoplexis* is only moderately supported. Nevertheless, pink stalked flowers and a chromosome base number of $x = 17$ in *Physoplexis* (versus blue, whitish or dark violet sessile flowers and chromosome base numbers $x = 10$ to 14 in *Phyteuma*) justify the separation of *Physoplexis* as a separate genus. Within *Phyteuma*, two well-supported monophyletic groups corresponding to previously recognised sections are found. Species of sect. *Phyteuma* have elongated spike-like inflorescences without an involucrum, while those of sect. *Capitata* have capitulum-like inflorescences with an involucrum. In most cases, the morphologically defined species are well supported by the molecular data. An exception is the taxonomically difficult group of *Ph. spicatum*, where several accessions included in our study intermix with accessions from other species, such as *Ph. ovatum* or *Ph. gallicum*. In some species, the molecular data suggest the presence of more than one taxon. This is particularly pronounced in *Ph. globulariifolium*, which falls in two clearly distinct groups corresponding to *Ph. globulariifolium* s. str. and *Ph. pedemontanum*.

CONTRIBUTION TO THE DIFFERENTIATION OF THE TWO SPECIES OF *ACONITUM* SUBGEN. *LYCOCTONUM* IN THE ĆIĆARIJA MOUNTAINS (NORTHERN ISTRIA)

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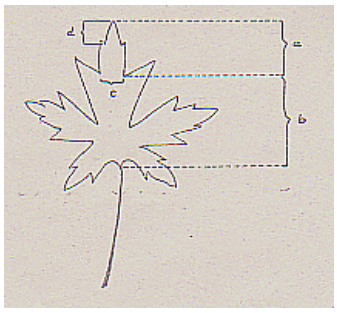
In the Ćićarija, the mountain range in northern Istria between Trieste in the west and Rijeka in the east, occur 5 species of the genus *Aconitum*. *Aconitum anthora* is rare in the hills north of the Slavnik. *Aconitum variegatum* grows only in the western part, eastwards to the mountains Žabnik and Žbevnica. *Aconitum degenii* is known until now only from the mountains Planik and Vojak.Yellow flowering Aconites of the subgenus *Lycoctonum* can be found in the whole mountain range, but they have not been differentiated yet.

The characteristics, which differ the two species are in first line the shape of the leaves (the parameters in figure 1 follow WARNCKE 1964) and in second line the pubescens of the inflorescence.



Index z1 = a:b is in ***Aconitum lupicida*** 8.8-1.4 (1.6) and z2 = c:d = 0.3-0.8. The number of leaf tips of the central leaf segment varies between 15-37. Inflorescense dense, with ascending branches. Tepals of flowers outside pubescent and/or glandular and/or rigid pilose. Growing in open high perennial herb associations, needs full light. Distributed in the western, central and southern Alps and the Karst region. Toponymes in the Ćićarija: Kokoš in 590 m, Slavnik in 980 m, Žbevnica in 800 m, 915 m, 920 m and 950 m.

Index z1 = a:b is in ***Aconitum lycoctonum*** (in the Ćićarija only subsp. *lycoctonum*) 0.2-0.9 and z2 = c:d = 0.6-1.8. The number

of leaf tips of the central leaf segment is less than 27. Inflorescense less dense to lax, with almost horizontal branches. Tepals of flowers outside always pubescent. Growing in open associations as well as in beech forests, needs not much light. Distributed in central and eastern Europe. Toponymes in the Ćićarija: Slavnik in 965 m, Zagrad to Glavičorka in 970 m, Žbevnica in 920 m, 950 m and 965 m, Lovranska Draga to Vojak in 800 m, Poklon saddle in 950 m, near Vela Učka, Poklon saddle to Vojak in 1145 m, Vojak in 1325 m, Brložnik in 980 m, Planik in 1105 m.

IZOENZIMSKA VARIJABILNOST PREDSTAVNIKA IZOFILNIH, "IZOFILOIDNIH" I HETEROFILNIH VRSTA ZVONČIĆA (*CAMPANULA* L., *CAMPANULACEAE*) U HRVATSKOJ

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Prema posljednjim podacima, u Hrvatskoj raste 30 vrsta i pet podvrsta roda zvončića (*Campanula*, Campanulaceae), od čega je čak 20 (57%) endemično. Većina endemičnih svojti pripada dvjema razvojnim linijama: jednakolisnim (izofilnim) zvončićima skupine *Garganica* u smislu Trinajstića (1978) te raznolisnim (heterofilnim) skupine *Rotundifolia* u smislu Kovande (1970). Najnovija molekularna istraživanja pokazuju da se između tih dviju dobro odijeljenih, paralelnih razvojnih linija razvilo nekoliko manje srodnih skupina, tzv. «izofiloidnih» zvončića, koji dijele morfološke i biogeografske karakteristike i s jednakolisnim i s raznolisnim skupinama, ali su neovisnog postanka. Koliko nam je

ISOENZYME VARIABILITY AMONG ISOPHYLLOUS, "ISOPHYLLOID" AND HETEROPHYLLOID *CAMPANULA* REPRESENTATIVES IN CROATIA

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Being exceptionally rich in plant species, Croatia has 30 *Campanula* (Campanulaceae) species and 5 subspecies, out of which as much as 20 (57%) endemic, with several narrowly distributed subendemics. Most of the endemic campanulas are members of two indigenous lineages: isophyllous *Garganica* sensu Trinajstić (1978) and heterophyllous *Rotundifolia* sensu Kovanda (1970). According to the latest molecular research, an interesting range of the intermediate taxa, so called the "Isophylloids", has been developed between those two superior *Campanula* groups. The "isophylloid" campanulas share some morphologic and biogeographic characteristics with both

poznato, izoenzimatska raznolikost tih vrsta i skupina zvončića dosad nije istraživana.

Razdvajanje izoenzima elektroforezom u nativnim uvjetima u ovom je istraživanju korišteno u cilju procjene raznolikosti između pojedinih vrsta zvončića, te utvrđivanja razlika između navedenih srodstvenih skupina. Izoenzimi se još uvijek često koriste u istraživanju unutarvrsnog i međuvrsnog polimorfizma, jer se uz jednostavnu pripremu i minimalne troškove može primijeniti širok raspon različitih enzima. Za takva su istraživanja dovoljne male količine biljnog materijala, što je u ovom slučaju vrlo važno, s obzirom na to da se često radi o rijetkim i malobrojnim vrstama zvončića raštrkanih populacija.

Istraživanje je obuhvatilo devet vrsta zvončića iz četiri srodstvene skupine, te četiri različita enzima. Uključena su dva predstavnika jednakolisnih zvončića (*Garganica*), hrvatski subenoendemi *C. fenestrellata* (Velebit) i *C. poscharskyana* (dubrovačko područje). Skupinu "izofiloidnih" zvončića predstavljaju dvije odvojene razvojne linije: hrvatski stenoendem *C. tommasiniana* (Učka) i subendem *C. waldsteiniana* (Velebit) iz agregata *Waldsteiniana*, te ilirsko-balkanski endem *C. pyramidalis* iz agregata *Pyramidalis*. Raznolisne svojte (*Rotundifolia*) predstavljene su endemima *C. hercegovina* (Čvrsnica, BiH) i *C. justiniana* (Snježnik), te

Garganicae and *Rotundifoliae*, but are undoubtedly of separate evolution.

In this study enzyme electrophoresis was employed to measure variation within and divergence among several representatives of these interesting *Campanula* groups. Isoenzymes have often been used to study the intra- and inter-specific polymorphism, since a range of enzymes can be easily studied with minimum preparation and cost, using a small quantity of material. This is very important, due to a fact that a number of investigated *Campanula* species is of tiny distributions, represented by scattered and low-numbered populations.

This research included 9 *Campanula* taxa from 4 separate groups, investigated by 4 different isoenzymes. The isophyllous (*Garganica*) representatives included in this research were Croatian subendemics *C. fenestrellata* (Velebit Mt) and *C. poscharskyana* (Dubrovnik region). Of the "isophylloid" campanulas we included the representatives of two separate lineages: Croatian subendemic *C. tommasiniana* (Učka Mt) and stenoendemic *C. waldsteiniana* (Velebit Mt) of the *Waldsteiniana* aggregate, while an Illyrian-Balkan endemic *C. pyramidalis* represents the *Pyramidalis* aggregate. Heterophyllous (*Rotundifolia*) taxa included were the endemics *C. hercegovina* (Čvrsnica Mt, Bosnia and Herzegovina) and *C. justiniana*

šire rasprostranjenima *C. scheuchzeri* (Platak) i *C. velebitica* (Velebit). Usporedbom izoenzima superoksid dismutaze (SOD), pirogalola, askorbat peroksidaze i esteraze utvrđena je statistički značajna raznovrsnost istraživanih skupina roda *Campanula*.

(Snježnik Mt, Croatia), and broadly distributed *C. scheuchzeri* (Platak, Croatia) and *C. velebitica* (Velebit Mt, Croatia). Isoenzyme patterns of superoxid dismutases (SOD), pyrogallol, ascorbat peroxidases and estherases were compared, showing significant variability among the studied *Campanula* groups.

POLLEN MORPHOLOGY OF THE SPECIES FROM SECTION *OROBUS* (GENUS *LATHYRUS, FABACEAE*) IN BULGARIA

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The pollen morphology of eight species from section *Orobus* of genus *Lathyrus* (*Fabaceae*) distributed in Bulgaria (*L. alpestris* (WK) Celak., *L. aureus* (Stev.) Brandza, *L. linifolius* (Reich.) Bässler, *L. niger* (L.) Bernh, *L. palustris* L., *L. transsilvanicus* (Spreng.) Fritsch, *L. venetus* (Mill.) Wohls. and *L. vernus* (L.) Bernh.) was studied with LO microscope and SEM.

The pollen grains are 3-zonocolporate, elliptical in equatorial view except for *L. vernus* (rectangular-obtuse-convex) and circular, rarely triangular-obtuse-convex (*L. palustris*) in polar view. The pollen grains are medium to large in size (P x E = 30.0 – 50.6 x 22.1 – 42.7 mm). The smallest pollen grains are those of *L. venetus* (P x E = 30.0 – 36.3 x 22.1 – 28.4 mm) while largest belong to *L. alpestris* (P x E = 44.2 – 50.6 x 33.2 – 41.1 mm). There is no correlation between the ploidy level and the size of the pollen grains in *L. palustris* (2n=6x=42). The ectocolpi are straight, shallow, with acute ends, broader at the equator. The colpus membrane is granulated. The endopori are circular, rarely elliptical-lalongate (*L. palustris*). The ornamentation is predominantly perforate-foveolate, but there are pollen grains with reticulate (*L. aureus*) and perforate-reticulate sculpture (*L. alpestris, L. palustris*) that is clearly visible in the mesocolpium. Single columellae are found in the largest lumina. The apocolpium is psilate except for the reticulate ornamentation found in *L. aureus*. The exine is thicker in the mesocolpium (1.2 – 2.6 mm) and slightly thinner in the apocolpium. All pollen grains investigated are assigned to *semi-erectus* (P/E = 1.20 – 1.32) pollen type.

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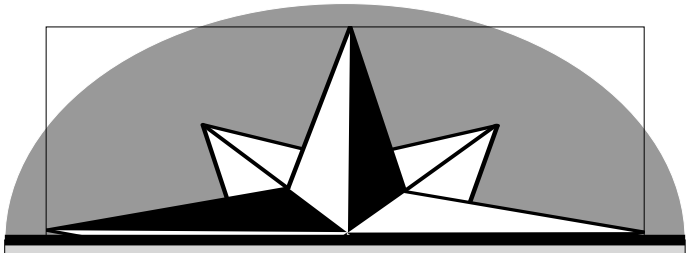

MOLEKULARNA BOTANIKA I FIZIOLOGIJA BILJA

MOLECULAR BOTANY AND PHYSIOLOGY OF PLANTS

ANDROSACE SECT. *ARETIA* (PRIMULACEAE) AS A MODEL SYSTEM FOR INVESTIGATING PHYLOGEOGRAPHIC PATTERNS IN THE EUROPEAN HIGH MOUNTAIN SYSTEMS

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The genus *Androsace* (Primulaceae) comprises ca. 140 species distributed mainly in northern hemisphere mountain ranges. Recent molecular phylogenetic studies have shown that the European endemic sect. *Aretia* forms a well supported monophyletic group, if the monotypic European genus *Vitaliana* and the amphi-Beringian genus *Douglasia* are included. With a few exceptions, the European representatives of this group are high mountain taxa in the central and southern European mountain ranges, particularly in the Alps and the Pyrenees. Apart from a few relatively narrow endemics with compact distribution areas, such as *A. brevis* (Alpi Bergamaschi), *A. pyrenaica* (Central Pyrenees), or *A. rioxana* (Sierra de la Demanda, Spain), these species have disjunct distribution areas within and/or between mountain ranges, thus rendering this group a good model system for studying phylogeographic patterns in the European high mountain systems. Disjunctions on a more regional scale include those between the northern and southern calcareous Alps, e.g., in *A. hausmannii* or *A. lactea*, or between the central Eastern Alps and the southern Dolomites in the silicicolous *A. wulfeniana*. These distribution patterns can often be explained by the Pleistocene glaciations. In contrast, disjunctions between mountain ranges as found in *A. helvetica* (Alps and Pyrenees), *A. vandellii* (Alps, Pyrenees, and Sierra Nevada), *A. lactea* (mountains of the Balkan Peninsula, Carpathians, Alps, Cantabrian Mountains), *A. obtusifolia* (Alps, Carpathians), and *A. mathildae* (Abruzzi, Balkan Peninsula), might have been formed in pre-Pleistocene times. The application of Amplified

Fragment Length Polymorphisms (AFLPs), a highly resolving molecular fingerprinting technique, will allow the determination of whether these disjunctions are the results of relatively recent long distance dispersals or not.

RESTRIKCIJSKA ANALIZA KLOROPLASTNE DNA TRIJU VRSTA RODA *THYMUS* (*Lamiaceae*)

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U ovom su radu uspoređene vrste *T. bracteosus* Vis. ex Benth., *T. serpyllum* L. i *T. vulgaris* L. na temelju restrikcijskih fragmenata kloroplastnog genoma. Vrste roda *Thymus* zanimljive su kao i brojne vrste porodice *Lamiaceae* zbog sadržaja eteričnog ulja te njihove primjene u farmaciji, proizvodnji mirisa i prehrani. Brojnim dosad provedenim istraživanjima utvrđen je visok stupanj morfološke i kemijske raznolikosti vrsta roda *Thymus*. Tako unutar vrste *T. serpyllum* L. postoji izuzetno velika morfološka raznolikosti, dok je u vrste *T. vulgaris* L. utvrđen velik broj kemotipova. Vrsta *T. bracteosus* Vis. ex Benth., mekolisna majčina dušica, endemična je biljka

RESTRICTION ANALYSIS OF CHLOROPLAST DNA OF THE THREE *THYMUS* SPECIES (*Lamiaceae*)

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Preliminary investigations of cpDNA polymorphism have been performed on individuals of species *T. serpyllum* L., *T. vulgaris* L. and *T. bracteosus* Vis. ex Benth. Members of the genus *Thymus*, as well as numerous species belonging to the family *Lamiaceae*, are of interest due to presence of essential oils and their use in pharmacy, cosmetics and nutrition. Numerous investigations show a high degree of morphological and chemical variability among species of genus *Thymus*. For example, *T. serpyllum* L. are morphologically very variable while *T. vulgaris* L. has a large number of chemotypes. Chemical composition and anatomical characteristics of the *T. bracteosus* Vis. ex Benth., an endemic species of Dinaric

dinarskog područja, čije je istraživanje kemijskog sastava i anatomskih osobina u tijeku.

S ciljem utvrđivanja raznolikosti kloroplastne DNA između vrsta roda *Thymus* kao i prikladnosti analize kloroplastne DNA u filogenetskim istraživanjima roda *Thymus*, provedeno je preliminarno istraživanje polimorfizma kloroplastne DNA između i unutar triju vrsta: *T. bracteosus* Vis. ex Benth., *T. serpyllum* L. i *T. vulgaris* L. Šest regija kloroplastne DNA dobiveno je amplifikacijom u lančanoj reakciji polimerazom uz specifične početnice. To su regije velike jednostruke kopije cpDNA između gena psaA i trnS, trnC i trnD, psbC i trnS, trnF i trnV1, trnH i trnK1r kao i trnK1 i trnK2r. Šest amplificiranih regija jednake su veličine u svim uzorcima triju vrsta. Nakon cijepanja s dvije restrikcijske endonukleaze Hinf I i Taq I uspoređeno je dvanaest dobivenih restrikcijskih profila triju vrsta. Vrsta *T. serpyllum* L. razlikuje se od ostalih vrsta u oba restrikcijska profila regije psaA – trnS. Uočen je polimorfizam između jedinki vrste *T. vulgaris* L. s različitih geografskih lokacija u regijama trnC - trnD, trnF - trnV1 i trnK1 - trnK2r. Dobiveni rezultati ukazuju na visok stupanj konzerviranosti cpDNA između ovih triju vrsta roda *Thymus*. Također postoji mogućnost geografski određenih haplotipova unutar ovog roda.

Karst, is currently under investigation.

With the aim to test cpDNA variability among *Thymus* species, as well as suitability of the cpDNA analyses for intra and interspecific phylogenetic study of genus *Thymus*, preliminary investigations of cpDNA polymorphism have been performed on individuals of species *T. serpyllum* L., *T. vulgaris* L. and *T. bracteosus* Vis. ex Benth. Six regions in large single copy of chloroplast DNA have been amplified by PCR with universal chloroplast primers. Regions obtained are between genes psaA and trnS, trnC and trnD, psbC and trnS, trnF and trnV1, trnH and trnK1r and finally trnK1 and trnK2r. Six fragment obtained are same in size for all species. Amplification products were digested using 4-base recognition endonucleases HinfI and TaqI and restriction patterns obtained were compared. *T. serpyllum* L. differs from the other species in both restriction profiles of region psaA – trnS. Intraspecific polymorphism was detected among individuals of *T. vulgaris* L. from different geographic locations in regions trnC - trnD, trnF - trnV1 i trnK1 - trnK2r. Obtained results point out the high conservation of chloroplast genome among compared species. Also presence of the geographic haplotypes in this genus are possible.

DIMENZIJE I POVRŠINE MEZOFILNIH STANICA U RAZVOJU IGLICA SMREKE

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U razvoju iglica smreke (*Picea abies* (L.) Karst.) dolazi do različitih strukturnih promjena, što dovodi do stvaranja različitih tkiva iglice: epidermalnog, hipodermalnog, mezofilnog i provodnog. Cilj istraživanja bio je utvrditi promjene u dimenzijama mezofilnih stanica u razvoju iglica.

Uzorkovano je šest razvojnih stadija: vegetativni pupovi, četiri razvojna stadija mladih iglica razvrstanih prema dužini (stadij I – 7 mm, stadij II – 11 mm, stadij III – 15 mm i stadij IV – 19 mm), te iglice iz prethodne sezone. Dimenzije mezofilnih stanica, kao i njihove površine, mjerene su na poprečnim prerezima, debelim 3 µm.

Usporedbom različitih razvojnih stadija utvrđene su razlike u građi i obliku mezofilnih stanica. Porast širine i dužine

DIMENSIONS AND AREAS OF MESOPHYLL CELLS DURING SPRUCE NEEDLE DEVELOPMENT

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Different structural changes are taking place during the development of spruce (*Picea abies* (L.) Karst.) needles resulting with formation of needle tissues: epidermal, hypodermal, mesophyll and vascular bundle. The aim of this study was to measure dimensions of mesophyll cells of spruce needles during development.

Six developmental stages of spruce needles were sampled: vegetative buds, four stages of young needles, distinguished regarding to the needle length (stage I - 7 mm, stage II - 11 mm, stage III - 15 mm and stage IV - 19 mm) and previous-season needles. The dimensions and areas of mesophyll cells were measured on 3 µm thick transversal sections of spruce needles and buds.

Differences in structure and shape of cells

stanica uočen je između svakog razvojnog stadija. Iznimke su dokazane između stadija II i III mladih iglica, jer promjena širine nije bila statistički značajna, te između stadija IV mladih iglica i iglica iz prethodne sezone, jer nije utvrđena značajnost razlika za vrijednosti dužine i površine stanica. Dobiveni rezultati pokazali su da je za razvoj mezofilnih stanica u mladim iglicama bilo potrebno vrijeme od oko dva mjeseca.

composing the needle mesophyll were shown comparing different developmental stages. Mesophyll cells showed increase in width and length between each developmental step. The exceptions were shown between stages II and III, where change in width was not approved to be statistically significant, as well as between stage IV and previous-season needles, where the lack of significance was present concerning length and area. The most pronounced change happened during transition from vegetative buds to developmental stage I of young needles, while the slightest changes were expressed between developmental stage IV and previous-season needles. Obtained results pointed out that time rate of about two months was needed for needles development regarding to the mesophyll cells dimensions and areas.

SIMPATRIČKE SUBPOPULACIJE PATOGENE GLJIVE *BOTRYOTINIA FUCKELIANA* (ANAMORF *BOTRYTIS CINEREA*) NA RAZLIČITIM BILJKAMA DOMAĆINIMA U OVISNOSTI O TRANSPOZABILNIM ELEMENTIMA

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Gljiva *Botryotinia fuckeliana* Whetz (de Bary) je teleomorfni stadij patogena poznatijeg pod nazivom *Botrytis cinerea* Pers. ex Fr., koji je kao anamorf uzročnik bolesti sive plijesni na preko 200 kultiviranih vrsta biljaka. Ta nekrotrofna, polifagna, filamentozna, heterotalična i haploidna patogena gljiva pokazuje veliku genotipsku i fenotipsku raznolikost i izuzetnu prilagodljivost. Uzroci genotipske raznolikosti su heterokarioza, aneuploidija i transpozabilni elementi, dok se fenotipska raznolikost uočava u morfološkoj diferencijaciji i otpornosti na botriticide. Razvojem molekularnih tehnika (PCR) došlo se do novih podataka o filogenetskim i

SYMPATRIC SUBPOPULATIONS OF THE PATHOGEN FUNGUS *BOTRYOTINIA FUCKELIANA* (ANAMORPH *BOTRYTIS CINEREA*) ON VARIOUS HOST PLANTS DEPENDING ON TRANSPOSABLE ELEMENTS

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The fungus *Botryotinia fuckeliana* Whetz (de Bary) is the teleomorph stage of the pathogen known as *Botrytis cinerea* Pers. ex Fr., which, as an anamorph causes grey mould diseases on more than 200 cultivated plant species. This necrotrophic, polyphagous, filamentous, heterothallic and haploid pathogen fungus presents extreme genotype and phenotype variability and exceptional adaptability. The causes of genotype variability are heterocariosis, aneuplodia and transposable elements, while the phenotype variability is observed in the morphological differentiation and resistance to botriticides. With the development of molecular techniques (PCR)

populacijskim specijalizacijama unutar te gljive, koja se razmatra više kao kompleks vrsta, a manje kao jedinstvena vrsta. Prema nedavnim istraživanjima vrsta je podijeljena na dvije simpatričke subpopulacije, na temelju sadržaja transposabilnih elemenata (TE). TE su dijelovi DNA, koji mogu mijenjati svoju poziciju unutar genoma, uzrokujući inaktivaciju gena, reaktivaciju pseudogena, poremećaje ekspresije gena i mutacije tipa delecija i insercija. Kod *B. cinerea* otkrivena su dva TE: retrotransposon Boty i transpozon Flipper. Simpatrička subpopulacija koja sadrži oba TE (Boty+Flipper+) nazvana je *Botrytis transposa,* a subpopulacija koja ih ne sadrži (Boty-Flipper-) *Botrytis vacuma*. Da bi smo utvrdili povezanost tih simpatričkih subpopulacija s biljkama domaćinima sakupljeni su izolati gljive s četiri biljke domaćina: vinove loze, jagode, krizanteme i paprike. Sadržaj TE utvrđen je molekularnim analizama PCR, korištenjem specifičnih primera. Određene su četiri subpopulacije sa sljedećim sadržajem TE: Boty+Fliper+, Boty-Flipper-, Boty+Fliper- i Boty-Flipper+. Udio subpopulacija kod jagode bio je sljedeći: *B. transposa* 41 %, *B. vacuma* 23%, a ostale dvije subpopulacije (Boty–Flipper+) 26 % i (Boty+Flipper-) 9 %. Na vinovoj lozi najviše je bila zastupljena subpopulacija *B. transposa* (84%), a manje *B. vacuma* (5%), dok se subpopulacija Boty +Fliper- javljala s 11 %. Na krizantemi *B. transposa* je bila 40%, *B. vacuma* 20%, a druge dvije subopulacije također po 20 %.

new insight has been gained into the phylogenetic and population specialisations within this fungus that is considered more as a complex species rather than one uniform species. According to recent research the species is divided into two simpatric subpopulations, based on the content of transposable elements (TEs). "TEs" are parts of DNA which can change their position within the genome causing inactivation of the gene, reactivation of the pseudogene, disturbances of gene expression and deletion and insertion mutations. Two "TEs" have been discovered in *B. cinerea*; retrotranspozone **Boty** and transposone **Flipper**. The sympatric subpopulation containing both TEs (Boty+Flipper+) has been named *Botrytis transposa*, while the subpopulation not containing them (Boty-Flipper-) is called *Botrytis vacuma*. In order to determine the connection between these sympatric subpopulations and host plants isolates of the fungus were collected from four host plants: grapevine, strawberry, chrysanthemum and pepper. The content of TEs was determined by PCR molecular analyses, using specific primers. Four subpopulations were determined with the following TEs content: Boty+Fliper+, Boty-Flipper-, Boty+Fliper- and Boty-Flipper+. The content on strawberry was as follows: *B. transposa* 41 %, *B. vacuma* 23%, and the remaining two subpopulations (Boty-Flipper+) 26 % and (Boty+Flipper-) 9 %. On grapevine the subpopulation *B. transposa*

Na paprici se javljala samo simpatrička subpopulacija Boty-Fliper+.

(84%) was the most frequent with less *B. vacuma* (5%), while subpopulation Boty +Fliper- appeared with 11 %. On chrysanthemum there was 40% *B. transposa* and 20% *B. vacuma*, while the other two sympatric subpopulations appeared at 20 % each. On pepper the only sympatric subpopulation observed was Boty-Fliper+.

CONTENT OF SOME MINERAL ELEMENTS IN SEVERAL BALKAN SERPENTINE ENDEMIC PLANTS

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The serpentine mother-rock that covers large areas in the Balkans is characterized by calcium deficiency and high concentrations of magnesium, aluminium, iron, nickel, cobalt and chromium. It is inhabited by significant number of local and regional endemic plants. The content and ratios of above mentioned elements have been analyzed in the following obligate serpentine endemics from Tara mt. (W Serbia): *Scrophularia tristis*, *Stachys schrysophaea*, *Silene paradoxa*, *Fumana bonapartei* and *Linaria rubioides*. The same analyses have been also carried out on facultative serpentine subendemic *Seseli rigidum*, taken from both serpentine and calcareous soil. The results have shown that in the obligate serpentine endemic plants magnesium concentration always predominated over calcium. Especially high Mg:Ca ratio was detected in roots of *S. tristis* (3.6) and in leaves of *F. bonapartei* (2.8). Iron and chromium contents in these plants were several times higher than those which are considered as toxic for plants (10 550 ppm and 22 ppm for Fe and Cr, respectively). Also, the high Fe quantity (1760 ppm) was recorded in the stem of *F. bonapartei*. Moreover, all these species are characterized by the significant accumulation of Cr in root, stem and leaves. Comparative analyses of *S. rigidum* from different soils have shown different Mg:Ca ratios, being 1 in those from serpentine and 2 in plants grown at calcareous soil. As expected, results for plants from calcareous soil showed smaller concentrations of all other investigated elements than those from serpentine. It is interesting to note that large quantity of chromium (over 2 ppm) was found in all plant organs of *S. rigidum* collected from both soils.

EKOLOGIJA KLIJANJA SJEMENKI ENDEMIČNE VRSTE *DEGENIA VELEBITICA* (DEGEN) HAYEK (BRASSICACEAE)

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Degenija (*Degenia velebitica*) svakako je najpoznatija hrvatska endemična vrsta, koja je tijekom stoljeća plijenila interese mnogih botaničara. Ipak, o fenologiji njenih sjemenki (kad sazrijevaju, kad se raspršuju i, najzanimljivije, kad klijaju) do danas se vrlo malo zna: nisu poznate ni temperature koje sjemenke zahtijevaju za klijanje te prolaze li uopće kroz fazu mirovanja (dormancija).

Sjemenke degenije za ovo istraživanje sakupljene su u Botaničkom vrtu PMF-a, te na prirodnom staništu (Bile, na padinama prema Tomišinoj dragi) u vrijeme prirodnog raspršivanja. Svježe sakupljene sjemenke isklijavane su na sobnoj temperaturi, temperaturi toplog staklenika i približnoj temperaturi prirodnog staništa. Dio sjemenki bio je također smješten na temperaturi od

GERMINATION ECOLOGY OF ENDEMIC SPECIES *DEGENIA VELEBITICA* (DEGEN) HAYEK (BRASSICACEAE)

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Degenia velebitica was and still is a very interesting plant for a lot of botanists. But we still know nothing about phenology of the seeds: when do the seeds mature, when are they dispersed, and when do they germinate?

For this research seeds were collected in the Botanical Garden of the Zagreb Faculty of Science and in natural habitat (Bile) at the time of natural dispersal. Freshly matured and collected seeds were placed under natural conditions, room temperature and in greenhouse conditions. One part of the seeds was placed on 5°C for 3, 6, 9 and 12 weeks and checked if cold stratification was needed. The most interesting part for germination phenology studies was exposing the seeds to temperature conditions similar to those in nature (in garden) and recording

5°C tijekom 3, 6, 9 i 12 tjedana te je provjeravano trebaju li hladnu stratifikaciju za poticanje klijanja. Za fenološko istraživanje sjemenki svakako je najzanimljiviji dio istraživanja u kojem su sjemenke izložene temperaturama sličnima onim s prirodnog staništa, odnosno dnevnom minimumu i maksimumu temperature.

Mijenja li se vijabilnost sjemenki degenije njihovim čuvanjem na sobnoj temperaturi? Je li hladna stratifikacija neophodna za klijanje? Povećava li promjenjiva temperatura klijavost sjemenki?

the maximum and minimum temperatures.

Do seeds change viability during dry storage? Is cold stratification necessary for germination? Would alternating the temperature increase germination?

EX SITU ZAŠTITA NEKIH HRVATSKIH STENOENDEMIČNIH BILJNIH VRSTA PUTEM MIKROPROPAGACIJE

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U Hrvatskoj je zabilježeno više od 300 endemičnih biljnih svojti, od kojih su mnoge hortikulturno zanimljive i mogle bi se lako uzgajati. Uspostavljanje trajnih kultura u botaničkim vrtovima, zaštićenim područjima i privatnim vrtovima uvelike bi pridonijelo očuvanju prirodnih populacija tih biljaka.

Zbog malih populacija i ograničenog izvora sjemenki *in vitro* tehnike predstavljaju alternativu klasičnim metodama uzgoja biljnog materijala. Mikropropagacijom je moguće uzgojiti desetke samostalnih biljaka iz jedne sjemenke (klijanca).

Cilj nam je bio istražiti mogućnosti mikropropagacije nekolicine hrvatskih stenoendemičnih biljnih vrsta; *Dianthus velebiticus* Borbas op. Kulcz, *Fibigia triquetra* (DC.) Boiss. ex Prantl, *Onosma*

EX SITU CONSERVATION OF SOME CROATIAN ENDEMIC PLANT SPECIES THROUGH MICROPROPAGATION

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There are more then 300 endemic plant species growing in Croatia, many of which are horticulturally desirable and could be widely grown. Establishing permanent cultures of such plants in conservatories and private gardens would greatly contribute to preservation of their natural populations. *In vitro* techniques could provide an alternative to classical propagation due to smallness of populations and limited seed production. Through micropropagation it is possible to obtain numerous independent plats from a single seed (seedling).

The aim of the study was to investigate micropropagation possibilities for several stenoendemic plant species; Dianthus *velebiticus* Borbas op. Kulcz, *Fibigia triquetra* (DC.) Boiss. ex Prantl, *Onosma*

javorkae Simonk. and *Alyssum austrodalmaticum* Trinajstić.

Za početnu kulturu koristili smo klijance uzgojene iz sjemenki sabranih na prirodnim staništima. Pratili smo multiplikacijske stope na podlogama s punom ili polovičnom koncentracijom MS makroelemenata, 1 mgL^{-1} GA_3 i 0.11 mgL^{-1} BA.

Nakon deset tjedana (dvije supkulture), odrezani izdanci su preneseni na tekuću podlogu za zakorjenjivanje koja je sadržavala punu koncentraciju MS makroelemenata i 0.5 mgL^{-1} BA

Zakorijenjeni izdanci su posađeni u sterilno tlo nakon čega je uslijedila aklimatizacija biljaka na vanjske uvjete temperature i vlažnosti zraka.

Sterilizacija sjemenki je bila zadovoljavajuća; nakon tri tjedna u kulturi većina sjemenki je proklijala. Najveće multiplikacijske stope zabilježene su na podlogama s punom koncentracijom MS makroelemenata. Zakorjenjivanje i aklimatizacija biljaka bila je zadovoljavajuća za sve istraživane vrste.

Ovi rezultati pokazuju da se *Dianthus velebiticus* Borbas op. Kulcz, *Fibigia triquetra* (DC.) Boiss. ex Prantl, *Onosma javorkae* Simonk. i *Alyssum austrodalmaticum* Trinajstic mogu uspješno uzgajati mikropropagacijskim tehnikama.

javorkae Simonk. and *Alyssum austrodalmaticum* Trinajstić.

The shoots that originated from aseptically germinated seeds collected in natural habitats were used for culture initiation. Multiplication rates were observed in half or full strength MS medium containing 1 mgL^{-1} GA_3 and 0.11 mgL^{-1} BA.

After 10 weeks and two subcultures, the shoots were cut off and rooted in full strength liquid MS medium containing 0.5 mgL^{-1} BA. Rooted shoots were planted into sterilized soil followed by two-phase acclimatisation to outer humidity and temperature conditions.

The sterilization of seeds was successful. After 3 weeks most seeds germinated. The highest multiplication rates per explant were achieved in full strength MS medium. The rooting phase and the acclimatization phase were satisfactory for all plant species investigated.

These results indicate that *Dianthus velebiticus* Borbas op. Kulcz, *Fibigia triquetra* (DC.) Boiss. ex Prantl, *Onosma javorkae* Simonk. and *Alyssum austrodalmaticum* Trinajstic could be succesfully preserved through micropropagation.

CITOGENETIČKA STABILNOST U DUGOTRAJNOJ KULTURI DUBROVAČKE ZEČINE (*CENTAUREA RAGUSINA* L.)

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Dubrovačka zečina (*Centaurea ragusina* L.) je endemična hrvatska biljna vrsta s kseromorfnim osobinama koje su nastale kao posljedica njenog prirodnog okoliša – okomite vapnenačke stijene iznad Jadranskog mora. Analiziran je i međusobno uspoređen citogenetički status dugotrajne kulture dubrovačke zečine (94 supkulture) i klijanaca nakon mjesec dana rasta. Citogenetička stabilnost istražena je u meristemskim stanicama korijena kultiviranih biljaka dubrovačke zečine porijeklom s lokaliteta Penđa (Konavoske stijene) i klijanaca koji potiču s tri različita lokaliteta južne Dalmacije (Penđa, Pasjača – Konavoske stijene te Komiža - otok Vis) koristeći kao parametre mito-tski indeks te mitotske i kromosomske

CYTOGENETIC STABILITY OF *CENTAUREA RAGUSINA* L. LONG-TERM CULTURE

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Centaurea ragusina L. (Asteraceae) is an endemic Croatian plant species, which developed xeromorphic characteristics as a consequence of its natural environment – vertical limestone cliffs above the Adriatic Sea. Cytogenetic status of *C. ragusina* long-term culture (94th subculture) and *C. ragusina* seedlings were analysed and compared after 4 weeks of growth. Cytogenetic stability was investigated in root meristem cells of *C. ragusina* cultured plants originated from Penđa (cliffs near Dubrovnik) and seedlings originated from three different localities in south Adriatic (Penđa, Pasjača - cliffs near Dubrovnik and Komiža - island of Vis) using mitotic index and mitotic and chromosomal abnormalities as parameters. Mitotic inde-

abnormalnosti. Mitotski indeksi biljaka iz kulture i "Penđa" klijanaca bili su međusobno slični te značajno povećani u usporedbi s vrijednostima mitotskih indeksa "Komiža" i "Pasjača" klijanaca. Iako je najveći broj mitotskih abnormalnosti zabilježen u meristemskim stanicama korijena kultiviranih biljaka dubrovačke zečine, taj je broj bio neznatno veći nego u meristemskim stanicama korijena "Penđa" i "Pasjača" klijanaca, dok je kod "Komiža" klijanaca postotak mitotskih aberacija bio upola manji u usporedbi s biljkama iz kulture. Distribucija analiziranih mitotskih abnormalnosti bila je vrlo slična u meristemskim stanicama korijena svih uzoraka s iznimkom "Komiža" klijanaca. Dobiveni rezultati pokazuju da dugotrajni uzgoj dubrovačke zečine u kulturi nije imao učinak na povećanje mitotskih aberacija te starenje kulture, jer je slična distribucija mitotskih abnormalnosti opažena kod "Penđa" i "Pasjača" klijanaca.

ces of cultured plants and "Penđa" seedlings were similar and showed significant increase compared to mitotic indeces of "Komiža" and "Pasjača" seedlings. Although the highest number of mitotic abnormalities was recorded in root meristem cells of cultured plants, it was only a bit higher than in root tips of "Pasjača" and "Penđa" seedlings, while that of "Komiža" was two times lower compared to cultured plants. Pattern of analysed mitotic abnormalities was very similar in root tips of cultured plants and "Pasjača" and "Penđa" seedlings, with exception of "Komiža" seedlings. Presented results suggest that long-term cultivation of *C. ragusina* has almost no effect on culture ageing considering similar distribution of scored mitotic abnormalities as in "Penđa" and "Pasjača" seedlings.

GENETIC VARIABILITY OF *OROBANCHE FOETIDA* POIR. POPULATIONS ATTACKING CULTIVATED AND WILD LEGUMES

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By far the most economically damaging parasitic plant species on legumes is *Orobanche crenata* Forks., *Orobanchaceae*, but some other broomrapes such as *O. minor* Sm. and *O. aegyptiaca* Pers. can also be of importance in certain areas. *O. foetida* Poir. is widely distributed in the Western Mediterranean area and it typically parasitizes wild plants. Only recently, it has been described as an agricultural problem in legume crops in Tunisia. The *O. foetida* populations growing on crops were sampled from chickpea (*Cicer arietinum* L.) and faba bean (*Vicia faba* L.) fields on the same farm in Beja, Tunisia. *O. foetida* populations parasitizing wild hosts were collected in Spain (Córdoba and Granada) and Morocco. The pattern of genetic variation was analysed by RAPD markers. An UPGMA cluster analysis based on Dice's distance matrix was performed. The analysis of molecular variance (AMOVA) was used to partition the total phenotypic variance within populations, among populations within groups, and between groups (populations on crops vs. populations on wild species). The resulting dendrogram showed a clear separation of all the populations sampled. A two-way nested AMOVA showed that the most of the phenotypic diversity was attributable to differences among individuals within populations (46.16 %). The remaining phenotypic diversity was distributed among populations (34.08 %) and between groups

(19.77 %). F-values were significant among populations within both groups but not significant between groups of populations growing on crops and wild species. In spite of a substantial internal variation among individuals within *O. foetida* populations growing on crops (69.80 %), there was a significant divergence among the two hosts considered (30.20 %; $f = 0.302$; $p < 0.001$), confirming a clear host-differentiation between *O. foetida* populations infecting chickpea and faba bean.

EFFECTS OF DIFFERENT CYTOKININS ON CHLOROPHYLL RETENTION IN MOSS *BRYUM ARGENTEUM* HEDW. (*BRYACEAE*)

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Cytokinins are a group of phytohormones that have important role in plant growth and developmental processes. Up to date, there are a few data on cytokinins in bryophytes. Only few cytokinins have been detected in moss tissues of which some as new compounds – like bryokinin, whose role in bryophytes is not known. There are scattered evidences that various cytokinins can play certain role in bud induction on bryophyte protonema, but no data on cytokinin effects of chlorophyll retention in bryophytes have been presented.

The aim of this study was to compare the effects of different cytokinins: kintein (KIN), 6-benzylaminopurine (BAP) and thidiazuron (TDZ) on chlorophyll content in shoots of moss *Bryum argenteum* grown *in vitro* with plants that were grown in nature. Plants derived from *in vitro* culture were grown on Murashige and Skoog (MS) medium, at 25±2°C.

Exogenous application of cytokinins had positive effect on chlorophyll retention in *B. argenteum* shoots grown *in vitro* as well in shoots grown in nature. All tested cytokinins had better effect in *in vitro* plants, according to chlorophyll content.

Kinetin was shown to be the most effective cytokinin in chlorophyll retention. Exogenous application of kinetin increased chlorophyll content. BAP had similar trends in *in vitro* and native mosses, increasing chlorophyll content till 1 mM and than significantly decreasing. Kinetin and BAP stimulated the chlorophyll level at all the concentrations applied. TDZ showed slightly better effect in *in vitro* mosses with the similar trends in both plant groups. TDZ increased the chlorophyll amount till 0.1 mM, and higher concentrations (1-10 mM) had negative effects on chlorophyll content, especially in native plants.

SPATIAL GENETIC STRUCTURE OF *HORDEUM CHILENSE* ROEM. & SCHULT. AS REVEALED BY AFLP MARKERS

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Hordeum chilense Roem. & Schult. is a native South American diploid, perennial, wild barley included in the section *Anisolepis* Nevski of the genus *Hordeum* in the *Triticeae* tribe. *H. chilense* is readily crossed with wheat, rye and also cultivated barley, what confers it a high potential as a bridge to transfer favourable traits to cultivated cereals. However, owing to the desertification process, *H. chilense* is gradually disappearing from some of its native environments. Sixty-five accessions of *H. chilense* were collected from six regions in Chile covering nearly complete distribution area of the species. Genetic differentiation among regions and spatial genetic structure were analyzed by amplified fragment length polymorphisms (AFLPs). The analysis of molecular variance (AMOVA) indicated significant genetic differentiation among regions, although most of the variability (66.66 %) was attributable to variation within regions. Pairwise geographic distances between individuals were calculated from the passport data and ten geographical distance classes were created in such a manner that the number of pairwise comparisons in each distance class was approximately the same. The spatial autocorrelation was tested using three methods suitable for dominant marker data: (1) the standardized Mantel statistics, (2) autocorrelation index for DNA analysis (AIDA) *II*, and (3) genetic distogram. All the methods yielded essentially the same results. For the first four distance classes (from 0 to appr. 200 km) the spatial genetics coefficients (Mantel's *r*, AIDA's *II*, d_k) were found significant indicating the existence of spatial autocorrelation. Nevertheless, the geographically most distant pairs formed mainly by accessions from the most northern region (no. 1) and from the most southern regions (nos. 5 and 6) were genetically far more

similar than it could be expected by isolation-by-distance hypothesis. Taking into account the responsible environmental and biological factors, selection of appropriate management and conservation methodologies will be discussed.

EFFECTS OF SOIL PHYSICO-CHEMICAL PROPERTIES ON OSMOREGULATION OF RESURRECTION PLANT *RAMONDA SERBICA* DURING DEHYDRATION AND REHYDRATION

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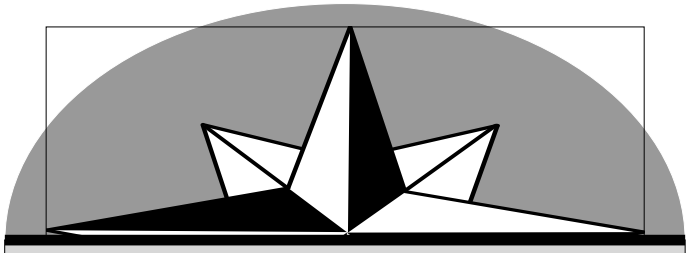
The Balkan endemo-relic species *Ramonda serbica* claims the attention by its poikilohydric or desiccation tolerant life strategy. It inhabits north-facing sides in the gorges and the northern rocky mountain slopes, thus sheltered from direct sunlight, in different regions of the Balkan Peninsula. This rare resurrection plant from the Northern Hemisphere can tolerate protracted periods of extreme water deficit, entering into anabiosis, and rapidly resumes normal physiological activity after reintroduction of water. The plant uses combination of cellular protection and repairing mechanisms to prevent and resist the harmful effects of dehydration and rehydration. Desiccation tolerance of this plant is based also on very efficient osmotic adjustment. Our results showed that osmotic adjustment (OA) in *R. serbica* is mainly based on accumulation of inorganic ions. The amounts of all examined ions (K^+, Ca^{2+}, Mg^{2+}, Na^+, SO_4^{2-}, NO_3^-, Cl^-), except phosphates, significantly increased in leaves during dehydration. Supposing that an active accumulation of ions in plant includes their absorption by roots, the aim of this research was to establish the extent by which the soil properties affected an accumulation of the ions engaged in OA.

The "soil" in *R. serbica* habitats from Serbia (gorges of Sicevo, Jelasnica, Zlot) is thin-layered organo-mineral supstate on limestone, rich in organic substances (39.4%) and of slight alkaline reaction (pH 7.7). The organic compounds are still in the form of undecomposed organic debris, approved by high percentage of large (sand-size) particles (88%). Concentrations of some inorganic ions in the soil solution were relatively low (4.5mM Ca^{2+}, K^+ 1mM, 0.35mM Mg^{2+}, 1.2mM SO_4^{2-}), but sufficient for completion of the osmotic adjust-

ment of *R. serbica*. Otherwise, the low concentrations of ions in the "soil", characterized by high total amounts of some inorganic elements (0.13 %N, 0.25% P, 0.04 %K, 0.04 %Ca, 0.007 %Mg, 0.13 %Fe), resulted from slow mineralization.



PRIMIJENJENA BOTANIKA

APPLIED BOTANY

THE STRUCTURE OF DENDROFLORA OF MONASTERIES' GARDENS AND CLUSTERS IN HERZEGOVINA

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Detailed study of literature showed that gardens and parks of Bosnia and Herzegovina were unknown and unexplored field. This resarch included 6 monasteries, 5 in Herzegovina: Široki Brijeg, Humac (Ljubuški), Mostar, Tomislavgrad and Konjic with one in Croatia: Slano. Study has been continued through available literature, graphic, maps and other written archival materials. A list of dendroflora was made in these gardens during June and Jule 2002. In Slano were found 32 species of dendroflora (7 autochthon, 2 alochton and 23 exotic), in Široki Brijeg were found 65 species (17 autochthon, 6 alochton and 42 exotic), in Humac were found 67 species (18 autochthon, 3 alochton and 46 exota), in Mostar – 19 species (4 autochthon, 1 alochton and 14 exota), in Tomislavgrad – 25 species (8 autochthon, 5 alochton and 12 exotic) and in Konjic 23 species of dendroflora (6 autochthon, 3 alochton and 14 exotic).

ANTIMIKROBNA AKTIVNOST ETERIČNIH ULJA RODA *SATUREJA*

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Eterična ulja i njihove komponente kao sekundarni metaboliti biljaka imaju značajnu primjenu u narodnoj medicini, prehrambenoj industriji te farmaciji. U ovom radu izvršene su fitokemijske analize GC/MS metodom i antimikrobna aktivnost eteričnih ulja vrsta *Satureja montana* L. i *Satureja cuneifolia* Ten. koje su sakupljene u submediteranskom dijelu Hrvatske. Glavna komponenta eteričnog ulja vrste *S. montana* je fenolni monoterpen karvakrol (45,7%). Druge važne komponente čine monoterpenski hidrokarbonati *p*-cimen (12,6%), γ-terpinen (8,1%) te njihovi derivati karvakrol metil eter, borneol, timol i timol metil eter. U sastavu eteričnog ulja vrste *S. cuneifolia* prevladava *β*-kubeben (8,7%), limonen (8,3%), *α*-pinen (6,9%) te spatulenol i *β*-kariofilen. Antimikrobna aktivnost ulja istraživana je metodom mikrorazrjeđenja u tekućem mediju koristeći veći broj kliničkih

ANTIMICROBIAL ACTIVITY OF GENUS *SATUREJA* ESSENTIAL OILS

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Essential oils of plants and their components, products from the secondary metabolism of a plant, have many applications in folk medicine, food flavoring and preservation as well as in pharmaceutical industries. The phytochemical GC/MS analysis and *in vitro* antimicrobial activity of the essential oils in aerial parts of *Satureja montana* L. (Winter savory) and *Satureja cuneifolia* Ten., collected in the littoral part of submediterranean region of Croatia, were performed. The major compound of *S. montana* oil was phenolic monoterpene carvacrol (45.7%). Other important compounds were monoterpenic hydrocarbons *p*-cymene (12.6%), γ-terpinene (8.1%) and oxygen-containing compounds carvacrol methyl ether, borneol, thymol and thymol methyl ether. The volatile oil of *S. cuneifolia* was characterized

patogenih i kontrolnih sojeva, kao što su *Bacillus subtilis*, *Enterococcus faecium, Staphylococcus aureus, Pseudomonas aeruginosa*, *Serratia marcescens, Esherichia coli*, *Candida albicans, Saccharomyces cerevisiae* i *Aspergillus fumigatus*. Svi testirani sojevi osim *B. subtilis* i *E. coli* višestruko su otporni na antibiotike. Istraživana ulja pokazuju antimikrobnu aktivnost na sve ispitivane mikroorganizme osim *P. aeruginosa.* Veća antimikrobna aktivnost ulja utvrđena je kod vrste *S. Montana* za razliku od *S. cuneifolia.* Najveći stupanj antimikrobne aktivnosti uočen je kod vrsta *E. coli,* metacilin-rezistentnih sojeva *S. aureus* i kvasnice *C. albicans*. Eterično ulje vrste *S. cuneifolia* također inhibira rast značajnih kliničkih patogena kao što su *S. aureus* i *E. coli.* Istraživana ulja imaju fungicidno djelovanje na vrste *C. albicans* i *S. cerevisiae.* Dobiveni rezultati ukazuju na visok stupanj antimikrobne aktivnosti eteričnih ulja i njihovu moguću primjenu u dodatnoj terapiji sistematskih infekcija.

with *β*-cubebene (8.7%), limonene (8.3%), *a*-pinene (6.9%), spathulenol and *β*-caryophyllene. The antimicrobial activity of oils was evaluated by broth microdilution method. Using a panel witch included clinical pathogens and laboratory control strains such as *Bacillus subtilis*, *Enterococcus faecium, Staphylococcus aureus, Pseudomonas aeruginosa*, *Serratia marcescens, Esherichia coli*, *Candida albicans, Saccharomyces cerevisiae* and *Aspergillus fumigatus*. All strains used for the tests, except *B. subtilis and E. coli* were resistant to at least one know antimicrobial agents. The antimicrobial effects of *S. montana* and *S. cuneifolia* oils were active against all the test strains with the exception of *P. aeruginosa.* The oil of *S. montana* exhibited greater antimicrobial activity than the oil of *S. cuneifolia*. Maximum activity of *S. montana* oil was observed against *E. coli,* methicillin-resistant *S. aureus* and against yeast (*Candida albicans*). The essential oil of *S. cuneifolia* was also found to inhibit the growth of medically important pathogens such as *S. aureus* and *E. coli.* The fungicidal activity in both oils against *C. albicans* and *S. cerevisiae* was also observed. We conclude that investigated oils can be safely used as a complementary therapy of systematic infection.

HRANIDBENA VRIJEDNOST PAŠNJAČKE ZAJEDNICE *TRIFOLIO-HORDEETUM SECALINI* NA OTOKU PAGU

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Republika Hrvatska temelji svoj gospodarski razvitak na konceptu ekološki održivog razvoja, u kojemu poljoprivreda i turizam zauzimaju središnje mjesto. Međutim, dosadašnja primijenjena istraživanja nisu dovoljno obuhvatila pravilno gospodarenje i optimalnu iskorištenost pašnjaka kao prirodnih resursa kojima Hrvatska obiluje i o kojima zavisi stočarska proizvodnja. Budući da je ishrana paških ovaca jedan od čimbenika koji presudno utječu na količinu i kakvoću mlijeka za proizvodnju poznatog paškog sira, prvenstveno je potrebno steći što po-

NUTRITIONAL VALUE OF THE PASTURE COMMUNITY *TRIFOLIO-HORDEETUM SECALINI* ON THE ISLAND OF PAG

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The Republic of Croatia has based its economic development on the concept of ecologically sustainable development, in which agriculture and tourism have taken centre stage. However, research conducted to date has insufficiently covered the proper management and optimal usage of pastures as a natural resource abundant in Croatia and upon which the livestock industry depends. Considering that the nutrition of Pag sheep is one of the factors which critically influence the quantity and quality of milk used in the production of the well-known Pag

tpuniji uvid u stanje biljnog pokrova na pašnjacima otoka Paga.

Stoga se od 2001. godine u okolici grada Novalje provodi inventarizacija vaskularne flore pašnjaka, kao i određivanje hranidbene vrijednosti vegetacije pašnjaka na pet obiteljskih gospodarstava koja se bave proizvodnjom paškog sira. Hranidbena vrijednost pašnjaka zajednice *Trifolio-Hordeetum secalini* H-ić 1934 (*Molinio-Hordeion secalini*) određivana je tijekom 2002. i 2003. godine na osušenim uzorcima zelene vegetacije u fazi pred cvatnju pred ispašu, odnosno košnju. Sadržaj sirovih bjelančevina (7.4-15.3%), pepela (7.5-18.8%) i kalcija (0.7-1.8%) jako varira, dok je sadržaj vlakana (22.4-30.1%), masti (2.6-3.8%) i fosfora (0.17-0.22%) ujednačen.

Dobiveni rezultati koristan su vodič za uspješno gospodarenje pašnjacima i pašnjačkom vegetacijom na obiteljskim gospodarstvima na otoku Pagu, jer omogućuju definiranje mjera zaštite i očuvanja pašnjaka što pridonosi ne samo očuvanju biljne raznolikosti, već i cjelovitijem iskorištavanju pašnjaka, a time i unapređenju stočarske proizvodnje. Proizvodnja tradicionalnih, autohtonih prehrambenih proizvoda kao što je paški sir ima i šire društveno značenje, jer potiče različitosti u poljoprivrednoj proizvodnji, te zaštićuje ruralna područja i okoliš.

cheese, it is first necessary to gain full insight into the standing of the plant coverage of pastures on the island of Pag.

Since 2001, in the areas surrounding the town of Novalja, inventory of the vascular plants in pastures has been taken, and the nutritional value calculated of the pasture vegetation on five family farms dealing with the production of Pag cheese. The nutritional value of the pasture community *Trifolio-Hordeetum secalini* H-ić 1934 (*Molinio-Hordeion secalini*) was determined for 2002 and 2003 on dried samples of green vegetation in pre-blooming phases prior to grazing or cutting. The crude protein (7.4-15.3%), ash (7.5-18.8%) and calcium (0.7-1.8%) contents varied greatly, while the fiber (22.4-30.1%), crude fat (2.6-3.8%) and phosphorous (0.17-0.22%) contents were similar.

The results obtained are a useful guide for the successful management of pastures and pasture vegetation on family farms on the island of Pag, as they permit the definition of protectionary measures and the preservation of pastures which contributes not only to the preservation of plant diversity, but also to the full utilization of the pasture, thus advancing livestock production. The production of tradition, autochthonous foodstuffs, such as Pag cheese, also has a wider social relevance, as it stimulates variety in agricultural production and protects both rural areas and the environment.

IZVJEŠĆE O SUBSPONTANIM BILJNIM VRSTAMA S POSEBNIM OBZIROM NA POJAVU INVAZIVNIH VRSTA U ARBORETUMU TRSTENO

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Renesansni perivoj, koji je danas jezgra Arboretuma Trsteno, odlikuje se vrlo dugom tradicijom unošenja egzotičnih biljaka. Unošenje stranih vrsta ovdje je započelo već rane 1494. godine, kada je osnovan perivoj uz ljetnikovac, ali značajnija, vrstama brojniji unos odvijao se u razdoblju od posljednjih 150 godina. To je bilo dovoljno dugo razdoblje da se među egzotama razvije značajan broj subspontanih vrsta.

Istraživanjem brojnosti, dobne strukture i vitalnosti svih 400 kultiviranih taksona na cjelokupnoj površini Arboretuma registrirano je 46 subspontanih vrsta (11,5%). Među njima se izdvajaju tri skupine, koje karakterizira graduiranje njihova odnosa prema okolnoj vegetaciji, od jednostavno subspontanih do izraženo invazivnih.

REPORT ON SUBSPONTANEOUS PLANT SPECIES WITH SPECIAL REGARD TO APPEARENCE OF INVASIVE SPECIES IN ARBORETUM TRSTENO

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The Renaissance garden, the nucleus of Arboretum Trsteno, is famous for its very old tradition of introduction of exotic plants, with the beginning in 1494, when the garden had been laid out around the villa. The greatest number of allochtonous plants has arrived in the period of the last 150 years. It was enough long for some exotes to develop into subspontaneous plants.

The research into numerical and age structure, and vitality of the 400 cultivated taxa on the whole extent of the Arboretum, reveals 46 subspontaneous taxa (11.5%). Among them, three groups are noticed, characterized by gradation of their impact on surrounding vegetation, from simply subspontaneous to aggressive invasives.

The most numerous group comprises 25 plant taxa which maintain the continuity on

Najbrojnija skupina obuhvaća 25 biljnih vrsta koje se spontano rasprostranjuju pojedinačnim i malobrojnim jedinkama, te tako održavaju kontinuitet na svom lokalitetu: *Acacia cyclops, Aesculus hippocastanum, Agave americana, Araujia sericifera, Asparagus densiflorus, Broussonetia papyrifera, Celtis australis, Cercis siliquastrum, Cinnamomum camphora, Cyperus involucratus, Diospyros virginiana, Eriobotrya japonica, Fatsia japonica, Gaillardia aristata, Ligustrum lucidum, Mirabilis jalapa, Paulownia tomentosa, Pennisetum alopecuroides, Phoenix canariensis, Pittosporum tobira, Phytolacca americana, Populus tremula, Sabal minor, Trachycarpus fortunei, Washigtonia filifera.*

Nešto manji broj vrsta (16) još se bolje udomaćio, šire se u skupinama i pokazuju svojstvo kompetitora koji istiskuje samonikle vrste na manjim, ograničenim površinama: *Acanthus mollis, Chelidonium majus, Erigeron karwinskianus, Fallopia baldschuanica, Gleditsia triacanthos, Leucaena leucocephala, Melia azedarach, Robinia pseudoacacia 'Unifoliolia', Symphytum tuberosum, Tagetes minuta, Tradescantia virginiana, Ulmus minor, Vinca difformis, Viola reichenbachiana , Colocasia esculenta 'Antiquorum', Zantedeschia aethiopica.*

Pet vrsta pokazuje izrazito invazivne osobine agresivnog kompetitora koji istiskuje

the same locality by spreading spontaneously by single and not numerous individuals: *Acacia cyclops, Aesculus hippocastanum, Agave americana, Araujia sericifera, Asparagus densiflorus, Broussonetia papyrifera, Celtis australis, Cercis siliquastrum, Cinnamomum camphora, Cyperus involucratus, Diospyros virginiana, Eryobotrya japonica, Fatsia japonica, Gaillardia aristata, Ligustrum lucidum, Mirabilis jalapa, Paulownia tomentosa, Pennisetum alopecuroides, Phoenix canariensis, Pittosporum tobira, Phytolacca americana, Populus tremula, Sabal minor, Trachycarpus fortunei, Washingtonia filifera.*

Second is the less numerous group of 16 taxa which are much better established and exhibit the characteristics of competitor, spreading by dense thickets and displacing other vegetation on the small and localized areas: *Acanthus mollis, Chelidonium majus, Erigeron karwinskianus, Fallopia baldschuanica, Gleditsia triacanthos, Leucaena leucocephala, Melia azedarach, Robinia pseudoacacia 'Unifoliolia', Symphytum tuberosum, Tagetes minuta, Tradescantia virginiana, Ulmus minor, Vinca difformis, Viola reichenbachiana , Colocasia esculenta 'Antiquorum', Zantedeschia aethiopica.*

Five species exhibit outstanding invasive characteristics of aggressive competitor that displace native species and progressively

samonikle vrste i progresivno se sve više širi: *Ailanthus altissima, Phyllostachys aurea, Pueraria lobata, Robinia pseudoacacia, Wisteria sinensis.* Te su vrste u perivoj unesene koncem 19. stoljeća. Stotinjak godina trajao je njihov 'period mirovanja', dok vanjskim faktorima nije bila potaknuta ekpanzija njihovih invazivnih osobina.

U ratnom požaru 1991. na velikoj je površini Arboretuma uništen dotadašnji vegetacijski sklop i promijenjeni životni uvjeti staništa. Presudni poticaj pojavi invazivnih osobina bila je poremećena ekološka ravnoteža izazvana požarom i neodgovarajućim održavanjem kultivirane vegetacije. Rezultat djelovanja invazivnih vrsta ne pokazuje se samo u širenju njihovih populacija, nestajanju autohtonih i smanjivanju raznolikosti vrsta, već također u neočekivanim posljedicama na sve ostale žive organizme staništa ili ekosistema.

Zato je pojava invazivnih vrsta u Arboretumu Trsteno ozbiljno upozorenje da se i u našoj zemlji stave pod promatranje i kontrolu sve unesene vrste i relevantni lokaliteti. Poučeni bogatim iskustvom razvijenih zemalja s mnogo naprednijom ekonomijom i standardom života, gdje su invazivne vrste postale, nakon uništenja staništa, druga po redu ugroza biološkoj raznolikosti, još uvijek možemo na vrijeme sagledati našu odgovornost u očuvanju prirodne baštine za nas i buduće generacije.

invade different habitats: *Ailanthus altissima, Phylostachys aurea, Pueraria lobata, Robinia pseudoacacia, Wisteria sinensis.* For these species which were introduced in the garden at the end of the 19th century, the duration of the time-lags between the introduction and its first record of invasiveness was about 100 years.

In the fire of 1991, caused by the war attack, the major part of vegetation in Arboretum was damaged, and the habitat changes have been induced. The ecological disturbance caused by fire and no adequate maintenance of cultivated vegetation, was the decisive stimulus to arise invasive characteristics. The results of the impact of invasive plants are not represented only in their expansion and replacement of native plant populations, but also in unexpected consequences on all the other organisms of the site or ecosystem.

The manifestation of invasive species in Arboretum Trsteno is very serious warning, which directs us towards monitoring and control of the all introduced species on relevant localities in our country. From the rich experience of developed countries with more advanced economies and standard of living, where invasive species became second most important threat to biodiversity, after habitat destruction, we can realize, just in time, our responsibility to protect our natural heritage for ourselves and future generations.

STANJE EPIKUTIKULARNOG VOSKA NA EPISTOMATALNOM OBRUBU PUČI NA ABAKSIJALNOJ STRANI IGLICA JELE (*ABIES ALBA* MILL.)

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Scanning elektronskim mikroskopom (SEM) istraživano je stanje epikutikularnog voska na epistomatalnom obrubu puči na abaksijalnoj površini ovogodišnjih i prošlogodišnjih iglica jele (*Abies alba* Mill.) s onečišćenih i "čistih" staništa tijekom dvije godine. Tijekom vremena kristalni vosak u obliku "rodletsa" na epistomatalnom obrubu puči na iglicama s oba lokaliteta, i u ovogodišnjih i prošlogodišnjih, fuzionira se i agregira u morfološki različite tipove voštanih amorfnih krasta, prije svega kompaktnih i ispucanih. Taj proces započinje vrlo rano, posebice na onečišćenom Risnjaku, a može se interpretirati kao moguća posljedica aeropolucije. Kvantitativne procjene

CONDITION OF EPICUTICULAR WAX ABAXIAL EPISTOMATAL RIMS OF STOMATA IN SILVER FIR TREES NEEDLES (*ABIES ALBA* MILL.)

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Abaxial wax surface of stomata in the current and previous-year needles of silver fir trees (*Abies alba* Mill.), both from the polluted and unpolluted sites, during two years, were examined with Scanning Electron Microscope. In the course of time the wax rodlets on the epistomatal rims of stomata on abaxial side in polluted and also in unpolluted needles surface, become fused and agglomerated to various extents of morphologically different types of amorphous wax crusts, primarily compact and particulate ones. This process begins very early, particularly in the polluted Risnjak site, and may be interpreted as a possible result of air pollution. Quantitative estimations indicate a very large total

ukazuju na vrlo velike količine amorfnog voska na ovogodišnjim iglicama, te vrlo veliki postotak na prošlogodišnjim iglicama. Također, amorfni vosak zatvara otvore puči te tako onemogućuje proces izmjene plinova. Postoji statistički značajna tendencija degradacije kristalnog voska u amorfni vosak u onečišćenom okolišu. Međutim, ne postoji značajna degradacija kristalnog voska u amorfni vosak između iglica sa stabala različitog stupnja oštećenja na oba istraživana staništa.

amount of amorphous wax crusts in the current-year needles, and a very high percentage of the amorphous wax in previous-year needles. Also, amorphous wax crusts cover stomatal pores, making the normal gas exchange impossible. Statistically there is a significant tendency of increase in wax degradation in the needles of the polluted site, but there is an insignificant wax degradation among the needles of damaged trees within each site.

ZASTUPLJENOST PORODICE *ASTERACEAE* U HORTIKULTURNOJ FLORI SEOSKIH CVJETNJAKA BILOGORSKE PODRAVINE

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Na prostoru Bilogorske Podravine, između gradova Đurđevca i Virovitice, u razdoblju od 1999.-2001. godine sustavno je istraživana flora seoskih cvjetnjaka. Navedenim istraživanjima hortikulturne flore u 39 naselja ustanovljeno je sveukupno 305 taksona, a po broju taksona najzastupljenija je porodica *Asteraceae*. Tom prilikom zabilježena su 44 taksona navedene porodice, što predstavlja 14.34 % taksona od ukupne hortikulturne flore. Njihova rasprostranjenost ovisi o mnogo čimbenika, kao što su zemljopisni smještaj, makroklimatske i mikroklimatske prilike, tipovi tla, autoktona flora i fauna, a posebno dekorativni izgled, broj kultivara pojedine vrste, otpornosti na bolesti i štetnike, tradicija uzgoja, veličina i položaj cvjetnjaka, materijalni i ekonomski status stanovništva, itd. Najučestalija vrsta koja je zastupljena u cvjetnjacima svih 39 naselja je *Chrysanthemum x hortum*. Slijede

PRESENCE OF THE FAMILY *ASTERACEAE* IN HORTICULTURAL FLORA OF RURAL FLOWER GARDENS IN BILOGORSKA PODRAVINA

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In the area of Bilogorska Podravina, between the towns Đurđevac and Virovitica, in the period from 1999 to 2001, a systematic research of rural garden flora was made. By the said horticultural flora research in 39 villages, a total of 305 taxa have been found, and according to the number of taxa the most frequent is the family *Asteraceae*. On that occasion, 44 taxa of the said family have been registered, that makes 14.34% of all horticultural flora taxa. Their distribution depends on many factors, such as geographic position, macroclimatic and microclimatic conditions, soil types, autochthonous flora and fauna, and in particular decorative appearance, the number of cultivars of individual species, resistance to diseases and garden pests, cultivation tradition, flower garden size and position, material and economic status of population, etc. The most frequent species present in flower gardens in all 39 villages is

Calendula officinalis, *Callistephus chiensis*, *Dahlia variabilis* i *Tagetes erecta* koje se susreću u 38 naselja. Postoje i vrste koje su uočene u malom broju naselja. To su *Chrysanthemum carinatum* i *Echinops ritro*, u 2 naselja te *Helicrysum italicum* i *Leontopodium alpinum,* u 3 naselja. Analizom životnih oblika pojedinih takosona najučestalija je skupina hemikriptofita, koja je zastupljena s 19 vrsta i skupina terofiti s 18 vrsta. Rezultati navedene analize su u skladu s općim klimatskim prilikama i kvalitetom tla. S obzirom na podrijetlo, 15 taksona potječe iz Sjeverne Amerike, 14 iz Europe, a preostalih 15 taksona podrijetlom je iz drugih kontinenata. Od utvrđenih taksona koji pripadaju porodici *Asteraceae,* a uzgajaju se u seoskim cvjetnjacima Bilogorske Podravine, 18 tijekom vremena odbjegne iz uzgoja i dalje se šire neovisno od čovjekove aktivnosti pa ih možemo uključiti u skupinu ergasiofigofiti.

Chrysanthemum x *hortum*. Then follow *Calendula officinalis, Callistephus chiensis, Dahlia variabilis* and *Tagetes erecta*, which are found in 38 villages. There are some species that have been noticed in a small number of villages. Such are *Chrysanthemum carinatum* and *Echinops ritro,* in 2 settlements, and *Helicrystum italicum* and *Leontopodium alpinum,* in 3 villages. According to the analysis of individual taxa living forms, the most frequent are the group of hemicryptophytes present with 19 species and the group of therophytes with 18 species. The results of this analysis are congruous with general climatic conditions and quality of soil. With regard to their origin, 15 taxa originate from North America, 14 from Europe while the remaining 15 taxa originate from other continents. Among the determined taxa belonging to the family *Asteraceae,* and cultivated in the Bilogorska Podravina rural flower gardens, 18 escape cultivation in the course of time and continue to spread independently from human activity, so they can be included in the group of ergasiophigophytes.

VODA OD MAGLE NA ZAVIŽANU

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Korištenje magle kao vodnog resursa poznato je u mnogim dijelovima svijeta. Voda iz magle našla je višestruku primjenu, u domaćinstvima, poljoprivredi, pošumljivanju (Schemenauer and Cereceda 1992)

Mjerenje maglene vode na Zavižanu započelo je 1954. Grunovim kolektorom magle koji je bio u upotrebi sredinom stoljeća (Mileta 1998). U ovom radu su prikazane količine maglene vode izmjerene standardnim kolektorom magle (SFC- standard fog collector) Schemenauer i Cereceda (1992), postavljenim na meteorološkoj postaji Zavižan (1594m). Mjerenja se vrše u toplom dijelu godine od ljeta 2000. Prema dobivenim rezultatima najveća dnevna količina maglene vode iznosi 25,5 l/m². dok u dane bez kiše maksimum iznosi 19,0 l/ m².

FOG WATER ON THE ZAVIŽAN (MOUNTAIN VELEBIT)

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Use of fog as a new water resource is well known practise in the world. It is being used in some parts of the world intensively for domestic consumption, agriculture and forestry. (Schemenauer and Cereceda 1992).

The fog water collection started in Croatia using Grunow type fog collector in 1954 (Mileta 1998). The present paper discusses the fog water amounts collected by standard fog collector (Schemenauer and Cereceda 1992) situated at the meteorological station Zavižan in summer 2000. According to measurements, the highest daily rate was 25.5 l /m² and in days without rain maximum was 19.0 l/ m²

GLJIVA *CRYPHONECTRIA PARASITICA* (MURR) BARR. - UZROČNIK RAKA KORE PITOMOG KESTENA

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Cryphonecrtia parasitica patogena je gljiva koja uzrokuje bolest pitomog kestena u vidu uzdužnog raspucavanja kore, stvaranja otvorenih rana te sušenja pojedinih grana i čitavih stabala.

Gljiva je porijeklom iz istočne Azije i Japana, gdje su joj domaćini kineski i japanski kesten. Zaraza se proširila na područje sjeverne Amerike 1904. godine i uništila je gotovo sve sastojine američkog kestena. U Europi je prvi put uočena u Italiji 1938. godine i zahvatila je mnoge kestenove sastojine europskih zemalja. U Hrvatskoj je primijećena 1955. godine na području Istre odakle se proširila u sve ostale dijelove zemlje.

1950-ih godina u Italiji je uočeno spontano zacjeljivanje rak-rana kao i površinske nekroze na pitomom kestenu. Ta ista pojava

FUNGUS *CRYPHONECTRIA PARASITICA* (MURR) BARR. - CAUSATIVE AGENT OF SWEET CHESTNUT BLIGHT

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Cryphonectria parasitica is a pathogenic fungus which causes a disease in sweet chestnut in the form of longitudinal bark splitting, formation of open wounds and dieback of some branches or entire trees.

This fungus originates from eastern Asia and Japan, where its hosts are Chinese and Japanese chestnuts. Infection spread into the area of North America in 1904, and destroyed almost all American chestnut stands. In Europe it was first observed in Italy in 1938 and affected many chestnut stands of European countries. In Croatia it was noticed in 1955 in the region of Istria, from whence it spread into all other parts of the country.

In Italy in the 1950s spontaneous callusing (healing) of cankers and superficial necroses on sweet chestnut, were observed. The same

u Hrvatskoj je primijećena osamdesetih godina. Za ozdravljenja je zaslužna pojava hipovirulentnog soja gljive *C. parasitica.* Hipovirulentan soj je nositelj dvolančane RNA hypovirusa koji svojim djelovanjem umanjuje virulentnost gljive i na taj način omogućuje prirodnu biološku kontrolu bolesti.

Bolest je prisutna u gotovo svim kestenovim sastojinama u Hrvatskoj u manjem ili većem intenzitetu (25 – 60%). Zbog zaraze gljivom *C. parasitica* mnoge kestenove sastojine su u lošem stanju, degradiraju i propadaju a staništa pitomog kestena se smanjuju. Prilikom registracije zdravstvenog stanja kestenovih sastojina ustanovljeno je da prosječno 20% stabala ima simptome zaraze hipovirulentnim sojem *C. parasitica.* Praćenjem stanja na trajnim plohama primijećeno je da na određenim staništima bolest napreduje.

Gljiva *C. parasitica* uvrštena je u popis 100 svjetski najgorih «napadača», koji obuhvaća sve vrste od mikroorganizama do biljaka i životinja. Popis je sačinila skupina znanstvenika i specijalista za invazivne vrste (ISSG) u sklopu udruženja za svjetsku konzervaciju (IUCN). Invazivne vrste prepoznate su na svjetskom nivou kao najveća prijetnja biodiverzitetu.

U okviru projekata Šumarskog instituta Jastrebarsko provode se istraživanja bolesti pitomog kestena, mogućnosti zaštite i

phenomenon was observed in Croatia in the 1980s. This recovery can be attributed to the appearance of a hypo-virulent strain of the fungus C. *parasitica*. This hypo-virulent strain is a bearer of the double-strand RNA of the hypovirus, which, by its activity, diminishes fungus virulence, thus, enabling natural biological control of the disease.

The disease is present in almost all chestnut stands in Croatia in more or less intensity (25-60%). Due to infection with *C. parasitica* many chestnut stands are in a poor condition, degrading and dying, resulting in a decrease in the number of sweet chestnut. During registration of the health condition of sweet chestnut stands it was established that on average 20% of trees showed symptoms of infection with a hypo-virulent *C. parasitica* strain. By monitoring conditions on the permanent plots it was noticed that the disease has progressed on some sites.

C. parasitica has been nominated as among 100 of the World's Worst invaders, which encompass all species from micro-organisms to plants and animals. The Invasive Species Specialist Group (ISSG) is part the Species Survival Commission of the World Conservation Union (IUCN). Invasive species have been recognised globally as a major threat to biodiversity.

Investigations of sweet chestnut diseases, protection possibilities and site re-

sanacije staništa. Istraživanja populacije *C. parasitica* provode se u suradnji s Prirodoslovno-matematičkim fakultetom u Zagrebu

establishment are carried out within the framework of a research project in the Forest Research Institute Jastrebarsko. Research on *C. parasitica* populations is carried out in co-operation with the Faculty of Natural Sciences and Mathematics in Zagreb.

ANTIMICROBIAL ACTIVITY OF THE ESSENTIAL OIL AND METHANOL EXTRACTS OF *ACHILLEA MILLEFOLIUM*

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The in vitro antimicrobial activities of the essential oil and methanol extracts of *Achillea millefolium. (Asteraceae)*, collected in Blidinje, Bosnia and Herzegovina were investigated. Essential oil contains about 36 compounds constituting 90.8% of the total oil. Eucalyptol, camphor, alpha-terpineol, beta-pinene, and borneol were the principal components comprising 60.7% of the oil. The oil showed antimicrobial activity against *Streptococcus pneumoniae, Candida albicans,* while extracts exhibited slight or no activity on *Echerichia coli.* This study confirms that the essential oil of *Achillea millefolium* possesses antimicrobial properties in vitro.

PHOTOSYNTHESIS, HEAVY METAL CONTENT AND ANATOMICAL CHARACTERISTICS OF *CARPINUS BETULUS* L. LEAVES FROM AIR POLLUTED URBAN AREA

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Urban environmental conditions changed by air pollution could have direct harsh effects on trees. Therefore, it is very important to select the resistant tree species adequate for planting in different city areas. We examined deciduous tree *Carpinus betulus* L. from the central zone of Belgrade in order to establish its vitality and adaptability to survive the unfavorable urban conditions.

Investigations included monitoring seasonal variations of: chl a, chl b, chl a+b (*Arnon*, 1949), Fv/Fm and half time required for fluorescence to reach Fm - $t_{1/2}$ (*Oquist and Wass*, 1988) in the leaves, as well as their anatomical structure by standard method for light microscopy (*Prozina*, 1960, *Blaženčić*, 1994). The analyses of heavy metal content (Pb, Cd, Mn, Fe, Cu, Zn) have been carried out on washed and unwashed leaves from polluted and unpolluted site (Roska banja, West Serbia) by atomic absorption spectroscopy.

Chlorophyll content varied during the vegetation season, chl a being always higher than chl b. Fv/Fm was under optimal values for vascular plants, mainly between 0.69 – 0.75, while $t_{1/2}$ reached its highest value at the end of the season. The significant anatomical damages were observed mostly in cuticle and epidermal cells. The high concentrations of Pb (24.19 – 30.61 μg/g DW) and Cd (2.02 -4.09 μg/g DW) were recorded both in leaves

from polluted city area and natural habitat. The differences in heavy metal quantity between washed and unwashed leaves indicated their deposition on leaf surface. The lower concentrations of Pb and Cd were recorded in October, after an extremely humid period. Hence, *C. betulus* could be classified as intermediate resistant tree to air pollution. These characteristics recommend *Carpinus betulus* L. for successful planting in urban areas.

FENOLOŠKI KALENDAR ANEMOFILNIH VRSTA GRADA SPLITA

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Od siječnja 2004. godine krenuli smo u izradu fenološkog kalendara anemofilnih (dijelom i zoofilnih) vrsta biljaka grada Splita. Istraživanjem su obuhvaćene alergogene vrste. Na terenu smo pratili početak i kraj cvjetanja (polinacije). Muške cvjetove smo sabirali i sušili na silikagelu. Za svaku biljnu vrstu smo odredili tip peludnog zrna i tretirali ga gelvatolom koji sadrži fuksin.

Ovim istraživanjem je obuhvaćeno trideset biljnih vrsta.

FENOLOGIC CALENDAR OF ANEMOFIL PLANTS FOR THE AREA OF SPLIT

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Since January 2004, we have started making fenologic calendar of anemofil (partly zoofil) species of plants for the area of Split. The research includes allergogenic species. In the field we observed the beginning and the end of blossoming (polination). The male flowers were collected and then dried on silicagel. For each species, we determined the type of pollen grain and treated it with gelvatol, which contained fuxin.

Thirty species are included in this research.

IRIS ADRIATICA TRINAJSTIĆ EX MITIĆ, POTENCIJALNA BILJKA POGODNA ZA UZGOJ KAO LONČANICA

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Istraživanje je provedeno na endemičnoj vrsti *Iris adriatica*, s atraktivnimniskim i kompaktnim habitusom, koja se još do sada nije uzgajala u komercijalne svrhe. Vegetativno razmnožene biljke uzgajane su u loncima u komercijalnom supstratu i gnojene tekućim mineralnim gnojivom u koncentraciji 0.5 v/v %.

IRIS ADRIATICA TRINAJSTIĆ EX MITIĆ, POTENTIAL PLANT SUITABLE FOR CULTIVATION IN POTS

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Researches were carried out on the endemic dwarf species *Iris adriatica* Trinajstić ex Mitić, with very attractive low and compact habitus, which had not been grown for commercial purposes previously. A group of vegetatively propagated plants were grown in pots filled with commercial substrate and fertilized with liquid mineral fertilizer in a 0.5 v/v % concentration.

Željeli smo ustanoviti mogućnost vegetativnog razmnožavanja i rasta vrste *I. adriatica*, kao ukrasne lončanice, te utvrditi utjecaj gnojidbe na karakteristike rasta (visina biljke, promjer, broj listova i cvjetova).

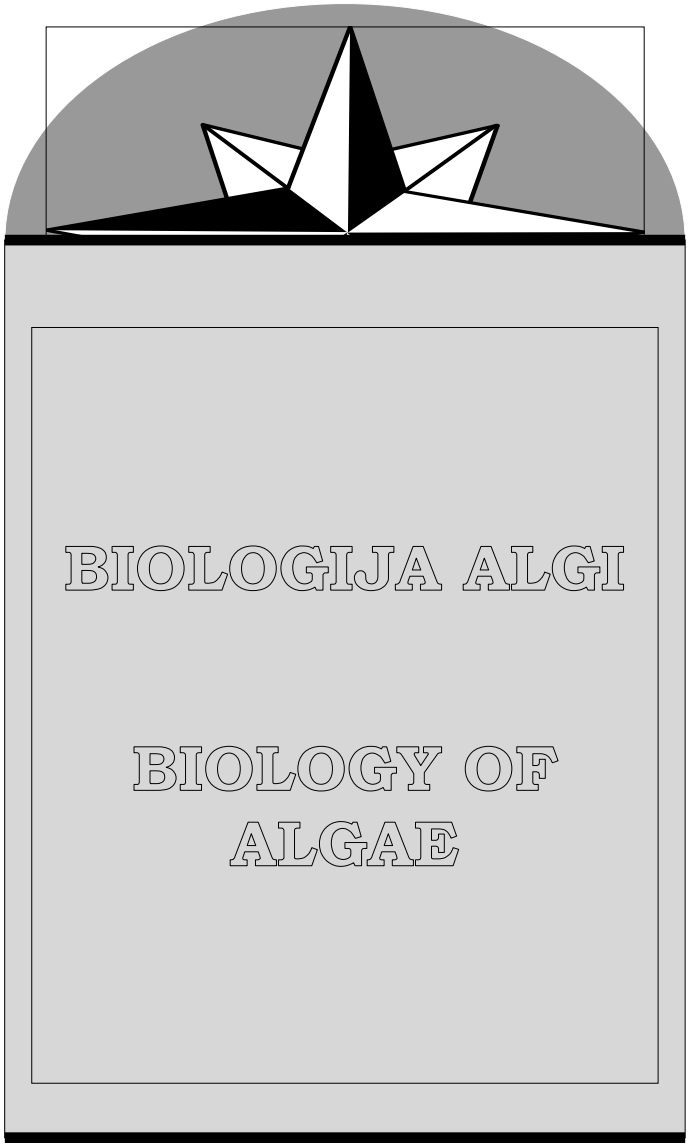
Rezultati ukazuju da vrsta *I. adriatica* ima veliki potencijal za uzgoj kao ukrasna lončanica, jer su biljke pokazale pozitivnu reakciju na primjenu tekućeg mineralnog gnojiva. Gnojene biljke bile su 14% višeg rasta i 12.9% većeg dijametra nego negnojene. Primjena gnojiva rezultirala je I s 50.7% više listova.

Uprkos primjeni gnojiva, nije narušen prirodni, vrlo atraktivan izgled biljaka, te su one ostale niske i kompaktne. Iako biljke u prirodi uobičajeno cvatu u rano proljeće, kod naših lončanica uočena je pojava cvjetova od druge polovice listopada, što je ukazalo na mogućnost ponovljene jesenske cvatnje. Za sada smo ustanovili tri atraktivne boje cvjetova ove patuljaste vrste, s velikim potencijalom za uzgoj kao ukrasne lončanice.

The objective of the research was to determine the possibility of growing *I. adriatica* propagated vegetatively as a pot plant and the influence of topdressing with liquid mineral fertilizer upon growing characteristics (plant height, diameter, number of leaves and flowers).

The results indicate that *I. adriatica* has a great potential for cultivation as a potted flowering ornamental plant, because they revealed a positive plant response to fertilizer application with respect to the traits studied. Fertilized plants were 14% taller than unfertilized ones and plant diameter was increased by 12.9%. Application of liquid mineral fertilizer resulted in 50.7% more leaves.

Despite the fertilizer application, the natural, very attractive appearance of the plants was not spoilt and the plants remained low and compact. Although in the nature the plants are usually flowering in early spring, the appearance of flowers in our pots was observed from the second part of October and showed a possibility of repeated flowering of *I. adriatica* in the autumn. For now, we identified three attractive types of flower colours for this dwarf species with great potential for cultivation as a potted flowering ornamental plant.



BIOLOGIJA ALGI

BIOLOGY OF ALGAE

FITOPLANKTON U SLANIM JEZERIMA MALOJ I VELIKOJ SOLINI (SREDNJI JADRAN)

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U razdoblju od studenog 1999. do studenog 2000. godine u slanim jezerima Maloj i Velikoj Solini (Zablaće kraj Šibenika) uzimani su uzorci za mjerenje fizikalno-kemijskih parametara, klorofila *a* i abundancije fitoplanktona, u mjesečnim intervalima. Raspon abundancije mikrofitoplanktona (stanice >20 µm) bio je 1,3 x 10^3-3,8 x 10^6 stanica L^{-1} u Maloj Solini, odnosno 1,2 x 10^3-1,9 x 10^5 stanica L^{-1} u Velikoj Solini. Abundancija nanofitoplanktona (stanice 2-20 µm) bila je 7,0 x 10^4-3,0 x10^7 stanica L^{-1} u Maloj Solini i 1,8 x 10^6- 2,2 x 10^7 stanica L^{-1} u Velikoj Solini. Najveća abundancija mikrofitoplanktona bila je u kolovozu na obje istraživane postaje, dok je najveća gustoća populacija nanofitoplanktona u Maloj Solini bila u srpnju, a u Velikoj Solini

PHYTOPLANKTON IN TWO SMALL SALTS LAKES (MALA SOLINA AND VELIKA SOLINA, MIDDLE ADRIATIC)

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Samples for physical-chemical parameters, chlorophyll *a*, and phytoplankton abundance were taken monthly from November 1999 to November 2000 in Mala Solina and Velika Solina Lakes (near Šibenik). Microphytoplankton (>20 µm) abundances varied from 1.3 x 10^3 to 3.8 x 10^6 cells L^{-1} in Mala Solina, and from 1.2 x 10^3 to 1.9 x 10^5 cells L^{-1} in Velika Solina. Nanophytoplankton (2 - 20 µm) abundances varied between 7.0 x 10^4 – 3.0 x10^7 cells L^{-1} in Mala Solina and 1.8 x 10^6- 2.2 x 10^7 cells L^{-1} in Velika Solina. Maximum microphytoplankton abundance was found in August at both stations. Highest nanophytoplankton abundance was found in July in Mala Solina and in August in Velika Solina. Diatoms dominated in autumn and winter 1999, while

u kolovozu. U jesen i zimu 1999. u Velikoj Solini dominiraju dijatomeje, dok u proljeće i jesen 2000. dominiraju dinoflagelati. U Maloj Solini u razdoblju od jeseni 1999. do proljeća 2000. dominiraju dinoflaglati, a ljeti i u jesen 2000. kloroficeje.

dinoflagellates became more abundant in spring and summer 2000 in Velika Solina. In Mala Solina dinoflagellates dominated from autumn 1999 until spring 2000 but in summer and autumn chlorophytes became more abundant.

DIVERZITET FITOPLANKTONA U LOKVAMA NA DUGOM OTOKU (DALMACIJA)

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U tri lokve na Dugom otoku u mrežnim uzorcima je utvđeno 85 svojti fitoplanktona svrstanih unutar četiri odjela alga, i to: 22 cijanobakterije (Cyanophyta), 14 kloroficeja i 17 konjugatoficeja (Chlorophyta), 15 euglenoficeja (Euglenophyta), te 17 dijatomeja (Chrysophyta). Nizak indeks diverziteta u kvantitativnim uzorcima odražavao je prevlast nekoliko svojti cijanobakterija. Indeks sličnosti fitoplanktonskih zajednica između lokava je bio nizak. Trofički status može biti jedan od glavnih faktora koji određuje strukturu fitoplanktonskih zajednica u tim ekosustavima. Podaci su temelj za procjenu važnosti lokava kao posebnih vlažnih bio-

PHYTOPLANKTON DIVERSITY IN POOLS FOUND ON THE KARSTIC ISLAND OF DUGI OTOK (DALMATIA)

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A total of 85 taxa of net phytoplankton belonging to four main divisions were recorded in three pools on the island of Dugi otok. The taxa included 22 cyanophytes (Cyanophyta), 14 chlorophytes and 17 conjugatophytes (Chlorophyta), 15 euglenophytes (Euglenophyta), and 17 diatoms (Chrysophyta). The low richness values in the quantitative samples corresponded to the predominance of a few taxa belonging to the cyanophytes. Low community similarities were recorded among the pools. A trophic status could be one of the main factors that influence phytoplankton structure in these ecosystems. The data presented here

topa na hrvatskim otocima. Njihovo održavanje i zaštita jedan je od načina očuvanja ukupne biološke raznolikosti na krškim otocima.

contribute essential base-line information that should aid the evaluation of the biotopes within the Croatian islands. Maintenance and conservation are ways of preserving the overall biodiversity of karstic islands.

SPRING ASPECT OF BENTHIC DIATOMS OF THE RASINA RIVER (CENTRAL SERBIA)

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The Rasina River is situated in the mountain region of the central part of Serbia. The lower part of the flow supplies water for the town of Kruševac. The samples for the analysis of epilithic and epiphytic algae were collected on three localities in the lower Rasina River during April, 2001. In this material 97 diatoms were determined, indicating high biodiversity of diatoms in the river. Four dominant genera were found, such as *Cymbella* (15 taxa), *Navicula* (13 taxa), *Nitzschia* (11 taxa) and *Fragilaria* (9 taxa). Planktonic diatoms in benthic community were also evident. The community of epilithic and epiphytic *diatoms* is typical for this kind of aquatic ecosystem during spring. There were also other numerous diatoms such as *Nitzschia palea*, *Stephanodiscus hantzschii*, *Fragillaria ulna*, *Cymatopleura eliptica* and others, which could bioindicate polluted water. The data indicated presence of high concentration of organic compounds in this river. Such environment influence development of other algae and the whole community. Further investigation is necessary to define whole algal community, and ecological state of the Rasina mountain river.

TAKSONOMSKI SASTAV I RASPODJELA KOKOLITOFORIDA (HAPTOPHYTA, PRYMNESIOPHYCEAE, COCCOSPHAERALES) U VELEBITSKOM KANALU I ESTUARIJU ZRMANJE (1998 - 2004)

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Interdisciplinarna istraživanja u Velebitskom kanalu i u estuariju Zrmanje (duž profila dugog 113 km) provode se od 1998. godine kako bi se definirali trofički odnosi u ovom slabo poznatom dijelu Jadrana. Istraživanja fitoplanktona uključuju različite taksonomske i veličinske kategorije. Kokolitoforidi čine većim dijelom nanoplankton (veličina stanica 2 – 20 μm).

TAXONOMIC COMPOSITION AND DISTRIBUTION OF COCCOLITHOPHORIDS (HAPTOPHYTA, PRYMNESIOPHYCEAE, COCCOSPHAERALES) IN THE VELEBIT CHANNEL AND ZRMANJA ESTUARY (1998 - 2004)

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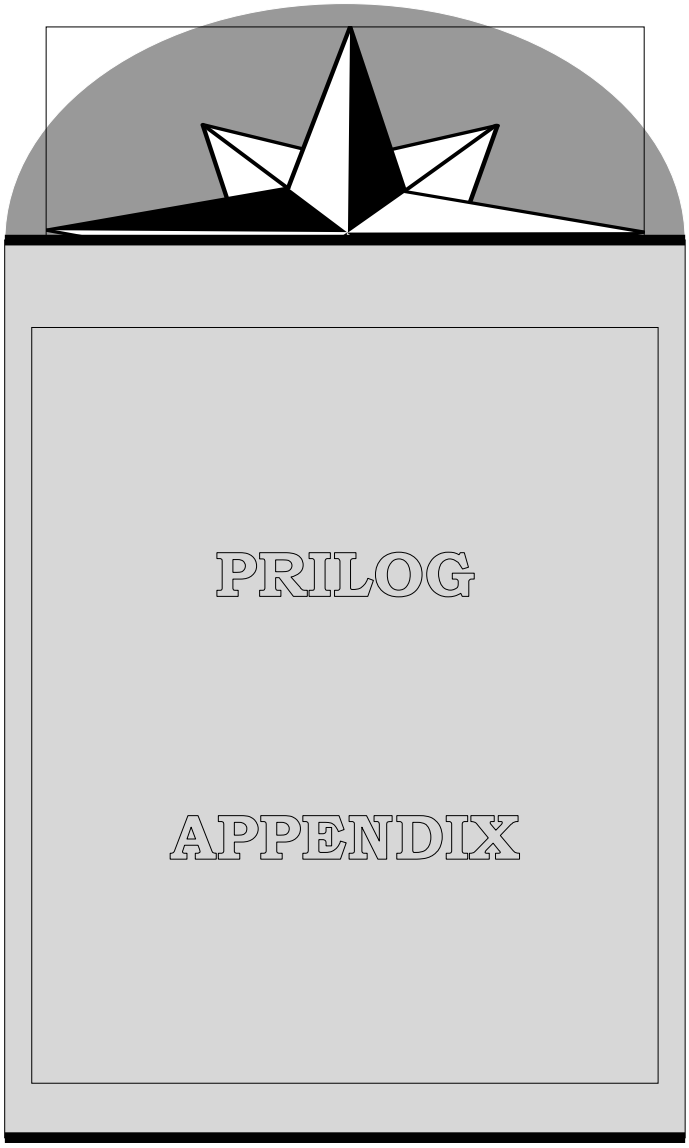
Since 1998, interdisciplinary research has been performed in the Velebit Channel and Zrmanja Estuary along the 113 km long profile. The scope of the research is to define taxonomic composition of phytoplankton, contribution of size categories, and trophic relationships in the area. Coccolithophorids are mostly nanoplanktonic (cells 2 – 20 μm). Periplast

Periplast stanica (kokosfera) sastoji se od karbonatnih pločica – kokolita. Oblik kokolita je važno taksonomsko obilježje. Dvadeset vrsta je bilo moguće odrediti pomoću svjetlosnog mikroskopa. Abundancija kokolitoforida određena je inverznim mikroskopom. Koncentracija karakterističnog pigmenta hexanoil-oksifukoksantina pokazuje raspodjelu biomase. Dominantna vrsta je *Emiliania huxleyii* s maksimalnom abundancijom od 3 x 10^6 stanica L^{-1}, a pronađena je u 40% od 104 analizirana uzorka. Maksimalni razvoj kokolitoforida zabilježen je u proljeće (2-6. mjesec) u hidrološki stabilnijim uvjertima (s većim salinitetom) u Velebitskom kanalu. Razvoj kokolitoforida ovisi o koncentraciji nutrijenata, pa se često nakupljaju u vanjskom (slanijem) dijelu estuarija Zrmanje. U gornjem dijelu estuarija, gdje je brža izmjena vodenih masa i smanjen salinitet, kokolitoforidi su odsutni.

of cells is composed of coccoliths (calcium carbonate). Morphology of coccolits is important taxonomic characteristic. Twenty species have been determined by light microscope. Abundances were determined using inverted microscope. Concentration of hexanoil-oxyfucoxanthin indicated distribution of biomass. *Emiliania huxleyii* was dominant species with maximum abundance of 3 x 10^6 cells L^{-1}, present in 40% of 104 samples. Maximum development of coccolithophorids appeared in spring (February to June), in hydrologicaly stabile conditions, in saltier areas of Velebit Channel. Development of coccolithophorids was stimulated by nutrients, resulting in their accumulation in the lower Zrmanja Estuary (Novigrad area). In the upper estuary, low residence time of water and low salinity did not allow coccolithophorids to be abundant.



PRILOG

APPENDIX

115. OBLJETNICA BOTANIČKOG VRTA PRIRODOSLOVNO-MATEMATIČKOG FAKULTETA U ZAGREBU

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Zamisao o osnivanju Botaničkog vrta potekla je još 1876. godine od Bohuslava Jiruša, tadašnjeg prvog profesora botanike na Sveučilištu u Zagrebu. Međutim, osnivač mu je prof. dr. Antun Heinz koji je 1889. zajedno s nadvrtlarom Viteslavom Durchanekom izradio nacrt za Botanički vrt, pa se ta godina smatra godinom njegova utemeljenja. Godinu dana kasnije izgrađena je vrtlarska kuća (danas upravna zgrada), prvi zemljani radovi počeli su 1891. godine, a prva sadnja 1892. Od samog osnutka Botanički vrt je zajedno s Botaničko-fiziologičkim zavodom pripadao Sveučilištu, kasnije postaje dio Mudroslovnog (filozofskog) fakulteta, a od 1946. godine dio Prirodoslovno-matematičkog fakulteta

THE 115TH ANNIVERSARY OF THE BOTANICAL GARDEN OF THE FACULTY OF SCIENCE IN ZAGREB

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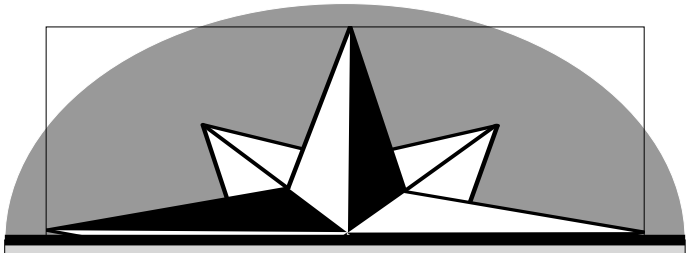
The idea to found a botanical garden was mooted as far back as 1976 by Bohuslav Jiruš, then the first professor of botany at Zagreb University. However, the actual founder was Professor Antun Heinz DSc who, in 1889, together with head-gardener Viteslav Durchanek, drew up a plan for the Botanical Garden, this year thus being considered the year of its foundation. A year later the gardener's house (today the administration building) was constructed, the first works on the land began in 1891, and the first planting took place in 1892. From its very foundation, the Botanical Garden, together with the Botanical and Physiological Institute, belonged to the University, and later on became part of the Faculty of

Sveučilišta u Zagrebu. U svojim počecima Botanički vrt je služio prvenstveno nastavnom i znanstvenom radu, a ta mu je osnovna zadaća ostala i danas. Zbog svoje velike obrazovne, kulturno-povijesne i turističke vrijednosti i sveukupnog značenja za grad Zagreb i Republiku Hrvatsku Botanički vrt je od 1971. godine zakonom zaštićen kao spomenik prirode i kulture. Botanički vrt nalazi se i danas na istom mjestu gdje je i ponikao. U svojim temeljima, Vrt je zadržao prvobitnu arhitekturu, a tijekom vremena izmijenile su se neke pojedinosti i to uglavnom u zapadnom dijelu Vrta. Najveći dio Vrta zauzima perivoj – arboretum, građen u pejzažnom stilu. Cvjetni parter u središnjem dijelu Vrta građen je u francuskom stilu, strogo simetričnih linija. Poviše cvjetnog partera smješteni su staklenici. Veliki dio bilja koje se u njima njeguje nalazi se ljeti vani na otvorenom (palme, fikusi, sukulente, mediteransko bilje itd.). U istočnom dijelu vrta nalaze se dva mala umjetna jezera s lopočima. Samonikla flora uzgaja se na nekoliko biljnogeografskih skupina. Nedostatak prostora za nove biljke, većinom dotrajali objekti i kronični nedostatak novca veoma otežavaju ostvarenja naših planova i nastojanja da obogatimo sadržaje i djelatnosti Vrta. Ipak, unatoč poteškoćama, zaposlenici Vrta, zajedno s drugim stručnim i znanstvenim institucijama, uvelike se posvećuju istraživanju, uzgoju i zaštiti hrvatskih

Philosophy, and then, in 1946, of the Faculty of Science of Zagreb University. At its beginnings, the Botanical Garden was used primarily for the purposes of teaching and scientific work, which has been its task down to the present day. Because of its great educational, cultural and historical as well as tourist value and its overall importance for the city of Zagreb and the Republic of Croatia, in 1971 the Botanical Garden was proclaimed a statutorily protected monument of nature and culture. The Botanical Garden lies today in the selfsame spot in which it came into being. In its foundations, the Garden has retained the original architecture, while over the course of years some of the details have changed, primarily in the western part of the Garden. The largest part of the Garden is occupied by the landscape garden and arboretum laid out in the landscape style. The flower parterre in the central part of the Garden is built in French style, with strictly symmetrical lines. Above the flower parterre are located the glasshouses. Many of the plants in them are placed outside in the summer (the palms, rubber plants, succulents, Mediterranean plants and so on). In the eastern part of the garden are two small ornamental lakes with water lilies. Wild flowers are allowed to grow in several groups defined according to plant geography. Lack of space for new plants, the mostly dilapidated buildings and the chronic shortage of money hamper the fulfilment of all our

autohtonih biljaka te informiranju i ekološkom obrazovanju studenata, učenika i ostalih posjetitelja Vrta. Posljednjih nekoliko godina uložena su znatna sredstva u osnovnu infrastrukturu Vrta, izradu potrebne dokumentacije za obnovu nekih objekata, tiskanje informativno-obrazovnih publikacija itd.

plans and our endeavours to enrich the contents and activities of the Garden. Nevertheless, in spite of all the difficulties, employees of the Garden, together with other professional and scientific institutions, vigorously devote themselves to research, the cultivation and protection of Croatian indigenous plants, and to providing information and ecological educational for students and schoolchildren and other visitors to the Garden. In the last few years considerable resources have been invested in the basic infrastructure of the Garden, the drawing-up of the documentation necessary for the renovation of certain facilities, the printing of educational and informative publications, and so on.



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