2. hrvatski botanički kongres

2nd Croatian Botanical Congress

s međunarodnim sudjelovanjem
with international participation

Zagreb, Hrvatska **20. - 22. rujna 2007.**
Zagreb, Croatia September **20th - 22nd 2007**

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2. hrvatski botanički kongres

2nd Croatian Botanical Congress

knjiga sažetaka

book of abstracts

PREDGOVOR

Dragi kolege,
Organizacijski odbor želi Vam izraziti dobrodošlicu na 2. Hrvatskom botaničkom kongresu s međunarodnim sudjelovanjem, koji je organiziralo Hrvatsko botaničko društvo (HBoD).
Domaćin kongresa je Agronomski fakultet Sveučilišta u Zagrebu, najstarija i vodeća visokoobrazovna i znanstvena institucija iz područja poljoprivrede i srodnih znanosti u Republici Hrvatskoj.
Cilj je Kongresa naglasiti nužnost uporabe podataka i dostignuća iz područja botanike, posebno u smislu zaštite biološke raznolikosti i primjene botanike u provođenju projekata održivog razvoja hrvatskoga gospodarstva.

Veliko je zadovoljstvo znati da je zajednički trud Znanstvenog i Organizacijskog odbora uložen u pripremu Kongresa polučio veliki interes i odaziv. Tako očekujemo više od 100 sudionika. Pored pozvanih predavanja pristiglo je 95 sažetka. Svi sažeci bili su pregledani od strane članova Znanstvenog odbora, te im ovom prilikom zahvaljujemo na njihovom vremenu i trudu. Za usmeno je izlaganje odabrano 30 sažetaka dok će ostali biti prezentirani u obliku postera.

PREFACE

Dear Colleagues,
Organizing Committee welcomes you to the 2nd Croatian Botanical Congress with international participation, organised by the Croatian Botanical Society (HBoD).
The Congress is hosted by the Faculty of Agriculture University of Zagreb, the oldest and the leading institution of higher education and research in the field of agriculture and related sciences in the Republic of Croatia.

It was a great pleasure to find out that joint effort of Scientific and Organizing Committee invested in preparation of the Congress yielded widespread interest. Therefore, we expect more than 100 participants. We have received abstracts of 95 contributions in addition to invited lectures. All the abstracts have been thoroughly reviewed by the members of Scientific Committee and hereby we thank them for their time and efforts. They have selected 30 abstracts for oral presentations, while the remaining contributions will be presented as posters.

As an outcome, we can expect that the Congress will emphasis the utilization of the data and accomplish-

Zadnje no ne i najmanje važno, Organizacijski odbor želi zahvaliti potpori sponzora. Bez njihove pomoći organizacija ovog Kongresa bila bi u mnogome otežana.
Želimo Vam vrlo uspješan rad i ugodan boravak u Zagrebu.

U ime Organizacijskog odbora,
Doc. dr. sc. Mihaela Britvec

ments in the field of the botany, especially towards biological diversity protection and implementation of the botany in the Croatian economy sustainable development projects.
And last but not the least; the Organizing Committee greatly appreciates support from the sponsors. Without their help the task of organizing this Congress would become extremely taunting.

We wish you all a very fruitful meeting and pleasant stay in Zagreb.

on behalf of the Organizing Committee
Mihaela Britvec, Ph. D.

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Hrvatsko botaničko društvo (HBoD)

ORGANIZATION

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UNDER THE AUSPICIES OF

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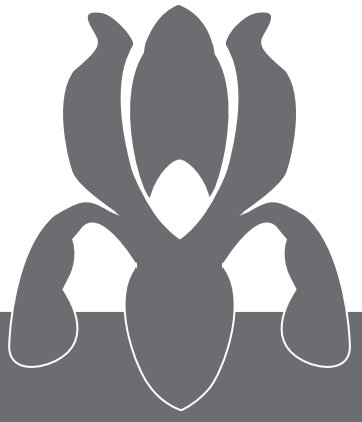
Primjenjena botanika / Applied botany

Biologija algi, gljiva i lišajeva / Biology of algae, fungi and lichens

Botanika i obrazovanje / Botany and education



plenarna predavanja

plenary lectures

THE REGULATION OF AUXIN LEVELS IN PLANTS – AN EVOLUTIONARY PERSPECTIVE

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Both higher and lower plants regulate auxin balance through interactions among de novo synthesis, degradation, transport, and conjugate synthesis/hydrolysis. To understand how the control of auxin homeostasis has evolved among land plants, a molecular genetic approach was used to isolate and characterize components involved in the regulation of auxin conjugate synthesis and hydrolysis in a variety of plant species. Several genes encoding putative auxin conjugate hydrolases were isolated from the dicots *Arabidopsis suecica*, a close relative to *Arabidopsis thaliana*, *Medicago truncatula*, a model legume, the monocot *Triticum aestivum* and the gymnosperm *Pinus taeda*. Different temporal and spatial expression patterns for the hydrolase genes from different species indicate different roles for each isoform during development. Expression of the hydrolase genes in *E. coli* allowed the investigation of substrate specificity, which showed strong differences among the amidohydrolases from various plant species. Synthesis of auxin conjugates with amino acids by members of the GH3 family was compared between the moss *Physcomitrella patens*, which has only two genes, and *Arabidopsis thaliana*, which has a large gene family. Expression of both moss genes in *E. coli* revealed that these ancient GH3 proteins possessed dual functions for auxin and for jasmonate homeostasis. Later, during land plant evolution, the GH3 family was expanded in *Arabidopsis*, where these proteins gained tighter substrate specificity.

FUNCTIONAL APPROACH IN GRASSLAND PHYTOSOCIOLOGY – CASE STUDIES FROM SLOVENIA

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Phytosociology is based on floristic relevés, but classifying plants according to their taxonomy has limitations when answering ecological questions at the scale of habitats, ecosystems and landscapes, including responses of vegetation to environmental variables, disturbances, land-use and climate change. An alternative way to address those issues is by classifying plants to plant functional types (PFT) - groups of species sharing similar functioning at the organismal level, similar responses to environmental variables and/or similar roles in ecosystems (e.g. productivity, nutrient cycling, flammability and resilience). They could also have the same plant strategies. Species comprising a PFT share a set of key morphological-functional traits (MFT).

The first step is to select the most important MFTs for both understanding and prediction of phenomena relevant for our research. MFT are obtained by field or lab measurements or from the literature. They are usually classified to life-history (life span, life-cycle), morphology (plant height, lateral spread, life form, spinescence, specific leaf area (SLA), leaf dry matter content (LDMC) and regeneration (seed characters - size and mass, germination behavior including recruitment frequency, dispersal mode, clonal ability, etc.). Grime's CSR strategies are also a very important functional parameter in plant communities.

Classification of the relevés of the *Mesobromion* grasslands in Slovenia, based on floristical approach, shows clear divergences to associations, while a functional approach, based on 11 MFTs shows no divergence – all grasslands have roughly the same functional structure. The same pair of classifications between karst meadows (*Scorzonerion villosae*) and karst pastures (*Satureion subspicatae*) shows divergences in both floristic and functional basis: floristically defined syntaxa differ also functionally.

Primary succession on sandstone sea cliffs and on pioneer gravel river banks was followed by means of Grime's CSR strategies; the releves followed the plant strategies as a response to abiotic factors.

The existing syntaxonomical scheme of halophile vegetation is "on the test" throughout functional classification, where SLA, LDMC and germination behaviour were selected as the key traits for halophile vegetation assemblages.

CARL VON LINNÉ – ŽIVOT I DJELO OCA BINOMNE NOMENKLATURE

Sanja Kovačić

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U godini 300-te obljetnice rođenja Carla von Linnéa Hrvatsko botaničko društvo odaje počast tom velikom čovjeku osvrtom na njegov život i djelo. Taj osebujni prirodoslovac jedinstvenih shvaćanja živoga svijeta rođen je 23. svibnja 1707. u provinciji Småland na jugu Švedske, gdje je proveo djetinjstvo i mladost. Školovan u Švedskoj i Nizozemskoj, 40-tak godina života proveo je kao profesor botanike i medicine u Uppsali. Tijekom bogate znanstvene karijere napisao više od 70 knjiga i 300 znanstvenih radova, pa ga Šveđani drže jednim od svojih najplodnonosnijih pisaca 18. stoljeća i najvećim švedskim znanstvenikom svih vremena. Za nas taj prirodoslovac ima poseban značaj zbog usavršavanja i popularizacije sustava dvojnog latinskog nazivlja (binomna nomenklatura), čija su pravila opće prihvaćena u biologijskim znanostima širom svijeta. Von Linné, koji je još za života stekao svjetski ugled i slavu, umro je 10. siječnja 1778. u Uppsali, ostavljajući za sobom mnogobrojne sljedbenike te opsežno nasljeđe za koje se danas dostojno brine Londonsko Linnéovo društvo (*Linnean Society of London*) sa svojim svjetskim podružnicama.

CARL VON LINNÉ – LIFE AND LEGACY OF THE FATHER OF BINOMIAL NOMENCLATURE

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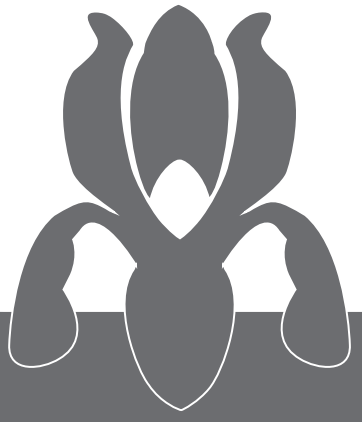
In the year 2007, the world celebrates tree centuries since the birth of Carl von Linné, whose life and work is honoured here by Croatian Botanical Society. The famous naturalist with unique perspective of the living world was born on 23 May 1707 in Småland province (southern Sweden), where he spent his childhood and adolescence. After education in Sweden and Holland, he spent 40 years at the University in Uppsala, teaching botany and medicine. During his career, von Linné wrote more than 70 books and 300 scientific papers and is therefore considered by his countrymen one of the most fruitful writers of the 18th century Sweden and the greatest Swedish scientific mind of all times. To us, he has a special importance for improving and popularizing the system of binomial nomenclature, the rules of which are recently used in biological sciences worldwide. Von Linné, who received world respect and fame during his life, died in Uppsala on 10 January 1778, leaving behind many disciples and large legacy, today respectfully cared for by the *Linnean Society of London* with its many world branches.



floristička istraživanja

floristic research

RASPROSTRANJENOST SVOJTI PODRODA *CYANUS* RODA *CENTAUREA* (ASTERACEAE) U FLORI HRVATSKE

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Od preko 80 svojti roda *Centaurea* L. navedenih u Popisu flore Hrvatske podrod *Cyanus* (Mill.) Hayek u hrvatskoj je flori zastupljen sljedećim svojtama: *Centaurea cyanus* L., *C. mollis* Waldst. et Kit., *C. montan*a L., *C. tuberosa* Vis. te *C. triumfetti* All. koja je uz osnovnu vrstu zastupljena i podvrstama *C. triumfetti* All. ssp. *adscendens* (Bart.) Dostál te *C. triumfetti* All. ssp. *stricta* (Waldst. et Kit.) Dostál. Sve navedene svojte rasprostranjene su kao i u ostalim europskim zemljama, većeg su ili manjeg areala, osim široko rasprostranjene vrste *C. cyanus* koja se uglavnom pojavljuje kao korov žitarica u sjevernom umjerenom području. Vrsta *C. mollis* rasprostranjena je u središnjoj i istočnoj Europi, *C. montan*a na planinama Europe, a areal vrste *C. tuberosa* obuhvaća planine od Hrvatske do južne Bugarske. Vrsta *C.*

DISTRIBUTION OF THE TAXA OF SUBGENUS *CYANUS* OF GENUS *CENTAUREA* (ASTERACEAE) IN THE FLORA OF CROATIA

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Of the 80 taxa of the genus *Centaurea* L. listed in the Index Florae Croaticae, the subgenus *Cyanus* (Mill.) Hayek is represented in the flora of Croatia by the following taxa: *Centaurea cyanus* L., *C. mollis* Waldst. et Kit., *C. montan*a L., *C. tuberosa* Vis. and *C. triumfetti* All., which along with the common species, is represented by its subspecies *C. triumfetti* All. ssp. *adscendens* (Bart.) Dostál and *C. triumfetti* All. ssp. *stricta* (Waldst. et Kit.) Dostál. All the above mentioned taxa have a broader or more restricted European distribution, except the widely distributed *C. cyanus* which is a weed of cornfields throughout the northern temperate region. The species *C. mollis* is distributed throughout central and eastern Europe, *C. montan*a on the mountains of Europe, while the area of distribution of the species *C. tuberosa* spans the mountains

triumfetti sa svojim je podvrstama rasprostranjena u središnjoj i južnoj Europi. Za navedene su svojte na temelju postojećih literaturnih i herbarskih podataka te terenskih opažanja unesenih u bazu podataka Flora Croatica Database 2.7. (FCD), izrađene karte rasprostranjenosti u Hrvatskoj s komentarima njihova taksonomskog statusa.

from Croatia to southern Bulgaria. The species *C. triumfetti* and its subspecies are distributed in central and southern Europe. For the mentioned taxa, distribution maps for Croatia were created based on literature, herbaria data and field observations entered in the Flora Croatica Database 2.7. (FCD). Comments are made as to their taxonomical status.

FLORA ULAZNIH DIJELOVA NEKIH JAMA I ŠPILJA ŽUMBERAČKOG GORJA

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U ovom radu prikazani su rezultati floristićkih istraživanja ulaznih prostora nekih speleoloških objekata Žumberačkog gorja. Istraživanjem je obuhvaćeno ukupno sedam speleoloških objekata od kojih su dvije jame (Puhaljka, Tomaševička) i pet špilja (Špilja u kamenolomu, Propuh, Vilinske jame, Židovske kuće, Jamina). Inventarizirana je flora na prostorima oko ulaza, te na različitim dubinama ulaznog dijela speleološkog objekta. Od ukupnog broja prikupljenih i popisanih vrsta manji je broj zabilježen u unutrašnjosti objekta.
Zabilježene biljke podvrgnute su: taksonomskoj analizi, analizi zastupljenosti prema tipu staništa (jama, špilja), analizi sličnosti među staništima (Sörensenov koeficijent sličnosti) te analizi indikatorskih vrijednosti i životnih oblika.

FLORA AT PIT AND CAVE ENTRANCES ON ŽUMBERAK MOUNTAIN

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This study presents results of floristic research performed at the entrances of speleological objects of Žumberak Mountain. Research was conducted in seven speleological objects: two pits (Puhaljka, Tomaševička) and five caves (Cave in the quarry, Propuh, Vilinske Pit, Židovske kuće, Jamina). The inventarization of flora was performed at the entrance surroundings and at different levels of the entrances of the speleological objects. Several of the collected and listed species were also recorded inside the objects. Recorded plants were analyzed both taxonomically and by the abundance in the type habitats (pit, cave). Furthermore, similarity between habitats (Sørensen index of similarity), indicatory values and life forms were also analyzed.

MORFOLOŠKA RAZNOLIKOST RODA *OCIMUM*

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Vrste roda *Ocimum* (Lamiaceae) jednogodišnje su ili višegodišnje začinske i ljekovite biljke ugodna mirisa i velike raznolikosti po kemijskim i morfološkim svojstvima. Razlog velike raznolikosti je u iznimnoj jednostavnosti međukrižanja unutar roda *Ocimum*. Između kultivara, botaničkih varijeteta, podvrsta, pa i vrsta bosiljka nema jasnog morfološkog diskontinuiteta pa je čest slučaj višestrukog imenovanja. Iz navedenih razloga, prema listi deskriptora koja omogućava preciznu identifikaciju različitih svojti bosiljka, analizirano je 65 primki Hrvatske banke biljnih gena koju čini 9 vrsta (*O. basilicum* L., *O. minimum* L., *O. americanum* L., *O.* x *citriodorum* Vis., *O. gratissimum* L., *O. tenuiflorum* L., *O. champechianum* Mill., O. *kilimandscharicum* Baker ex Gürke, *O. selloi* Benth.). Fenotipska udaljenost između primki izračunata je po koficijentu jednostavnog podudaranja. Nakon provedene analize UPGMA, primke vrste *O. basilicum*, *O. minimum*, *O. americanum*, *O.* x *citriodorum* i *O. champechianum* odvajaju se u zasebnu skupinu „Basilicum“ unutar koje postoji nekoliko podskupina.

MORPHOLOGICAL DIVERSITY WITHIN THE GENUS *OCIMUM*

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The genus *Ocimum* (Lamiaceae) comprises annual and perennial herbs and shrubs which are used as spices and medicinal plants. The genus is characterized by high levels of both chemical and morphological variability. The source of this wide variability is simplicity of hybridization within the genus *Ocimum*. As there is no clear morphological discontinuity between cultivars, botanical varieties, subspecies and even species, the taxonomy of the genus *Ocimum* is complex and confusing. For the purpose of identification, 65 basil accessions of Croatian Bank of Plant Genes were analyzed according to the list of descriptors which enables accurate identification of different species, forms and cultivars. Analyzed accessions belong to *O. basilicum* L., *O. minimum* L., *O. americanum* L., *O.* x *citriodorum* Vis., *O. gratissimum* L., *O. tenuiflorum* L., *O. champechianum* Mill., *O. kilimandscharicum* Baker ex Gürke and *O. selloi* Benth. Phenotypic dissimilarities between all pairs of accessions were calculated by simple matching distance and the results were shown by UPGMA dendrogram. A number of clearly defined

Najuočljivija razlikovna svojstva primki podskupina Genovese, Minimum i Difforme su zeleni listovi i bijeli cvjetovi, dok se primke podskupine Purpurascens odlikuju ljubičastom bojom listova, cvjetova i/ili stabljike. Posebnom se granom iz skupine Basilicum odvojila vrsta *O. selloi*. Primke vrste *O. gratissimum* čine zasebnu skupinu kao i primke vrste *O. tenuiflorum* uz primku vrste *O. kilimandscharicum*. Radi boljeg rukovanja kolekcijom ljekovitog i aromatičnog bilja, navedeni rezultati bit će upotpunjeni podacima dobivenim na temelju molekularnih i biokemijskih biljega u Zavodu za sjemenarstvo, Agronomskog fakulteta Sveučilišta u Zagrebu.

clusters have been detected based on analyzed morphological traits. Accessions belonging to *O. basilicum*, *O. minimum*, *O. americanum*, *O.* x *citriodoru*, and O. *champechianum* form the cluster „Basilicum" with four separated subclusters. Accessions within subclusters „Genovese", „Minimum", and „Difforme" are characterized by green leaves and white flowers. Violet colour of leaves, flowers and/or stems are the most important traits for the accessions that formed „Purpurascens" subcluster. *O. selloi* was separated from „Basilicum" cluster. Accessions belonging to *O. gratissimum* formed a clearly distinct cluster, as did the accessions belonging to *O. tenuiflorum* and an accession belonging to *O. kilimandscharicum*. These results will be complemented with molecular and biochemical marker data to be used in management of the gene bank collection of the medicinal and aromatic plants held at the Department of Seed Science and Technology, Faculty of Agriculture, University of Zagreb.

WOMBSOFT – METODA ZA PRONALAŽENJE BARIJERA U EKOLOGIJI I POPULACIJSKOJ GENETICI TEMELJENA NA WOMBLING PRISTUPU

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Točno određivanje prostorne raspodjele bioraznolikosti jedan je od preduvjeta uspješnog definiranja konzervacijskih planova. Određivanje barijera (definiranje područja značajne promjene promatrane varijable) potencijalan je način opisivanja te raspodjele.
U ekologiji se upotrebljavaju metode za pronalaženje barijera, a sve im se više pozornosti pridaje i u području populacijske genetike (za pronalaženje barijera slobodnom toku gena). U ovom je radu prikazana metoda za pronalaženje i testiranje značaja barijera temeljena na Wombling pristupu u kojoj se vrijednosti sistemičke funkcije procjenjuju korištenjem lokalne polinomijalne regresije. Wombsoft je distribuiran u obliku paketa za program R i može se primijeniti za analizu kodominantnih (npr. mikrosateliti) ili dominantnih (npr.

WOMBSOFT – WOMBLING-BASED METHOD FOR BOUNDARY DETECTION IN ECOLOGY AND POPULATION GENETICS

Ameline Crida[1], Toni Safner[1, 2] and Stéphanie Manel[1]

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Identification of the spatial pattern of biodiversity is one of the requirements for the successful conservation planning. Delineation of boundaries (i.e., detection of areas of sharp change for the variable of interest) is a potential approach to describe such patterns.
Boundary detection methods are widely used in ecology, and are recently receiving more attention in population genetics (for detection of boundaries to gene flow). Here we introduce an original Wombling-based method for detection and testing the significance of boundaries in which the values of the systemic function are estimated using a local polynomial regression. Wombsoft is implemented as an R package and it can be applied to codominant (i.e. microsatellites) or dominant markers (i.e. AFLP), as well as contingency (i.e. species frequency) data on geo-referenced

AFLP) biljega, kao i podataka u kontingencijskim tablicama (npr. učestalost vrsta) prikupljenih za georeferencirane jedinke (ili točke). Definirane barijere mogu se prikazati na kartama pomoću GIS programa i povezati s okolišnim varijablama kroz perspektivu krajobrazne ekologije.
Tipična primjena metode prikazana je na primjeru analize seta podataka iz projekta INTRABIODIV.

sampling points (or individuals). Detected boundaries can be projected on a map using GIS software and correlated to environmental variables in a landscape ecology perspective.
The typical application is illustrated by the analysis of a dataset from an INTRABIODIV project.

FLORISTIČKA KOMPARACIJA PANONSKIH I MEDITERANSKIH SLATINA

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Za florističku analizu izabrana je mediteranska slatina u okolini Tivta i jedna panonska slatina u okolini Bašaida. Jedini prirodno očuvani lokalitet mediteranskih slatina tipa primorske slatine-močvare u Bokokotorskom zaljevu (Crna Gora) su Tivatska solila. Tivatska solila pripadaju mediteranskoj biogeografskoj regiji, europsko-mediteranskoj podregiji, jadransko-jonskoj provinciji. Tip tla na Tivatskim solilima je solončak. Panonske, odnosno kontinentalne slatine u okolini Bašaida, nalaze se u Vojvodini i pripadaju pontskoj biogeografskoj regiji, panonsko-vlaškoj podregiji, panonskoj provinciji. Tip tla na Bašaidskim slatinama je solonec, mjestimično solončak. Panonske i mediteranske slatine su jedni od centara floističkog diverziteta Srbije i Crne Gore. Komparativna floristička analiza kontinentalnih (slatine kod Bašaida) i meditranskih (Tivatska solila) slatina je obavljena klasičnom floističkom analizom i statističkom metodom korespodentne analize.

FLORISTIC COMPARISON BETWEEN PANNONIAN AND MEDITERRANEAN SALT PANS

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Mediterranean salt pans near Tivat and a Pannonian salt pan near Bašaid were selected for floristic analysis. The only naturally preserved locality of the Mediterranean salt pan type of marine–salt marshes, is the "Tivatska solila" or Tivat salt pans in Boka Kotorska Bay (Montenegro). The Tivat salt pans belong to the Mediterranean biogeography region, European-Mediterranean subregion, Adriatic-Ionian province. The soil type is solonchak. Pannonian, or continental, salt pans near Bašaid are in Vojvodina and belong to the Pontic biogeographical region, Pontic-Wallachian subregion, Pannonicum province. The soil types of the Bašaid salt-pans are mainly solonetz and some solonchak. Pannonian and Mediterranean salt pans are one of few biodiversity centres in Serbia and Montenegro. Comparative floristic analysis of continental (Bašaid salt plans) and Mediterranean (Tivat salt pans) were conducted using classical floristic analysis and the statistical method of correspondent analyses.

FLORISTIČKI SASTAV I GOSPODARSKA VRIJEDNOST LIVADA PLEŠIVIČKOG PRIGORJA (SZ HRVATSKA)

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Na području Plešivičkog prigorja livade se prostiru na 8200 ha. Livade Plešivičkog prigorja floristički su istraživane na devet lokacija tijekom dvije vegetacijske sezone (2002, 2003). Primijenjene su uobičajene metode bilježenja biljaka, prikupljanja i identifikacije. Nomenklatura svojti je usklađena prema Tutinu (1964-1980, 1993). Gospodarska vrijednost livada analizirana je s aspekta krmne (Šoštarić – Pisačić i Kovačević, 1974), medonosne (Šimić, 1980) i ljekovite vrijednosti biljnih vrsta (Gelenčir i Gelenčir, 1991).
Na istraživanom području Plešivičkog prigorja zabilježene su 103 biljne svojte livadne flore u okviru 27 porodica. Analizom floističkog sastava zabilježene su 24 vrste kvalitetnih krmnih biljaka, 79 korovnih vrsta, 46 medonosnih vrsta, te 39 ljekovitih biljaka.

FLORISTIC COMPOSITION AND ECONOMIC VALUE OF MEADOWS ON PLEŠIVICA HILLS (NW CROATIA)

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Meadows cover approximately 8200 ha of the Plešivica hills. The meadows were explored on Plešivica hills (NW Croatia) at 9 locations during two vegetational seasons (2002, 2003). Typical methods of plant recording, collecting and identification were applied in the research of garden weed flora. The nomenclature of plants is according to Tutin et al. (1964-1980, 1993).
The economic value of the meadow species was analyzed as forage value (Šoštarić – Pisačić & Kovačević, 1974), honey plants (Šimić, 1980) and medicinal value of plants (Gelenčir & Gelenčir, 1991).
103 taxa, belonging to 27 families, were recorded in the meadow flora. The floristic composition of the meadows shows 24 species of very high forage quality, 79 weed species, 46 honey plants and 39 medicinal herbs.

RASPROSTRANJENOST RODA *RUBUS* U HRVATSKOJ

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Autohtone i samonikle svojte roda *Rubus* proširene su po cijelom svijetu, a najviše u Europi i Sjevernoj Americi. Rod *Rubus* zastupljen je u svijetu s više od 200 svojti, a u Europi se spominje 75 svojti. Približno pola svojti prisutnih u Europi zabilježeno je u različitim regijama Republike Hrvatske. Prema dosadašnjim podacima u Hrvatskoj se unutar roda *Rubus* navode 33 svojte. Mnoge svojte roda *Rubus* su tetraploidi, a poznati su diploidi, triploidi, pentaploidi i heksaploidi, što utječe na taksonomsku i floristička raznolikost ovog roda. Intenzivnim selekcijskim radom dobiven je velik broj novih, gospodarski vrijednih sorti kupina i malina.
Rod *Rubus* u svijetu je uveden u proizvodnju prije 150 godina, a kod nas prije 40–tak godina. Na području Hrvatske u komercijalnoj proizvodnji i na okućnicama uzgajaju maline (*Rubus idaeus* L.), kupine (*Rubus* spp.) i križance različitih malina i kupina, a za proširenje uzgoja postoje vrlo povoljni ekološki uvjeti.
Zbog izuzetne dijetoterapeutske vrijednosti, a osobito zbog sadržaja antioksidativnih tvari koje štite stanicu

THE SPREAD OF *RUBUS* SPP. IN CROATIA

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Autochthonous and wild edible taxa of the genus Rubus are distributed worldwide, but mostly in Europe and North America. The genus *Rubus* is represented with more than 200 taxa globally, of those 75 taxa are distributed in Europe. Approximately one-half of all European *Rubus* taxa are represented in different regions of Croatia. According to available literature, 33 taxa within the genus *Rubus* are distributed in Croatia. Many taxa of the genus *Rubus* are tetraploids, though diploids, triploids, pentaploids and hexaploids are also known, influencing the taxonomic and floristic variability of the genus. Numerous new economically important blackberry and raspberry varieties are created, as a result of selection and breeding.
The genus *Rubus* was introduced in cultivation approx. 150 years ago, but only some 40 years ago in Croatia. Raspberries (*Rubus ideaus* L.), blackberries (*Rubus* spp.) and intercrosses of raspberries and blackberries are cultivated in commercial orchards and gardens in Croatia. Favourable conditions for expanding cultivation exist. Due to exceptional nutritive and therapeuti-

od nepoželjnog djelovanja slobodnih radikala, sve je veća potražnja plodova koji su za konzumaciju u svježem ili prerađenom stanju.

Cilj je ovog rada prikazati rasprostranjenost predstavnika samoniklih svojti roda *Rubus* na području različitih regija Hrvatske, te ukazati na njihove potencijale.

cal value, and especially high contents of antioxidants which protect cells from free radicals, consumption demand for these fruits, either fresh or processed, is increasing.

The objective of this paper is to present the spread of wild edible *Rubus* taxa in different regions of Croatia, pointing out the potentials of their utilization.

BIORAZNOLIKOST VOČNIH VRSTA U HRVATSKOJ

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Prirodna vegetacija na području Hrvatske teži svom prirodnom klimaksu, a to je primarni ekološki sustav - šuma. Upravo šuma sa šumskim rubom obiluje velikim brojem vrsta samoniklog voća koje predstavlja izuzetno vrijedno bogatstvo. Najzastupljenije svojte u Hrvatskoj pripadaju rodovima *Rubus* (33 svojte), *Prunus* (21 svojta), *Sorbus* (13 svojti), *Crataegus* (10 svojti), *Fragaria* (6 svojti), *Malus* (5 svojti), *Pyrus* i *Vaccinium* (4 svojte). Pretpostavlja se da su populacije samoniklog voća u Hrvatskoj jedinstvene, te da je nutritivna kakvoća plodova pojedinih voćnih vrsta natprosječna u odnosu na komercijalno uzgajane sorte. Oplemenjivanjem bilja stvorene su brojne sorte u komercijalnoj proizvodnji, a izvorište im je u samoniklim srodnicima. Hortikulturna proizvodnja traži nova rješenja kako u poboljšanju postojeće proizvodnje voća, tako i u oblikovanju okoline u kojoj živimo.

BIODIVERSITY OF WILD EDIBLE FRUIT SPECIES IN CROATIA

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Natural vegetation in Croatia tends towards its own, typical climax: forest, the primary eco-system. The forest and forest edge are very abundant in Croatia, with numerous species of wild edible fruits that represent an exceptionally valuable natural resource. The most represented fruit taxa in Croatia belong to the genera *Rubus* (33 taxa), *Prunus* (21 taxa), *Sorbus* (13 taxa), *Crataegus* (10 taxa), *Fragaria* (6 taxa), *Malus* (5 taxa), *Pyrus* and *Vaccinium* (4 taxa). As presumed, the populations of wild edible fruits are unique, they often have a nutritional value higher than commercially produced fruit varieties. Plant breeding programmes have resulted with many fruit varieties introduced to commercial production, but all these varieties have their origin among wild relatives. Horticultural production is searching for new solutions aimed at improving existing production, but also at shaping the environment

Stoga je potrebno obavljati detaljna istraživanja radi inventarizacije genetskih izvora postojećeg samoniklog voća i sačuvati zanimljive jedinke u bankama gena.

in which we live. Therefore, detailed research with the objective of constructing the base inventory of the genetic resources of existing wild edible fruits is needed, alongside conservation of interesting accessions in the gene banks.

VASKULARNA FLORA PODRUČJA PANTAN

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Pregledom dostupne literature i prigodom floističkog istraživanja (2005./06. god.) vaskularne flore na području Pantan (UTM XJ01 i XJ02), zabilježeno je sveukupno 269 taksona. Od tog broja, tijekom ovog istraživanja, utvrđeno je novih 177 taksona. Od ukupnog broja taksona njih 107 ili 39 % pripada skupinama mediteranskog flornog elementa, među kojima su najbrojnije općemediteranske biljke. Dominantnost mediteranskog flornog elementa, velik broj taksona porodice *Fabaceae* (40) te broj terofitskih (121 takson ili 45 %) vrsta govori o mediteranskom karakteru istraživanog područja. Na istraživanom području zabilježena je kritično ugrožena vrsta (CR) *Aeluropus litoralis* (Gouan.) Parl., ugrožene svojte (EN): *C. extensa* Gooden. i *Glaucium flavum* Crantz, osjetljive vrste (VU): *Desmazeria marina* (L.) Druce, *Hainardia cylindrica* (Willd.) Greuter, *Salsola soda* L. i *Suaeda maritima* (L.) Dumort.

VASCULAR FLORA OF THE PANTAN TERRITORY

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In a review of the available literature and during a study (2006) of vascular flora in the Pantan territory (UTM XJ01 and XJ02), a total number of 269 taxa was registered. Of this total, 107 or 39% belong to groups of Mediterranean flora elements, with general Mediterranean plants as dominant. The dominance of Mediterranean flora elements, a great number of taxa from the *Fabaceae* family (40), and a number of terophyta (121 taxa or 45%) shows the Mediterranean character of the study area. The critically endangered species (CR) *Aeluropus litoralis* (Gouan.) Parl., endangered species (EN): *C. extensa* Gooden. and *Glaucium flavum* Crantz, vulnerable species (VU): *Desmazeria marina* (L.) Druce, *Hainardia cylindrica* (Willd.) Greuter, *Salsola soda* L. and *Suaeda maritima* (L.) Dumort were reported.

FLORA SREDIŠNJEG DIJELA NACIONALNOG PARKA RISNJAK

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Nacionalni park Risnjak smješten je na području Gorskog kotara, zapadna Hrvatska. Površine je 64 km2, s najvišim vrhom Veliki Risnjak koji dostiže nadmorsku visinu od 1528 metara. Prosječna godišnja količina padalina iznosi 3579 mm, a prosječna temperatura 6.5 0C. Prema Koppenovoj klimatskoj razdiobi istraživano područje pripada snježno–šumskoj klimi sa svježim ljetom. Glavni dio masiva Risnjak sastoji se od slojeva vapnenca, a manji dio od dolomita. Geološka građa je, uz klimu, glavni činilac razvoja raznovrsnog biljnog svijeta od gotovo 1000 biljnih svojti.
Floističkim istraživanjem provedenim u kolovozu 2006.godine obuhvaćeno je šumovito područje između Velikog Risnjaka i Bijelih stijena, ukupne površine 5 km2 . Pronađeno je 210 svojti višeg bilja iz 57 porodica. Zastupljenošću se ističe porodica *Asteraceae*

FLORA OF THE CENTRAL PART OF RISNJAK NATIONAL PARK

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Risnjak National Park is located in the Gorski Kotar area in western Croatia. The park covers an area of 64 km2 and its peak, Veliki Risnjak, is 1528 m above sea level. The average amount of precipitation is 3579 mm and average annual temperature is 6.5°C. According to the Koppen climate classification, the study area belongs to the snow-forest climate with cold summer (Dfc). The main part of the Risnjak massif is formed predominantly of limestone and the rest is dolomite. Geological structure, together with climate, is the main factor of development of almost 1000 plant taxa.
Floristic research conducted in August 2006 covered the forest area between Veliki Risnjak and Bijele stijene, with an overall area of 5 km2. In this study, 210 taxa of higher plants from 57 families were found. The most abundant families are *Asteraceae* (9.0%),

(9.0%), *Ranunculaceae* (7.1%), *Apiaceae* (6.7%), *Liliaceae* (6.2%) i *Lamiaceae* (5.7%). U spektru životnih oblika značajan udjel imaju hemikriptofiti (62.9%), slijede geofiti (13.3%), hamefiti i nanofanerofiti (s po 7.6%), fanerofiti (6.2%) te terofiti (2.4%). U Crvenoj knjizi vaskularne flore Hrvatske nalazi se ukupno 16 vrsta (VU 6, NT 8, LC 1, DD 1). Prema Zakonu o zaštiti prirode, 13 svojti je strogo zaštićeno, a 48 ih je svrstano u kategoriju zaštićenih zavičajnih svojti. Značajno je otkriće pet vrsta koje do sada nisu bile zabilježene, a u flori su Nacionalnog parka Risnjak: *Bromus ramosus* Huds., *Dryopteris expansa* (C.Presl) Fraser-Jenk. et Jermy, *Goodyera repens* (L.) R.Br., *Scabiosa hladnikiana* Host i *Trifolium ochroleucon* Huds.

Ranunculaceae (7.1%), *Apiaceae* (6.7%), *Liliaceae* (6.2%) and *Lamiaceae* (5.7%).

In the life form spectrum, hemicriptophyta are dominant (62.9%) followed by geophyta (13.3%), chamaephyta and nanophanerophyta (each 7.6%), phanerophyta (6.2%) and therophyta (2.4%). In the *Red Book of Vascular Flora of Croatia,* 16 taxa are listed (VU 6, NT 8, LC 1, DD 1). According to the Nature Conservation Act, 13 taxa are strictly protected and 48 taxa are protected. The most valuable contribution of this study is the discovery of five new species for the Risnjak flora: *Bromus ramosus* Huds., *Dryopteris expansa* (C.Presl) Fraser-Jenk. et Jermy, *Goodyera repens* (L.) R.Br., *Scabiosa hladnikiana* Host and *Trifolium ochroleucon* Huds.

INTENZITET ZARAZE HRASTA KITNJAKA (*QUERCUS PETRAEA* /MATT./ LIEBL.) ŽUTOM IMELOM (*LORANTHUS EUROPAEUS* JACQ.) U HRVATSKOJ

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Žuta imela (*Loranthus europaeus* Jacq.) listopadna je kritosjemenjača iz porodice *Loranthaceae* koja živi kao poluparazit na različitim domaćinima. U Hrvatskoj je zabilježena na deset domaćina koji pripadaju rodovima iz porodica *Fagaceae* i *Betulaceae*, od čega je sedam vrsta iz roda *Quercus* L. Dijagonalnim pregledom odsjeka starijih od 30 godina provedeno je istraživanje intenziteta zaraze hrasta kitnjaka (*Quercus petraea* /Matt./ Liebl.) žutom imelom na području kojim gospodare Hrvatske šume d.o.o., Uprave šuma podružnice: 1. Bjelovar (šumarije Bjelovar, Garešnica, Pakrac, Sirač, Suhopolje, Velika Pisanica, Virovitica i Vrbovec), 2. Karlovac (šumarije Gvozd, Jastrebarsko, Karlovac, Slunj i Topusko), 3. Koprivnica (šumarije Ivanec, Križevci i Sokolovac), 4. Našice (šumarije Ćeralije, Đurđenovac, Slatina i Voćin), 5. Nova Gradiška (šumarije Nova Gradiška, Nova Kapela, Novska, Okučani, Oriovac, Slavonski Brod i Trnjani),

THE INCIDENCE OF YELLOW MISTLETOE (*LORANTHUS EUROPAEUS* JACQ.) ON SESSILE OAK (*QUERCUS PETRAEA* /MATT./ LIEBL.) IN CROATIA

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Yellow mistletoe (*Loranthus europaeus* Jacq.) is an epiphytic angiosperm of the *Loranthaceae* family living as a hemiparasite on different hosts. In Croatia, this species was observed on ten hosts belonging to the *Fagaceae* and *Betulaceae* families. Most of the hosts, seven species, were oaks. The research on incidence of yellow mistletoe on the sessile oak (*Quercus petraea* (Matt.) Liebl.) was carried out in natural stands, in the area managed by the company Croatian Forests d.o.o.. Forest Administrations: 1. Bjelovar (Forest Offices Bjelovar, Garešnica, Pakrac, Sirač, Suhopolje, Velika Pisanica, Virovitica and Vrbovec), 2. Karlovac (Forest Offices Gvozd, Jastrebarsko, Karlovac, Slunj and Topusko), 3. Koprivnica (Forest Offices Ivanec, Križevci and Sokolovac), 4. Našice (Forest Offices Ćeralije, Đurđenovac, Slatina and Voćin), 5. Nova Gradiška (Forest Offices Nova Gradiška, Nova Kapela, Novska, Okučani, Oriovac, Slavonski Brod and Trnjani), 6.

6. Osijek (šumarije Đakovo i Levanjska Varoš), 7. Požega (šumarije Čaglin, Kamenska, Kutjevo, Pleternica, Požega i Velika), 8. Sisak (šumarije Dvor i Lekenik) i 9. Zagreb (šumarije Dugo Selo, Novoselec, Popovača, Samobor, Zagreb i Zlatar). Istražena je međuovisnost intenziteta zaraze hrasta kitnjaka žutom imelom i sljedećih stanišnih i sastojinskih parametara: boniteta, ekspozicije, tla, fitocenoze, starosti, sklopa i nadmorske visine.

Osijek (Forest Offices Đakovo and Levanjska Varoš), 7. Požega (Forest Offices Čaglin, Kamenska, Kutjevo, Pleternica, Požega and Velika), 8. Sisak (Forest Offices Dvor and Lekenik) and 9. Zagreb (Forest Offices Dugo Selo, Novoselec, Popovača, Samobor, Zagreb and Zlatar). In the study, compartments older than 30 years were selected and diagonally examined. Site and stand parameters (site quality, exposure, soil type, forest community, age, crown closure and elevation) were analysed in order to determine the presence of a correlation between those parameters and mistletoe incidence.

PALINOLOŠKA ANALIZA NEKIH PREDSTAVNIKA PORODICA ASTERACEAE I CICHORIACEAE

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Tijekom ovog palinološkog istraživanja sakupljene su ukupno 23 biljne svojte, od čega 18 predstavnika porodice Asteraceae i 5 predstavnika porodice Cichoriaceae. Palinološke analize izvršene su svjetlosnim mikroskopom i skenirajućim elektronskim mikroskopom te je utvrđeno da svi predstavnici porodica Asteraceae i Cichoriaceae imaju trizonokolporatan pelud. S obzirom na karakteristike peludnih zrnaca, predstavnici porodice Asteraceae svrstani su u nekoliko tipova: *Ambrosia* tip, *Centaurea nigra* tip, *Anthemis* tip i *Aster* tip, a predstavnici porodice Cichoriaceae u *Cichorium intybus* tip. Dobiveni podaci poslužit će kao dopuna podacima u okviru sadašnjeg projekta ''Palinološki model miocenskih naslaga u Paratethysu'' te budućeg projekta ''Palinološka flora Hrvatske''.

POLLEN ANALYSIS OF CERTAIN TAXA OF THE ASTERACEAE AND CICHORIACEAE FAMILIES

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During this palynological study, 23 plant taxa were collected, including 18 taxa of the Asteraceae family and 5 taxa of the Cichoriaceae family. Pollen analyses were performed under the light microscope and the scanning electron microscope. All taxa of Asteraceae and Cichoriaceae families were found to have trizonocolporate pollen grains. Based on the characteristics of pollen grains, representatives of the Asteraceae family were classified into several types: *Ambrosia* type, *Centaurea nigra* type, *Anthemis* type and *Aster* type, and representatives of the Cichoriaceae family in *Cichorium intybus* type. The results can be used as a supplement for the present project ''Palynological Model of the Miocene Deposits in the Central Paratethys'' and for the future project ''Palynological Flora of Croatia''.

LJETNI ASPEKT KOROVSKE FLORE VINOGRADA HERCEGOVINE

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U radu je dat pregled korovske flore vinograda Hercegovine u ljetnjem aspektu. Istraživano područje obuhvata općine: Trebinje, Stolac, Počitelj, Mostar, Čitluk, Grude, Široki Brijeg i Ljubuški. Flora je obrađena sa stanovišta taksonomskog diverziteta, biološkog spektra i spektra areal tipova. Florističkim istraživanjem konstatirano je 67 korovskih vrsta. Taksonomskom analizom ustanovljeno je da sve konstatirane korovske vrste pripadaju odjeljku *Spermatophyta* (odjeljak *Magnoliate* 57 vrsta i odjeljak *Liliate* 10 vrsta). Flora je raspoređena u 27 porodica.

WEED FLORA OF VINEYARDS IN HERZEGOVINA FROM A SUMMER ASPECT

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The weed flora of vineyards in Herzegovina during the summer season is presented in this paper. The survey was conducted in the following municipalities: Trebinje, Stolac, Počitelj, Mostar, Čitluk, Grude, Široki Brijeg, and Ljubuški. Taxonomic diversity, biological spectrum and area spectrum were standpoints for flora research.
Floral characterization revealed 67 weed species within 27 families. Taxonomic analyses showed that all species were from the division - *Spermatophyta* (57 species division: *Magnoliate*, 10 species division: *Liliate*).

PRILOG FLORI NACIONALNOG PARKA "SJEVERNI VELEBIT"

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,'Sjeverni Velebit'' proglašen je 1999. godine nacionalnim parkom, pa je najmlađi nacionalni park u Hrvatskoj. Park obuhvaća puno privlačnih i dragocjenih prirodnih područja u sjevernom dijelu Velebita. Na temelju istraživanja tijekom 2006. godine, u jugozapadnom području Nacionalnog parka „Sjeverni Velebit" (33,75 km2) ustanovljene su 252 svojte vaskularne flore (225 vrsta i 27 podvrsta) u okviru 160 rodova i 58 porodica. Također je obavljena taksonomska analiza, te analiza životnih oblika i flornih elemenata.

CONTRIBUTION TO THE FLORA OF NORTHERN VELEBIT NATIONAL PARK

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Northern Velebit is the youngest of Croatia's national parks, declared as such in 1999. The park comprises the most attractive and, with regard to nature, the most valuable areas of the northern part of the Velebit range. Floristic research in the southwestern part of Northern Velebit National Park (33.75 km2) was carried out in 2006. A total of 252 vascular plants (225 species and 27 subspecies) were found. The taxa belonged to 160 genera and 58 families. Analyses of taxonomy, lifeforms and floral elements were also carried out.

URESNA FLORA VRTOVA VELIKE GORICE (HRVATSKA)

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Istraživanje uresne flore velikogoričkih vrtova provedeno je od ožujka 2005. do ožujka 2006. godine. U 30 istraživanih vrtova utvrđeno je ukupno 157 uresnih svojti. Najbrojnija je porodica *Asteraceae* (21 svojta), dok su 24 porodice zastupljene sa samo jednom svojtom. Rezultati analize pokazuju da je od 157 determiniranih svojti 36 autohtonih, 53 izvorne alohtone svojte, 66 kultivara i jedna svojta čije je podrijetlo nepoznato. Posebna pozornost posvećena je autohtonim proljetnicama: od 10 nađenih svojti najzastupljenija je vrsta *Primula vulgaris* (26 vrtova). Najveći broj svojti zabilježen je u vrtovima u Školskoj ulici 21 i Školskoj ulici 47 (50 svojti) a najmanje u vrtu u Habdelićevoj ulici 13 (pet svojti).

DECORATIVE FLORA OF THE GARDENS OF VELIKA GORICA (CROATIA)

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Field research of the garden flora of Velika Gorica was conducted between March 2005 and March 2006. Overall, 157 taxa were found in 30 investigated gardens. The best represented were the plants of the daisy family (*Asteraceae*, 21 taxa), while 24 families were represented by only one taxa. The result of the analysis shows that out of 157 identified taxa, there were 36 autochthonous, 53 allochtonous taxa, 66 cultivars and one taxon of unknown origin. Of special attention were autochtonous spring blossoming plants: out of 10 taxa, the most frequently represented species was *Primula vulgaris* (26 gardens). The largest number of different taxa was registered in the gardens of Školska ulica 21 and 47 (50 taxa), while the lowest was in the garden of Habdelićeva ulica 13 (five taxa).

FLORA OTOČNE SKUPINE RAVA

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Ove godine započeli smo istraživanje vaskularne flore otoka Rave i pripadajućih otočića (Ravica, Maslinovac, Galiolica i Mrtovnjak). Otočje pripada Zadarskom arhipelagu. Otok Rava ima površinu 3,6 km^2. Na otoku su naselja Mala i Velika Rava. Otok vegetacijski pripada svezi *Quercion ilicis*. Osobito su raširene vrste kaćuna – *Orchis tridentata*, *Anacampytis piramidalis*, *Serapias parviflora* i *Ophrys sicula*. Posebno je vrijedan nalaz drvenaste mlječike (*Euphorbia dendroides*) na otočiću Galiolica. Do sada je zabilježeno 420 vrsta. Istraživanja se nastavljaju.

FLORA OF THE RAVA GROUP OF ISLANDS

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Earlier this year, we started researching the vascular flora of the island of Rava and neighbouring islets (Ravica, Maslinovac, Galiolica and Mrtovnjak). This group of islands belongs to the Zadar archipelago. The island of Rava covers an area of 3.6 km^2 and there are two settlements on the island – Mala and Velika Rava. In terms of vegetation, the island belongs to the *Quercion ilicis* alliance. Among the orchid species, *Orchis tridentata*, *Anacampytis piramidalis*, *Serapias parviflora* and *Ophrys sicula* are particularly widespread. On the islet of Galiolica, we made a valuable recording of the *Euphorbia dendroides* species. This is an ongoing study, with 420 species recorded thus far.

TRETIRANJE INVAZIVNIH BILJNIH VRSTA (IAS) U HRVATSKOJ – SADAŠNJOST I BUDUĆNOST

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Prvi nacionalni projekt o invazivnim biljnim vrstama u Hrvatskoj započet je 2006. godine. Za tretiranje stranih vrsta (IAS) predloženo je sljedeće:
1. Stručnjaci botaničari trebaju prihvatiti nacionalne kriterije i standarde za terminologiju i klasifikaciju alohtone flore
2. Pripremanje preliminarne liste invazivnih biljnih vrsta u Hrvatskoj
3. Razvijanje baze podataka i obrazaca s podacima za sve invazivne biljke u Hrvatskoj
4. Istraživanje i dokumentiranje opasnosti uzrokovanih djelovanjem specifičnih i najvažnijih invazivnih biljaka
5. Multidisciplinarna istraživanja na nacionalnom nivou – sugestije za moguće mjere gospodarenja i kon-

TREATMENT OF INVASIVE ALIEN PLANT SPECIES IN CROATIA – PRESENT AND FUTURE

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In 2006, the first national project on invasive Croatian flora began. Objectives for invasive alien plant species (IAS) treatment were proposed:
1. adoption of national criteria and standards for terminology and categories of allochthonous flora by experts;
2. compiling the list of alien invasive plant species in Croatia;
3. developing of database and taxon sheets for all invasive alien plants in Croatia;
4. exploration and documentation of the threats posed by specific and the most important invasive plant species (IAS);
5. multidisciplinary studies at the national level - suggestion for possible management options in IAS con-

trole invazivnih biljnih vrsta
6. Informiranje i senzibilizacija javnosti o problemu IAS-a.
Dosadašnji rezultati predstavljaju realizaciju prva tri cilja predložene strategije:
Ad 1) Završen je prijedlog nacionalnih standarda, kriterija i terminologije, usklađenih s globalnim i, posebno, europskim standardima
Ad 2) Načinjena je preliminarna lista invazivnih biljaka u Hrvatskoj (62 svojte)
Ad 3) Unutar baze "Flora Croatica Database" načinjen je poseban modul za unos i pretraživanje podataka o invazivnim biljkama u Hrvatskoj (http://hirc.botanic.hr/fcd/InvazivneVrste/Search.aspx).
Posebna pažnja posvećena je definiranju kriterija za utvrđivanje statusa potencijalno invazivnih vrsta u Hrvatskoj kao što je: podrijetlo, datum i način unosa te status svojte. Za svaku svojtu s preliminarnog popisa pripremljen je standardizirani obrazac svojte. Također je moguće automatsko generiranje karata rasprostranjenosti invazivnih svojti.
Preliminarna lista invazivnih biljaka u Hrvatskoj, kao i standardi i kriteriji za njihovo tretiranje predstavljaju dobru osnovu za buduća istraživanja i dokumentiranje štetnih utjecaja pojedinih invazivnih biljnih vrsta. Time se ujedno može omogućiti javnosti, vladinim strukturama, istraživačima itd. uvid u probleme uzrokovane invazivnim vrstama. Budućim nacionalnim i internacionalnim projektima i fondacijama moći ćemo primijeniti intenzivnija istraživanja invazivnih biljaka te ponuditi moguće mjere gospodarenja i njihove kontrole (ciljevi 4-6).

trol;
6. dissemination of information and public education and awareness.
The results thus far present implementation of three objectives:
Ad 1) The proposal for national standards, terminology and criteria has been completed. The terminology recommended is globally accepted and aligned with European standards;
Ad 2) The preliminary list of plant IAS in Croatia was prepared (62 taxa);
Ad 3) Preparations of the special part of the Flora Croatica Database for data entry about IAS are complete (http://hirc.botanic.hr/fcd/InvazivneVrste/Search.aspx). Special attention was paid to defining the criteria for the status of plant species potentially invasive in Croatia, such as their origin, residence and invasion status – a standard taxon sheet for each taxon from the preliminary list was produced; automatic generation of maps for invasive plant species are available.
The preliminary list of invasive alien plants in Croatia, as well as standards and criteria for their treatment should form a sound basis for future exploration and documentation of the threat posed by specific invasive plant species. The list will also provide background information on the problem of invasive species for the general public, government structures, researchers and others. Through national and international projects and funding, more intensive research in plant invasions could be carried out, to offer possible management options in the control of such invasions (objectives 4-6).

FLORISTIČKA ANALIZA LOKVE U JEZERIMA

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Istražujući floru i vegetaciju otoka Murtera na prostoru Lokve u Jezerima zabilježila sam nekoliko vrsta iz Crvene knjige. Od osjetljivih svojti (VU) zabilježena je *Lythrum portula* (L.) D. A. Webb, od kritično ugroženih svojti (CR) *Baldellia ranunculoides* (L.) Parl. i *Myosurus minimus* L., a od ugroženih svojti (EN) *Ranunculus ophioglossifolius* Vill. Posebno je značajna vrsta *Damasonium polyspermum* Cosson – kojoj je Lokva u Jezerima jedino zabilježeno nalazište u Hrvatskoj. Ovaj prostor je pod intenzivnim antropogenim utjecajem pa su i brojne vrste u opasnosti. Zadnjih par godina prostorom se intenzivno širi neofitska vrsta *Aster squamatum* (Sprengel) Hieron. Ekološka i vegetacijska istraživanja ovog prostora su u tijeku.

FLORISTICAL ANALYSIS OF THE LOKVE AREA IN JEZERA

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Having explored the flora and the vegetation of the island of Murter around the Lokve area in Jezera, I recorded several species from the Red book. As for the vulnerable species (VU), I recorded the *Lythrum portula* (L.) D. A. Webb, of the critically endangered (CR) the *Baldellia ranunculoides* (L.) Parl. and *Myosurus minimus* L. and of the endangered species (EN) the *Ranunculus ophioglossifolius* Vill. The *Damasonium polyspermum* Cosson is particularly important as Lokve in Jezera is its sole habitat in Croatia. This area is under intensive anthropogenous influence so numerous species are in danger. A neophytic *Aster squamatum* (Sprengel) Hieron has been intensively spreading for a few years. Environmental and vegetation research of this area in under way.

KARTIRANJE KAĆUNA OTOKA VRGADE

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Kartiranjem kaćuna na otoku Vrgada zabilježile smo 8 vrsta : *Limodorum abortivum* (L.) Sw.; *Ophrys bertolonii* Moretti; *O. sphegodes* Mill.; *O. sicula* Tineo; *Orchis morio* L.; *O. tridentata* Scop.; *Serapias parviflora* Parl. i *Spirantes spiralis* (L.) Koch. Ovom broju bi trebalo dodati i vrstu *Orchis coriophora* L koju za Vrgadu bilježi Host. Ovim istraživanjima nalaz te vrste nije potvrđen. Prema najnovijoj Crvenoj knjizi u kategoriji ugroženih (EN) na Vrgadi je *Ophrys sicula*, a u kategoriji osjetljivih (VU) na Vrgadi su *Ophrys bertolonii; Ophrys sphegodes* i *Orchis tridentata.*
Vrste rastu na suhim travnjacima. Obilne populacije zabilježile smo za vrstu *Ophrys bertolonii*, dok smo vrstu *Spirantes spiralis* zabilježile na jednom lokalitetu s 5-6 jedinki. Vrste su u opasnosti zbog nestanka travnjačke vegetacije (sukcesija je u tijeku).

DOT-MARKING OF ORCHIDS ON THE MAP OF VRGADA ISLAND

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Our orchid marking on the map of the Vrgada Island included eight species: *Limodorum abortivum* (L.) Sw.; *Ophrys bertolonii* Moretti; *O. sphegodes* Mill.; *O. sicula* Tineo; *Orchis morio* L.; *O. tridentata* Scop.; *Serapias parviflora* Parl. and *Spirantes spiralis* (L.) Koch. *Orchis coriophora* L. is another species recorded for this island by Host and should be added to the above number, though this study did not confirm the presence of this species. The latest Red Book report referring to Vrgada Island lists *Ophrys sicula* in the category of endangered species (EN), and *Ophrys bertolonii, Ophrys sphegodes* and *Orchis tridentata* as vulnerable (VU).
These species grow in dry grasslands. Populations of *Ophrys bertolonii* grow in abundance. On the contrary, the species *Spirantes spiralis* was recorded at only one location, with not more than 5-6 individual plants. These species are endangered by the disappearance of grassland vegetation (succession is underway).

NOVI PODACI ZA RIJETKE I ZAŠTIĆENE BILJKE U FLORI VOJVODINE

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U periodu 2004-2007. godine izvršena je kvalitativna analiza vaskularne flore Apatina i okoline, s posebnim osvrtom na floristički značajne biljke. U skladu s podacima iz literature zabilježeno je 940 taksona. Istraživano područje pripada Specijalnom rezervatu prirode „Gornje Podunavlje“ koji je uključen u EURONATUR projekt i nominiran za Ramsarsko i IPA područje. Konstatirana su dva nova taksona za floru Srbije: istočno-azijska vrsta *Carpesium abrotanoides* L. (Asteraceae) i *Cerastium diffusum* Pers. subsp. *subtetrandrum* (Lange) P. D. Sell & Whitehead, atlansko srednje-europska podvrsta. Tijekom naših istraživanja zabilježene su i nove biljke za floru Vojvodine a to su: *Gymnocarpium robertianum* (Hoffm.) Newman, cirkumpolarna vrsta, atlansko-srednjeevropskog karaktera, *Moehringia pendula* (Waldst. & Kit.) Fenzl, koja pripada submezijskom flornom elementu i *Montia fontana* agg. L., euroazijski (-med.) agregat.
Također smo zabilježili grupu biljaka koje imaju mali broj lokaliteta u Vojvodini, a samim tim nova nalazišta su od značaja za poznavanje flore ovog dijela Srbije.

NEW RECORDS OF RARE AND PROTECTED VASCULAR PLANTS FROM VOJVODINA

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In the period 2004-2007, a qualitative analysis of vascular flora of Apatin and its surroundings was carried out with an emphasis on groups of floristically significant plants. In accordance with data from the related literature, 940 taxa were observed. The study area is part of the Gornje Podunavlje (Upper Danube) Special Nature Reserve, which was included in the EURONATUR project (Biosphere reserve Drava–Mura project) and nominated under the Ramsar and IPA programmes. New recorded taxa for the flora of Serbia were noted: eastern Asian species *Carpesium abrotanoides* L. (Asteraceae) and Atlantic-Central European subspecies *Cerastium diffusum* Pers. *subsp. subtetrandrum* (Lange) P. D. Sell & Whitehead (Caryophyllaceae). Newly recorded species in the flora of Vojvodina province are *Gymnocarpium robertianum* (Hoffm.) Newman, a circumpolar species with Atlantic-Mediterranean significance, *Moehringia pendula* (Waldst. & Kit.) Fenzl, a submoesian floristic element, and the Eurasian (Mediterranean) aggregate *Montia fontana*

Nova nalazišta u okolini Apatina konstatirana su za: *Apera interrupta* (L.) Beauv., *Berula erecta* (Hudson) Coville, *Elatine alsinastrum* L., *Stellaria pallida* (Dumort.) Piré, *Viola mirabilis* L., *Trigonella procumbens* (Besser) Reichenb., *Tetragonolobus maritimus* (L.) Roth, *Colchicum autumnale* L. *var. pannonicum* (Gris. ex Schenk) Zachariadi. Novozabilježeni taksoni i novi lokaliteti za rijetke biljke doprinose boljem poznavanju specijskog diverziteta istraživanog područja i flore Vojvodine.

agg. L. A group of plants with insufficiently known distribution in Vojvodina were also recorded: *Apera interrupta* (L.) Beauv., *Berula erecta* (Hudson) Coville, *Elatine alsinastrum* L., *Stellaria pallida* (Dumort.) Piré, *Viola mirabilis* L., *Trigonella procumbens* (Besser) Reichenb., *Tetragonolobus maritimus* (L.) Roth, *Colchicum autumnale* L. *var. pannonicum* (Gris. ex Schenk) Zachariadi. Data on the newly recorded taxa and its habitats were obtained; these contributed to better recognition of species and habitat diversity in the observed area and flora of Vojvodina.

ENDEMIČNE BILJKE KRAJIŠTA U JUGOISTOČNOJ SRBIJI

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Krajište je oblast koja se nalazi u R Bugarskoj (zauzima krajnji jugozapadni dio Zapadnih graničnih planina) i R Srbiji (istočno od Rodopskih planina: Klinčanice, Bukove glave, Krvavog Kamika, Pandžinog Groba, Velikog i Malog Strešera, Besne Kobile, Koćure i Dukat planine), a koje se preko niskog razvođa Milevske i Rudina planine vezuju za glavnu maticu Krajišta u R Bugarskoj.
Geološku podlogu ovog prostranog planinskog područja čine silikati (zeleni škriljci, mikašisti, graniti, granit-gnajsevi, amfiboliti), a u masi silikata se nalaze otoci vapnenca (dolomitisani mermeri). Na njoj se razvijaju različiti tipovi geološke podloge: gajnjače, podzolirana tla, planinske crnice, smonice, tresetne crnice i močvarno-glejno tlo.
Ovako raznovrsna geo-pedološka podloga i umjerenokontinentalna klima, sa značajnim uticajima stepske i mediteranske klime, uslovljava raznovrsnu vegetaciju i interesantnu floru. Ovu oblast karakteriziraju brojni endemiti i relikti, od kojih izdvajamo: *Anthyllis au-*

THE ENDEMIC PLANTS OF KRAJI\TE IN SOUTHEASTERN SERBIA

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Krajište is an area situated in Bulgaria (covering the southwestern part of the West border mountains) and Serbia (east of the Rodopian mountains: Klinčanica, Bukova glava, Krvavi Kamik, Pandžin Grob, Veliki and Mali Strešer, Besna Kobila, Koćura and Dukat mountain), connected to main part of Krajište in Bulgaria across the low watershed of Milevska and Rudina mountain.
The geologic base of this vast mountainous area consists of silicates (green slates, granites, granite-gnaisses, amphibolites), and limestone islands surrounded by silicates (dolomite marbles). The different types of geologic bases are developed there: ferralsols, podzoluvisols, mountain fertile soils, vertisols, peat fertile soils and swamp- gleysols.
This diverse geo-pedologic base and moderate-continental climate, with significant influence of steppe and mediterranean climate, have resulted in diverse vegetation and interesting flora. This area is charac-

rea, *Edrianthus serbicus, Astragalus wilmottianus, Tragopogon pterodes, Achillea serbica, A. clypeolata, Sesleria rigida, S. comosa, Digitalis viridiflora, Festuca valida, F. stojanovi, F. paniculata, Linaria macedonica, Knautia macedonica, Genista depressa, G. carinalis, G. subcapitata, Silene lerchenfeldiana, Pastinaca hirsuta, Armeria rumelica* i dr.

terized by numerous endemisms and relicts, and we cite the species: *Anthyllis aurea*, *Edrianthus serbicus, Astragalus wilmottianus, Tragopogon pterodes, Achillea serbica, A. clypeolata, Sesleria rigida, S. comosa, Digitalis viridiflora, Festuca valida, F. stojanovi, F. paniculata, Linaria macedonica, Knautia macedonica, Genista depressa, G. carinalis, G. subcapitata, Silene lerchenfeldiana, Pastinaca hirsuta, Armeria rumelica* and others.

FLORNE OSOBITOSTI OGULINSKOG KRAJA

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S obzirom na zemljopisni položaj i konfiguraciju terena, na ogulinskom su području razvijeni različiti tipovi vegetacije s bogatom florom, što pokazuju već usputna istraživanja biljnog pokrova toga kraja. Dosad zabilježene vrste ni izdaleka ne odražavaju bogatstvo flore ogulinskog područja, što se pokazalo već na početku sustavnih florističkih istraživanja. Valja istaknuti i niz zaštićenih i ugroženih vrsta koje rastu na tom području te neke rijetke biljke hrvatske flore, npr. *Tofieldia calyculata* i *Pinguicula vulgaris*. U izlaganju će biti predočena analiza flore (florni elementi, životni oblici) toga područja izrađena na temelju dosad zabilježenih svojti.

CHARACTERISTICS OF THE FLORA OF THE OGULIN CITY AREA

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Preliminary research has shown that different vegetation types and rich flora are developed in the Ogulin city area due to the geographical position and terrain configuration. Plant species so far recorded hardy reflect the floristic richness of that area, clearly observed in the first stage of systematic research. The high percentage of endangered plant species, those enjoying statutory protection, as well as several rare species, i.e. *Tofieldia calyculata* and *Pinguicula vulgaris,* are of particular significance. Analysis of flora (floristic elements and life forms) based on data collected so far will be presented.

VASKULARNA FLORA SAVICE (ZAGREB, HRVATSKA)

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U jugoistočnom dijelu Grada Zagreba, na lijevoj obali Save, nalazi se zaštićeno područje – Savica. Područje koje obuhvaća rukavac rijeke Save i 12 međusobno povezanih jezeraca predstavlja mozaik vodenih, močvarnih i kopnenih staništa. Ukupna površina iznosi oko 75 ha, od čega je 30 ha vodena površina. Inventarizacija vaskularne flore provedena je direktnim kartiranjem upotrebom GPS uređaja u vremenskom razdoblju od travnja do listopada 2006. godine. Izvršena je analiza flore po pripadnosti porodicama, životnim oblicima i flornim elementima. Flora istraživanog područja obuhvaća 279 svojti papratnjača i sjemenjača iz 71 porodice. Po broju vrsta najzastupljenije porodice su: *Asteraceae* (13,6%), *Poaceae* (12,2%), a s više od 5% *Lamiaceae*, *Fabaceae*, *Rosaceae* i *Cyperaceae*. Iznad 3% zastupljene su *Scrophulariaceae* i *Brassicaceae*, a iznad 2% *Apiaceae*, *Ranunculaceae* i *Salicaceae*. U flori Savice yve ostale porodice zajedno zastupljene su s 37,1%.

VASCULAR FLORA OF SAVICA (ZAGREB, CROATIA)

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The protected area Savica is located in the southeastern part of Zagreb, on the left bank of the River Sava. The area includes an armlet of the River Sava and 12 interconnected lakes, and represents a mosaic of aquatic, wetland and terrestrial habitats. The total area is approximately 75 ha, out of which 30 ha is water surface. The inventarisation of vascular flora was done by direct mapping using a GPS receiver in the period between April and October of 2006. The analysis of flora belonging to families, life forms and floral elements was conducted. The flora of the researched area includes 279 taxa of *Pteridophyta* and *Spermatophyta* classified into 71 families. According to the number of species, the most abundant families are *Asteraceae* s.l. (13.6%), *Poaceae* (12.2%), followed by over 5% *Lamiaceae*, *Fabaceae*, *Rosaceae* and *Cyperaceae*. Families represented above 3% are *Scrophulariaceae* and *Brassicaceae*, above 2% are *Apiaceae, Ranunculaceae* and *Salicaceae.* All other families present in the

U spektru životnih oblika dominiraju hemikriptofiti (47%) i terofiti (20,8%). Analiza flornih elemenata pokazala je da na području Savice 57,4% vrsta pripada euroazijskim svojtama (31,5%) i kozmopolitima (26,9%). Udio vrsta karakterističan za ilirsko florno područje iznosi 0,7%, dok udio srednjeuropskih vrsta iznosi 4,3%, a neofita 10,6%. Vrste iz Crvene knjige vaskularne flore Hrvatske zabilježene unutar granica istraživanog područja su: *Agrostis canina* L. (NT), *Asparagus tenuifolius* Lam. (NT), *Cyperus serotinus* Rottb. (VU) i *Leersia oryzoides* (L.) Sw. (NT). Također je zabilježeno 45 zaštićenih i četiri strogo zaštićene biljne svojte. Prema preliminarnoj listi invazivnih biljaka Hrvatske, zabilježeno je 19 invazivnih biljnih svojti.

flora of Savica together make up 37.1%. According to analysis of the life forms, the *Hemicryptophyta* (47%) and *Therophyta* (20.8%) are dominant. Chorological analysis shows that 57.4% taxa occurring on Savica belongs to the Eurasiatic plants (31.5%) and cosmopolites (26.9%). The share of species characteristic for the Illyrian area is 0.7%, Central-European species (4.3%) and neophytes (10.6%). Species listed in the Red book of vascular flora of Croatia, recorded in the investigated area are: *Agrostis canina* L. (NT), *Asparagus tenuifolius* Lam. (NT), *Cyperus serotinus* Rottb. (VU) and *Leersia oryzoides* (L.) Sw. (NT). Moreover, 45 protected and 4 strictly protected taxa were found. According to the preliminary list of invasive plant taxa of Croatia, 19 invasive species were found.

USPOREDBA URBANE FLORE SPLITA, DUBROVNIKA I MOSTARA

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Najrazličitijim biljnim vrstama (pridošlicama), nakon otkrića prekomorskih zemalja, izmijenjena je flora u europskim državama. U novije vrijeme intenzivno se istražuje urbana flora mnogih europskih gradova. Uspoređuju se floristički sastavi pojedinih gradskih četvrti s obzirom na tipove staništa, ali i u odnosu na pripadajuću autohtonu floru biljnogeografskih zona.
U ovom radu uspoređuje se flora gradova Splita, Dubrovnika (Hrvatska) i Mostara (Bosna i Hercegovina). Svrha rada je utvrditi stupanj sličnosti flore, analizirati floru gradova s obzirom na pripadnost životnim oblicima i flornim elementima. Posebna pozornost usmjerena je utvrđivanju udjela adventivnih biljaka, te njihovu podrijetlu.

A COMPARISON OF URBAN FLORA IN SPLIT, DUBROVNIK AND MOSTAR

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European flora changed with the introduction of diverse plant species (e.g. neophytes), which occurred following the discovery of oversea countries. Recently, research on urban flora found in many European cities has greatly intensified. A comparison is made of the floristic content of particular city districts with regards to types of habitats, and according to the autochthonous flora belonging to biogeographical zones.
This paper makes a comparison between the urban flora found in Split and Dubrovnik (Croatia), and Mostar (Bosnia and Herzegovina). The aim of the paper is to determine the degree of floral similarities, and to analyze city flora in terms of life forms and floral elements. Particular attention is paid to determining the share of adventive plants and their origin.

BILJNA RAZNOLIKOST OTOKA ZEČEVO

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Otok Zečevo nalazi se 2 km sjeveroistočno od mjesta Vrboske na otoku Hvaru. Dužina obale otoka je 1539 m, a površina 113 288 m2. Klima otoka je mediteranska s prosječnom godišnjom količinom oborina od oko 700 mm. Status zaštićenog krajolika Zečevo uživa od 1972 godine.
Istraživanja flornog sastava otoka Zečevo obavljana su tijekom vegetacijske sezone 2006. godine. Na terenu je pronađeno i determinirano 120 svojti samonikle vaskularne flore raspoređene unutar 47 porodica. Najzastupljenije porodice bile su mahunarke (*Leguminosae*, 13 %), glavočike (*Compositae*, 12 %), trave (*Gramineae*, 8 %) te porodica ljiljana (*Liliaceae*, 6 %).
Do sada, na otoku Zečevo nisu obavljana ozbiljnija floristička istraživanja, pa ovo jednogodišnje istraživanje držimo početkom uvida u potpuno stanje brojnosti flore ovoga otoka.

PLANT DIVERSITY OF ZEČEVO ISLAND

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Zečevo Island is situated 2 km northeast of the town Vrboska on Hvar Island. Its area covers 113,288 m2 and its coastal length is 1539 m. The climate is Mediterranean, so the island receives 700 mm of annual rainfall. Zečevo Island has had the status of a protected area since 1972.
Flora research on Zečevo Island was conducted during the 2006 vegetation season. During field research, 120 species of indigenous vascular flora distributed in 47 families were recorded.
The most abundant families were plants from pea family (*Leguminosae*, 13%), daisy family (*Compositae*, 12%), grass family (*Gramineae*, 8%) and lily family (*Liliaceae*, 6%).
Considering the fact there has been no flora research on Zečevo Island to date, this research has laid the foundation for further exploration.

FLORA BEDEKOVČINE U SJEVEROZAPADNOJ HRVATSKOJ

Zvjezdana Stančić

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Vaskularna flora Bedekovčine istraživana je tijekom proteklih nekoliko godina. Dosad je utvrđeno 480 vrsta razvrstanih u 90 porodica. Najveći broj vrsta pripada biljnim porodicama: *Poaceae* (42 vrste), *Asteraceae* (39 vrsta), *Fabaceae* (31 vrsta).
Biljnogeografska analiza flore pomoću flornih elemenata prema Horvatiću i sur. (1967), pokazuje da prevladavaju biljke euroazijskog flornog elementa (33 %): Slijede biljke široke rasprostranjenosti (25 %), biljke europskog flornog elementa (12 %), biljke južnoeuropskog flornog elementa (9 %), cirkumholarktičke biljke (8 %), kultivirane i adventivne biljke (7 %) i biljke ostalih flornih elemenata s vrlo malim udjelima. Udjeli pojedinih flornih elemenata pokazuju pripadnost istraživanog područja srednjoeuropskoj provinciji unutar eurosibirsko-sjevernoameričke regije.
Analiza zastupljenosti životnih oblika prema Raunkiaer-u (1934) pokazuje da prevladavaju hemikriptofiti (45 %), zatim slijede terofiti (25 %), geofiti (13 %), fanerofiti (9 %), hamefiti (5%) i hidrofiti (3 %). Dominacija hemikriptofita posljedica je utjecaja umjerene kontinentalne klime, a znatan udio terofita može se

FLORA OF BEDEKOVČINA IN NORTHWESTERN CROATIA

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The vascular flora of Bedekovčina has been investigated during the past few years. 480 species have been determined to date and sorted into 90 families. Within the data, the most common plant families are: *Poaceae* (42 species), *Asteraceae* (39 species), and *Fabaceae* (31 species).
Geobotanical analysis of flora by means of floral elements, according to Horvatić *et al*. (1967) show a dominance of plants of the Euro-Asian floral element (33%), followed by widely spread plants (25%), plants of the European floral element (12%), the south-European floral element (9%), plants of circumholartic distribution (8%), cultivated and adventive species (7%), as well as plants of other floral elements. Shares of certain floral elements indicate the affiliation of the study area to the Central European provinces within the Euro-Siberian-Northern-American region.
Analysis of life forms according to Raunkiaer (1934) indicates the predominance of hemicryptophytes (45%), followed by therophytes (25%), geophytes (13%), phanerophytes (9%), chamaephytes (5%) and hydrophytes (3%). The prevalence of hemicryptophytes is due to the influence of the moderate con-

tumačiti velikim brojem ruderalnih biljaka.
U sastavu flore Bedekovčine se razvija relativno mali broj ugroženih biljnih vrsta koje su na popisu Crvene knjige Republike Hrvatske. Ukupno su utvrđene 3 osjetljive vrste, 4 gotovo ugrožene i 4 s nedostatnim podacima.
Na području Bedekovčine velik dio staništa je pod izrazitim utjecajem čovjeka, zbog čega je u flori Bedekovčine znatan broj neofitskih biljnih vrsta. Zabilježena su 33 neofita, od čega je 29 naturaliziranih, a samo se četiri pojavljuju kao povremeno odbjegli iz kulture.
Sastav i raznolikost flore istraživanog područja posljedica je vrlo mozaičnog krajolika u kojemu se izmjenjuju razne vrste ruderalnih staništa, obradive površine, šume, travnjaci i močvarna vegetacija.

tinental climate, while the substantial content of therophytes can be explained by the presence of many ruderals.
The flora of Bedekovčina comprises a relatively small number of threatened species listed in the Red Book of Vascular Flora of Croatia. 3 vulnerable species were determined, 4 nearly threatened and 4 data deficient species.
In the Bedekovčina area, a large portion of habitats are under heavy human influence, which results in the significant presence of neophytic species there. 33 neophytes were noted, of which 29 are naturalized, and only four appear as casually escaped from culture.
The composition and diversity of the study area's flora are consequences of a very diverse landscape consisting of frequently interchanged various ruderal habitats, cultivated land patches, woods, meadows and marshland vegetation.

FLORA MALIH OTOKA KVARNERSKOG ZALJEVA

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U istraživanje je uključeno sedam malih otoka Kvarnerskog zaljeva (Dolfin, Maman, Lukovac, Šailovac, Lisac, Galebovi otoci, Sridnjak, Sv. Marin). Otoci Maman, Sridnjak, Šailovac i Lukovac u blizini su otoka Raba, Lisac je južno od Senja, a Sv. Marin leži ispred Novog Vinodolskog. Dolfin je blizu otoka Paga, a Galebovi otoci južno od Golog otoka. Površine otoka kreću se od 0,843 ha (Sv. Marin) do 25,978 ha (Dolfin). Geološka osnova otoka je vapnenačka, te je dio dinarskog krša. Na nekim od otoka vapnenačka podloga prekrivena je tankim slojem pjeskovitog tla (Maman, Sridnjak i Šailovac). Klimu istraživanog područja karakterizira prosječna godišnja temperatura od 15°C i 1150 mm godišnjih oborina. Na klimu nekih od otoka (Lukovac, Lisac, Sv. Marin, Dolfin, Galebovi otoci) dodatno utječe bura.

Na temelju terenskih opažanja i kasnije obrade herbarskog materijala načinjene su po prvi put florne liste za svaki otok. Istraživanje je provedeno tijekom vegetacijskih sezona 2006.-2007. Ukupna flora istraživanih otoka obuhvaća 200 svojti iz 64 porodice. Najzastupljenije porodice su: Fabaceae (11%), Asteracae (8%), Poaceae (6,5%), Liliaceae (5,5%) i Chenopo-

FLORA OF ISLETS IN KVARNER BAY

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Seven islets of Kvarner Bay (Dolfin, Maman, Lukovac, Šailovac, Lisac, Galebovi otoci, Sridnjak, Sv. Marin) were included in the research. The islets of Maman, Sridnjak, Šailovac and Lukovac are situated near the island of Rab; Lisac is south of the town of Senj, Sv. Marin lies before the town of Novi Vinodolski; Dolfin is near the island of Pag and Galebovi otoci are south of the island of Goli. The area of islets vary from 0.843 ha (Sv. Marin) to 25,978 ha (Dolfin). Geologically, all of the islets are made of limestone and are part of the Dinaric karst. On some islets (Maman, Sridnjak and Šailovac), the limestone is covered with a thin layer of sandy soil. The climate of the researched area is characterized by a mean annual air temperature of 15°C and 1150 mm of precipitation per year. Additionally, the climate on some of the islets (Lukovac, Lisac, Sv. Marin, Dolfin, Galebovi otoci) is influenced by the northeastern bora wind. For the first time, a list of complete vascular flora was made for each islet based on field observations and determination of collected herbarium material. The research was carried out during the vegetation seasons 2006-2007. The total flora of all researched islets is comprised of

diaceae (5%). Za potrebe uspoređivanja bogatstva vrsta izračunate su c- i z- vrijednosti na temelju eksponencijalnog modela (Arrheniusova jednadžba), kao i α-indeks raznolikosti. Testirano je i nekoliko modela koji opisuju odnos broja vrsta i površine na temelju konveksnih i sigmoidnih krivulja. Također je za sve otoke izračunana i usporedna učestalosti svojta.

200 taxa from 64 families. The most abundant families are: Fabaceae (11%), Asteracae (8%), Poaceae (6.5%), Liliaceae (5.5%) and Chenopodiaceae (5%). For the purpose of comparing species richness, c- and z- values from the power function model (Arrhenius equation) were calculated, as well as α-index of diversity. Several species-area models were tested using convex and sigmoid curve groups. Comparative frequencies of species were also calculated for all islets.

INTRASPECIJSKA VARIJABILNOST VRSTE *CAMPANULA LINGULATA* WALDST. ET KIT. (CAMPANULALES, CAMPANULACEAE) U SRBIJI I CRNOJ GORI

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Rod *Campanula* L. je zastupljen sa 144 vrste u flori Europe. U flori Srbije je zabilježeno 28 vrsta a u flori Crne Gore 32 vrste. Centar diverziteta roda *Campanula* L. je mediteranska regija. Vrsta *Campanula lingulata* Waldst. et Kit. je balkanska biljka. Na teritoriji Srbije i Crne Gore se nalazi njen centar areala kao i sjeverna granica rasprostranjenja (Vojvodina, Srbija). Pregledom literature utvrđen je nejasan taksonomski status vrste i infraspecijskih oblika. Opisani taksoni ne odgovaraju činjeničnom stanju na terenu. Analiza varijabilnosti je obuhvatila 29 morfoloških kvantitativnih i kvalitativnih značajki u tri populacije sa sljedećih lokaliteta: Valdanos (Crna Gora), dolina rijeke Vlasine (južna Srbija) i Fruška Gora (Vojvodina, Srbija). Herbarski vaučeri su deponirani u Herbarijumu BUNS. Za obradu rezultata je korištena diskriminantna analiza, analiza glavnih komponenti i kore-

INTRASPECIFIC VARIABILITY OF *CAMPANULA LINGULATA* WALDST. ET KIT. (CAMPANULALES, CAMPANULACEAE) IN SERBIA AND MONTENEGRO

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The genus *Campanula* L. comprises 144 species in the flora of Europe. The flora of Serbia includes 28 species while the flora of Montenegro includes 32 species. The Mediterranean region is the centre of diversity of *Campanula* L. *Campanula lingulata* Waldst. et Kit. is a Balkan plant. The territory of Serbia and Montenegro includes the centre of its distribution area and northern boundary (Vojvodina, Serbia). The taxonomical status of this species is very unclear and data for infraspecific taxa described in local checklists are questionable. This study included 29 morphological (quantitative and qualitative) characters in three populations: Valdanos (Montenegro), Vlasina (southern Serbia) and Fruška gora (Vojvodina, Serbia). Herbarium vouchers are deposited in the BUNS Herbarium. Discriminant, correspondent and principal components analysis have been used for statistical description. The results show

spondentna analiza. Rezultati su pokazali postojanje značajnih razlika između primorskih i kontinentalnih populacija. Najbitnije značajke vezane su za grananje, prisustvo aksilarnih cvatova, oblik i veličina dijelova cvijeta: odnos dužina cijevi i režnjeva čašice, dužinu krunice, oblik i dlakavost stubića i žigova.

very significant differences between coastal and continental populations. The most significant characters are stem (simple or branched), presence of axillary inflorescence, flower shape and size: relation between calyx tube and calyx lobe length, corolla length, shape and hairiness of style and stigma.

DISTRIBUCIJA PORODICE HALORAGACEAE U OHRIDSKOM JEZERU

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U Ohridskom jezeru iz porodice Haloragaceae prisutan je rod *Myriophyllum* – krocanj s vrstama: *Myriophyllum spicatum* L. i *Myriophyllum verticillatum* L.
Podaci o distribuciji vrste iz porodice Haloragaceae u Ohridskom jezeru dobiveni su iz detaljnih istraživanja sprovedenih na 59 lokaliteta koji obuhvaćaju skoro cijelu obalu Jezera (na teritoriji Republike Makedonije, odnosno od Radozde do Sv.Nauma).
Rezultati istraživanja ukazuju da postoje razlike u distribuciji vrsta porodice Haloragaceae između istraživanih lokaliteta u Ohridskom jezeru. Razlike u distribuciji su rezultat različitih ekoloških uvjeta na istraživanim lokalitetima, kao i specifične karakteristike pojedinih vrsta.
Naime, obje vrste su bile evidentirane uglavnom na istraživanim lokalitetima duž sjeverne i sjeverozapadne obale Jezera gdje vladaju optimalni uvjeti za njihov intenzivni rast i razvitak i rastu u gustim populacijama. Na ovim lokalitetima dno ima blagi nagib, uglavno je pijesak i mulj, izloženost vjetrovima i valovima je mala, a unos nutrijenata je velik. Na istraživanim lokalitetima duž južne obale obje vrste su rijetko prisutne jer uvjeti za rast i razvitak su nepovo-

DISTRIBUTION OF FAMILY HALORAGACEAE IN LAKE OHRID

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In Lake Ohrid, the family Haloragaceae is represented by the genus Myriophyllum (water milfoil) with two species: *Myriophyllum spicatum* L. (Euroasian water milfoil) and *Myriophyllum verticillatum* L. (whorled leaf water milfoil).
The data for distribution of species from the family Haloragaceae in Lake Ohrid were obtained in a detailed study at a total of 59 localities covering almost the entire coastline of the lake (in the territory of Macedonia, from Radozda to St. Naum).
The study results show that there are differences in the species distribution from the family Haloragaceae between researched localities in Lake Ohrid. The differences in distribution are mostly due to different ecological conditions in the researched localities, and the specific character of each species.
Namely, both species were mostly recorded in the researched localities along the north and northeast coastline of the lake. Optimal ecological conditions are present here for its intensive growth and development and they grow in dense populations. Here, the slope of the bottom is gradual, mostly sand and mud,

ljni: dno ima strmni nagib, uglavno je kamenje i stijenje, izloženost vjetrovima i valovima je velika, dok je unos nutrijenata mali.

Dobiveni rezultati ukazuju da je vrsta *Myriophyllum spicatum* bila evidentirana na 32 lokaliteta, što iznosi 54.24 % od svih istraživanih lokaliteta duž Makedonske obale (59), dok je vrsta *Myriophyllum verticillatum* evidentirana samo na 5 lokaliteta (8.47 %).

the exposure of the winds and waves is small, and input of nutrients is great. In researched localities on the eastern coastline, both species were rarely present because conditions for its growth and development are unfavourable: the slope of the lake bottom is steeper, mostly stones and rocks, the exposure to the winds and waves is great and input of nutrients are lower.

The obtained results shows that *Myriophyllum spicatum* was present in 32 localities, or 54.24% of all researched localities along the Macedonian shoreline (59), whereby *Myriophyllum verticillatum* was present at only 5 localities (8.47%).

ZNAČENJE GRČKIH I FENIČKIH KOLONIJA ZA OBJAŠNJENJE DANAŠNJE RASPROSTRANJENOSTI VRSTA *QUERCUS COCCIFERA* I *QUERCUS CALLIPRINOS* U SREDOZEMLJU

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Quercus coccifera agg. obuhvaća dva taksona - vrste *Q. coccifera L*. i *Q. calliprinos* Webb. U sklopu kompleksa *Q. coccifera – C. calliprinos* mogu se razlikovati dva razmjerno dobro diferencirana tipa, u prvom redu na temelju anatomije lista. U listu tipa koji pripada vrsti *Q. coccifera* razvijen je samo jedan sloj subepidermalnih, sklerenhimskih stanica, a u drugom tipu, koji je opisan kao *Q. calliprinos*, razvijena su dva sloja takvih stanica. Najveći prigovor gledištu o dvije samostalne vrste odnosi se na geografsku rasprostranjenost prema kojoj se obje vrste više-manje difuzno distribuiraju duž obala Sredozemnoga mora i obzirom na rasprostranjenost, prema podacima Gentilea i Gastaldo (1976), među njima nema nikakve zakonitosti. Za obje je vrste značajan nametnik – ušenac *Kermes vermilio*. Od njegovih osušenih ženki dobivala se crvena boja kermes (al kermes, grimiz) koja je u starom vijeku služila za bojenje vunenih tkanina. Zato su vrste *Q. coccifera* i *Q. calliprinos* uzgajali te širili i Grci i Feničani koji su u Sredozemlju imali svoje

SIGNIFICANCE OF THE GREEK AND PHOENICIAN COLONIES FOR DISTRIBUTION OF *QUERCUS COCCIFERA* AND *QUERCUS CALLIPRINOS* IN THE MEDITERRANEAN

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Quercus coccifera agg. includes two taxa – the species *Q. coccifera* L. and *Q. calliprinos* Webb. Within the *Q. coccifera-Q. calliprinos* complex, two relatively well differentiated types can be distinguished primarily on the basis of leaf anatomy. In the type belonging to *Q. coccifera*, only one layer of subepidermal, sclerenchymatous cells is developed in the leaf, while in the second type, described as *Q. calliprinos*, two layers of cells are developed. The main objection to the presented point of view refers to the geographical distribution according to which both species are more or less diffusely distributed along the Mediterranean. Between them, according to data by Gentile and Gastaldo (1976), there is no regularity with respect to distribution.

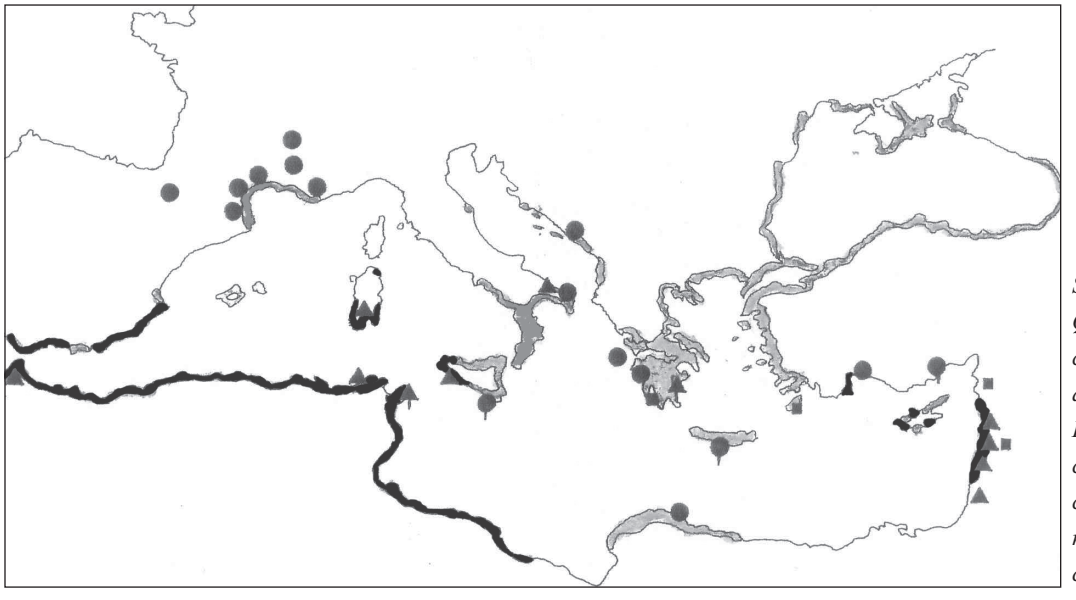
A parasite, the aphid *Kermes vermilio,* is significant for both species. From the dried bodies of its females, red dyestuff kermes (al kermes, crimson) was obtained, which was used to dye woollen fabrics in the Ancient World. For this reason, *Q. coccifera* and *Q. callipri-*

kolonije. Ako se na kartu (sl. 1) grčkih kolonija (sivo) i feničkih (crno) unesu simboli koji označavaju *Q. coccifera* (●), odnosno *Q. calliprinos* (▲), dobiva se skoro potpuna podudarnost rasprostranjenosti *Q. coccifera* na prostoru grčkih i *Q. calliprinos* na prostoru feničkih kolonija, uz neznatan udio intermedijarnih oblika (● ▲ ■).

U hrvatskom dijelu Sredozemlja rasprostranjena je samo vrsta *Q. coccifera* i to upravo na onim lokalitetima na kojima su bile grčke kolonije (Osor, Lumbarda, Orebić, Potomje, Saplunara, Cavtat).

nos were distributed through cultivation by the Greeks and Phoenicians, who had their colonies on the coasts of the Mediterranean. If the symbols representing *Q. coccifera* (●) and *Q. calliprinos* (▲) are introduced on the map (Fig. 1) of the Greek colonies (gray) and the Phoenician colonies (black), the result is an almost complete distribution correspondence of *Q. coccifera* and *Q. calliprinos* with the area of the Greek colonies and Phoenician colonies, respectively, with an insignificant portion of the intermediary forms (● ▲ ■).

In the Croatian part of the Mediterranean, *Q. coccifera* is only distributed at the sites of the former Greek colonies (Osor, Lumbarda, Orebić, Potomje, Saplunara, Cavtat).



Sl. 1: Nalazišta vrsta Quercus coccifera i Q. calliprinos u Sredozrmlju analizirana anatomski

Fig. 1: Localities of Quercus coccifera and Quercus calliprinos in the Mediterranean analyzed anatomically

FLORA UZ RIJEKU PLITVICU (HRVATSKO ZAGORJE)

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Tijekom vegetacijske sezone 2004. i 2005. istraživana je flora područja uz rijeku Plitvicu pokraj Varaždina. Ovo je prvo sustavno istraživanje flore na tom području. Pronađena je ukupno 291 svojta vaskularnih biljaka.

Analizom flornih elemenata utvrđeno je jedanaest glavnih skupina: južnoeuropski florni element (6,21%), istočnoeuropsko-pontski (0,69%), jugoistočnoeuropski (0,34%), srednjeeuropski (2,76%), europski (10,00%), euroazijski (31,38%), cirkumholarktični (6,21%), široko rasprostranjene biljke (28,97%), kultivirane i adventivne biljke (8,28%), biljke subpanonskog (0,34%) i submediteranskog područja (0,69%), te nerazvrstane biljke (4,41%). Ovaj sastav upućuje na pripadnost nižem šumskom pojasu ilirske provincije eurosibirsko-sjevernoameričke regije holarktisa.

Analizom životnih oblika utvrđeno je najviše hemikriptofita (51,55%), zatim slijede terofiti (20,96%), fanerofiti (11,68%), geofiti (9,62%), hamefiti (3,09%) i hidrofiti (1,72%). Četiri biljke ostale su nerazvrstane

THE FLORA ALONG THE PLITVICA RIVER (CROATIAN ZAGORJE)

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During the vegetation seasons 2004 and 2005, the area along the Plitvica River near Varaždin was floristically researched. This was the first systematic research of flora of this area. A total of 291 vascular plants was recorded.

Phytogeographical analysis showed that the Euroasiatic element is predominant, with 31.38% of taxa, followed by widespread plants 28.97%, European 10%, Circumholartic 6.21%, southern-European 6.21%, Central European 2.76%, Eastern-European-Pontic 0.69%, submediterranean 0.69% and subpannonic plants 0.34%. Cultivated and adventive plants account for 8.28% and unsorted plants 4.14% of taxa. According to this analysis, the region surrounding the River Plitvica belongs to the Euroasian-North American region of Holarctis.

In the lifeform spectrum, hemycriptophyta are predominant (51.55%), followed by therophyta (20.96%), phanerophyta (11.68%), geophyta (9.62%), chamaephyta (3.09%) and hydrophyta (1.72%). Unclassified

(1,37%). Rezultati analize potvrđuju pripadnost pojasu umjereno tople kišne klime.
Analizom flore prema kategorijama ugroženosti utvrđena je jedna gotovo ugrožena (NT) i tri osjetljive (VU) svojte.

plants account for 4.14%. Results of this analysis confirm that region of the River Plitvica belongs to the temperate warm humid climate.
According to levels of threat, one near threatened (NT) species and three vulnerable (VU) species were noted.

VASKULARNA FLORA POKUŠALIŠTA "JAZBINA"

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U radu je istraživana samonikla vaskularna flora vinograda i voćnjaka pokušališta "Jazbina", znanstveno-nastavnog poligona Agronomskog fakulteta Sveučilišta u Zagrebu.
Tijekom istraživanja 2005. godine u vinogradima "Jazbine" ustanovljeno je 110 biljaka (107 vrsta i 3 podvrste) iz 77 rodova i 27 porodica. Većina je biljaka pripadala glavočikama (*Asteraceae*) - 16.96%, travama (*Poaceae*) - 15.18% i mahunarkama / leguminozama (*Fabaceae*) - 13.39%. Analizom životnih oblika utvrđena je prevlast Hemicryptophyta (H – 51.81%) i Terophyta (T – 35.45%) .
Rezultati istraživanja prilog su poznavanju biljaka koje se mogu koristiti za zatravnjivanje tla u vinogradu, što bi moglo pridonijeti ne samo unapređenju ekološke vinogradarske proizvodnje na pokušalištu "Jazbina", već i očuvanju biljne raznolikosti kako na pokušalištu "Jazbina", tako i u čitavoj Hrvatskoj.

VASCULAR FLORA OF THE JAZBINA EXPERIMENTAL STATION

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Autochthonous vascular flora was researched in the vineyards and orchards of the Jazbina experimental station, the scientific and educational station of the Faculty of Agriculture, University of Zagreb. During research in 2005 in the Jazbina vineyards, a total of 110 plant taxa (107 species and 3 subspecies) from 77 genera and 27 families were recorded. The most dominant families are: *Asteraceae* (16.96%), *Poaceae* (15.18%) and *Fabaceae* (13.39%). According to analysis of life forms, the most numerous are hemicryptophytes (51.81%) and therophytes (35.45%).
The results of the floristic research contribute to knowledge of the plants which can be used for grass instalments in the vineyard. These results can contribute not only to the improvement of the organic vineyard production of the Jazbina experimental station, but also to the preservation of plant diversity in Jazbina and in Croatia.

ANALIZA REDA *RANUNCULALES* IZ HERBARA C. STUDNICZKE

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Analiza herbara započela je 2005. god. analizom herbarskog materijala svrstanog u red *Ranunculales*, odnosno prema starijoj klasifikaciji *ord. Ranunculaceen*. U njemu je 246 herbarskih listova unutar kojih se nalazi 661 herbarizirana biljka. Najveći dio biljaka sakupljen je u Europi (227 listova, 92 %). S područja današnje Austrije sabrano je najviše (47) herbarskih listova, a zatim iz: Italije, Francuske, Poljske, Češke, Hrvatske, Crne Gore, USA, Njemačke, Alžira, Grčke, Rumunjske, Rusije, Švicarske, Mađarske, Norveške, Slovenije, Portugala, Slovačke, Španjolske i Švedske. Najviše herbarskog materijala potječe iz zbirke Flora Dalmatiens (21 list), a slijede zbirke: Flora von Wr. Neustadt, Flora Böhmens, Flora von oesterr. Polen, C. Baenitz-Herbarium Europaeum, Flora von Triest, Eggert-Herbarium Americanum, E Flora Austriae inf., Flora Algeriensis exsiccata, Flora Gallica exsiccata, Flora Karnthen, Flora Suddalmatiens. Na 51 listu nije

THE ANALYSIS OF THE ORDER *RANUNCULALES* IN THE HERBARIUM OF C. STUDNICZKA

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The analysis of the herbarium began in 2005 with a study of the order *Ranunculales* or, under an old classification, the order *Ranunculaceen*. The herbarium contains 246 herbarium sheets with 661 herbarised plants. Most plants were collected from Europe (227 sheets or 92%), of which those from Austria make up the bulk (47) of herbarium sheets and the rest of plants come from: Italy, France, Poland, Czech Republic, Croatia, Montenegro, USA, Germany, Algeria, Greece, Romania, Russia, Switzerland, Hungary, Norway, Slovenia, Portugal, Slovak Republic, Spain, and Sweden. Most herbarium material originates from the collections Flora Dalmatien (21 sheets) followed by Flora von Wr. Neustadt, Flora Böhmens, Flora von oesterr. Polen, C. Baenitz-Herbarium Europaeum ,

napisano kojoj herbarskoj zbirci pripadaju. Preostala 64 herbarska lista raspoređena su s po jednim, dva ili tri herbarska lista u još 42 herbarske zbirke. Osim Studniczke koji je sakupio 97 herbarskih listova, registrirano je još 49 botaničara ili sakupljača biljaka. *Ord. Ranunculaceen* sakupljan je 36 godina (od 1868. do 1904. god.), a najveći broj herbarskih listova (152) sakupljen je u razdoblju od 1871. do 1880. god. Na 18 etiketa nije navedena godina sakupljanja. Studniczka je unutar 246 herbarskih listova *ord. Ranunculaceen* sakupio 24 roda i 157 vrsta u okviru kojih su zabilježena 22 niža taksona (var. ili f.). Prema djelu Flora Europae taj bi se broj danas sveo na 25 rodova, 128 vrsta i 13 nižih svojti. Analiza herbara C. Studniczke se nastavlja.

Flora von Triest, Eggert-Herbarium Americanum, E Flora Austriae inf., Flora Algeriensis exsiccata, Flora Gallica exciccata, Flora Karnthen , Flora Suddalmatiens. About 51 sheets lack information on their origin. One to three sheets of the remaining 64 sheets belong to 42 other collections. Apart from Studniczka, who collected 97 herbarium sheets, plants were collected by 49 other botanists or plant collectors. The order *Ranunculaceen* was collected over a period of 36 years (from 1868-1904) and most herbarium sheets (152) are from 1871-1880. The year of collection was not shown on 18 labels. Within 246 herbarium sheets of the order *Ranunculaceen,* Studniczka collected 24 orders and 157 species, of which 22 lower taxa (var. Or f.) were recorded. After the *Flora Europae,* this number should be reduced to 25 orders, 128 species, and 13 lower taxa. The analysis of the herbarium of Studniczka is still underway.

ALOHTONE BILJKE GORJA PLEŠIVICE (KRAJ SAMOBORA)

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Tijekom vegetacijskih sezona od 2003. do 2006. istraživana je flora samoborske Plešivice, te je na istraživanom području, uz autohtone svojte, zabilježeno i 14 alohtonih biljki. Taksonomskom analizom ustanovljeno je da sve alohtone vrste pripadaju dvosupnicama, a najviše ih je iz porodice Asteraceae (šest vrsta). Analizom rasprostranjenosti alohtonih vrsta gorja Plešivice, te usporedbom s podacima iz baze Flora Croatica Database (http://hirc.botanic.hr/fcd/InvazivneVrste/Search.aspx), utvrđeno je, da su u Hrvatskoj sva zabilježena nalazišta utvrđenih alohtonih vrsta - nova. Analizom alohtone flore prema vremenu dolaska i stupnju invazivnosti utvrđeno je da među alohtonim vrstama prevladavaju neofiti (osam vrsta), ostalo su arheofiti, dok je jedna vrsta kultivirana. Svi neofiti na istraživanom području invazivnog su karaktera. Utvrđeno je također, da najveći broj zabilježenih neofita potječe iz Sjeverne

ALLOCHTHONOUS PLANTS OF MT. PLEŠIVICA (NEAR SAMOBOR)

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During the vegetation seasons in 2003-2006, the flora of the area of Mt. Plešivica (near Samobor) was studied. Among autochthonous taxa, 14 species of allochthonous plants were noted. Taxonomical analysis showed that all allochthonous species belong to the Dicotyledones and the most dominant family is Asteraceae with 6 species. According to the Flora Croatica Database (http://hirc.botanic.hr/fcd/InvazivneVrste/Search.aspx), all localities of allochthonous species in the study area were recorded as new for Croatia. According to the analysis of invasion status, it has been established that 8 taxa are invasive neophytic species, five are archeophytic species, and one is a cultivated species. According to the analysis of residence status, it was established that the North American plants are dominant (five species), followed by Asian plants (three species). Within the life form spectrum,

Amerike (pet vrsta) a manji broj iz Azije (tri vrste). Analizom životnih oblika utvrđeno je, nadalje, da među zabilježenim alohtonim vrstama prevladavaju jednogodišnje biljke - terofiti (sedam vrsta), slijede ih hemikriptofiti (pet vrsta) dok su fanerofiti i geofiti podjednako zastupljeni s jednom vrstom.

therophyta are dominant (seven species), followed by hemicryptophyta (five species), phanerophyta (one species) and geophyta (one species).

PRIDOŠLICE U RUDERALNOJ I KOROVNOJ FLORI ŽUMBERKA

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Prema rezultatima dosadašnjih istraživanja ruderalnu i korovnu floru Žumberka čine 433 taksona vaskularnih biljaka. Dominiraju autohtone biljke, ali je utvrđen i određeni broj alohtonih biljaka ili pridošlica - vrsta koje su na ovo područje unesene posrednim ili neposrednim utjecajem čovjeka.
U radu je prikazana analiza ruderalne i korovne flore cijelog područja te analiza biljaka zabilježenih na svakom istraživanom antropogenom staništu. Ukupna flora svrstana je u četiri odabrane skupine prema geografsko-povijesnoj klasifikaciji antropogene flore: apophyta, archaeophyta, neophyta (u širem smislu) i ephemerophyta.
Najveći dio ruderalne i korovne flore ovog područja čine apophyta - domaće vrste koje rastu i na antropogenim staništima - 74,52 %, dok su od pridošlica najzastupljenije archaeophyta, a najmanje ephemerophyta – 1,68 %.

NEWCOMERS IN THE RUDERAL AND WEED FLORA OF ŽUMBERAK

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According to earlier studies, the ruderal and weed flora of Žumberak consists of 433 vascular plant taxa. Autochthonous plants dominate, though a certain number of newcomers, plants introduced by direct or indirect human activities, was also noted.
This paper presents an analysis of the entire ruderal and weed flora of Žumberak and an analysis of species recorded on each researched man-made habitat. The entire flora is sorted into four selected categories according to the geographic-historical classification of synanthropic plants: apophytes, archaeophytes, neophytes (sensu lato) and ephemerophytes.
The majority of ruderal and weed flora of this region consists of apophytes, native species occurring in man-made habitats (74.52%). The most numerous among the newcomers are archaeophytes, while ephemerophytes make up the smallest part (1.68%).

VASKULARNA FLORA PARKA PRIRODE VRANSKO JEZERO S POSEBNIM OSVRTOM NA ZANIMLJIVE PREDSTAVNIKE

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Vransko jezero je površinom najveće jezero u Hrvatskoj (30,02 km2) i specifičnih je geološko-geografskih karakteristika. Smješteno je u srednjoj Dalmaciji te predstavlja kriptodepresiju dinarskog smjera pružanja u neposrednoj blizini morske obale. S morem komunicira podzemnim pukotinama te kanalom Prosika u jugoistočnom dijelu. Područje oko jezera karakterizira jedinstvena kombinacija močvarnih staništa, antropogenih površina i dinarskog krša, zbog čega je jezero zajedno s okolnim područjem 21. srpnja 1999. g. proglašeno Parkom prirode. No unatoč svom velikom biološkom značenju ono nikada nije intenzivno niti sustavno floristički istraživano. U u prethodnim florističkim istraživanjima ovdje je zabilježeno samo 148 svojti vaskularne flore. Inventarizaciju i kartiran-

VASCULAR FLORA OF VRANSKO LAKE NATURE PARK, WITH A SPECIAL FOCUS ON INTERESTING TAXA

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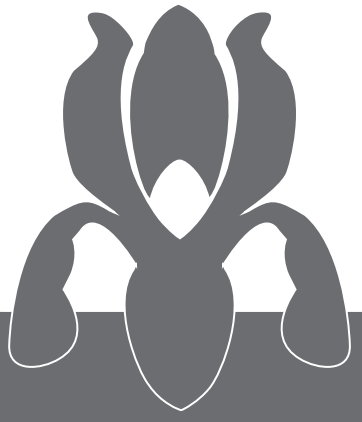
Vransko Lake is the largest lake in Croatia, covering an area of 30.02 km2. The lake is a kryptodepression, specific for its geological-geographical characteristics and is situated in central Dalmatia. It has a Dinaric direction of extension in the proximity of the sea shore. It is connected to the sea through underground interstices, as well as through the Prosika canal, at the southeast part of the lake. The area around the lake is characterized by a unique combination of marsh habitat, anthropogenic surfaces and Dinaric karst. Therefore, the lake and its surroundings were declared a Nature Park on 21 July 1999. In spite of its great biological importance, there has never been an intensive or systematic investigation of its flora, and to date only 148 vascular plant taxa have been recorded. Inventory and mapping of the Park's vascu-

je vaskularne flore Parka započeli smo u lipnju 2006. g. korištenjem standardne metodologije kartiranja u MTB 1/64 mreži prema predloženom nacionalnom standardu. Istraživanje smo nastavili u listopadu iste godine te ponovo u svibnju 2007. godine, radi što potpunijeg uvida u floru jezera s obzirom na vegetacijsku sezonu. Prema dosad obrađenim podacima, u dosadašnjim smo terenskim izlascima zabilježili više od 400 biljnih svojti, no budući da planiramo još nekoliko terenskih izlazaka držimo da će broj zabilježenih svojti biti veći. Sve podatke o zabilježenim biljnim svojtama unijet ćemo u bazu podataka Flora Croatica Database 2.7. (FCD). Predstavljena je vaskularna flora Parka prirode Vransko jezero te analizirana na temelju pripadnosti porodicama, s posebnim osvrtom na rijetke, endemične, ugrožene i zaštićene biljne svojte.

lar flora was started in June 2006 using the standard MTB 1/64 mapping methodology, according to the proposed national standard. The investigation continued in October 2006 and May 2007 with the objective of obtaining as thorough an overview of vascular flora as possible considering the vegetational season. According to data processed so far, more than 400 plant taxa have been recorded. Further field investigations are planned, and thus this number is not expected to be final. All the data on recorded plant taxa will be entered in the Flora Croatica Database 2.7. (FCD). This paper presents the vascular flora of the Vransko Lake Nature Park, as well as showing the family affiliation of recorded plants. Special attention is given to rare, endemic, endangered and protected plant taxa.



vegetacija i ekologija, očuvanje raznolikosti flore i staništa

vegetation and ecology, conservation of the diversity of flora and habitats

RASPROSTRANJENOST I STANIŠTA LIVADNOG PROCJEPKA (*CHOUARDIA LITARDIEREI* (BREISTR.) SPETA (= *SCILA LITARDIEREI* BREISTR., *S. PRATENSIS* WALDST. ET KIT.), *HYACINTHACEAE*) U HRVATSKOJ

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Livadni procjepak endemična je ilirska vrsta vlažnih livada krških polja. Rasprostranjen je u dinarskom kršu od Senja i Paga do Dubrovnika, a u unutrašnjosti do crte Karlovac – Sarajevo – Kolašin uz nekoliko izoliranih staništa sjeverno od te linije. Sva nalazišta poznata iz herbarskih zbirki ZA i ZAHO, literature i terenskih opažanja geokodirana su i unesena u «Flora Croatica Database». Za potrebe istraživanja staništa izrađene su fitocenološke snimke po standardnoj srednjoeuropskoj metodi. Središte rasprostranjenosti ove vrste u Hrvatskoj su Lika i Krbava, otkuda se areal prema jugu i jugoistoku širi prema Pagu, središnjem Velebitu, dolini Zrmanje, Vranskom jezeru, te zaleđu Zadra i Ninu. U zaleđu se areal širi u Vrličko, Hrvatačko, Sinjsko i Cetinsko polje. Na obali su poznata nalazišta u okolici Šibenika, Splita, Solina, Trogira i u dolini Omble kod Dubrovnika. Livadni procjepak raste na

DISTRIBUTION AND HABITATS OF *CHOUARDIA LITARDIEREI* (BREISTR.) SPETA (= *SCILA LITARDIEREI* BREISTR., *S. PRATENSIS* WALDST. ET KIT.), *HYACINTHACEAE*) IN CROATIA

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Chouardia litardierei is an endemic Illyrian species of periodically wet meadows of karst fields. It is distributed in the Dinaric karst from Senj and the island of Pag to Dubrovnik, and in the hinterland to the line Karlovac-Sarajevo-Kolašin with some isolated localities north of this line. All localities known from herbaria ZA and ZAHO, literature and field observations are geocoded and added to the "Flora Croatica Database". In order to study its habitats, phytosociological relevés were made according to the standard Central-European method. Centre of distribution of *Ch. litardierei* in Croatia are areas of Lika and Krbava with extensions of the areal to the south and south-east towards the island of Pag, central parts of Mt. Velebit, valley of Zrmanja, Vransko Lake, and to the hinterland of Zadar and Nin. In the hinterland, the areal is spread in karst fields of Vrlika, Hrvace, Sinj and the

livadama krških polja kojima se tlo u kišnom periodu dulje ili kraće vrijeme nalazi pod vodom. To su razvijene travnjačke zajednice iz reda *Trifolio-Hordeetalia* Horvatić 1963. (*Molinio-Arrhenatheretea* Tx 1937.) koje obuhvaćaju vlažne livade submediteranske zone. Na krškim poljima u zaleđu primorskih Dinarida, te u Lici i Krbavi livadni procjepak je najobilnije zastupljen na livadama košanicama as. *Molinio-Lathyretum pannonici* Horvatić 1963. i as. *Deschampsietum mediae illyricum* (Zeidler) Horvatić 1963. (=*Scillo litardierei-Deschampsietum mediae* Trinajstić 2004 nom. nudum). U primorskom dijelu submedieranske zone (otok Pag) raste u as. *Peucedano-Molinietum litoralis* Horvatić 1934., te u slabo halofilnoj travnjačkoj as. *Trifolio-Hordeetum secalini* Horvatić (1934.) 1958. U mikrodepresijama livada Like i Krbave javljaju se elementi vegetacije niskih cretova iz sveze *Caricion davallianae* Klika 1934. (*Molinio-Lathyretum pannonici caricetosum davalianae*), pa je u njima livadni procjepak također bogato zastupljen. Na obalama Begovačkog jezera livadni procjepak raste u periodično plavljenim travnjacima iz reda *Agrostidetalia stoloniferae* Oberd. 1967. Nalazište u okolici Kostajnice pripada as. *Bromo-Cynosuretum cristati* Horvatić 1930. (*Molinio-Arrhenatheretea* Tx 1937.), karakterističnoj posavskoj livadnoj zajednici koja plavi u proljeće.

River Cetina. In coastal areas, localities are known in the surroundings of the towns of Šibenik, Split, Solin, Trogir and in the valley of the Ombla River near Dubrovnik. *Ch. litardierei* grows in karst fields flooded during the rainy season, in grassland communities of the order *Trifolio-Hordeetalia* Horvatić 1963 (*Molinio-Arrhenatheretea* Tx 1937) which encompasses periodically wet meadows of the submediterranean zone. In the karst fields in the hinterland of the littoral Dinarids and in the areas of Lika and Krbava, the species is most abundant in the ass. *Molinio-Lathyretum pannonici* Horvatić 1963, and ass. *Deschampsietum mediae illyricum* (Zeidler) Horvatić 1963 (=*Scillo litardierei-Deschampsietum mediae* Trinajstić 2004 nom. nudum). In the littoral part of the submediterranean zone (the island of Pag), it grows in ass. *Peucedano-Molinietum litoralis* Horvatić 1934, and in the weakly halophilic grasslands of ass. *Trifolio-Hordeetum secalini* Horvatić (1934) 1958. Some elements of bog vegetation of the alliance *Caricion davallianae* Klika 1934 (*Molinio-Lathyretum pannonici caricetosum davalianae*) are developed in microdepressions on the grasslands of Lika and Krbava, where *Ch. litardierei* is also abundant. It is also present in periodically flooded grassland vegetation of the order *Agrostidetalia stoloniferae* Oberd. 1967 developed on the banks of Begovac Lake. The locality near Kostajnica belongs to the ass. *Bromo-Cynosuretum cristati* Horvatić 1930 (*Molinio-Arrhenatheretea* Tx 1937), a characteristic spring-flooded grassland community of Posavina.

ZAŠTIĆENE BILJNE VRSTE KARPATSKO-BALKANSKE SRBIJE

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Karpatsko-balkanski planinski sustav zauzima značajan dio Srbije, i to sjeveroistočni i centralni dio Istočne Srbije. Ovom planinskom sustavu pripadaju slijedeće orografske cjeline: Šomrda, Liskovac, Miroč, Homoljske planine, Veliki i Mali Krš, Deli Jovan, Beljanica, Kučajske planine, Rtanj, Tupižnica, Stara planina, Ozren, Devica, Leskovik, Svrljiške planine, Vidlič, Veliki i Mali Stol, Greben, Ruj, Vlaška i Suva planina.

Geološku podlogu Karpatsko-balkanskog planinskog sustava čine mezozojski vapnenci, nastali još u paleozoiku ili mezozoiku. Međutim, osim vapnenca nalaze se još i filiti, crveni peščari, laporci kao i metamorfisani kristalasti škriljci: gnajs, amfiboliti, filiti i anglošisti, kao i metamorfne stijene predstavljene kvarcitima i mramorima. Stoga su se na ovim prostorima formirali različiti tipovi pedološkog supstrata: sirozemi, rankeri različitog tipa, kiselo smeđa tla, lesivirana tla, podzoli i dr. Na vapnencima i dolomitima javljaju se vapnenački sirozemi, skeletna rendzina, braunizirana rendzina, smeđe i lesivirano smeđe tlo.

U Flori Srbije je do sada evidentirano oko 3562 tak-

THE PROTECTED PLANT SPECIES OF CARPATIAN-BALKAN SERBIA

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The Carpathian-Balkan mountain system comprises a significant part of Serbia, in the northeastern and central part of Eastern Serbia. The following orographic entities are parts of this system: Šomrda, Liskovac, Miroč, Homoljske mountains, Veliki and Mali Krš, Deli Jovan, Beljanica, Kučajske mountains, Rtanj, Tupižnica, Stara mountain, Ozren, Devica, Leskovik, Svrljiške mountains, Vidlič, Veliki and Mali Stol, Greben, Ruj, Vlaška and Suva mountain.

The geologic base of the Carpathian-Balkan mountain system consists of mezozoic limestone, arising in the Palaeozoic or Mesozoic. In addition to limestone, the system is also comprised of phillites, red sandy soils, marls, and metamorphosed crystallized slates: gneiss, amphibolites, phillites, etc., and metamorphed rocks represented by quartzes and marbles. For this reason, different types of pedologic substrates are formed in this region: different types of rankers, acidic brown soils, podzols etc. The frame rendzinas, brownized rendzinas, brown soil appear on limestones and dolomites.

In the flora of Serbia, 3562 taxa have been recorded to

sona, od čega je 215 zaštićeno zakonom, a na osnovu Uredbe o zaštiti prirodnih retkosti (Službeni glasnik RS br. 50/93 i 93/93). Od spomenutih taksona 40 % ili 86 zaštićenih biljnih vrsta se nalazi na spomenutom planinskom sustavu. U Crvenoj knjizi Flore Srbije (prva knjiga, 1999.) određena je kategorija ugroženosti za 171 vrstu, od čega je 58 taksona zabilježeno za istraživanu oblast, što predstavlja blizu 34 %. Interesantan je podatak da se 50 % ili 29 biljnih vrsta iz Crvene knjige ne nalazi na spisku Uredbe o zaštiti. To govori da je Uredba zastarjela i da se mora revidirati. Od ukupno 23 isčezla taksona u Srbiji, za ovu oblast su evidentirana 15, od kojih izdvajamo: *Tulipa hungarica* Borbas, *Crocus banaticus* Gay, *Iris aphylla* L. i dr.

date. Of these, 215 are protected by law, pursuant to the Decree of nature rarity protection (Official Gazette RS 50/93, 93/93). Of these taxa, 40% or 86 protected plant species can be found in the mentioned mountain system. In the Red Book of Flora of Serbia (first edition, 1999) the endangerment category is determined for 171 species. Of these, 58 taxa are reported for the explored area, representing almost 34%. The interesting fact is that near 50% or 29 plant species from Red book cannot be found on the list of Decree of protection. That means Decree is out of date and must be revised. Of the total of 23 vanished taxa in Serbia, 15 taxa are noted for this area, including: *Tulipa hungarica* Borbas, *Crocus banaticus* Gay, *Iris aphylla* L. etc. These and other protected species will be described in the paper.

GUSTOĆA NASELJA I PROCJENA PRIMARNE PRODUKCIJE MORSKE CVJETNICE *POSIDONIA OCEANICA* (L.) DELILE U JADRANSKOM MORU

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Naselja morske cvjetnice *Posidonia oceanica* (L.) Delile zbog kompleksnosti, visoke primarne produkcije i bioraznolikosti među najvažnijim su staništima Jadranskog mora. Ona obogaćuju morsku vodu kisikom i stabiliziraju sediment. Ipak, u hrvatskom dijelu Jadrana njihova osnovna obilježja još su uvijek slabo poznata. Svrha ovog istraživanja bila je utvrditi gustoću izdanaka i procijeniti primarnu produkciju u šest naselja posidonije na otocima duž istočne obale Jadranskog mora: na Dugom otoku (3), Krapnju (1), Visu (1) i Lastovu (1). U dobro razvijenim naseljima, od 2002. do 2006. godine, sakupljeno je za biometriju listova i lepidokronološku analizu po 20-50 izdanaka posidonije, na dvije do četiri dubine duž dubinskog gradijenta, ovisno o naselju. *In situ* su utvrđene gornja i donja granica rasprostiranja naselja te su prebrojani izdanci po dubini (u 10 kvadrata 40 x 40 cm po sva-

MEADOW DENSITY AND PRIMARY PRODUCTION ESTIMATION OF *POSIDONIA OCEANICA* (L.) DELILE IN THE ADRIATIC SEA

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Meadows of marine phanerogam *Posidonia oceanica* (L.) Delile are considered to be one of the most important habitats in the Adriatic Sea because of its complexity, high primary production and biodiversity. They oxygenate seawater and stabilize sediment. However, in the Croatian part of the Adriatic, their basic characteristics are still poorly known. The objective of this study was to determine shoot density and estimate primary production in six *Posidonia* beds on the islands along the eastern coast of the Adriatic Sea: Dugi otok (3), Krapanj (1), Vis (1) and Lastovo (1). In well developed meadows, from 2002 to 2006, 20-50 *Posidonia* shoots (fascicles) were taken for leaf biometry and lepidochronological analysis at 2 to 4 depths along the depth gradient, depending on the meadow. The upper and the lower bathymetric

koj dubini). U nekim je naseljima također izmjeren intenzitet svjetlosti na različitim dubinama. Zbog svjetlosnog gradijenta u svakom od istraživanih naselja primijećene su razlike po dubini u gustoći izdanaka, indeksu lisne površine, biomasi i procijenjenoj primarnoj produkciji. Naselja su međusobno uspoređena s obzirom na gustoću i procijenjenu primarnu produkciju u funkciji dubine, a napravljena je i usporedba s objavljenim podacima za naselja posidonije u Sredozemlju.

extension of the meadows were determined *in situ* as well as the number of shoots along the depth (10 40 x 40 cm squares per each depth). The light intensity at different depths was also measured in some of the meadows. Due to the light gradient in each of the researched meadows, differences by depth were noted in shoot density, leaf area index, biomass and estimated annual primary production. Meadow density and estimated primary production as the function of depth were compared among the researched meadows as well as with the published data for *Posidonia* beds in the Mediterranean.

RASPROSTRANJENOST VRSTE *AMBROSIA ARTEMISIIFOLIA* L. U REPUBLICI HRVATSKOJ

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Pelinolisna ambrozija, znanstvenog naziva *Ambrosia artemisiifolia* L. (sin. *Ambrosia elatior* L) jednogodišnja je zeljasta biljka sjevernoameričkog podrijetla. Osim prijevoda lat. naziva, u narodu se rabe još nazivi limundžik, pelinolisni limundžik, partizanka, fazanuša i krausova trava. Pisani tragovi upućuju da je ambroziju, odnosno njezine sjemenke, u Hrvatskoj po prvi put zamijetio prof. dr. Josip Kovačević 1940. godine u sjemenu crvene djeteline podrijetla iz Pitomače.
Kao pridošlica, postala je najvažnijim korovom okopavina. Nakon žetve, masovno zakorovljuje strništa. Sastavni je dio flore i na neobrađenim površinama u ruralnim i u urbanim mjestima. Osim što je veliki kompetitor poljoprivrednim kulturama jednako veliki značaj ima kao izvorište alergenog po-

THE DISTRIBUTION OF *AMBROSIA ARTEMISIIFOLIA* L. IN THE REPUBLIC OF CROATIA

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Common ragweed, *Ambrosia artemisiifolia* L. (syn. *Ambrosia elatior* L.) is an annual weed species originated from North America. In Croatia it was first described in 1940 by Professor Josip Kovačević when he found its seeds in red clover seeds from Pitomača. As neophyte, common ragweed became the most important weed in row crops. Stubbles are greatly infested with common ragweed after harvest too,as well in ruderal and urban places. Besides being a strong competitor in arable fields the plant produces pollen with high allergic potential. Croatian Public Health Department estimates that more than 10 % of Croatian population is sensitive to common ragweed pollen. European plant protection organization classifies *common* ragweed as an invasive weed plant. and therefore every country should bring the

lena koji kod 10% populacije (prema procjenama Zavoda za javno zdravstvo) izaziva teške alergije. Zbog navedenog, EPPO (European Plant Protection Organization) svrstava ju na listu invazivnih korovnih vrsta za koje je potrebno donijeti nacionalne mjere kontrole i suzbijanja.

Mjere suzbijanja obuhvaćaju kemijske, agrotehničke, mehaničke i biološke mjere, a zbog navedene štetnosti sve veći značaj imaju i administrativne mjere. Tako je Ministarstvo poljoprivrede, šumarstva i vodnog gospodarstva donijelo «Naredbu o poduzimanju mjera obveznog uklanjanja ambrozije - *Ambrosia artemisiifolia* L.» (NN 66/04, 90/06, 72/07).

U okviru državnog programa nadzora štetnih organizama bilja (Projekt «Limundžik (*Ambrosia artemisiifolia* L.) – raširenost, biologija, ekologija, štetnost i suzbijanje») obavljeno je kartiranje odnosno utvrđivanje raširenosti ambrozije na području R. Hrvatske. Kartiranje je obavljano tijekom tri godine (2004-2006). Državni zavod za za zaštitu bilja u poljoprivredi i šumarstvu Republike Hrvatske i Zavod za herbologiju Agronomskog fakulteta su u navedenom razdoblju obavili 1937 pregleda u 21 županiji (u 473 općine). U nekim općinama (90) pregledi su obavljani u više navrata. Na osnovi provedenih pregleda, prisutna je u svim kontinentalnim općinama Republike Hrvatske. U 31 priobalnoj općini nije utvrđena. Na temelju jače zakorovljenosti uz rubove prometnica može se zaključiti da prometna sredstva imaju značajnu ulogu u širenju ambrozije.

administrative weed control methods to prevent its spreading. Common ragweed can be controlled with all weed control methods. Over and above chemical, agrochemical and biological methods, administrative methods became very important nowadays. According that, Ministry of Agriculture, Forestry and Water Management brought: "Decree for obligatly control of *Ambrosia artemisiifolia* L. (NN 66/04, 90/06, 72/07)".

This paper reports the results of a three year (2004-2006) monitoring of common ragweed in the Republic of Croatia. In mentioned period 1937 surveys in 21 counties and 473 districts were mapped. In 90 districts surveys were done more than once. The results based on a three year field surveys show that common ragweed is present in every part of continental Croatia. However, it was not found in 31 district near Adriatic sea. Based on higher density near traffic roads it suggests that means of transportation have the main role in spreading of common ragweed. This project "Common ragweed - *Ambrosia artemisiifolia* L. spreading, biology, ecology, damages and control measures" was supported by Ministry of Agriculture, Forestry and Water Management.

MONITORING OF VASCULAR FLORA ALONG THE RIVER DRAVA IN HUNGARY AND CROATIA

"Improving nature conservation relations and enhancing cooperation in biomonitoring activities in areas along the frontier River Drava, for developing the European Ecological Network, DRAVA-INTERECO"

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The Drava is the only river in Europe remaining unregulated on its upper-middle section. Because of their high biodiversity and great natural values, considerable sections of the Drava River are protected as a national park in Hungary. The European ecological network, NATURA 2000 requires neighbouring countries to harmonize their conservation activities. The main purpose of our Project is to increase information exchange and launching of cooperation between the two countries.
Vascular plants, among other taxa, have been monitored on the Hungarian side since 2000. Biomonitoring of the Croatian part of the River Drava will be set off according to the experiences and monitoring protocols of both countries.
Basic biodiversity assessment was carried out and 20 vascular plants selected for monitoring in Croatia: *Butomus umbellatus, Carex riparia, Cyperus longus, Equisetum hyemale, Fritillaria meleagris, Galanthus nivalis, Glyceria fluitans, Hippuris vulgaris, Hottonia palustris, Iris sibirica, Leucojum aestivum, Lindernia procumbens, Listera ovata, Marsilea quadrifolia, Myricaria germanica, Orchis morio, Peucedanum verticillare, Primula vulgaris, Salix eleagnos (=S. incana)* and *Trapa natans*. Survey results will also be presented on maps.
(This work is supported by INTERREG III A, SLO-HU-CRO 2006/01/167/HU).

THERMOPHILOUS DECIDUOUS FORESTS IN SOUTHEASTERN EUROPE

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The work focuses on the vegetation of the order *Quercetalia pubescentis* in Southeastern Europe. In the region, alliances such as *Fraxino orni-Ostryion*, *Carpinion orientalis, Syringo-Carpinion, Quercion confertae, Quercion petraeae-cerris, Quercion pubescenti-sessiliflorae* and *Aceri tatarici-Quercion* have been established. *Fraxino orni-Ostryion* is found in the northern, more continental part of the region and is of the transitional type to the class *Erico-Pinetea*, a subcontinental mountainous thermophilous vegetation dominated by *Pinus sylvestris. Carpinion orientalis* is found in areas influenced by the Mediterranean climate: along the Adriatic coast as well as in the southern part of the Balkans. *Syringo-Carpinion orientalis* is distributed in the most continental part of the eastern Balkans. *Quercion confertae* is an alliance distributed in lowlands under the influence of the continental climate. *Quercion petraeae-cerris* is found at higher altitudes in the eastern and southern part of the research area. *Quercion pubescenti-sessiliflorae* is an alliance with a Central European distribution pattern and has the most southern irradiation in this region, while *Aceri tatarici-Quercion* is the most continental alliance, distributed in the Pannonian plain. In the final tabulation, some initial communities and the degradation stages dominated by *Syringa vulgaris* from the easternmost part (classified within the *Pruno tenellae-Syringion*) and those dominated by *Paliurus spina-christi*, found on the coastal and inland regions (classified within the class *Paliuretea*) are presented. The results are presented in a synoptic table, with a chorological analysis, analysis of bioindicator values and calculation of diagnostic species.

GENOME SIZE OF MARINE HALOPHYTES

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Halophytes are plants that are able to live under elevated salinities in their growth media. The salty soils occur in diverse regions from hot and dry deserts to moist and cool marshes. Their unique habitat makes the ecological group interesting also from the genome size point of view, which is an important biodiversity character with practical and predictive uses in biology. Genome size data are used in many studies, including molecular biology, systematics, ecology and evolution. It was shown that genome size can be influenced by ecological factors, which can also result in intraspecific genome size variation.
In this study, twelve marine halophyte species were analysed to obtain chromosome number and nuclear DNA amount (C-value). Seeds, shoot tips or flower buds of *Arthemisia caerulescens, Arthrocnemum fruticosum, Aster tripolium, Atriplex prostrata, Chritmum maritimum, Halimione portulacoides, Inula crithmoides, Limonium vulgare, Puccinelia, palustris, Ruppia cirrhosa, Salsola soda* and *Suaeda maritima* were fixed at the collection site (saltpan Strunjan, Slovenia). Seeds were germinated to harvest root tips. Meristematic regions were stained with Feulgen reaction and C-value was measured with DNA image cytometry, consisted of light microscope and computer with image analysis software. Genome size data of halophytes are compared with non-halophyte species or genus within the family. Their possible role in genome size evolution is also discussed.

PREGLED RASPOLOŽIVIH EKOLOŠKIH INDIKATORSKIH VRIJEDNOSTI ZA FLORU HRVATSKE

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Od svog objavljivanja, Ellenbergove indikatorske vrijednosti biljaka pobuđivale su velik interes i doživjele brojne kritike i pohvale. Autori diljem Europe prilagođavali su i/ili nadopunjavali njihove vrijednosti za nacionalne flore u svrhu povećanja njihove upotrebljivosti. Iako za Hrvatsku postoje vrijednosti Ellenbergovih indeksa za manje od jedne trećine njene flore, takvo proširivanje i prilagodbe nikada nisu sustavno provedene. Udio flore za koju postoje poznate indikatorske vrijednosti kreće se od 27,3% za indeks temperature, do 32,3% za indeks svjetla. Radi većeg udjela poznatih indikatorskih vrijednosti koje je Landolt prilagodio za floru Švicarske (oko 36% za sve indekse), autori iz Hrvatske često su koristili njegovu skalu. Nedavno objavljene indikatorske vrijednosti Ellenbergovih indeksa za floru Italije povećali su udio poznatih indikatorskih vrijednosti hrvatske flore skoro za trećinu i sada se kreću u rasponu od 63,5% za indeks temperature, do 64,9% za indeks svjetla. Međutim, rezultati pojedinih analiza, kao i činjenica da trenutno poznate vrijednosti potiču iz dva

AN OVERVIEW OF ECOLOGICAL INDICATOR VALUES AVAILABLE FOR CROATIAN FLORA

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Since their initial publication, Ellenberg‘s indicator values have aroused great interest with numerous criticism and approval. To increase their potential usage, authors throughout Europe have adjusted and/or expanded these indicators to their national floras. Such adjustments have never been made for Croatian flora, although for less than one third of Croatian flora, indicator values are available from the original Ellenberg list. Percentages of known values vary from 27.3% for the temperature index to 32.3% for the light index. Landolt‘s adjustments for Swiss flora contain values for 36% of Croatian flora. As such, some Croatian authors have used this scale in their analysis. Recently published indicator values for the flora of Italy has increased the share of Croatian flora with known indices from 63.5% for temperature index to 64.9% for light index. However, results of several analyses, as well as the fact that known indicator values for Croatian flora have their origin in two sources (i.e. Ellenberg and Pignatti) that are not identical for all species common to both lists, imply the necessity of overall analyses

različita izvora (Ellenberg i Pignatti) koji nisu za sve zajedničke vrste jedinstveni u njihovim indikatorskim vrijednostima, upućuju na nužnost sveobuhvatne analize flore Hrvatske radi izrade jedinstvenih proširenih i/ili prilagođenih indikatorskih vrijednosti.

of Croatian flora with the goal of producing a unique adjusted and/or expanded list of indicator values.

ZNAČAJKE PAŠNJAČKE ASOCIJACIJE *BRACHYPODIO-CYMBOPOGONETUM HIRTI* H-IĆ. 1961 U BLIŽOJ OKOLICI TROGIRA

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Na brdu Jelinak kod Trogira, 2006. godine otkrivena je kamenjarsko-pašnjačka zajednica *Brachypodio-Cymbopogonetum hirti* H-ić. 1961, te je obavljena fitocenološka analiza na temelju 25 snimki.
Građena je od razmjerno malenog broja travnjačkih elemenata. Kao stalne i dominantne vrste ističu se *Brachypodium retusum* i *Hyparrhenia hirta* (*Cymbopogon hirtus*). Ova zajednica ograničena je na eumediteransku i stenomediteransku vegetacijsku zonu a razvijena je na izrazito kamenitoj podlozi tipičnog kamenjarskog tla. Kako nema intezivne ispaše, vrlo brzo zarasta u makiju, gdje u ovom slučaju dominiraju *Myrtus communis* i *Spartium junceum.*

CHARACTERISTICS OF THE PASTURE ASS. *BRACHYPODIO-CYMBOPOGONETUM HIRTI* H-IĆ. 1961 NEAR TROGIR

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In 2006, a rocky-pasture association *Brachypodio-Cymbopogonetum hirti* H-ić. 1961 was discovered on Jelinjak hill, near Trogir. The phytosociological analysis was made according to 25 vegetational records.
The association is comprised of a relatively small number of grass elements. Permanent and dominant species stand out, including *Brachypodium retusum* and *Hyparrhenia hirta* (*Cymbopogon hirtus*). This association is limited within the eumediterranean and stenomediterranean vegetational zone, growing on a distinctly rocky bed with typical rocky ground soil (lithosol). Although there is a lack of intensive grazing, it becomes quickly overgrown with macchia, in this case dominated by *Myrtus communis* and *Spar-*

U radu je iznesena i usporedba s istom biljnom zajednicom, prethodno zabilježenom na susjednom otoku Čiovu.

tium junceum.
This paper presents a comparison with the same association, formerly described on the nearby island of Čiovo.

VEGETATION AND POPULATION ECOLOGY AS TOOLS FOR ECOLOGICAL RESTORATION

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Construction and re-vegetation of ski runs in the subalpine and alpine belt of the Austrian Alps have led to severe impacts on landscape and vegetation. Moreover, eroding ski slopes are dangerous for the inhabitants of the settlements underneath. Reasons include the use of wrong methods of construction and re-vegetation, and badly adapted seeding materials. Proof of the failure of formerly used seeding mixtures are records of species numbers, species composition, cover percentages, and the indicator values according to Ellenberg (1992) of poorly re-vegetated ski runs. Our study compares the situation of the years 1986-88 and today. Adapted and site specific seeds are sufficiently available now, and methods have become more sustainable. In 2005, 5 years after a "modern" greening experiment at St. Anton/Arlberg (Austria), the following results were obtained: dry seeding plus cover crops with straw-bitumen top cover has positive effects on species frequency, cover percentage and soil diaspore community. Native or regional mixtures lead to a dense sward consisting of mainly clonally growing species such as *Festuca rubra* s. l. and bunch grasses with sufficient seed production like *Poa alpina*. These species had formerly also been frequent as immigrants on ski runs when only badly adapted mixtures existed. Now they are available as seeds and perform very well. Lowland seed mixtures and hydroseeding, however, still provoke stony and mossy gaps in the vegetation. In these gaps, up to 30,000 seeds/m² of small native immigrants such as *Sagina saginoides* are trapped in the uppermost soil and moss layer. Due to their morphological and biological traits, those tiny and weak immigrants cannot prevent erosion. This means that a dense cover has to be achieved in the first season after greening, not only to fight erosion successfully but also to initiate secondary succession towards a more adequate semi-natural community.

SADAŠNJE ISTRAŽIVANJE RAZNOLIKOSTI FLORE I VEGETACIJE ARBORETUMA TRSTENO HAZU

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Ovaj prilog dio je rezultata sveukupnih istraživanja na projektu «Studija postojećeg stanja – vrednovanje Arboretuma Trsteno» koja su u tijeku od 2006. godine na cjelokupnoj površini Arboretuma (25 ha). Zbog specifičnosti objekta koji je već 50 godina pod zakonskom zaštitom kao iznimno vrijedan botanički i kulturno-povijesni lokalitet, kao i zbog posebnih zahtjeva primjene rezultata, za ovo je istraživanje kreirana posebna, prilagođena metodologija, kao kompilacija metoda koje se koriste u fitocenološkim istraživanjima, pejsažnoj arhitekturi i radu Arboretuma radi sistematične i znanstvene obrade postojećeg stanja. Vrsta i karakter podataka, kao i rezultati istraživanja, također su prilagođeni stvaranju digitalne baze podataka za Arboretum na osnovi softwarea BG-Base. Grafički prikaz cjelokupne površine Arboretuma izrađuje se u digitalnom obliku u softwareu Allplan Nemetschek 2006. na podlozi geodetske snimke.
Svrha ovog istraživanja je zaštita i očuvanje biološke i krajobrazne raznolikosti na površinama pod autohtonom vegetacijom, na kultiviranim površinama kao dijelu kulturnog krajolika i na površinama pod

PRESENT RESEARCH OF FLORISTIC AND VEGETATION DIVERSITY OF THE HAZU TRSTENO ARBORETUM

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This paper is a part of a comprehensive study within the project entitled “Study of the current state – evaluation of Arboretum Trsteno” conducted on the entire area of the Arboretum (25 ha) until 2006. Due to the specificities of the arboretum, protected for the past 50 years, and due to its exceptional value as a botanical and cultural site and the specific demands in application of the results, a special, adapted methodology was created for this study. This methodology is a compilation of conventional methods used in phytocoenological studies, landscape architecture and work in arboreta, aimed at systematic and scientific investigation of the current state. The selection and the characteristic of the data, and the study results, were adapted to create a computerized database using the BG-Base software. The graphic display of the entire area of the Arboretum is shown in digital form on the geodetic map using CAD software (Allplan Nemetschek 2006).
The objective of this study was aimed at the protection and preservation of biological and landscape diversity in areas with indigenous vegetation, in cultivated areas as part of a cultural landscape, and in areas with

posebnim kulturama kao što je zbirka kultiviranih alohtonih vrsta arboretuma, zbirka starih dubrovačkih sorata maslina i dr.
Ovo istraživanje potvrdilo je izrazito bogatstvo i raznolikost biljnih taksona i vegetacijskih jedinica što proizlazi iz velike raznolikosti topografskih i geomorfoloških oblika terena i samog položaja gdje se miješa zimzeleno i listopadno područje primorja. Zbog velike raznolikosti i mozaičnog rasporeda malih biotopa, uz neke prostorno izrazito razvijene zajednice, neke se zajednice pojavljuju samo fragmentarno. Sintaksonomska raznolikost očituje se u diferencijaciji u 5 vegetacijskih formacija, 7 razreda, 7 redova, 10 sveza i 9 zajednica. Floristička analiza pokazala je ukupni broj od 510 registriranih autohtonih taksona i 460 taksona kultiviranih biljaka.

special cultures, such as the collection of cultivated allochthonous species of the arboretum, the collection of old olive Dubrovnik varieties, etc.
This study confirmed the outstanding wealth and diversity of plant taxa and plant communities resulting from the considerable diversity of topographical and geomorphologic features of the terrain and its position, allowing the phenomenon of intermixing of evergreen and deciduous coastal regions. Due to the high diversity and mosaic disposition of little stands, some communities are developed and spatially well defined, while others appear only fragmentary. Syntaxonomical diversity appears through differentiation in 5 vegetation formations, 7 classes, 7 orders, 10 alliances and 9 communities. Floristic analysis reveals a total number of 510 registered indigenous taxa and 460 cultivated allochthonous plant taxa.

BAZA PODATAKA ŠUMSKE VEGETACIJE HRVATSKE

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U današnjoj znanosti rad s velikim brojem objavljenih i neobjavljenih vegetacijskih snimaka, te podataka o geografskoj rasprostranjenosti biljaka i biljnih zajednica postao je nemoguć bez uspostavljanja elektronske baze podataka. Zbog toga su baze podataka vrlo aktualna tema u modernoj znanosti o vegetaciji, te većina zemalja zapadne i srednje Europe ima više ili manje sređene baze podataka vegetacijskih snimaka. Baza podataka šumske vegetacije Hrvatske pohranjena je u TURBOVEG sustavu i sadrži preko 3000 vegetacijskih snimaka. U Hrvatskoj se za istraživanje vegetacije koristi standardna srednjeeuropska metoda pa su sve snimke koje su uključene u bazu napravljene u tom sustavu. Najstarije snimke su iz 1934. godine a u radu se analizira zastupljenost snimaka obzirom na vrijeme nastanka, pripadnost različitim sintaksonima i kvalitetu prikupljenih podataka.

CROATIAN DATABASE OF FOREST VEGETATION

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For todays science it has become impossible to work with large amounts of published and unpublished vegetational relevés and with data about the geographical spreading of plants and plant communities without using an electronic database. Because of this fact database have become a very actual subject in modern vegetation science and most Western and Middle European countries have their database of releves more or less in order. The Croation forest vegetation database is stored in the TURBOVEG system and contains about 3000 relevés. The standard Middle European method is used in Croatia in order to explore vegetation, so all photographs included in the database have been created in this system. The oldest releves were made in the year 1934 and the abundance of the releves analized every time in correlation to the time when they were made, their affiliation to different syntaxa and the quality of the collected data.

THE IMPACT OF MARINA ON THE SEAGRASS COMMUNITY IN THE NOVIGRAD SEA

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In September 2006, in the Novigrad Sea, an enclosure off the Central Croatian Adriatic, the shallow benthic habitats off a concrete enclosed marina and beach development were compared with those in neighboring locations. At each of the 21 study sites dive transects were performed and quadrat samples taken from two different habitat types: i) dense seagrass beds (*Nanozostera noltii*, *Zostera marina, Cymodocea nodosa*) and ii) sparse beds of *Nanozostera noltii* or unvegetated sedimentary benthos, both located between the dense seagrass bed and the nearshore rocky habitats. While dive transects quantified seagrass coverage, nonvegetated sedimentary benthos type, and overall fish and cephalopod abundance, quadrats allowed for seagrass identification and shoot counts. The dense seagrass bed at the three sites located within the marina development exhibited higher total shoot density with shoots of *Nanozostera noltii* present in higher proportion (99%) than at outside study sites (75%). Also, the dense seagrass started closer to shore and in shallower water. The benthos between the nearshore rocky habitats and the dense seagrass bed had higher *Nanozostera noltii* coverage (96%) at the marina sites as compared to outside sites (38%). These results suggest: i) a replacement of unvegetated sedimentary benthos by *Nanozostera noltii* and ii) a transformation of the usually sparse shallow water *Nanozostera noltii* communities into dense seagrass beds under these disturbed conditions. Along with this increase in seagrass coverage and density in shallow benthic habitats the overall fish abundance (based on day and night visual census counts) was significantly lower. The presented findings suggest that anthropogenic disturbances associated with the investigated marina development can have a profound effect on the structure and distribution of shallow benthic habitats and thereby may have an overall negative impact on the associated fauna.

MESOPHILOUS MEADOWS OF THE MECSEK MOUNTAINS AND THE DRAVA PLAIN

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The preliminary results of a phytosociological investigation of *Arrhenatheretalia* meadows are discussed. Grazed, mown and recently abandoned meadows were studied in the Mecsek mountains and on the Drava Plain, including both Croatian and Hungarian sites. Relevés were made according to the Zürich-Montpellier methodology and field data were analysed using multivariate methods. Ordination and classification results show that the floristic differentiation of the studied vegetation type in this region is mostly influenced by geographic factors. Disturbance caused by various site history and current management is the second important element, while type of regular human impact (i.e. grazing or mowing) seems to be determinative only at a smaller scale. Effect of geomorphology and soil conditions seem to have no significance. Groups of relevés were delimited following the results of the numeric analyses and they were characterised by diagnostic species. The results were evaluated in a syntaxonomic context.
(This work is supported by INTERREG III A, SLO-HU-CRO 2006/01/167/HU).

FOREST VEGETATION ALONG THE MURA RIVER IN SLOVENIA

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In line with Central European procedures, we investigated forest communities along the River Mura, on the fringe of the Pannonian lowland. This area receives only 800 mm of precipitation annually, the lowest level in Slovenia.

The following zonation on the banks of the River Mura was discovered: a belt of the association *Salicetum albae* was found along the bank, the community *Fraxino-Ulmetum laevis* is somewhat higher with the community *Genisto elatae-Quercetum roboris* higher, on the frontier with the Pleistocene terrace.

We also determined the next communities: on the Pleistocene terraces, outside of the impacts of flooding and stagnant water, there are widespread forests of association *Pruno padi-Carpinetum betuli* and acidophilous forests of association *Vaccinio myrtilli-Carpinetum betuli*. In depressions where water stagnates, there are widespread swamp forests, above all forests of the associations *Lonicero caprifolii-Quercetum roboris*, *Carici elongatae-Alnetum glutinosae* and *Pruno padi-Fraxinetum angustifoliae* ass. nova ad int. All the discovered communities above and their degraded shapes can also be found in smaller areas on the plains along the Mura River. Therefore we can find the community *Carici brizoides-Alneutm glutinosae* on habitats of the forest association *Lonicero caprifolii-Quercetum roboris* and forests of association *Pruno padi-Fraxinetum angustifoliae* on habitats where the underground water table has already decreased. As such, forests of the association *Carici elongatae-Alnetum glutinosae* are disappearing gradually and development towards oak forests can be expected.

ŠUME PITOMOG KESTENA U HRVATSKOJ - FITOCENOLOŠKE, EKOLOŠKE I GOSPODARSKE KARAKTERISTIKE

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U čitavom svome europskom arealu pitomi kesten dolazi uglavnom u plantažama za uzgoj ploda i u sitnim panjačama. Zbog tako snažnog antropogenog utjecaja, fitocenološka istraživanja na staništima pitomog kestena nisu imala većega smisla.
U Hrvatskoj, također zbog snažnog antropogenog utjecaja, šume pitomog kestena nisu gubile svoju strukturu, a često su zadržale i svoj mješovit sastav. Fitocenološka istraživanja u njima provedna su još 1938. godine (Horvat) kada je opisana zajednica *Querco-Castanetum croaticum* Horvat 1938. U posljednjih 70-tak godina kestenove šume u Hrvatskoj zahvatile su značajne promjene (sušenje zbog raka kestenove kore, napuštanje intenzivnog gospodarenja). Ovim smo radom pokašali utvrditi kako su se ove promjene odrazile na florni sastav. U razdobljima 2002.-2004. i 2006.-2007. godina načinjen je značajan broj fitocenoloških snimaka najvećim dijelom areala kestenovih šuma u Hrvatskoj.
Rezultati pokazuju grupiranje snimaka u dvije glavne grupe (asocijacije), a vidljive su i značajne promjene

SWEET CHESTNUT FORESTS IN CROATIA - PHYTOCOENOLOGICAL, ECOLOGICAL AND SILVICULTURAL CHARACTERISTICS

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All around southern Europe, sweet chestnut is found primarily in orchards and in coppices under strong anthropogenic influences. On these stands, phytocoenological research makes little sense.
In Croatia, although influenced, most of the chestnut stands never lost their mixed forest structure. Nevertheless, no important floristic and ecological studies have been performed in these forests for many years (since Horvat 1938). In the past seventy years, major changes have occurred in these stands: dieback caused by *Cryphonecrtia parasitica*, less anthropogenic influence (through intensive use and management). Therefore, some changes in floristic composition were also expected. In the period 2002-2004 and 2006-2007, a significant number of phytocoenological releves was made in all sweet chestnut regions of Croatia.
On the basis of floristic data, sweet chestnut forests in Croatia are divided in two main clearly different groups (associations). Also, important changes in floristic compositions (comparing releves from 1938) were observed.
Management issues in these forests are also reviewed

flornog sastava u odnosu na snimke iz 1938. godine. Pregled načina i problematike gospodarenja ovim šumama također su u uskoj svezi s flornim sastavom u pojedinim kestenovim sastojinama.

through the floristic composition in some chestnut stands.

FLORNI SASTAV ASOCIJACIJE *RHAMNO-PALIURETUM* TRINAJSTIĆ 2002 U HERCEGOVINI

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Tijekom 2006. godine obavljena su istraživanja flornog sastava dračika (*Rhamno-Paliuretum* Trinajstić 2002) na devet lokaliteta u Hercegovini. U asocijaciji je utvrđeno od 22 do 50 biljnih vrsta. Prosječan broj biljnih vrsta po snimci bio je 31. Utvrđena je velika sličnost flornog sastava između istraživanih lokaliteta.

THE FLORISTIC COMPOSITION OF THE ASSOCIATION *RHAMNO-PALIURETUM* TRINAJSTIĆ 2002 IN HERZEGOVINA (BOSNIA AND HERZEGOVINA)

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During 2006, the floristic composition of the association *Rhamno-Paliuretum* Trinajstić 2002 was studied at nine localities in Herzegovina (Bosnia and Herzegovina). There were 20-50 plant species per relevé. The average number of plant species per relevé was 31. The floristic composition among localities was very similar.

CONTINENTAL AND PANNONIAN LOESS FLORA AND VEGETATION ON THE SOUTHERN BORDER OF ITS DISTRIBUTION

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Areas covered by loess are parts of the forest steppe zone distributed in the Great Hungarian Plain. A botanical survey was carried out on the southern (southwestern), marginal part of loess ridges, on Baranya Hills (S Hungary) and on Bansko Hill in Baranya (NE Croatia).
The last natural climax community of the forest steppe zone on loess substratum was *Aceri tatarici - Quercetum roboris* Zólyomi 1957. Some places were covered by species-rich loess steppe grasslands such as *Salvio nemorosae - Festucetum rupicolae* Zólyomi ex Soó 1964.
The majority of these lands had been converted to agricultural fields, and only small fragments of original loess vegetation have remained unploughed.
On the basis of recent survey loess vegetation of Bansko Hill can be "reconstructed". This now consists of very few fragments of differently degraded semi-natural stands of forest-steppe and steppe grasslands.
Extremely steep loess cliff surfaces are covered by natural vegetation patches of open, pioneer grasslands (*Agropyro cristati - Kochietum prostratae* Zólyomi 1958).
A comparison was made between loess flora of the Hungarian and Croatian part of Baranya. We will also present new data collected during 2007, about populations of some plants which are rare or poorly documented in the continental part of Croatia, e.g.: *Acer tataricum*, *Agropyron pectinatum*, *Astragalus cicer, Astragalus onobrychis, Campanula bononiensis*,*Chamaecytisus supinus, Euonymus verrucosus*, *Festuca valesiaca*, *Nonea pulla*, *Salvia nemorosa*, *Thymus glabrescens.*
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INVENTARIZACIJA MAKROFITSKIH VODENIH BILJAKA RIJEKE DRAVE

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Srednji tok rijeke Drave s pritokom Murom čini jedan od posljednjih nedirnutih riječnih koridora u središnjoj Europi. Drava teče 720 km dugim tokom od izvora u Alpama do Dunava te prolazi Austrijom, Slovenijom, Hrvatskom i Mađarskom. Velik dio rijeke Drave je ukrođen i oblikovan ljudskim aktivnostima. Uzvodno od ušća Mure 22 hidroelektrane oduzimaju rijeci energiju. Nizvodno od Barcsa Drava je regulirana za promet brodova, posebno u 19. stoljeću, čime su mnogi meandri i rukavci odsječeni. Donji tok rijeke Drave još uvijek ima mnoge prirodne karakteristike nizinske rijeke: otoke, obalne šume, rukavce i pritoke.

Prvi cilj Dravske lige bilo je sprječavanje izgradnje građevine kod Novog Virja, a drugi izrada cjelovite inventarizacije staništa i vrsta Drave i Mure, potreban korak u zakonskom postupku zaštite prirode u Hrvatskoj. Tako su Dravska liga i WWF Dunavsko-karpatski program odlučili surađivati u jednogodišnjem projektu inventarizacije rijeke Drave.

Tijekom proljeća i ljeta 2004. – 2006. godine u više navrata izvršena je inventarizacija staništa i makrofitskih biljaka na šest lokaliteta. To je područje: Donje Dubrave GPS koordinata N46°19`04,5``

INVENTARIZATION OF MACROPHYTE VEGETATION OF THE DRAVA RIVER

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The middle section of the River Drava, with its main tributary the Mura, forms one of the last unspoiled natural riverine corridors in Central Europe. The Drava flows 720 km from its source in the Italian Alps to the Danube, and the river and its basin also span territories in Austria, Slovenia, Croatia and Hungary. There are also many hydropower plants on the Mura. Downstream of Barcs, the Drava was regulated for shipping, especially in the nineteenth century, and many meanders and side-branches were cut off. However, the Lower Drava still has many of the natural features of a broad lowland river, with islands, riparian forests, some side-branches and tributary streams. Between the Mura confluence and the Hungarian city of Barcs, the Drava is almost pristine: hardly a settlement or a building to be seen, the river a maze of gravel banks and islands, side-branches and channels, dynamic, ever-shifting, and a haven for wildlife.

The first objective of the Drava League was to prevent construction at Novo Virje, the second was to establish a complete inventory of habitats and species along the Drava and Mura, a necessary step in the legal procedures of nature protection in Croatia. Thus,

E16°44`35,8`` područje od Botova do Novog Virja od 227. do 202. km rijeke Drave, područje Širinskog otoka, Križnice i Jelkuša 176. do 162. km rijeke Drave, područje Županijskog kanala od N45°52`02,1`` E17°33`19,2`` do N45°48`39,6`` E17°42`06,9`` njegova toka, područje šljunčare kod Gabajeve Grede N46°08`53,5`` E17°00`44,2`` i područje nizvodno od Podravskih Podgajaca do Nehaja od 70. do 39. km rijeke Drave.Na istraživanim područjima popisivane su biljne vrste u vodi i u uskom pojasu na obali. Istraživanja su provedena u više navrata obilascima čamcem kako bi što veći dio vodene površine bio što bolje istražen. Tip staništa (habitat code) određen je prema izboru Corine biotopa popisa za Europu.

Zabilježeno je 66 vrsta makrofitskih biljaka, od kojih je osam na popisu ugroženih vrsta. Najveći broj vrsta je u Županijskom kanalu – 45 vrsta (68%), dok je najmanji broj, tj. 14 vrsta (21%) na području nizvodno od Podravskih Podgajaca. Na svim lokalitetima zabilježene su vrste: *Myriophyllum spicatum* L. - klasasti krocanj, *Lythrum salicaria* L. – purpurna vrbica, *Phragmites australis* (Cov.) Trin.ex Stend.- trska, i *Iris pseudacorus* L. - žuta perunika. U samom toku rijeke Drave nalazimo vrste *Myriophyllum spicatum* L., *Potamogeton natans* L., *P. polygonifolius* Pourr., *P. pectinatus* L. *i P. perfoliatus* L.. Veći broj vrsta razvija se u rukavcima.

Na području Županijskog kanala, koji utječe u Dravu nizvodno od Virovitice, nalazimo vrlo razvijenu vodenu vegetaciju. U pojedinim dijelovima svoga toka Županijski kanal prolazi kroz stare dravske meandre

the Drava League and the WWF-Danube-Carpathian Programme decided to co-operate in a one-year project to carry out this inventorization process.

During spring and summer of 2004–2006, the inventorization of macrophyte vegetation was conducted on several occasions at 6 sites. These are: the region of Donja Dubrava (N46°19’04.5”, E16°44’35.8”); the region from Botovo to Novo Virje, (227-202 km of Drava); region of Širinski otok, Križnica and Jelkuš (176-162 km Drava); the region of Županijski channel (from N45°52’02.1”, E17°33’19.2” to N45°48’39.6”, E17°42’06.9”); the region of the Gabajeva Greda gravel pit (N46°08’53.5”, E17°00’44.2”) and the region downstream of Podravski Podgajci to Nehaja (70-39 km Drava). Plant species in the water and in the zone close to the bank were listed for the research sites. Research was conducted on a few occasions by boat, in an attempt to explore the larger water bodies. Habitat codes were determined according to the Corine biotope list for Europe.

66 macrophyte plant species were recorded. Eight of these are endangered according to the Red List of endangered plants and animals. The majority of species are found in the Županijski channel – 45 species, while the least species – 14 (21%) are found downstream of Podravski Podgajci. The following species were found at all sites: *Myriophyllum spicatum* L., *Lythrum salicaria* L., *Phragmites australis* (Cov.) Trin.ex Stend. and *Iris pseudacorus* L.. In the river itself, some plants were found: *Myriophyllum spicatum* L., *Potamogeton natans* L., *P. polygonifolius* Pourr., *P. pectinatus* L.

gdje je njegov tok vrlo spor, a vegetacija bujna.
Na gornjem dijelu istraživanog toka rijeke Drave zbog veće brzine vode i svakodnevne promjene vodostaja, ponekad više od metra (utjecaj hidroelektrane), biljke su ili otplavljene ili se ne mogu razviti jer u jednom dijelu dana na tome području nema vode. Vodena vegetacija se razvija jedino u rukavcima gdje je manje izražena promjena razina.
Nizvodno od Podravskih Podgajaca dno rijeke je pjeskovito i pomično što ne pogoduje razvoju vodenih biljaka, pa ovdje nalazimo mali broj vrsta. Jedino područje gdje je vodena vegetacija dobro razvijena je ušće rijeke Karašice s poplavnom šumom uzvodno od ušća.
Šljunčara kao umjetno vodeno stanište omogućuje razvoj većem broju vrsta močvarnih i vodenih biljaka koje tu nalaze nove životne prostore budući da se stari rukavci i mrtvaje isušuju i nestaju ubrzanim procesima eutrofizacije često uzrokovani utjecajem čovjeka (produbljenje korita rijeke Drave i pad podzemnih i površinskih voda).

and *P. perfoliatus* L. However, the majority of species grow in the side branches of the main stream.
Very developed aquatic vegetation is found in the region of the Županijski channel, downstream of Virovitica. This canal is at some places flowing in the old Drava meanders, where it becomes very slow and overgrown by lush wetland and water vegetation.
Downstream of Podravski Podgajci, the Drava bed is made of sand and shifts, conditions which do not support the growth of aquatic plants, so we found here a small number of species. The only region where aquatic vegetation is well-developed is the mouth of the Karašica River, which has a flooded forest upstream of the confluence.
As an artificial water habitat, gravel pits make the development of many species of wetland and water plants possible, as in this way they find new niches. This is important as old side-branches and oxbows dry out and disappear through the process of eutrophication, often accelerated by human influences – the deepening of the river bed and a consequent drop in underground water levels.
In the upper stretches of the Drava, plants are washed away due to the greater speed of the flow, or the more than 1 meter fluctuation in water level (a consequence of the hydropower dam), or cannot grow at all. Aquatic vegetation develops only in the side branches, where fluctuations in the water level are not as pronounced.

SEAGRASS MONITORING BY UNDERWATER VIDEOGRAPHY: DISTURBANCE REGIMES, SAMPLING DESIGN, AND STATISTICAL POWER

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Marine flowering plants ("seagrasses") are economically and ecologically valuable communities that are capable of dramatic changes in areal extent over short time intervals. Worldwide, seagrass coverage is thought to be declining by at least one percent per year due primarily to anthropogenic pollution of coastal waters. Precise quantification of such losses before they become large and irreversible is necessary for informed scientific management of these valuable resources. In a recent review, Duarte (2002) highlights the "urgent need to design more effective monitoring approaches, capable of detecting losses of 10% or less" in order to adequately protect the resource in all situations. This paper is intended as a step towards designing a seagrass monitoring approach capable of 10% loss detection that is feasible under a variety of disturbance regimes and over a useful range of spatial scales. Within the specific constraints of a surface-based videographic assay of a seagrass meadow, two basic sampling issues need to be addressed: how is statistical power affected by length of region sampled per random start point, and by an unpaired or paired (repeated measures) sampling design within a single meadow? Here I investigate the statistical power of this method applied to a natural meadow and to virtual meadows created by a spatially explicit model of seagrass disturbance, regrowth, and colonization. The approach is found to detect a 5-10% short term loss at 95% probability, with a sampling design emphasizing long transects (400-1500 m) and analysis in which transects are paired before and after disturbance. A field effort function shows that this precision is possible within a single working field day for 1-km² sampling regions. Surface-based videography is a powerful monitoring tool that can provide managers with precise and timely knowledge of small changes in seagrass cover.

STANIŠTA NEOFITSKIH VRSTA VASKULARNE FLORE U HRVATSKOJ

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Na osnovi višegodišnjih istraživanja ustanovljeno je 155 vrsta neofita na području Hrvatske. Od ukupnog broja, 97 vrsta su naturalizirane biljke, a 58 vrsta se samo povremeno pojavljuje u prirodi. U ovome radu nisu uzete u obzir svojte koje rastu samo u kulturi, premda mnoge od njih mogu potencijalno postati povremeno odbjegle ili naturalizirane.
Do sada u Hrvatskoj nije bilo sustavnih istraživanja staništa neofita. U ovome su radu izneseni preliminarni rezultati takvih istraživanja. Analize staništa neofita provedene su pomoću publiciranih fitocenoloških i florističkih podataka, a na osnovi vlastitih istraživanja i zapažanja. Prema tipu staništa neofiti se mogu svrstati u nekoliko skupina: ruderalne biljke, korovi, biljke koje rastu na vlažnim staništima uz obale, u sastavu vodene i močvarne vegetacije, u šumama, na šumskim rubovima, na suhim mediteranskim travnjacima, na zapuštenim travnjacima kontinentalnog dijela Hrvatske, na halofilnim staništima uz morsku obalu, te one vrste za koje u litetaturi ne postoje precizni podaci o staništu a mogu se objediniti u grupu vrsta nešumskih antropogeno utjecanih staništa.
Najveći dio neofita zabilježen je na raznim vrstama

HABITATS OF NEOPHYTIC PLANT SPECIES OF VASCULAR FLORA IN CROATIA

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Based on several years of investigations, 155 neophyte species have been recorded in Croatia, of which 97 species are naturalized plants, while 58 species appear casually in nature. Only cultivated taxa were not considered, although many of these could also become either casually escaped or naturalized.
There have been no systematic studies of neophyte habitats in Croatia to date. This work lists preliminary results of the said habitats. Neophyte habitats analyses have been carried out with published phytosociological and floristic data, and based on investigations and observations by the author. According to the type of their habitat, neophytes can be sorted into several groups: ruderals, weeds, plants growing on wet habitats next to bodies of water, in water and marshland vegetation, in woods, at wood-edges, in dry Mediterranean grasslands, in abandoned grasslands in continental Croatia, in halophilous habitats along the sea coast, as well as those species having no precise data about their habitats and accountable into the group of species with non-forest human-influenced habitats.
The majority of neophytes have been noted in various

antropogenih staništa (razredi: *Chenopodietea, Artemisietea vulgaris* i *Stellarietea mediae*). Sva takva staništa imaju zajedničko obilježje, tj. čovjek oštećuje biljni pokrov, a na golim površinama stvara se mogućnost za razvoj neofita.

Relativno malo neofita prodire na staništa prirodne i poluprirodne vegetacije kao što su šume (*Fraxinus americana, F. pennsylvanica*), šikare (*Echinocystis lobata*), travnjaci (*Erigeron annuus*) i močvare (*Acorus calamus*). Vrsta *Erigeron annuus* do sada je zabilježena na najvećem broju različitih staništa. Najugroženija staništa u Hrvatskoj su razne vrste vlažnih površina u dolinama velikih rijeka gdje širenje neofita s jedne strane potpomažu poplave, a s druge strane provođenje regulacija vodenih tokova prilikom čega se uklanja prirodna vegetacija obala.

Štetnost neofita očituju se na nekoliko načina: s gledišta zaštite prirode invazivne vrste neofita potiskuju prirodnu floru i vegetaciju (*Amorpha fruticosa*), štetno djeluju na ljudsko zdravlje (*Ambrosia artemisiifolia*) te uzrokuju gospodarsku štetu kao korovi (*Panicum capillare, P. dichotomiflorum*).

types of anthropogenic habitats (classes: *Chenopodietea, Artemisietea vulgaris* and *Stellarietea mediae*). All such habitats are similar in that plant cover is damaged through human activity, and the stripped areas offer possibility for neophytes to develop.

Relatively few neophytes grow in habitats of natural and semi-natural vegetation such as woods (*Fraxinus americana, F. pennsylvanica*), shrubs (*Echinocystis lobata*), grasslands (*Erigeron annuus*) and marshes (*Acorus calamus*). The species noted in the majority of different habitats is *Erigeron annuus*. All kinds of wetlands in large river valleys can be considered most endangered, as the spread of neophytes is encouraged by floods and by irrigation system development, due to which the natural vegetation of the river banks is removed.

The negative impacts of neophytes are manifested in several ways: ecologically seen, the invasive species of neophytes suppress natural flora and vegetation (*Amorpha fruticosa*), are harmful to human health (*Ambrosia artemisiifolia*) and cause economic damage as weeds (*Panicum capillare, P. dichotomiflorum*).

MOČVARNA VEGETACIJA PARKA PRIRODE VRANSKO JEZERO U HRVATSKOJ

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Močvarna vegetacija razreda *Phragmito-Magnocaricetea* s područja Parka prirode Vransko jezero istraživana je tijekom 2004. i 2006. godine. Terenska istraživanja provedena su u skladu sa standardnom Braun-Blanquet metodologijom. Zajednice su shvaćene u smislu tradicionalnog sintaksonomskog sustava temeljenog na dijagnostičkim vrstama. Kao rezultat terenskog rada izrađene su 62 fitocenološke snimke.
Razred *Phragmito-Magnocaricetea* na području Parka prirode Vransko jezero obuhvaća red *Phragmitetalia* i to dvije sveze: *Phragmition* i *Magnocaricion*, te ukupno 10 zajednica. Sveza *Phragmition* sadrži 7 asocijacija: *Butometum umbellati, Cladietum marisci, Cyperetum longi, Phragmitetum australis, Scirpetum lacustris, Scirpetum maritimi, Typhetum angustifoliae.* Sveza *Magnocaricion* sadrži 3 zajednice: *Caricetum otrubae*, *Eleocharitetum palustris* i *Iris pseudacorus* zajednicu.

MARSHLAND VEGETATION OF VRANSKO LAKE NATURE PARK IN CROATIA

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The marshland vegetation of the class *Phragmito-Magnocaricetea* in Vransko Lake Nature Park was investigated during 2004 and 2006. Field research was carried out in accordance with standard Braun-Blanquet methodology. The communities are understood in the sense of the traditional syntaxonomical system based on the diagnostic species. As a result of this investigation, 62 relevés have been made.
The marshland vegetation of the class *Phragmito-Magnocaricetea* in the area of Vransko Lake Nature Park covers the order *Phragmitetalia*; two alliances: *Phragmition* and *Magnocaricion*, and a total of 10 communities. The alliance *Phragmition* contains 7 associations: *Butometum umbellati, Cladietum marisci, Cyperetum longi, Phragmitetum australis, Scirpetum lacustris, Scirpetum maritimi, Typhetum angustifoliae.* The alliance *Magnocaricion* contains 3 communities: *Caricetum otrubae*, *Eleocharitetum palustris* and *Iris pseudacorus* community.
The most widespread marshland community of the in-

Na istraživanom području najčešća zajednica močvarne vegetacije je *Phragmitetum australis*, često su zastupljene *Scirpetum lacustris, Scirpetum maritimi*, *Eleocharitetum palustris*, a nešto rjeđe *Typhetum angustifoliae*. Valja istaknuti da je na području Vranskog jezera po prvi put za Hrvatsku utvrđena asocijacija *Caricetum otrubae*.

Najugroženije močvarne zajednice Vranskog jezera su *Butometum umbellati, Caricetum otrubae* and *Cyperetum longi.* Uzroci ugroženosti su vrlo male površine navedenih zajednica unutar Parka prirode, mali broj poznatih lokaliteta na području čitave Hrvatske (Stančić 2007), a isto tako i činjenica da je za održavanje navedenih zajednica potrebno ekstenzivno stočarstvo.

vestigated area is *Phragmitetum australis*, with *Scirpetum lacustris, Scirpetum maritimi*, and *Eleocharitetum palustris* also well represented, and *Typhetum angustifoliae* somewhat less frequently. It is worth pointing out that within the area of Vransko Lake, the association *Caricetum otrubae* has been established for the first time for Croatia.

The most endangered marshland communities of Vransko Lake are *Butometum umbellati, Caricetum otrubae* and *Cyperetum longi.* Sources of threat are the very small surfaces of these communities within the nature park, the low number of known localities within the territory of Croatia as a whole (Stančić 2007), and the fact that extensive livestock breeding is required for maintenance of these communities.

MALA MJEŠINKA (*UTRICULARIA MINOR* L.) –RASPROSTRANJENOST I UGROŽENOST POPULACIJE U NACIONALNOM PARKU PLITVIČKA JEZERA

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Najveća i najbolje očuvana površina prelaznog creta u Hrvatskoj nalazi se unutar granica Nacionalnog parka Plitvička jezera. Na južnom dijelu Prošćanskog jezera, blizu utoka rijeke Matice koja napaja Plitvička jezera, došlo je do zarastanja i postupnog formiranja creta još od razdoblja boreala.
Tu je, na nadmorskoj visini oko 636 mnv, razvijena cretna biljna zajednica zvjezdastog šaša i rosike (as. *Drosero-Caricetum echinatae*). Uz karakteristične cretne svojte, kao što su mah tresetar (*Sphagnum* sp.), okruglolisna rosika (*Drosera rotundifolia* L.), širokolisna suhoperka (*Eriophorum latifolium* Hoppe.), cretna crvotočina (*Lycopodiella inundata* **(L.) Holub) i** trolistica (*Menyanthes trifoliata* L.), zabilježena je i rijetka vodena biljka, mala mješinka (*Utricularia minor* L.). Prema dosadašnjim literaturnim podacima, ovo je u Hrvatskoj jedino poznato nalazište male mješinke.

LESSER BLADDERWORT (*UTRICULARIA MINOR* L.) – DISTRIBUTION AND THREATS TO THE POPULATION IN PLITVICE LAKES NATIONAL PARK

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The largest and best preserved area of transition peat bog in Croatia is found within the boundaries of the Plitvice Lakes National Park. The gradual formation of peat bog, since the Boreal era, has been taking place at the southern part of Prošćansko Lake, near the inflow of the Matica River that fills the Plitvice Lakes. The peat bog community comprised of yellow sedge and sundew *(*as. *Drosero-Caricetum echinatae),* has developed at an altitude of 636 m.
With the characteristic peat taxa, such as sphagnum moss (*Sphagnum* sp.), round leaf sundew (*Drosera rotundifolia* L.), broad leaved cottongrass (*Eriophorum latifolium* Hoppe.), inundated clubmoss (*Lycopodiella inundata* **(L.) Holub) and** buckbean (*Menyanthes trifoliata* L.) the rare aquatic plant, lesser bladderwort (*Utricularia minor* L.) was recorded.
According to the literature to date, this is the only re-

U ovom su radu prikupljeni postojeći podaci o rasprostranjenosti i ekologiji ove vrste poznate iz literature, a izvršena su terenska opažanja kojima je potvrđena i detaljnije obrađena distribucija populacije na navedenoj lokaciji. Ugroženost populacije definirana je kroz ugroženost staništa.

Naime, iako se ne drži ugroženom svojtom u Hrvatskoj, primarno stanište *U. minor*, cretovi, su među kritično ugroženim staništima Hrvatske.

Mala mješinka je vodena karnivorna biljka iz porodice *Lentibulariaceae* koja je, iako rijetka, globalno široko rasprostranjena. To je mala, višegodišnja biljka, manje ili više pričvršćena za supstrat u plitkim jaružicama ispunjenim vodom, na staništu siromašnom nutrijentima, s malim koncentracijama kisika i visokom organskom tvari. Pripadnici roda *Utricularia* poznati su po svojim smrtonosnim stupicama u obliku okruglastih mješinica kojima hvataju sitne vodene životinje.

Na opstanak populacije male mješinke u NP Plitvička jezera direktno utječe zarastanje creta johom (*Alnus glutinosa*) i beskoljenkom (*Molinia caerulea*), koje zasjenjuju stanište, crpe vodu, uzdižu i isušuju teren, a indirektnu opasnost predstavlja onečišćenje vodotoka jer je svojta vrlo osjetljiva na promjene kvalitete vode.

corded habitat of this species in Croatia. Existing data on the distribution of this species were collected from literature and field observations were carried out. Detailed analysis of distribution of the population at this location was conducted. Threat to species is defined through threat to habitat because, though not considered an endangered species in Croatia, the primary habitat of *U. minor*, the peat bogs, are among the critically endangered habitats in Croatia. The lesser bladderwort is an aquatic carnivorous plant from the *Lentibulariaceae* family which, though rare, is globally distributed.

This is a small, perennial plant that is more or less attached to a substrate in shallow pools in nutrient poor habitats, with low oxygen concentrations and high levels of organic matter. Members of this genus are known for the lethal traps in the shape of bladders that capture small aquatic animals.

The population of lesser bladderwort in Plitvice Lakes National Park is directly affected by alder (*Alnus glutinosa*) and purple moorgrass (*Molinia caerulea*) which are overgrowing the peat bog, shading out the habitat and drying out the soil. The species is indirectly impacted by water pollution since it is very sensitive to changes in water quality.

PRILOG VEGETACIJI STIJENA SVEZE *CENTAUREO-PORTENSCHLAGIELLION* TRINAJSTIĆ 1980

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Upoznavši se sa studijom utjecaja na okoliš u sklopu izgradnje Omiške zaobilaznice, uočile smo nedostatak istraživanja vegetacije stijena. U toj vegetaciji, naime, rastu vrste koje imaju uzak areal: *Fibigia triquetra*, *Campanula portenschlagiana*, *Molkea petraea*, *Portenschlagiella ramossisima*…
Istraživale smo vegetaciju klasičnom metodom po Braun-Blanquet-u. Načinile smo 25 vegetacijskih snimaka. Dobivene rezultate obradile smo statistički (klaster i muldimenzionalno skaliranje).

ADDITION TO THE ROCK VEGETATION OF THE *CENTAUREO-PORTENSCHLAGIELLION* TRINAJSTIĆ 1980 ALLIANCE

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Having read the environmental impact study concerning the construction of the bypass road at Omiš, we noticed its incompleteness in terms of adequate rock vegetation research. Species with narrow areals, such as *Fibigia triquetra*, *Campanula portenschlagiana*, *Molkea petraea*, *Portenschlagiella ramossisima* and others grow within this vegetation.
We explored the vegetation using the classical Braun-Blanquet method and made 25 releves. The compiled data were processed statistically.

VEGETATION ECOLOGY AS A NEW APPROACH IN WASTE MANAGEMENT

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Waste management provides several possibilities to implement methods of vegetation ecology.
To detect typical emissions (gas and leachate) from waste material, physical and chemical parameters are often improper tools. The costs of a valid assessment with such measurements are often quite high. On the other hand, plants are strongly affected by these impacts. Landfill gas creates a deficit of oxygen in the root zone; trace substances are directly toxic. Leachate usually leads to severe salinity stress. Some typical ingredients are toxic as well. Especially, plant life traits appropriately display the impacts of emissions. Indicator plants can provide specific information about the emission situation. Furthermore the quality and quantity of landfill cover material can be estimated by the plants growing on the top cover.
Another part of interest is the after-use of closed landfills. Very often, recultivation with vegetation is suggested. Also, during the aftercare phase, vegetation cover is required for leachate minimisation. Our investigations showed the possibility of combining ecological restoration and the oxidation of reduced methane emissions. As landfills as habitats differ strongly from other sites, special considerations are necessary to secure successful restoration. Various projects are presented where the analysis of ecological indicator values and of life traits was implemented in the assessment of landfill gas emissions in eastern Austria. On a closed landfill near Vienna, vegetation ecology helped to resolve problems with the revegetation process. On another closed landfill, test plots for the establishment of a semi dry meadow represent aspects of nature conservation in after use conceptions.

NOMENKLATURNO-SINTAKSONOMSKA ANALIZA PANONSKIH BUKOVO-JELOVIH ŠUMA (*ABIETI-FAGETUM „PANNONICUM“*) U HRVATSKOJ

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Šume bukve i jele u gorju jugozapadnog dijela Panonije u Hrvatske relativno su slabije opisane u fitocenološkoj literaturi. U novije vrijeme nije bilo njihove podrobne nomenklaturno-sintaksonomske analize koja bi u potpunosti bila sukladna međunarodnim nomenklaturnim pravilima (Barkman i dr. 1976, 1986, Weber i dr. 2000). To su bili razlozi da smo nakon njihovog diferenciranja od dinarskih bukovo-jelovih šuma (Vukelić i Baričević 1996) u 2007. godini pristupili njihovom istraživanju, imenovanju i određivanju prema ostalim šumskim zajednicama ovog dijela Europe.

U glavnom arealu bukovo-jelovih šuma na Macelju, Medvednici i Papuku (približno 15.000 ha) fitocenološki smo analizirali 25 ploha. Relativno su bogatoga floističkoga sastava u kojem ukupno dolazi 135 vrsta. Prevladavaju vrste reda *Fagetalia* i njegovih nižih jedinica od kojih su posebno značajne vrste sveze *Aremonio-Fagion*. Floristički sastav, ekološki uvjeti, fizionomija i način gospodarenja ovih sastojina

NOMENCLATURAL-SYNTAXONOMIC ANALYSIS OF PANNONIAN BEECH-FIR FORESTS (*ABIETI-FAGETUM “PANNONICUM”*) IN CROATIA

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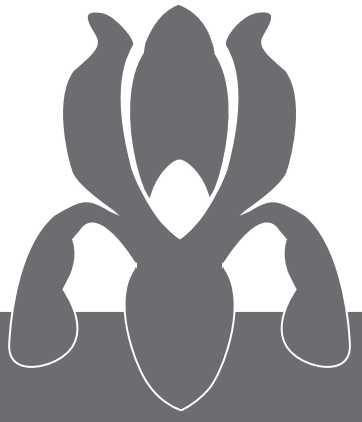
Phytosociologycal releves provide relatively little information about forests of beech and fir in the mountains of South-western Pannonia in Croatia. No detailed nomenclatural-syntaxonomic analysis has recently been made that would fully conform to international nomenclatural rules (Barkman et al., 1976, 1986, Weber et al., 2000). It is for these reasons that in 2007, upon differentiating these forests from Dinaric beech-fir forests (Vukelić and Baričević 1996), we undertook to investigate, name and determine them in relation to other forest communities in this part of Europe.

Phytosociologycal analysis comprised a total of 25 plots in the main distribution range of beech-fir forests on Macelj, Medvednica and Papuk (approximately 15,000 ha). These forests, with their 135 species in all, have a relatively rich floristic composition. There is a prevalence of the species of the *Fagetalia* and their lower units, of which species of the *Aremonio-Fagion* have special importance. The floristic composition,

opravdavaju izdvajanje zasebne asocijacije. Označili smo ju imenom *Festuco drymeiae-Abietetum* (šuma bukve i jele sa šumskom vlasuljom) prema najzastupljenijoj i sociološki važnoj vrsti *Festuca drymeia* i edifikatoru jeli (*Abies alba*). Time se jasno odvaja i prepoznaje među ostalim bukovim i bukovo-jelovim asocijacijama unutar sveze *Aremonio-Fagion* i podsveze *Lamio orvalae-Fagenion* kojima je podređena. Sastojine u sjeverozapadnom dijelu Hrvatske, na Macelju i Medvednici floristički su raznovrsnije i bogatije od sastojina na Papuku – poglavito vrstama sveze *Aremonio-Fagion*, no statistička analiza nije pokazala opravdanost njihova razdvajanja. U radu je prikazana tipološka raščlamba asocijacije, analiziraju se fitogeografske razlike unutar njenog areala u Hrvatskoj i odnos prema srodnim zajednicama na istraživanom i susjednim područjima.

ecological conditions, physiognomy and methods of managing these stands justify their status of a separate association. It was named *Festuco drymeiae-Abietetum* (forest of beech and fir with fescue) according to the best-represented and sociologically important species *Festuca drymeia* and edifier fir (*Abies alba*). This clearly distinguishes it from other beech and beech-fir associations within the *Aremonio-Fagion* and the sub-alliance *Lamio orvalae-Fagenion* to which it is subordinated. Compared to the stands on Papuk, those in the north-western part of Croatia, on Macelj and Medvednica, are floristically richer and more diverse – particularly in the species of the alliance *Aremonio-Fagion*. However, statistical analysis did not justify their separation.

The paper presents typological analysis of the association. Phytogeographic differences within its range in Croatia are analysed and so it its relationship towards affiliated communities in the investigated and adjacent areas.



molekularna botanika i fiziologija bilja

molecular botany and physiology of plants

BIOKEMIJSKI BILJEZI MORFOGENEZE U KULTURI TKIVA HRENA (*ARMORACIA LAPATHIFOLIA* GILIB.)

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Biljke hrena (*Armoracia lapathifolia* Gilib.) razmnožene su u uvjetima *in vitro*. Tumori su inducirani na fragmentima lista bakterijom *Agrobacterium tumefaciens*, soj B6S3. Uspostavljene su dvije linije transformiranog tkiva: neorganizirani tumor (TN) i teratom (TM). Teratom se sastoji od neorganiziranog tkiva (TMn) koje regenerira izdanke (TMsh). Svrha rada bio je utvrditi biokemijske biljege morfogeneze u kulturi tkiva hrena. Usporedili smo tkiva s obzirom na aktivnost i sastav izoenzima peroksidaze (PPX, EC 1.11.1.7) i askorbatne peroksidaze (APX, EC 1.11.1.11) te s obzirom na aktivnost fenilalanin-amonij lijaze (PAL, EC 4.3.1.5) i sadržaj fenola. Sva transformirana tkiva sadržavala su više vode (91,85-94,42 %) nego list (86,25 %), a izdanci teratoma imaju tipičan izgled hiperhidriranog tkiva. Aktivnost peroksidaze 4 do 5 puta je viša u transformiranim tkivima nego u listu za oba supstrata gvajakol i

BIOCHEMICAL MARKERS OF MORPHOGENESIS IN HORSERADISH (*ARMORACIA LAPATHIFOLIA* GILIB.) TISSUE CULTURE

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Horseradish (*Armoracia lapathifolia* Gilib.) was propagated *in vitro* and tumours were induced on leaf fragments with *Agrobacterium tumefaciens* strain B6S3. Two lines of transformed tissues were established: unorganised tumour (TN) and teratoma (TM). Teratoma consists of unorganised tissue (TMn) from which shoots (TMsh) regenerate. The aim of this study was to establish biochemical markers of morphogenesis in horseradish tissue culture. We compared tissues with regard to peroxidase (PPX, EC 1.11.1.7) and ascorbate-peroxidase (APX, EC 1.11.1.11) activity and isoenzymes, phenylalanine ammonia lyase (PAL, EC 4.3.1.5) activity and phenolic contents. All transformed tissues contained more water (91.85-94.42%) than leaves (86.25%). Teratoma shoots had a typical hyperhydric phenotype. The PPX activity was 4 to 5 times higher in transformed tissues than in the

pirogalol. Aktivnost askorbatne peroksidaze 3 do 5 puta je viša u transformiranim tkivima nego u listu. Najviša specifična aktivnost peroksidaze i askorbatne peroksidaze izmjerena je u tkivima TMn i TN. Ukupno su razdvojena četiri izoenzima peroksidaze za oba supstrata. Sva četiri uočena su u tkivima TM i TMn te, iako vrlo slabo i u TMsh. List pokazuje dvije slabo obojene vrpce s gvajakolom i jednu s pirogalolom. Ukupno je otkriveno devet izoformi askorbatne peroksidaze prisutnih u tumoru (TN). List je imao samo tri izoenzima, dok je teratomsko tkivo TMn i TMsh imalo identične uzorke od pet izoenzima. Sadržaj ukupnih fenola bio je 2,5 puta viši u listu nego u ostalim tkivima. Aktivnost enzima PAL u listu i tumoru bila je podjednaka, dok je u teratomu bila povišena. Glavnina aktivnosti u tkivu TM dolazi iz TMn dok TMsh ima sličnu aktivnost kao i list biljke. Svi testirani parametri, osim enzima PAL, mogu se smatrati biokemijskim markerima morfogeneze u kulturi tkiva hrena.

leaves, regardless of substrate pyrogallol or guiaiacol. APX activity was 3 to 5 times higher in tumour than in leaves. The highest specific peroxidase activity was measured in TMn and TN with all applied substrates. In total, four peroxidase isoforms were resolved either with guaiacol or pyrogallol. They were all present in TM and TMn as well as in TMsh, although as very faint bands. Leaf exhibited two faint isoenzymes with guaiacol and one with pyrogallol. In total, nine APX isoenzymes were detected. All nine were present in TN and only three in the leaf. The APX-patterns of teratoma TMn and TMsh were almost identical, exhibiting five isoforms. The PAL activity of leaf and TN were similar. It was significantly elevated in TM. The majority of activity in TM was coming of the TMn, while the TMsh activity was similar to the activity in leaves. Total phenolic content was 2.5 higher in the leaf than in transformed tissues. All tested parameters, except PAL, could be considered as biochemical markers of morphogenesis in horseradish tissue culture.

MOLEKULARNO GENETIČKA IDENTIFIKACIJA HRASTA LUŽNJAKA (*QUERCUS ROBUR* L.) U BOSNI I HERCEGOVINI

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U ovom istraživanju određivali smo molekularno genetičku varijabilnost 14 prirodnih populacija hrasta lužnjaka u Bosni i Hercegovini. Molekularno genetička varijabilnost analizirana je na razini DNK, uz pomoću četiri nuklearna mikrosatelitna biljega, ssrQpZAG1/5, ssrQpZAG9, ssrQpZAG36 i ssrQpZAG108. Cilj istraživanja je bio utvrditi postoji li značajna varijabilnost između populacija, što bi bilo važno za gospodarenje i obnovu šumama hrasta lužnjaka, kao i za osnivanje banaka i arhiva gena metodama *in situ* i *ex situ*.
Uporabljeni mikrosatelitni biljezi omogućili su analizu 111 različitih alela, a što je pokazalo da su između populacija prisutne značajne razlike u frekvencijama određenih alela. Također, statističkom obradom je i kod drugih parametara kao što su efektivni broj alela, heterozigotnost, fiksacijski indeks, genetička udaljenost i bliskost, potvrđena prisutnost značajnih razlika između istraživanih populacija.

MOLECULAR GENETIC IDENTIFICATION OF COMMON OAK (*QUERCUS ROBUR* L.) POPULATIONS IN BOSNIA AND HERZEGOVINA

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In this study we conducted molecular genetic analysis of 14 *Quercus robur* populations originating from Bosnia and Herzegovina. The analysis was carried out using four nuclear microsatellites ssrQpZAG1/5, ssrQpZAG9, ssrQpZAG36 and ssrQpZAG108. The aim was to determine the existence of genetic variation among the Bosnian populations from disjunct habitats occupied by the species. This could be useful for the species management, recultivation and conservation using *ex* and *in situ* methods. Totally, 111 allels were scored using the nuclear microsatellite markers and significant differences were observed for allele frequences between the populations. Also, the effective number of alleles, heterozigosity, fixation indices, genetic distances showed the significant variation between the populations analyzed. Observed allele heterozigosity was higher relative to the populations from the western Europe. It could be hypothesized that studied populations have not lost their genetic capaci-

Važno je napomenuti da je kod istraživanih populacija dobivena veća alelna heterozigotnost nego što je registrirana u populacijama hrasta lužnjaka u zapadnoj Europi. To nam ukazuje da istraživane populacije nisu mnogo izgubile od svoga genetičkog potencijala za adaptaciju, te da su na relativno maloj udaljenosti od glacijalnog pribježišta. Stoga su Bosanskohercegovačke populacije vjerojatno prilično otpornije od populacija sa zapada jer posjeduju dovoljno genetičke varijabilnosti, iako su stoljećima jako antropogeno utjecane i dovedene na granicu opstanka.
Na temelju dobivenih rezultata, u narednom periodu bi trebalo raditi na održavanjau genetičkih izvora, kroz uspostavu što gušće mreže banki gena *in situ* i *ex situ*, nužnih za održanje genetičke raznolikosti populacija hrasta lužnjaka.

Ovo istraživanje je realizirano kao Bilateralni projekt između Šumarskog fakulteta u Sarajevu i Instituta DIVAPRA. Projekt je financirala Regija Lombardia, preko svoje direkcije za šume (ERSAF) te ga implementirala preko organizacije Alisei, te im stoga dugujemo veliku zahvalnost.

ty during the adaptations despite their relative vicinity to a putative glacial refugia in the Balkans. Long-term human influence during the history shaped extremely disjunct distribution of common oak in Bosnia and Herzegovina but the populations possessed higher genetic diversity than the western ones. Since many populations of the species are extremelly small and using the obtained results it is necessary to estabilish *in* and *ex situ* gene banks to conserve genetic diversity of the species.

REAKCIJA TRI KULTIVARA JAGODE NA ZASLANJENOST HRANIDBENE PODLOGE: VEGETATIVNI PARAMETRI

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Ispitana je reakcija tri kultivara jagode *Fragaria ananassa* Duch. na slanost (0-kontrola; 0,5; 1,0; 2,0; 3,0 i 4,0 g NaCl/L vode za zalijevanje, što odgovara EC vrijednostima: 0,73; 1,65; 2,66; 4,37; 5,93 i 7,81 mS/cm). Vegetacijski pokus proveden je tijekom 1997. i 1998. godine na Agronomskom fakultetu u Zagrebu. Testirani su sljedeći parametri: „ljestvice stupnja oštećenja" izdanka, broj listova, broj vrježa, prinos svježe mase i suhe tvari izdanka i korijena, postotak suhe tvari izdanka i korijena, prinos suhe tvari primarnog korijena i sekundarnog korijena (razvijenog tijekom pokusa), te maseni odnos suhe tvari primarnog i sekundarnog korijena.
Kultivari jagode značajno su se razlikovali u stupnju oštećenja (nekroze i propadanje biljaka pri višim koncentracijama NaCL-a). Najviši stupanj oštećenja, u

REACTION OF THREE STRAWBERRY CULTIVARS TO THE SALINITY OF GROWING SUBSTRATE: VEGETATIVE PARAMETERS

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The study aimed at analysing the reaction of three strawberry *Fragaria ananassa* Duch. cultivars to salinity (0-control, 0.5, 1.0, 2.0, 3.0 and 4.0 g of NaCl l^{-1} in irrigation water: equivalent of the following EC values: 0.73, 1.65, 2.66, 4.37, 5.93 and 7.81 mS cm^{-1}). The vegetation trial was carried out at the Faculty of Agriculture in Zagreb during 1997 and 1998. The following parameters were tested: degrees of damage of shoots, number of leaves, number of stolons, yield of fresh biomass and dry matter of shoots and roots, percentage of dry matter of shoots and roots, dry matter yield of primary and secondary roots (developed dur-

obje godine istraživanja, imala je Elsanta, zatim Marmolada pa Miranda. Isti trend kultivari su pokazali kad je u pitanju broj listova i vrježa.

Prinos svježe mase i suhe tvari izdanka i korijena značajno su smanjeni primjenom NaCl-a. Najveći prinos svježe mase i suhe tvari imala je Miranda, zatim Marmolada pa Elsanta. Prosječno smanjenje prinosa svježe mase izdanka u odnosu na kontrolu bilo je: 45, 33 i 22%, a suhe tvari 34, 28 i 18% kod Elsante, Marmolade i Mirande. Prinos ukupne suhe tvari (izdanak + korijen) u Elsante značajno se smanjio pri 0,5 g/L, a u Marmolade i Mirande pri 1,0, odnosno 2,0g NaCL-a/L. Prinos suhe tvari sekundarnog korijena, te maseni odnos suhe tvari primarnog i sekundarnog korijena kultivara značajno su se razlikovali. Miranda je imala najveći prinos suhe tvari sekundarnog korijena, zatim Marmolada pa Elsanta. Odnos suhe tvari primarnog i sekundarnog korijena bio je također najpovoljniji (najniži) u Mirandi, zatim u Marmoladi pa u Elsanti.

ing the trial) and weight ratio of dry matter of primary and secondary roots.

Tested cultivars showed significant differences of the level of damage (necrosis and dieback of plants due to high NaCl concentration). The highest degree of damage was shown by Elsanta in both trial years, followed by Marmolada and Miranda respectively. The analysis of the number of leaves and stolons confirmed the same trend.

The yield of fresh biomass and dry matter of shoots and roots was significantly reduced with the application of NaCl. Miranda was characterised by the highest fresh biomass and dry matter yield, followed by Marmolada and Elsanta. Average decrease of fresh biomass yield of shoots in comparison to the control was 45, 33 and 22% in Elsanta, Marmolada and Miranda, respectively. Dry matter yield of shoots decreased correspondingly by 34, 28 and 18%, respectively. Total dry matter yield (shoots + roots) of Elsanta was significantly reduced at 0.5 g NaCl l^{-1} and of Marmolada and Miranda at 1.0 and 2.0 g l^{-1}, respectively. Dry matter yield of secondary roots as well as weight ratio of dry matter of primary and secondary roots of three cultivars showed significant differences. Miranda had the highest dry matter yield of secondary roots, followed by Marmolada and Elsanta. The most favourable (lowest) ratio of dry matter of primary and secondary roots was also shown by Miranda, followed by Marmolada and Elsanta.

PRELIMINARNO ISTRAŽIVANJE PORIJEKLA VRSTE *HYPERICUM PERFORATUM* L.

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Hypericum perforatum L. smatramo hibridnom vrstom. Potencijalna davna hibridizacija desila se u sjeveroistočnoj Aziji, između europske vrste *H. maculatum* Crantz i azijske vrste *H. attenuatum* Choisy, na području preklapanja njihovih areala.
Svrha ovog istraživanja bila je utvrditi može li se hibridno porijeklo vrste *H. perforatum* L. detektirati analizom kloroplastne DNK. Tri su vrste uspoređene na temelju restrikcijskih fragmenata dviju nekodirajućih regija u velikoj jednostrukoj kopiji kloroplastnog genoma. Od ukupno sedam restrikcijskih profila, vrsta *H. perforatum* L. razlikuje se u svima, dok su potencijalne roditeljske vrste *H. maculatum* Crantz i *H. attenuatum* Choisy identične. Dobiveni rezultati ukazuju na visok stupanj promjena u uspoređenim fragmentima molekule kloroplastne DNK tijekom razvoja vrste *H. perforatum* L. Restrikcijska analiza drugih područja kloroplastnog genoma ili sekvenciranje omogućilo bi bolju usporedbu tih triju vrsta i bolje dokaze o roditeljskim vrstama.

PRELIMINARY INVESTIGATION OF *HYPERICUM PERFORATUM* L. ORIGIN

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Hypericum perforatum L. is considered to be a hybrid species. Potential ancient hybridisation occurred in northeast Asia between the European species *H. maculatum* Crantz. and Asian species *H. attenuatum* Choisy in the overlapping zone of their distributions.
The objective of the present study was to determine whether the hybrid origin of *Hypericum perforatum* L. could be detected using restriction analysis of cpDNA. Three species were compared on the basis of restriction patterns of two non-coding regions within a large single copy of chloroplast genome. Of the seven restriction patterns, *H. perforatum* L. differed in all seven, while the potential parent species *H. attenuatum* Choisy and *H. maculatum* Crantz. were identical. The obtained results indicate a high degree of rearrangement in the compared parts of the cpDNA molecule during speciation of *H. perforatum* L. Restriction analysis of other chloroplast genome regions or sequencing should provide better comparison of these three species and evidence of parental species.

VEGETATIVNO RAZMNOŽAVANJE VRSTE *EPIMEDIUM ALPINUM* L. U UVJETIMA *IN VITRO*

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Rod *Epimedium* (biskupska kapica) iz porodice *Berberidaceae* obuhvaća oko 60 vrsta trajnica. Mnoge vrste, hibridi i kultivari uzgajaju se kao ukrasne biljke u vrtovima divljeg tipa i naturaliziranim područjima. U Hrvatskoj *Epimedium alpinum* L. ima status osjetljive vrste ugrožene nekontroliranim branjem. Razmnožava se podankom i sjemenkama. Zbog otežalog sakupljanja sjemenki i njihove slabe vijabilnosti, biskupska kapica je vrsta pogodna za razmnožavanje u kulturi tkiva. U nastojanju da razvijemo sustav za mikropropagaciju *E. alpinum*, ispitani su učinci različitih koncentracija tidiazurona (TDZ) i *N*-(2-klor-4-piridil)-*N'*-feniluree (CPPU) na indukciju organogenog kalusa iz nezrelih sjemenki. Najbolji učinak imao je kratkotrajan (48 sati) tretman s 20 μM CPPU ili 80 μM TDZ nakon kojega su sjemenke kultivirane na hranidbenoj podlozi WPM ('woody plant medium') bez hormona. Čvrsto kalusno tkivo s bijelim kvržicama sporo je raslo na hranjivoj podlozi bez hormona. Da bismo potaknuli zametanje adventivnih izdanaka, ispitan je učinak različitih

IN VITRO PROPAGATION OF *EPIMEDIUM ALPINUM* L.

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The genus *Epimedium* (bishop's hat, barrenwort) in the family *Berberidaceae* comprises about 60 species of rhizomatous perennials. A number of species, hybrids, and cultivars are grown as ornamentals in woodland gardens and naturalized areas. In Croatia, *Epimedium alpinum* L. has the status of a v**ulnerable species, threatened** due to uncontrolled collecting. The plant can be propagated by division of its long rhizomes or by seeds. The difficulties associated with gathering the seeds and low seed viability make bishop's hat a suitable species for propagation by tissue culture. In an attempt to develop a system for micropropagation of *E. alpinum*, the effects of various concentrations of thidiazuron (TDZ) and *N*-(2-chloro-4-pyridyl)-*N'*-phenylurea (CPPU), on the induction of organogenic callus was evaluated. Organogenesis from immature seeds occurred most efficiently when they were transiently exposed (48 hours) to 20 μM CPPU or 80 μM TDZ followed by culture on hormone-free woody-plant medium (WPM). Organogenic callus consisting of white, compact clumps of tissue proliferated slow-

koncentracija 2,4-diklorfenoksioctene kiseline (2,4-D) i 6-benziladenina (BA). Podloga WPM s dodatkom 1,1 μM 2,4-D i 4,4 μM BA pogodovala je rastu kalusa, dok je dodatak 1,1 μM 2,4-D i 2,2/22 μM BA poticao zametanje i izduživanje izdanaka. Pupovi su uspješno zakorijenjeni na podlozi WPM bez dodatka regulatora rasta, a dobro razvijene biljčice presađene su u tlo.

ly on hormone-free WPM. To promote adventitious shoot induction, the effects of different concentrations of 2,4-dichlorophenoxyacetic acid (2,4-D) and 6-benzyladenine (BA) were investigated. WPM containing 1.1 μM 2,4-D and 4.4 μM BA was optimal for callus proliferation while shoot induction and elongation was enhanced on media with 1.1 μM 2,4-D and 2.2 or 22 μM BA. Shoots were successfully rooted on hormone-free WPM and well-developed plantlets were transferred to soil.

UČINAK AUKSINA NA ZAKORJENJIVANJE REZNICA VISOKE AMERIČKE BOROVNICE *VACCINIUM CORYMBOSUM* L.

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Auksini i njegovi sintetski analozi često se upotrebljavaju za zakorjenjivanje reznica, ali njihova djelotvornost ovisi o eksperimentalnim uvjetima, a još više o istraživanoj vrsti i njenim hortikulturnim sortama. Američka visoka borovnica *Vaccinium corymbosum* L. jedna je od teško zakorjenjivih vrsta. Ovdje istražujemo učinak indol-3-octene kiseline (IAA), indol-3-maslačne kiseline (IBA) i njihovih aminokiselinskih konjugata na zakorjenjivanje neodrvenjelih reznica na primjeru varijeteta Bluecrop, Jersey, Burlington i Bluetta. Primijenjene su dvije metode tretiranja reznica: a) krakotrajno (oko 5 sekundi) uranjanje reznica u koncentrirane otopine (1000 do 10 000 ppm), b) prekonoćno tretiranje reznica u otopinama koncentracije od 50 do 1000 ppm. Metoda kratkog uranjanja dala je bolje rezultate. Opseg zakorjenjivanja ovisio je o sorti borovnice i o primijenjenom auksinu. U optimalnim uvjetima oko 40 % reznica počelo je razvijati

EFFECT OF AUXINS ON ROOTING OF CUTTINGS IN AMERICAN HIGHBUSH BLUEBERRY *VACCINIUM CORYMBOSUM* L.

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Auxins and their synthetic analogues are commonly used for the rooting of cuttings, but their efficiency depends on the experimental set-up and, even more importantly, on the species and the cultivar investigated. Highbush blueberry (*Vaccinium corymbosum* L.) is reportedly difficult to root. Here we investigate the effect of indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), and their amino acid conjugates on the rooting of softwood cuttings of the varieties Bluecrop, Jersey, Burlington and Bluetta. Two methods of auxin treatment were tested: (a) short term treatment (*ca.* 5 seconds) with high concentrations (1000-10 000 ppm), and (b) overnight treatment with concentrations in the range of 50-1000 ppm. The short term treatment (a) was more effective. The rooting response depended on the blueberry variety and on the auxin used. Under optimal conditions, approximately 40% of the cuttings were rooted, six to eight weeks upon auxin

korijene nakon šest do osam tjedana. Korijenje sorti Jersey, Bluetta i Burlington bilo je brojnije i duže negoli sorte Bluecrop. Primjenom aminokiselinskih konjugata auksina potaknut je razvoj razgranatog i bujnog korijenovog sustava.

treatment. In the varieties Jersey, Bluetta and Burlington, the roots were longer and more numerous than in Bluecrop. Treatment with auxin amino acid-conjugates afforded a particularly vigorous, well-branched root system.

POPULACIJSKA STRUKTURA PARAZITSKE BILJKE *CISTANCHE PHELYPAEA* (L.) COUT. U ŠPANJOLSKOJ

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Cistanche phelypaea (L.) Cout. (*Orobanchaceae*) je obligatni višegodišnji parazit korijena drvenastih bil-

POPULATION STRUCTURE OF THE PARASITIC PLANT *CISTANCHE PHELYPAEA* (L.) COUT. IN SPAIN

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Cistanche phelypaea (L.) Cout. (*Orobanchaceae*) is an obligate perennial root parasite infecting woody

jaka porodice *Chenopodiaceae*. Genetska raznolikost španjolskih populacija dvije podvrste *C. phelypaea* (ssp. *lutea* i ssp. *phelypaea*) analizirana je pomoću biljega RAPD. Rezultati analize glavnih koordinata (PCoA) na temelju udaljenosti po Diceu potvrdili su razdvajanje jedinki prema podvrsti kojoj pripadaju. Analiza molekularne varijance (AMOVA) pokazala je da se najviše genetske raznolikosti može pripisati razlikama između podvrsta (67%). Uzimajući u obzir populacije ssp. *lutea*, postotak raznolikosti uzrokovan razlikama između populacija bio je veći od onog uzrokovanog razlikama između jedinki unutar populacija. S druge strane, populacije ssp. *phelypaea* zadržale su većinu raznolikosti unutar populacija. U svrhu analize genetske strukture i definiranja broja izvornih populacija (genskih skupova) korištena je Bayesovska metoda razvrstavanja u skupine na temelju višelokusnih podataka RAPD biljega. Kao što se i moglo očekivati, najvjerojatniji broj skupina bio je K = 2 pri kojem su se sve jedinke iste podvrste svrstale zajedno. Budući da je vjerojatnost pripadnosti za sve jedinke bila 99% za podvrstu kojoj pripadaju, čini se da između dvije podvrste *C. phelypaea* ne dolazi do protoka gena.

Chenopodiaceae. The genetic diversity among populations of two *C. phelypaea* subspecies (ssp. *lutea* and ssp. *phelypaea*) growing in Spain was analysed using RAPD markers. The results of principal co-ordinate analysis (PCoA) based on pairwise Dice distances clearly established the separation between individuals according to their subspecies affiliation. The analysis of molecular variance (AMOVA) indicated that most of the genetic diversity was attributable to differences between subspecies (67%). Considering ssp. *lutea* populations, the percentage of diversity attributable to among-population differences was greater than that corresponding to within-population diversity. On the other hand, ssp. *phelypaea* populations retained the most variation within populations. A Bayesian model-based clustering method was applied on multilocus RAPD data to infer genetic structure and define the number of clusters (putative gene pools) in the dataset. As expected, the most likely number of clusters was K=2 and all individuals belonging to each subspecies were grouped together. As membership probabilities for all the individuals were above 99% for the subspecies it belonged to, it seems that the gene flow between two subspecies of *C. phelypaea* is completely absent.

PRELIMINARNA ISTRAŽIVANJA BIOKEMIJSKIH POKAZATELJA STRESA U LISTOVIMA MORSKE CVJETNICE *POSIDONIA OCEANICA*

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Posidonia oceanica (L.) Delile je endemična morska cvjetnica koja ima vrlo važnu ekološku ulogu u obalnom ekosustavu Jadranskog mora. Ona tvori široke livade od površine mora pa sve do dubina većih od 30 m. Zbog različitih prirodnih činilaca, a osobito zbog ljudskog utjecaja, populacije ove morske cvjetnice sve se više smanjuju. Zbog svoje rasprostranjenosti širom Mediterana, sesilnog života i osjetljivosti na ekološke promjene *P. oceanica* se često koristi za biomonitoring pa je nužno što bolje poznavanje njene fiziologije i mogućnosti prilagodbe na različite stresne uvjete. Oksidacija lipida, antioksidacijski enzimi, sekundarni metaboliti i sadržaj fotosintetskih pigmenata korisni su biomarkeri koji ukazuju na promjene u ekosistemu ali i u samoj biljci. U ovom istraživanju sakupljeni su uzorci listova vrste *P. oceanica* s nezagađenog područja, unutar Parka prirode Telašćica u uvali

PRELIMINARY INVESTIGATIONS OF BIOCHEMICAL STRESS MARKERS IN *POSIDONIA OCEANICA* LEAVES FROM THE CENTRAL ADRIATIC

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Posidonia oceanica (L.) Delile is an endemic Mediterranean seagrass that is ecologically very important for the coastal ecosystem in the Adriatic Sea. It forms vast meadows from the sea surface down to depths of more than 30 meters. Recently, many populations of *P. oceanica* are declining due to both natural and anthropogenic disturbances. Due to its wide distribution, sedentary habit, abundance and sensitivity to ecological modifications, *P. oceanica* has been used for biomonitoring. The knowledge of physiology of this marine plant and its ability to cope with various stressors is of considerable importance. Lipid peroxidation, antioxidative enzymes, secondary metabolites and photosynthetic pigment content are valuable biomarkers that could indicate ecosystem disturbance as well as health of the organism. For this preliminary

Lojišće te je okarakterizirana livada koju biljka ondje tvori (gustoća livade i primarna produkcija). U svrhu određivanja bazične razine stresnih biomarkera u nezagađenom okolišu u ekstraktima listova izmjeren je sadržaj prolina, stopa oksidacije lipida te aktivnost i sastav antioksidacijskih enzima (pirogalol i askorbat peroksidaza i katalaza).Ovo je prvo istraživanje biokemijskih pokazatelja stresa u morskoj cvjetnici *Posidonia oceanica* duž istočne obale Jadranskog mora.

study, samples of *Posidonia* leaves from an unpolluted site in Lojišće cove (Telašćica Nature Park) were collected and the meadow was characterized (meadow density and primary production). In order to reveal basic levels of stress biomarkers in an unpolluted environment, prolin level, lipid peroxidation and activity, and isoenzyme pattern of antioxidative enzymes (pyrogallol and ascorbate peroxidase and catalase) were determined in extracts of *P. oceanica* leaves. These biochemical stress markers were investigated for the first time for *P. oceanica* along the eastern coast of the Adriatic Sea.

REGULACIJA RAZINE VODIKOVOG PEROKSIDA U PRERANO OSTARJELIM LISTOVIMA SREBRNOG JAVORA (*ACER SACCHARINUM* L.)

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Vodik peroksid (H2O2) utječe na modifikaciju osnovnih signalnih procesa kao što su mobilizacija kalcija, fosforilacija proteina i ekspresija gena. Uočeno je da mnoga stabla srebrnog javora (*Acer saccharinum* L.) u gradu Osijeku (Hrvatska) imaju blijede listove već u rano ljeto i kroz cijelu vegetacijsku sezonu. Svrha ovog istraživanja bila je istražiti procese koji reguliraju razinu H2O2 u zdravim (zelenim) i prerano ostarjelim (blijedim) listovima. Radi toga je istražena fotosintetska aktivnost i antioksidativni odgovor zelenih i blijedih listova srebrnog javora. Uzorkovanje je učinjeno u mjesecu srpnju 2006. godine.
Blijedi listovi imaju oko 15 % višu razinu vodikovog peroksida, tri puta višu razinu ukupnih topljivih proteina (oko 308 %) dok je razina askorbinske kiseline (AA) niža (oko 66 % vrijednosti u zelenim listovima). Koncentracije klorofila *a*, klorofila *b*, ukupnih kloro-

THE REGULATION OF HYDROGEN PEROXIDE LEVEL IN LEAVES OF PREMATURELY AGED SILVER MAPLE (*ACER SACCHARINUM* L.)

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Essential signalling processes such as changes in calcium mobilization, protein phosphorylation and gene expression are known to be modulated by hydrogen peroxide (H2O2). A large number of silver maple (*Acer saccharinum* L.) trees in the city of Osijek (Croatia) were noticed to have bleached leaves already in early summer and throughout the entire vegetation season. In this study, we aimed to investigate the processes that regulates H2O2 levels in healthy (green) and prematurely aged (bleached) leaves. For that purpose, photosynthetic performance and antioxidative response of green and bleached silver maple leaves were studied. Sampling was conducted in July 2006.
Bleached leaves had about a 15% higher hydrogen peroxide level, three-fold level of total soluble proteins (about 308%) as well as a lower level of ascorbic

fila i ukupnih karotenoida kao i maksimalna efikasnost fotosustava II (Fv/Fm) bile su značajno niže u blijedim listovima, što ukazuje na njihovu oslabljenu fotosintetsku aktivnost. Nadalje, blijede listove karakterizira niža specifična aktivnost glavnih antioksidativnih enzima (APX, GPOD, CAT i SOD) koja utječe na njihovu sposobnost zaštite od ROS-a. Smanjena sposobnost fotosintetiziranja i smanjena specifična aktivnost antioksidativnih enzima, kao i razina AA, uzrokuju porast sadržaja H2O2 u blijedim listovima i njihovo preuranjeno starenje.

acid (AA) (about 66% of the value in green leaves). Concentrations of chlorophyll *a*, chlorophyll *b*, total chlorophylls and total carotenoids as well as maximum quantum yield of photosystem II (Fv/Fm) were significantly lower in bleached leaves. This indicated their impaired photosynthetic performance. Furthermore, bleached leaves were characterized by lower specific activities of the main antioxidative enzymes (APX, GPOD, CAT and SOD), which influenced their ROS scavenging capability. Down regulation of photosynthetic performance and reduced antioxidative enzymes specific activities and AA level caused the increase in H2O2 content in bleached leaves and, in turn, their premature aging.

USPOREDBA STRUKTURE I FUNKCIJE LISTOVA DVA KULTIVARA MASLINA

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Masline pripadaju najčešće uzgajanim drvenastim kulturama u Dalmaciji, dakle mediteranskom dijelu Hrvatske. Svrha rada bila je usporediti strukturu i funkciju listova dva kultivara maslina: Oblice i Leccino radi dobivanja preliminarnih podataka za istraživanje utjecaja stresa na rast i produktivnost kultivara masline. Analizirani su listovi s pet stabala oba kultivara. Mjerene su aktivnosti gvajakol peroksidaze, askorbat peroksidaze, katalaze i superoksid dismutaze, te sadržaj fotosintetskih pigmenata i polifenola, efikasnost fotosustava II i disanje.
Uočene su značajne razlike u aktivnosti GPOD i APX te u sadržaju klorofila *a* i *b* kao i u sadržaju karotenoida. Kultivar Oblica pokazao je manju aktivnost

COMPARATIVE STUDY OF LEAF STRUCTURE AND FUNCTION IN TWO OLIVE CULTIVARS

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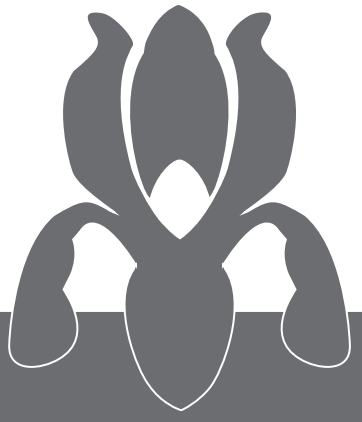
Olive is one of the most cultivated trees in Dalmatia, the Mediterranean part of Croatia. The aim of this study was to compare the structure and function of leaves from two different olive cultivars: Oblica and Leccino, for the purpose of obtaining preliminary data for further investigations of stress influence on growth and productivity of olive cultivars. The leaves from five trees of each cultivar were collected. The guaiacol peroxidases, ascorbat peroxidases, superoxide dismutase and catalase activity, photosynthetic pigments content, total phenolic content, photosystem II efficiency and respiration were measured.

askorbat peroksidaze (2,75 min-1g-1 FW) i veću aktivnost gvajakol peroksidaze (2,35 min-1g-1 FW) u odnosu na kultivar Leccino. Nisu uočene značajne razlike u aktivnosti katalaze između dva kultivara. Vrijednosti efikasnosti fotosustava II pokazale su da je on podjednako dobro razvijen u oba kultivara. U listovima kultivara Oblica utvrđena je veća koncentracija ukupne količine klorofila *a* i *b* (1,38 mg g-1 FW) nego u listovima kultivara Leccino (1,03 mg g-1 FW). Utvrđene razlike u anatomiji listova istraživanih kultivara bit će prikazane na posteru.

There were significant differences in GPOD and APX activity, chlorophyll *a*, chlorophyll *b* and carotenoid content. The Oblica cultivar had lower APX activity (2.75 min-1g-1 FW) and higher GPOD activity (2.35 min-1g-1 FW) than the Leccino cultivar. The activity of CAT did not indicate significant differences between the two cultivars. The photosystem II efficiency values (Fv/Fm) in both cultivars indicated that they have a fully functional photosystem II. The Oblica cultivar had higher total chlorophyll content (1.38 mg g-1 FW) compared to the Leccino cultivar (1.03 mg g-1 FW). The marked differences in leaf anatomy concerning investigated cultivars will be presented.



primjenjena botanika

applied botany

TAKSONOMSKA I KOROLOŠKA ANALIZA HERBARIJSKE ZBIRKE DOMENICA PAPPAFAVE

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Herbarijska zbirka Domenica Pappafave pohranjena je u Prirodoslovnom odjelu Narodnog muzeja u Zadru. Zbirka datira iz 19. stoljeća, no malobrojni literaturni podaci ne daju uvid u točan broj taksonomskih kategorija, pa čak ni točan broj primjeraka. U ovom radu dio zbirke je analiziran taksonomski i korološki. Taksonomska analiza je pokazala da obrađeni dio zbirke sadrži uglavnom primjerke *Pteridophyta* i *Spermatophyta*, a utvrđeni ukupni broj primjeraka je oko tri puta veći od broja vrsta i nižih sistematskih kategorija. Za jedan manji dio primjeraka nije bilo podataka o rodu i vrsti. U obrađenom dijelu herbarija redeterminirane su tri biljke, koje su bile zabilježene pod imenima *Alisma alschingeri* Papp., *Polygala pappafave* Welw. i *Senecio visianii* Papaf. U obrađenom dijelu zbirke istraženi su i sinonimi i ortografske varijante rodova. Za primjerke čije ime roda nije bilo napisano kao prihvaćeno ime roda, a pronađene razlike ne spadaju ni u sinonime ni u ortografske varijante,

TAXONOMIC AND CHOROLOGICAL ANALYSIS OF THE DOMENICO PAPAFFAVA HERBARIUM

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The Domenico Pappafava Herbarium is kept at the Department of Natural Sciences, Public Museum in Zadar. The herbarium collection dates from the 19th century, but obscure literature data gives no insight into the exact number of taxonomic categories or even the exact number of samples. In this study, taxonomic and chorological analyses were carried out on part of the herbarium collection. Taxonomic analysis showed that the analysed part of the collection contains mainly samples from *Pteridophyta* and *Spermatophyta* and that the total number of samples exceeds the number of species and lower systematic categories by about three times. Redetermination was conducted on three plants, initially named as *Alisma alschingeri* Papp, *Polygala pappafave* Welw. and *Senecio visianii* Papaf. The analysed part of the herbarium collection was examined for synonyms and orthographic variants of genera. Correction of sample names was carried out in cases where the name of the genus was not writ-

izvršena je redaktura. Korološka je analiza pokazala da je samo 9% ukupnog broja primjeraka s nalazišta u području Hrvatske. Stoga je u bazu *Flora Croatica Database* upisano 140 primjeraka s lokalitetom iz Hrvatske, od čega ih je 80% geokodirano.

ten according to the accepted nomenclature, and represented neither the synonym nor the orthographical variant. Chorological analysis showed that only 9% of the total number of samples had a locality on Croatian territory. 140 samples with a locality in Croatia were entered into *Flora Croatica Database*, and 80% were geocoded.

AMBROZIJA (*AMBROSIA ARTEMISIIFOLIA* L.) - ALERGENT NOVOG DOBA U BOSNI I HERCEGOVINI

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U ovom radu opisane su temeljne značajke vrste *Ambrosia artemisiifolia* L., koja je za čovjeka zanimljiva kao korovska biljka, ali i podjednako zanimljiva s medicinskog aspekta glede činjenice da spada u skupinu alergogenih biljaka. Napose je obrađeno podrijetlo i rasprostranjenost, te dinamika njezina širenje u našem području.
Rad ukazuje na mogućnosti djelotvorne borbe protiv ovog korova, osobito na preventivne i neke kurativne mjere.

COMMON RAGWEED (*AMBROSIA ARTEMISIIFOLIA* L.) – IN THE BOSNIA AND HERZEGOVINA

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In this paper the basic information about species *Ambrosia artemisiifolia* L. are given. Both, from the agricultural and medical point of view the species is interesting as a weed and as a allergenic plant. The origin, dispersion and the dynamics of spreading in our region is described. The paper gives answers on successful fight against weed especially on prevention.

VARIJABILNOST MORFOMETRIJSKIH SVOJSTAVA SJEMENA HRASTA LUŽNJAKA (*QUERCUS ROBUR* L.) IZ SJEMENSKIH SASTOJINA U HRVATSKOJ

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Sjemenska razdioba šuma hrasta lužnjaka provedena je na temelju ekoloških razlika, produktivnosti sastojina i administrativno-gospodarskih posebnosti u području kontinentalnog područja Hrvatske. Prema važećoj razdiobi, šume hrasta lužnjaka razdijeljene su na sedam sjemenskih zona, stoga je preporučeno da se sjeme i sadni materijal ne prenosi na veće udaljenosti, osim - iznimno - između susjednih zona. Sjemenska zonacija uvjetovana je Uputama Europske Unije o prometu šumskim reprodukcijskim materijalom (1999/105/EC).
Temelj za pravilnu sjemensku razdiobu su genetski uvjetovane razlike između pojedinih zona, odnosno provenijencija. Radi verifikacije opravdanosti postojećih zona u Hrvatskoj, a na temelju znanstvenih spoznaja o genetskoj varijabilnosti vrste, započeto je s istraživanjima genetske varijabilnosti hrasta lužnjaka

MORPHOMETRIC SEED TRAIT VARIABILITY AMONG AND WITHIN PEDUNCULATE OAK (*QUERCUS ROBUR* L.) SEED STANDS IN CROATIA

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Seed delineation of pedunculate oak forests in Croatia has been conducted based on ecological differences, stand productivity and administrative specificities in the continental regions of the country. According to the present delineation, pedunculate oak forests are divided into seven seed zones. Use of forest reproductive material is not recommended between different zones, with the exception of neighbouring ones. Seed zonation is conditioned by the EU Council Directive on the Marketing of Forest Reproductive Material (1999/105/EC).
Genetic differences between provenances are the basis for appropriate seed zonation. In an attempt to verify the present seed zones in Croatia, a decision was made to begin with a study of pedunculate oak genetic variability within its national distribution range. Acorns were collected from the majority of Croatian certified seed stands. The main purpose of seed stands is to

u području njegova prirodnog areala u našoj zemlji. S tim u svezi, prikupljeno je sjeme iz većeg broja tzv. priznatih sjemenskih sastojina čija je osnovna uloga izvorište sjemena za potrebe obnove gospodarskih sastojina.

U ovom su radu prikazani prvi rezultati morfometrijske analize sjemena hrasta lužnjaka iz 17 uzorkovanih sjemenskih sastojina koje reprezentiraju kompletan areal vrste u Hrvatskoj. Iz svake je sastojine prikupljeno sjeme sa po 25 stabala, a na uzorku od prosječno 30 sjemenki po stablu izmjereni su dužina, maksimalnu širina i masa svakog žira. Na temelju dužine i širine izračunat je i volumen žira prema formuli za izračunavanje volumena valjka. Analiza varijance provedena je MIXED procedurom u SAS-u, a analizirani su slučajni efekti populacija i stabala unutar populacija. Svrha analize varijance bila je utvrditi značajnost međupopulacijskih i unutarpopulacijskih razlika za istraživana svojstva sjemena.

Rezultati su pokazali da se uzorkovane sjemenske sastojine međusobno statistički značajno razlikuju u svim istraživanim svojstvima sjemena. Najveće prosječne dimenzije imali su žirevi iz sjemenske sastojine kasnolistajuće forme hrasta lužnjaka Domačaj-Kovačevački lug (Šumarija Karlovac), dok su najmanje dimenzije imali žirevi iz sastojine Česma (Šumarija Bjelovar). Međutim, utvrđene međupopulacijske razlike nisu odgovarale postojećoj sjemenskoj razdiobi, tj. nisu potvrdile obrazac geografske pravilnosti. Utvrđena je i statistički značajna unutarpopulacijska varijabilnost istraživanih svojstava sjemena. U nasserve as a seed source for the regeneration of managed forests.

This poster presents the first results of morphometric analysis of pedunculate oak seeds originating from 17 sampled seed stands, representing its entire distribution range in Croatia. Seed from 25 trees were collected within each stand, and a sample of 30 acorns per tree were used for acorn measurements: length, width, weight and volume (calculated according to the formula for cylinder volume).

Analysis of variance was carried out using the MIXED procedure in SAS. Random effects of stands and trees within stands were analysed aiming at determination of between population and within population significance of differences for studied traits.

Results showed statistically significant between population variability for all studied morphometric traits. On average, the late flushing pedunculate oak seed stand "Domačaj-Kovačevački lug" (Karlovac Forest Office) had the highest acorn dimensions, while the "Česma" stand (Bjelovar Forest Office) had the smallest acorns. However, between population differences did not show geographic patterns which could have verified present seed zonation. Statistically significant within population variability was also noticed.

In order to obtain more precise results on pedunculate oak genetic variability in Croatia, this study will be continued and field tests with plants raised from sampled acorns to be established. Correlations between acorn dimensions and plant vigor will be determined, in addition to genetic variability for various quantitative traits.

tavku istraživanja bit će praćeno uspijevanje sadnica iz uzorkovanog sjemena i utvrditi korelacije između dimenzija sjemena i rasta biljaka, kao i genetska varijabilnost različitih kvantitativnih svojstava.

BOTANICAL ORIGIN AND INORGANIC CONTENT IN BEE HONEY FROM NORTHEASTERN BULGARIA (SHUMEN REGION)

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Honey samples from the Shumen region (NE Bulgaria) collected in 2006 were analyzed palynologicaly and the botanical origin of the honey was identified. The palynological results showed the most important nectariferous plants for the region (*Robinia pseudoacacia, Helianthus annuus, Lotus corniculatus*, *Echium vulgare*, different species of Apiaceae and Brassicaceae).
Electrical conductivity was determined in honey samples using a Multiline P3 instrument. Heavy metals and toxic elements Cd, Pb, Cu, Zn, Cr, Al, As, and V were analyzed by atomic emission spectrometry with induced coupled plasma (ICP-AES) in a certified lab. The obtained results are assessed using regression analysis, correlation analysis and descriptive statistical characteristics.

PRINCIPI KRAJOBRAZNOG UREĐENJA U KORIDORU AUTOCESTA

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Iako se Republika Hrvatska odlikuje izuzetno bogatom krajobraznom raznolikošću, na njeno očuvanje negativno utječu brojne ljudske aktivnosti, a jedna od njih je i ubrzana izgradnja velikih infrastrukturnih zahvata kao što su autoceste.
Planiranju, projektiranju, izgradnji i korištenju cesta općenito - a posebno na ekološki osjetljivim područjima, sa svim mogućim potencijalnim negativnim utjecajima na okoliš - treba suprostaviti kvalitetne i sveobuhvatne mjera zaštite koje je moguće ostvariti suvremenim metodama projektiranja.
Krajobrazno uređenje, odnosno izrada krajobraznih projekata provodi se utvrđivanjem i procjenom stanja svih sastavnica krajobrazne raznolikosti, izradom uvjeta i mjera zaštite u skladu s posebnostima krajobraznih jedinica na prostoru planiranom za zahvat, te sustavom Nacionalne klasifikacije staništa (NKS) i ekološke mreže tj. poštivajući autohtonost i identitet prostora. Također, mjere i program praćenja stanja okoliša utvrđeni rješenjem o prihvatljivosti zahvata za okoliš obvezni su sadržaj dozvola za provedbu zahvata, tj. izgradnje autoceste, te ih je potrebno

LANDSCAPE PLANNING PRINCIPLES FOR HIGHWAY CORRIDORS

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The Republic of Croatia can be proud of its very rich landscape diversity. However, despite this fact, there are various human activities that negatively impact the process of landscape maintenance. One of them is rapid infrastructure construction, such as highway construction.
Negative impacts of planning, design, construction and use of highway on the environment, especially in ecologically delicate areas, must be balanced against comprehensive protective measures. This can be achieved using contemporary design methods.
The components of landscape planning or landscape design imply the definition and evaluation of all landscape diversity unit conditions, and development of protection conditions and measures. All these components must agree with the distinctions of landscape units, the Croatian National Habitat Classification and ecological network. This means that the indigenousness and identity of an area must be observed. The environment monitoring program is also an obligatory component of the construction license and must be re-

poštivati i ugraditi u krajobrazne projekte.
U Hrvatskoj za zada ne postoji propisana obvezna metodologija u postupku procjene utjecaja na okoliš za krajobraz i vizualnu izloženost, kao niti propisani standardi za izradu projekata krajobraznog uređenja za prometnice, te se prilikom izrade istih koriste i primjenjuju donešene smjernice.
Planiranje i projektiranje autocesta, kao i krajobrazno uređenje u koridoru autocesta, trebalo bi biti rezultat multidisciplinarnog promišljanja i prožimanja tehničkih i prirodnih stručnih područja, uz pronalaženje najboljeg rješenja očuvanja krajobraza i optimalnog uklapanja autocesta u prostor.

spected and included into landscape projects.
Currently, there are no regulations in Croatia that address the proper way of evaluating environmental impacts in case of landscape or visual items. Nor is there a norm dealing with landscape planning projects in the case of traffic routes. The currently valid rules are used in the project design process.
Highway planning and project design, together with landscape planning in highway corridors, should be the result of multidisciplinary consideration and intertwining of both the engineering and nature protection fields. It is important to find the best solution for landscape protection and how to optimally fit highways into the environment.

UPOTREBA KLOROFIL METRA U OCJENI UTJECAJA DUŠIKA NA RAST I RAZVOJ RANOG KRUMPIRA

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Poljski pokus s krumpirom (*Solanum tuberosum* L.) cv. Adora, cv. Liseta i cv. Cleopatra postavljen je u Jasenici (Bosna i Hercegovina). Ocjena relativnog sadržaja klorofila u listu, prinosa gomolja i koncentracije N u listu provedena je na krumpiru tretiranom s četiri razine gnojidbe dušikom 100, 200, 300 kg N/ha, te kontrola (0 kg N/ha). U osnovnoj gnojidbi primijenjeno je pola ukupnog N prije sadnje, a pola N dodano je u prihrani 45 dana nakon sadnje. Relativni sadržaj klorofila u listu krumpira i koncentracija N u listu određeni su na svim tretmanima 65, 75, 85 i 95 dana nakon sadnje (DNS). Relativni sadržaj klorofila u listu krumpira povećava se s porastom razine gnojidbe dušikom. Na kontrolnoj varijanti relativni sadržaj klorofila signifikantno je niži u kontrolnoj varijanti nego u tretmanu gnojidbe dušikom, posebice kasni-

USE OF CHLOROPHYLL METERS TO ASSESS NITROGEN IMPACTS ON GROWTH AND DEVELOPMENT OF EARLY POTATO

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Field trial white potatoes (*Solanum tuberosum* L.) cv. Adora, cv. Liseta and cv. Cleopatra were conducted in Jasenica (Bosnia and Herzegovina). Assessment of relative chlorophyll content, tuber yield and leaf nitrogen concentration was conducted on potatoes treated with four levels of nitrogen fertilization 100, 200, 300 kg N/ha, and the control (0 kg N/ha). At basic fertilization, one-half of the total nitrogen was applied before sowing and one-half was applied by dressing 45 days after sowing. Relative chlorophyll content in potato leaf and leaf N concentration was determined on all treatments, 65, 75, 85 and 95 days after sowing (DAS). Relative chlorophyll content in potato leaf increased significantly with increasing nitrogen rate. In the control treatment, relative chlorophyll content

je u sezoni rasta. Relativna koncentracija klorofila dobivena SPAD klorofilmetrom 65 i 85 DNS pokazuje značajnu korelacijsku vezu s koncentracijom N u listu krumpira (r=0,65** i r=0,64**). Prinos svježe mase gomolja signifikantno se povećava s porastom razine gnojidbe dušikom, a razlike između sorti su izrazito velike (1,89 do 3,01 kg po biljci). Signifikantan korelacijski odnos (r=0,49* i r=0,47*) utvrđen je između relativne koncentracije klorofila i prinosa svježih gomolja 75, odnosno 85 DNS. Rezultati istraživanja pokazuju da usjev ranog krumpira dobro reagira na gnojidbu dušikom, te da se SPAD klorofilmetar može koristiti kao pouzdan indikator statusa N.

was significantly lower than in N fertilized treatments, particularly later in the growing season. Relative chlorophyll concentration measured using the SPAD chlorophyll meter 65 and 85 DAS show significant correlation with potato leaf N concentration (r=0.65** and r=0.64**) respectively. Fresh tuber yield was increased significantly with increasing nitrogen rate and the difference between varieties was great (1.89 do 3.01 kg per plant). A significant correlation (r=0.49* and r=0.47*) was determined between relative chlorophyll concentration and potato fresh tuber yield, 75 and 85 DNS respectively. This research results show that early potato crops have a good response to nitrogen fertilization and that the SPAD chlorophyll meter can be used as good indicator of nitrogen status.

RAZLIKE U ODZIVU DESET KLONOVA TOPOLA NA GNOJIDBU I KLIMATSKE PRILIKE PRI NISKOJ RAZINI PODZEMNE VODE

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Izgradnja novih hidroenergetskih objekata rezultirala je sniženjem razine podzemnih voda uz derivacijske kanale u porječju Drave kod Varaždina, uzrokujući tako značajna sušenja i slabu prirodnu obnovu poplavnih šuma. Za unapređenje gospodarenja šumama na ovom području najprije valja riješiti problem izbora vrsta drveća, ali i tipa te intenziteta gospodarenja. Poljski pokus s četiri svojte topola (5 klonova *P. deltoides*, 3 klona *P.*x*euramericana* i po 1 klon *P. nigra* i *P. alba*) započeo je 2001. godine, a 2004. i 2005. godine u njega je uklopljen gnojidbeni pokus radi utvrđivanja odziva klonova na četiri doze dušičnog gnojiva: 0, 100, 200 i 300 kg dušika/ha. Odziv postotka debljinskog, visinskog i volumnog prirasta značajno se razlikovao između klonova i tretiranja. Masa lišća, koncentracija,

DIFFERENTIAL RESPONSE OF TEN POPLAR CLONES TO FERTILIZATION AND CLIMATE EFFECTS ON A LOW GROUNDWATER TABLE

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The building of new river dams for electricity production has resulted in significant lowering of groundwater levels along derivation channels in the Drava River basin at Varaždin, causing severe dieback and poor natural regeneration of riparian forests. The enhancement of forest management in the area requires solutions with respect to the choice of tree species and the type and intensity of management. The trial of four poplar taxa (5 *P. deltoides* clones, 3 *P.* x*euramericana* clones and 1 clone each of *P. nigra* and *P. alba*) was established in the 2001. In 2004 and 2005, a fertilization experiment was incorporated into the existing trial to test the response of clones to four nitrogen (N) fertilizer doses: 0, 100, 200 and 300 kg N/ha. The response of height, diameter and volume increment percentages differed significantly among clones and N treatments.

sadržaj i odnos biogenih elemenata upotrijebljeni su da bi se objasnile te razlike. Klimatske prilike bile su dodatni izvor varijabiliteta, utječući na ishranu i na rast klonova. Rezultati istraživanja (1) potvrđuju mogućnost osnivanja uspješnih plantaža topola u prevladavajućim uvjetima klime i visine podzemne vode koje bi djelomično nadoknadile gubitak prirodnih poplavnih šuma. Također (2) osnova su za odabir klonova za regeneraciju oštećenih prirodnih šuma i (3) naglašavaju važnost optimalnog stanja ishrane topola u odnosu na uvriježeni naglasak isključivo na razinu podzemne vode.

Leaf mass, foliar concentrations, content, and ratios of mineral elements were used to explain these differences. Climate properties were an additional source of variability influencing both the growth and nutrition of clones. The results (1) confirm the possibility of establishing successful poplar plantations in the prevailing climate conditions and groundwater levels, thus partly compensating for the disappearance of natural riparian forests, (2) help select clones to be used for regeneration of natural forests and (3) stress the importance of optimal nutrition of poplars, as opposed to the more traditional focus on groundwater table levels only.

UDIO DRVNIH TRAKOVA U DVA KLONA TOPOLE UZRASLA NA DVA RAZLIČITA STANIŠTA U HRVATSKOJ

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Ovaj rad predstavlja dio istraživanja strukture drva I-214 (*P. x euroamericana*) i S1-8 (*P. deltoides*) klonova topole uzraslih na dva različita staništa u Hrvatskoj u nizini rijeke Drave. Stabla klonova pripadaju plantažama starim 20 godina. Na boljem staništu tlo je bilo humofluvisolno, a na lošijem aluvijalno. Na oba staništa klon S1-8 ima bolji (superiorniji) prirast i preživljavanje. U prvih 10 godina klon S1-8 ima veći udio drvnih trakova i veću širinu goda (mjereno na prsnoj visini). Rezerva hrane nagomilana u drvnim tracima jedan je od činitelja koji doprinosi i pomaže intenzivnom prirastu u prvih deset godina u oba klona na oba staništa. Bolje preživljavanje stabala klona S1-8 može se djelomično objasniti većim udjelom drvnih trakova koji omogućuju bolje korištenje rezervne hrane.

WOOD RAY PERCENTAGE OF TWO POPLAR CLONES GROWN ON TWO CONTRAST SITES IN CROATIA

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This work is a part of the investigation on wood structure properties of I-214 (*P. x euroamericana*) and S1-8 (*P. deltoides*) poplar clones. Trees were collected from 20 year old plantations managed on two contrast sites in the lowland of the River Drava in Croatia. The better site is on humofluvisol soil, while the second is on alluvial soil. Clone S1-8 has better (superior) volume increment and surviving (existence) at both sites. The wood ray percentage and the growth ring width (measured at breast height) in the first ten years are greater in the clone S1-8. One of the factors contributing to and supporting the intensive growth in the first ten years in both clones at both sites is certainly food reserve accumulated in wood rays. Better surviving properties can be partly explained with a higher percentage of wood rays, which makes better use of food reserves possible.

FITIOTERAPIJA U VETERINARSKOJ MEDICINI

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Ljekovito bilje i njegovi pripravci zasigurno su prvotne tvari u medicini koje je čovjek rabio u liječenju. Tako i upotreba ljekovitog bilja u veterinarskoj medicini ima dugu tradiciju. Nakon razdoblja napuštanja liječenja biljem i sastojcima biljaka, suvremena veterinarska medicina sve češće rabi fitoterapiju ponajprije pri preventivi, liječenju i održavanju zdravlja gospodarski značajnih domaćih životinja u sustavu ekološkog uzgoja, ali i drugih životinja posebice kućnih ljubimaca. Vlasnici su za liječenje životinja u ekološkoj proizvodnji prinuđeni koristiti alternativne oblike liječenja jer upotreba antibiotika, hormona i drugih farmakoloških pripravaka nije uvijek dopuštena zbog rezidua u mesu i mlijeku (Pravilnik o ekološkoj proizvodnji životinjskih proizvoda, NN 13/02). Fitoterapija danas označava pojam liječenja i sprječavanja bolesti pomoću biljaka, biljnih dijelova i njihovih pripravaka. Takvi pripravci imaju široko terapijsko djelovanje zbog bogatstva i kombinacije djelatnih, ali i drugih

PHYTOTHERAPY IN VETERINARY MEDICINE

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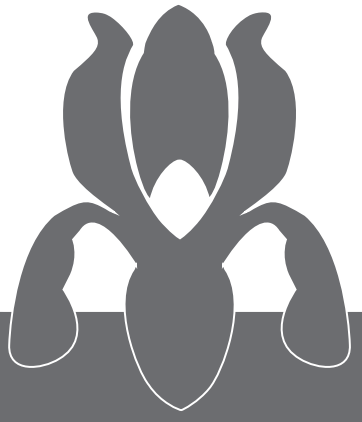
Medicinal plants and their preparations are certainly the first substances in medicine used by humans for healing. And so, the use of medicinal plants in veterinary medicine has a long tradition. After abandoning the usage of plants in therapy, contemporary veterinary medicine is increasing using phytoteraphy in prevention, healing and maintaining health in domestic animals in organic breeding, but also in other animals especially pets. Breeders with organic production are forced to use alternate forms of healing, as the use of antibiotics, hormones and other pharmacological preparations is not always permitted due to residues in meat and milk (Regulation of organic production of products of animal origin, OG 13/02). Today, phytotherapy implies healing and prevention of diseases with aid of plants, parts of plants and their preparations. Such preparations have a wide therapeutic effect because of the variety and combination of active and other substances. The concept "medicinal plants" is common for plants that produce healing substances.

pratećih tvari. Pojam ljekovito bilje uvriježen je za biljke koje sadrže ljekovite tvari, a pod ljekovitim tvarima se u općeprihvaćenom smislu podrazumijeva tvar koja u određenoj količini izaziva ljekoviti učinak ili u određenim uvjetima služi za sprječavanje, odstranjivanje, ublažavanje, liječenje bolesti ili simptoma bolesti i štetnih pojava u organizmu ljudi i životinja. Ljekovite biljke spadaju u najrazličitije biljne porodice. U ovome radu bit će prikazane pojedine biljne vrste koje se najčešće koriste u veterinarskoj medicini, te njihove botaničke karakteristike, a također će biti navedeni podaci o simptomima i tijeku bolesti te način liječenja ljekovitim biljem.

The usual concept of healing substances is that they are substances that, in certain doses, produce some healing effect or, under certain conditions, can be used in the prevention, lessening, elimination and healing of a disease or symptom of disease in humans or animals. Medicinal plants fall into many different plant families. This paper presents only the most commonly used in veterinary medicine and their botanical characteristics. Data on symptoms and the course of diseases for which medical plants can be used and their methods of administering are also presented.



biologija algi, gljiva i lišajeva

biology of algae, fungi and lichens

PROSTORNA I VREMENSKA RASPODJELA FITOPLANKTONA U LIMSKOM KANALU (SJEVERNI JADRAN)

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Limski kanal je uzak zaljev na zapadnoj obali Istarskog poluotoka. Istraživanja duž Limskog kanala provedena su u okviru nacionalnog projekta Jadran, od 2001. do 2006. godine, na tri postaje u vanjskom (postaja LIM1), srednjem (postaja LIM2) i unutrašnjem (postaja LIM3) dijelu kanala. Unutrašnji dio je plići (16 m dubine) od vanjskoga (30 m) s pojačanim dotokom slatke vode iz potpovršinskih izvora (vrulja). U unutrašnjem i srednjem dijelu razvijen je uzgoj riba, a predviđa se uzgoj školjkaša.
U ovom istraživanju analizirana je prostorna i sezonska raspodjela fitoplanktona.. Analizirali smo sastav fitoplanktona, bioraznolikost i dominantnost vrsta, te koncentraciju nutrijenata i termohalina svojstva
Maksimalna abundancija mikrofitoplanktona (2.7 x 106 stanica L-1) utvrđena je u unutrašnjem dijelu zaljeva tijekom ljetnih mjeseci (od lipnja do rujna). Uku-

SPATIAL AND TEMPORAL DISTRIBUTION OF PHYTOPLANKTON IN THE LIM CHANNEL (NORTHERN ADRIATIC SEA)

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The Lim Channel is a narrow embayment on the western Istrian coast (northern Adriatic Sea). The inner part of the channel is shallow, influenced by some input of freshwater from submarine springs. There are fish farming activities in the inner and middle part of the channel, with plans for organizing shellfish farms. The research was carried out at the three stations along the channel as a part of Croatian national monitoring programme “Jadran”. Samples were taken at approximately bimonthly intervals over a five-year period (2001-2006).
In this study, spatial and temporal distribution of phytoplankton were analyzed. Phytoplankton species composition, diversity, taxa dominance, community dissimilarities and related environmental parameters (nutrients, temperature, salinity) were correlated.
Maximum microphytoplankton abundance (2.7 x 106

pno je određeno 176 vrsta od kojih brojnošću dominiraju dijatomeje (102 vrste) kao što su *Pseudonitzchia* sp. (2.2 x 106 stanica L-1), *Leptocylindrus danicus* (2.4 x 106 stanica L-1) te *Chaetoceros* sp. (1.2 – 6.4 x 105 stanica L-1)..

cells L-1) was determined in the inner part of the channel during the summer months (June to September). A total of 176 taxa were identified. The most prominent group was Baccilariophyceae (102 taxa) with frequent and most abundant species of *Pseudonitzchia* sp. (2.2 x 106 cells L-1), *Leptocylindrus danicus* (2.4 x 106 cells L-1) and *Chaetoceros* sp. (1.2 – 6.4 x 105 cells L-1).

TAKSONOMSKI SASTAV FITOPLANKTONA U JABUČKOJ KOTLINI (JADRANSKO MORE)

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Taksonomski sastav i ekologija fitoplanktona istraživana je u Jabučkoj kotlini (srednji Jadran) kao dio međunarodnog projekta "Adriatic Circulation Experiment - Mesoscale Dynamics and Response to Strong Atmospheric Forcing" na istraživačkom brodu Knorr. Istraživano područje posjećeno je dva puta: tijekom jakog miješanja vodenog stupca (veljača, 2003.) i u vrijeme stratifikacije (svibanj/lipanj 2003.).
Tijekom oba istraživana razdoblja dominantne grupe su bile dijatomeje i kokolitoforidi, ali su postojale razlike u taksonomskom sastavu te njihovoj horizontalnoj i vertikalnoj distribuciji.

TAXONOMIC COMPOSITION OF PHYTOPLANKTON IN THE JABUKA PIT (ADRIATIC SEA)

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Taxonomic composition and ecology of phytoplankton was investigated in the Jabuka Pit, central Adriatic Sea as part of the international project "Adriatic Circulation Experiment - Mesoscale Dynamics and Response to Strong Atmospheric Forcing" on board the R/V Knorr. The investigated area was visited twice, during the period of the water column mixing (February 2003) and water column stratification (May/June 2003).
During both investigation periods, the dominant groups were diatoms and coccolithophorids. However, the species composition, vertical and horizontal

Fitoplanktonska zajednica bila je sastavljena od 38 taksona diatomeja, 29 taksona dinoflagelata, 20 primnezioficeja, 2 krizoficeja te neindetificiranih kriptofita i zelenih flagelata. Dominantne vrste (abundancija > 10^4 stanica L^{-1}, učestalost pojavljivanja >20%) bile su *Calyptrosphaera* sp, *Emiliania huxleyii* (Lohmann) Hay Mohler, *Cerataulina pelagica* (Cleve) Hendey, *Chaetoceros socialis* Lauder, *Pseudonitzschia* spp. i neindentificirani taksoni nanoplanktonskih dinoflagelata, kokolitoforida, kriptofita i zelenih flagelata.

distribution of the encountered species was different. Recognizable phytoplankton was composed of 38 diatom taxa, 29 dinoflagellate taxa, 20 prymnesiophyceae, 2 chrysophyceae, unidentified chryptophytes and green flagellates. Dominant (abundance >10^4 cells L^{-1}, frequency of appearance>20%) species were *Calyptrosphaera* sp, *Emiliania huxleyii* (Lohmann) Hay Mohler, *Cerataulina pelagica* (Cleve) Hendey, *Chaetoceros socialis* Lauder, *Pseudonitzschia* spp. and unidentified nanoplanktonic dinoflagelates, coccolithophorids, cryptophytes and green flagellates.

PREGLED DOSADAŠNJIH ISTRAŽIVANJA ALGA U BOSNI I HERCEGOVINI

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Prve podatke o algama u Bosni i Hercegovini dao je Kummer 1849. godine. Istraživanja nastavljaju Beck (1886, 1890, 1028), Karlinski (1896), Protić (1897, 1899, 1901, 1904, 1907, 1908, 1908, 1941 i dr.) i Gutwinski (1896,1899) dajući popise alga s pojedinih područja. Intenzivnija istraživanja taksonomije i ekologije alga nastavljena su u drugoj polovici 20. stoljeća pod okriljem Prirodno-matematičkog fakulteta i Biološkog instituta Univerziteta u Sarajevu.
Pregledom dijela literaturnih podataka, ukupno je do sada utvrđeno 1987 vrsta i nižih taksonomskih svojti slatkovodnih alga. Preliminarni rezultati ukazuju da je razred *Bacillariophyceae* najbogatiji rodovima (55), vrstama (719) i varijetetima (222), a vrlo bogati svojtama su i razredi zelenih algi s ukupno 98 rodova, 461 vrstom i 56 varijeteta.
Rodovi najbogatiji vrstama su *Cosmarium, Closterium, Navicula, Eunotia, Cymbella* itd.

A SURVEY OF ALGAL RESEARCH IN BOSNIA AND HERZEGOVINA

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Kummer (1849) cited the first data on algae in Bosnia and Herzegovina. Research was continued by Beck (1886, 1890, 1028), Karlinski (1896), Protić (1897, 1899, 1901, 1904, 1907, 1908, 1908, 1941 etc.) and Gutwinski (1896, 1899), which resulted in lists of algae for certain regions. In the 20th century, the Faculty of Science and the Institute of Biology of the University of Sarajevo carried out more intensive research on the taxonomy and ecology of algae.
A review of some of the available data shows the existence of 1,987 species and lower taxa of freshwater algae. Preliminary results indicate that the class *Bacillariophyceae* has the most genera (55), species (719) and varieties (222). The green algae class also shows a wealth of taxa, with a total of 98 genera, 461 species and 56 varieties.
The families with the most species are *Cosmarium, Closterium, Navicula, Eunotia, Cymbella,* etc.

CVJETANJE FITOPLANKTONA U UVALI BISTRINA (MALOSTONSKI ZALJEV)

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Početkom travnja 2007. u uvali Bistrina (Malostonski zaljev) zabilježen je intenzivan razvoj fitoplanktona. More je bilo izrazito žuto-zelene boje. Uzorci za analizu fizikalno-kemijskih parametara, kolorofila *a* i fitoplanktona uzeti su prvi dan (3. travnja 2007.) i dva tjedna nakon pojave cvjetanja (19. travnja). Uzorkovano je na tri postaje.
Najveća abundancija fitoplanktona (1.3 x 10^8 stanica L^{-1}), uvjetovana razvojem zelenog nanoflagelata *Tetraselsmis* sp., utvrđena je pri dnu. Najveća koncentracija klorofila *a* bila je 22.61 µg L^{-1}. Najveća abundancija mikrofitoplanktona bila je 1.7 x 10^5 stanica L^{-1}, a u zajednici su dominirale dijatomeje *Cocconeis* sp., *Chaetoceros* spp., te vrste rodova *Navicula*, *Nitzschia* i *Pseudo-nitzschia*, kao i „ostale penatne dijatomeje".
Na postaji s najvećom abundancijom fitoplanktona temperatura mora u stupcu vode bila je 17.1-17.5ºC, salinitet 13.64-21.30 i zasićenje kisikom 1.27-1.41. Haloklina je bila na dubini od 1 m. Izmjerene su sljedeće koncentracije hranjivih soli: ukupni anorganski dušik 1.56-2.13 µmol L^{-1}, reaktivni fosfor 0.22-0.34 µmol L^{-1} i reaktivni silicij 27.10-46.70 µmol L^{-1}.

PHYTOPLANKTON BLOOM IN BISTRINA INLET (MALI STON BAY)

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In early April 2007, an intensive phytoplankton bloom was noted in Bistrina (Mali Ston Bay). The sea was of a pronounced yellow-green colour. Samples for an analysis of physical-chemical parameters, chlorophyll *a* concentrations and phytoplankton were taken on the first day (April 3, 2007), and two weeks after the appearance of blooming (April 19). Sampling was carried out at three stations.
The greatest phytoplankton abundance (1.3 x 10^8 cells L^{-1}) was recorded at the bottom, caused by the development of the green-nanoflagellate *Tetraselsmis* sp. The greatest chlorophyll *a* concentration was 22.61 µg L^{-1}. The greatest abundance of microphytoplankton was 1.7 x 10^5 cells L^{-1}. The community was dominated by the diatoms *Cocconeis* sp., *Chaetoceros* spp., and by taxa of the genera *Navicula*, *Nitzschia* and *Pseudo-nitzschia*, as well as by "other pennate diatoms".
At the station with the greatest abundance of phytoplankton, the sea-water temperature was 17.1-17.5ºC, salinity 13.64-21.30 and oxygen saturation 1.27-1.41.

Dva tjedna nakon pojave cvjetanja intenzitet dotoka slatke vode vruljama bio je smanjen, salinitet se povećao (28.87-29.17), a vodeni je stupac postao stabilniji. Smanjena je koncentracija reaktivnog fosfora (0.06-0.10 μmol L^{-1}), rekativnog silicija (5.88-7.75 μmol L^{-1}) te koncentracija klorofila *a* (0.70 μg L^{-1}), dok je koncentracija ukupnog anorganskog dušika (2.00-2.54 μmol L^{-1}) porasla.

Koncentracije reaktivnog fosfora i reaktivnog silicija, klorofila *a* te abundancija fitoplanktona utvrđene tijekom cvjetanja fitoplanktona u travnju 2007., najveće su otkada se obavljaju ekološka istraživanja u uvali Bistrina.

The halocline was at a 1 meter depth. Nutrient concentrations were: total inorganic nitrogen 1.56-2.13 μmol L^{-1}, reactive phosphorus 0.22-0.34 μmol L^{-1}, and reactive silicate 27.10-46.70 μmol L^{-1}.

The inflow of fresh spring water declined two weeks after the appearance of blooming, salinity increased (28.87-29.17), and the water-column became stable. The concentration of reactive phosphorus (0.06-0.10 μmol L^{-1}), reactive silicate (5.88-7.75 μmol L^{-1}), and chlorophyll *a* (0.70 μg L^{-1}) decreased, while the total inorganic nitrogen concentrations (2.00-2.54 μmol L^{-1}) increased.

The concentrations of reactive phosphorus and reactive silicate, chlorophyll *a*, and phytoplankton abundance during the phytoplankton bloom in April 2007 were the highest noted since the start of ecological research in Bistrina Bay.

FITOPATOGENA GLJIVA *CRYPHONECTRIA PARASITICA* I HIPOVIRUS 1 U HRVATSKOJ

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Nitasta gljiva iz skupine askomikota *Cryphonectria parasitica* (Murr.) Barr, uzročnik raka kestenove kore, najvećim dijelom uzrokuje propadanje pitomog kestena (*Castanea sativa* Mill.) u Hrvatskoj. Budući da oporavak šuma pitomog kestena ovisi o prisutnosti hipovirulentnih sojeva gljive *C. parasitica*, odredili smo učestalost hipovirulence u centralnom dijelu Hrvatske. Sedamdeset i osam izolata fitopatogene gljive *C. parasitica* sakupljeno je iz četiriju populacija (Markuševac1, Markuševac 2, Samobor, Sljeme). Trideset i četiri izolata imala su bijelu morfologiju, 19 prijelaznu i 25 narančastu. Celuloznom

CRYPHONECTRIA PARASITICA AND ASSOCIATED HYPOVIRUS 1 IN CROATIA

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Cryphonectria parasitica (Murr.) Barr, the filamentous ascomycete that causes chestnut blight, is largely responsible for the decline of the European chestnut (*Castanea sativa* Mill.) in Croatia. Since recovery of the chestnut forests is dependent on the presence of hypovirulent *C. parasitica* strains in chestnut populations, we determined the incidence of hypovirulence in the central part of the country. Seventy eight isolates of the chestnut blight fungus *C. parasitica* were sampled from four populations (Markuševac1, Markuševac 2, Samobor, Sljeme) from 2004 to 2006. Thirty four had white morphology, 19 intermediate, and 25 orange. Twenty six isolates (21 white, 2 intermediate and 3 orange) were screened for the presence of double strand-

kromatografijom i elektroforezom na agaroznom gelu testirano je dvadeset i šest izolata (21 bijele, 2 prijelazne i 3 narančaste morfologije) na prisutnost dvolančane hipovirusne RNA (dsRNA). Hipovirusna dsRNA, približne veličine 12,7 kb, detektirana je u svim testiranim bijelim izolatima. Četiri izolata imalo je i M-dsRNA. Istraživani hipovirusni izolati identificirani su reverznom transkripcijom, lančanom reakcijom polimerazom dvaju otvorenih okvira čitanja hipovirusa, te analizom polimorfizma dužine restrikcijskih odsječaka. Restrikcijski obrasci umnoženih PCR-produkata pokazali su malu varijabilnost među istraživanim hrvatskim hipovirusnim izolatima. Šest obrazaca bilo je potpuno identično s obrascem hipovirusnog izolata iz gljive sakupljene u Hrvatskoj prije 22 godine. Filogenetskom analizom, na osnovi restrikcijskih obrazaca, utvrđeno je da svi hipovirusi iz Hrvatske pripadaju talijanskom podtipu CHV 1.

ed RNA (dsRNA) by cellulose chromatography and electrophoresis on agarose gels. Hypoviral dsRNA of approximately 12.7 kb in length was detected in all the white isolates tested. In 4 isolates, M-dsRNA was also detected. The identity of the hypoviral isolates was determined by reverse transcription, polymerase chain reaction of two hypoviral open reading frames and restriction fragment length polymorphism analysis. Restriction patterns of the amplified products showed little variation among the examined hypoviruses from Croatia. Six patterns were completely identical with that of a hypoviral isolate from a fungus collected in Croatia 22 years ago. Cluster analysis based on the RFLP pattern grouped all hypoviruses from Croatia to the Italian subtype of CHV-1.

RAŠIRENOST FITOPATOGENIH GLJIVA NA POJEDINIM BILJNIM SVOJTAMA PARKA PRIRODE BIOKOVO I BOTANIČKOG VRTA KOTIŠINA

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Tijekom travnja 2007. praćena je pojava fitopatogenih gljiva na pojedinim biljnim svojtama u području parka prirode Biokovo uključujući i botanički vrt Kotišina. Od velikog broja biljnih svojti raspostranjenih na tom području, za istraživanje raširenosti fitopatogenih gljiva izabrane su svojte koje imaju status endemičnih i zaštićenih vrsta ili one svojte koje mogu biti primijenjene u hortikulturi. To su svojte: *Allyssoides utriculatum*, *Allysum montanum*, *Arbutus unedo, Asphodelus aestivus, Asphodeline lutea, Agave americana, Campanula portenschlagiana, Coronilla emeroides, Cyclamen hederaefolium, Erythronium dens-canis, Euphorbia sp., Helianthemum sp., Juniperus oxycedrus, Iris pseudopallida, Myrtus communis, Petteria ramentacea, Phillyrea sp., Pistacia lentiscus, Prunus mahaleb, Pirus amygdaliformis, Ruscus aculeatus, Quercus ilex, Sempervivum sp., Senecio rupestris, Smilax aspera i Vinca major*. Na temelju pojave

OCCURRENCE OF PHYTOPATHOGENIC FUNGI ON CERTAIN PLANT TAXA IN BIOKOVO NATURE PARK AND KOTI\INA BOTANICAL GARDEN

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The occurrence of phytopathogenic fungi on certain plant taxa was monitored in April 2007 in the area of Biokovo Nature Park and Kotišina Botanical Garden. Among plants present in these areas, only endemic and protected taxa or taxa that could be used in horticulture were selected for this research. Selected plant taxa were the following: *Allyssoides utriculatum*, *Allysum montanum*, *Arbutus unedo, Asphodelus aestivus, Asphodeline lutea, Agave americana, Campanula portenschlagiana, Coronilla emeroides, Cyclamen hederaefolium, Erythronium dens-canis, Euphorbia* sp., *Helianthemum* sp., *Juniperus oxycedrus, Iris pseudopallida, Myrtus communis, Petteria ramentacea, Phillyrea* sp., *Pistacia lentiscus, Prunus mahaleb, Pyrus amygdaliformis, Ruscus aculeatus, Quercus ilex, Sempervivum* sp., *Senecio rupestris, Smilax aspera* and *Vinca major*. Phytopathogenic fungi were determined on the basis of disease symptoms

simptoma fitomikoza in situ na navedenim svojtama i laboratorijskom determinacijom gljiva, te na temelju morfoloških karakteristika njihovih sporulirajućih struktura, determiniran je veći broj fitopatogenih vrsta gljiva. Na endemičnoj vrsti perunike *Iris pseudopallida* utvrđene su dvije fitopatogene gljive *Cladosporium iridis* i *Drechslera iridis* (pjegavost i palež lišća). Na *Asphodelus aestivus* utvrđena je gljiva *Didymella asphodeli* (antraknoza stabljike). Gotovo svi pregledani primjerci *Smilax aspera* bili su zaraženi gljivom *Cercospora smilacina* (pjegavost lišća). Također je većina pregledanih grmova *Ruscus aculeatus* bila zaražena gljivom *Paraphaeosphaeria rusci* (paleži lišća i izboja). Na *Erythronium dens-canis* utvrđena je gljiva *Uromyces erythronii* (hrđa). Na *Cyclamen hederaefolium* utvrđena je gljiva *Septoria cyclaminis* (pjegavost lišća). Sukulentni listovi *Agave americana* bili su zaraženi gljivom *Colletotrichum agaves* (antraknoza). Na *Arbutus unedo* utvrđena je gljiva *Septoria unedonis* (pjegavost lišća). Rijetki primjerci *Vinca major* velikim intenzitetom bili su zaraženi gljivom *Puccinia vincae* (hrđa). Na *Juniperus oxycedrus* i *Pirus amigdaliforimis* utvrđena je gljiva *Gymnosporangium fuscum* (kruškin pikac ili hrđa) koja kao heterecijska hrđa dolazi na ove dvije vrste. Na ostalim pregledanim biljnim svojtama nije utvrđena pojava fitopatogenih gljiva. O raširenosti većine determiniranih vrsta fitopatogenih gljiva u Hrvatskoj prvi puta se govori u ovome radu.

in situ on plants and morphological identification of fungal fructification structures in the laboratory. Two phytopathogenic fungi were found on the endemic species *Iris pseudopallida*: *Cladosporium iridis* (leaf spot) and *Drechslera iridis* (leaf blight). On *Asphodelus aestivus,* the fungus *Didymella asphodeli* (stem anthracnose) was found. Almost all examined samples of *Smilax aspera* were infected with the fungus *Cercospora smilacina* (leaf spot). The majority of examined *Ruscus aculeatus* shrubs were infected with the fungus *Paraphaeosphaeria rusci* (leaf and cane blight). On *Erythronium dens-canis,* the fungus *Uromyces erythronii* (rust) was determined. On *Cyclamen hederaefolium,* the fungus *Septoria cyclaminis* (leaf spot) was determined. Succulent leaves of *Agave americana* were infected with the fungus *Colletotrichum agaves* (anthracnose). On *Arbutus unedo,* the fungus *Septoria unedonis* (leaf spot) was determined. Rare *Vinca major* specimens were heavily attacked by the fungus *Puccinia vincae* (rust). On *Juniperus oxycedrus* and *Pyrus amigdaliformis,* the heteroecious rust fungus *Gymnosporangium fuscum* was determined on both plant hosts. No occurrence of phytopathogenic fungi was determined on other examined plants. The majority of phtopathogenic fungi determined in this research are reported for the first time in Croatia.

POPULACIJSKA STRUKTURA GLJIVE *CRYPHONECTRIA PARASITICA* MURR, BARR. U HRVATSKOJ KOSTAJNICI

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Cryphonectria parasitica, uzročnik raka kore pitomog kestena, pojavljuje se u svim sastojinama kestena na području Hrvatske Kostajnice. Na zaraženim kestenovim stablima pojavljuju se svi oblici karakterističnih tvorevina: površinska nekroza, kalusirajući rak i aktivni rak iz kojih su izolirani bijeli, prijelazni (bijelo-žuti i žuto-bijeli) i žuti sojevi gljive. U odabranoj kestenovoj sastojini prevladavaju površinski i kalusirajući oblici raka što ukazuje na prisutnost hipovirusa u gljivi. Hipovirus 1 utvrđen je u svim istraženim bijelim izolatima. Prisutnost hipovirusa pozitivno se odražava na zdravstveno stanje kestenovih stabala pa tako i na izgled šume.

POPULATION STRUCTURE OF THE FUNGUS *CRYPHONECTRIA PARASITICA* MURR, BARR. IN HRVATSKA KOSTAJNICA

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Chestnut blight, caused by the fungus *Cryphonectria parasitica* is present in all chestnut stands in Hrvatska Kostajnica. All types of chestnut blight were found on infected chestnut trees: superficial necrosis, callusing- and active cancer, from which white, intermediate and orange strains were isolated. Superficial and callusing-forms of cancer were dominant, indicating the presence of hypovirus in the fungi. Hypovirus 1 was found in all tested white isolates. Hypovirulence has a positive effect on health condition of chestnut trees and the overall forest state. Population structure of the fungus from the chestnut stand (Department 92a) was

Populacijska struktura gljive iz odabrane kestenove sastojine (Odjel 92a) istražena je uspoređivanjem izoliranih sojeva s 30 najčešćih europskih tipova (testera) *C. parasitica* primjenom testa vegetativne kompatibilnosti, te upotrebom molekularnih markera. Istražena 44 izolata pripadaju u 8 vegetativno kompatibilnih tipova. Najveći broj izolata pripada europskim tipovima EU2, EU1, EU12 i EU11, a manje su zastupljeni tipovi EU3, EU5, EU 20 i EU29. Molekularnom analizom potvrđeno je spolno razmnožavanje gljive. Iako je populacijska struktura gljive vrlo raznolika, prisutnost hipovirulentnih sojeva omogućuje prirodnu biološku kontrolu bolesti.

analyzed using vegetative compatibility test and molecular markers.
Of the 44 analyzed isolates, 8 vegetative compatible (vc) types were found. Isolates mostly belonged to vc types: EU2, EU1, EU12 and EU11. Along with those vc types, EU3, EU5, EU 20 and EU29 were also found. Sexual reproduction was confirmed using molecular analyses of mating types. Although the population structure of the fungus is highly diverse, presence of hypovirulent strains enables natural biological control of chestnut blight.

NASELJAVANJE PERIFITONSKIH DIJATOMEJA U ESTUARIJU RIJEKE OMBLE

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Naseljavanje perifitonskih dijatomeja na podlogama od pleksistakla praćeno je u estuariju rijeke Omble (na dubinama 0.2, 0.5, 1.2, 1.5, 3.0 i 3.3 m) tijekom srpnja 2006. Perifiton je uzorkovan svakih sedam dana. Najveća abundancija dijatomeja (2.5×10^7 stanica cm^{-2}) utvrđena je nakon dva tjedna inkubacije u sloju 0.2-0.5 m. U dubljim slojevima maksimalne abundancije zabilježene su nakon četiri tjedna inkubacije. Salinitet je u estuariju varirao od 17.95 do 37.87, temperatura od 17.5 do 23.7 ˚C, a koncentracija ortofosfata 0.10 do 0.24 μmol L^{-1}. Najveće koncentracije ukupnog anorganskog dušika (4.43 μmol L^{-1}) i silikata (9.34 μmol L^{-1}) zabilježene su na dubini od 0.2 m. Prozirnost vodenog stupca bila je 3.5 m, dok je zasićenje kisikom variralo od 77 do 111 %. Multivarijantna statistička analiza (Cluster Analysis, Principal Component Anal-

COLONIZATION OF PERIPHYTIC DIATOMS IN THE OMBLA RIVER ESTUARY (EASTERN ADRIATIC SEA, CROATIA)

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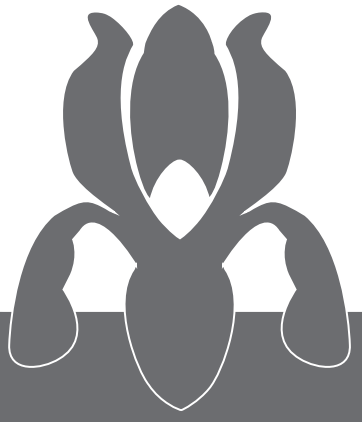
Colonization of periphytic diatoms was analyzed on artificial substrates (Plexiglas) in the relatively deep and highly stratified Ombla River Estuary, in the southern Adriatic Sea near Dubrovnik, during July 2006. Periphyton samples were taken on a weekly basis. Regarding vertical distribution at 0.2, 0.5, 1.2, 1.5, 3.0 and 3.3 m, the greatest diatom abundances ($2.1–2.5\times10^7$ cells cm^{-2}) were found in the 0.2–0.5 layer after two weeks of incubation. In the deeper layers, maximum abundances were detected after four weeks of incubation. Salinity varied between 17.95 and 37.87 and temperature between 17.5 and 23.7˚C. There was no observable pattern of vertical or temporal changes in orthophosphate concentrations (0.10-0.24 μmol L^{-1}). Maximum concentrations of total inorganic nitrogen (4.43 μmol L^{-1}) and silicates (9.34 μmol L^{-1}) were de-

ysis) pokazuje koji su fizikalno-kemijski uvjeti najviše pogodovali razvoju perifitonskih dijatomeja.

tected at the 0.2 m depth. Transparency was 3.5 m and oxygen saturation ranged between 77 and 111%. Cluster and Principal Component Analysis was performed to display physical and chemical parameters favouring diatom development.



botanika i obrazovanje

botany and education

PRIMJENA PROGRAMA GLOBE U NASTAVI BOTANIKE

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Uključivanjem u međunarodni program GLOBE, učenici istražuju i prate stanje okoliša, motivirani svojim doprinosom svjetskoj znanosti i očuvanju okoliša. Program GLOBE se u hrvatskim školama provodi od 1996. godine i uključeno je stotinjak osnovnih i srednjih škola. Provodeći različita mjerenja i opažanja te analizirajući prikupljene podatke oni uče na temelju neposrednog iskustva, kroz praktičan rad i primjenu teoretskih znanja. Učenici prezentiraju vlastite ideje, osmišljavaju i realiziraju istraživačke projekte. Tako realiziran program GLOBE jest izvrstan instrument odgoja i obrazovanja za okoliš. Program se temelji na multidisciplinarnosti i interdisciplinarnosti. Multidisciplinarnost omogućuje realizaciju programa više nastavnika različitih struka, a interdisciplinarna dimenzija se očituje u povezivanju i objedinjavanju znanja i vještina, odnosno u sustavnom integriranju sadržaja.
U programu GLOBE zastupljeni su sadržaji meteorologije, hidrologije, geologije, pedologije, biologije i dr. Botanička istraživanja u programu GLOBE su fenologija, tipovi pokrova zemljišta i daljinska istraživanja, biomasa i MUC klasifikacija različitih tipova staništa, interpetacija satelitskih snimaka, pro-

IMPLEMENTATION OF THE GLOBE PROGRAMME IN BOTANY TEACHING

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Students who participate in the international GLOBE programme perform different activities such as exploring and observing the environmental conditions, motivated by their own contribution to science and protection of the environment.
About a hundred Croatian elementary and secondary schools have been included in the GLOBE programme since 1996 (the Murterski školji elementary school since November 1996). Students put their theoretical knowledge to practical use and learn empirically, relying on observation and experience, carrying out different measurements and analysing collected dana. They present their own ideas, create and carry out research projects. Thus realized, the GLOBE programme is an excellent instrument in environmental issues education. It is based on multidisciplinarian and interdisciplinarian principles.
Its multidisciplinarian aspect enables different subjects teachers to carry out their programmes and the interdisciplinarian dimension can be seen in connecting and synthesizing knowledge and skills or more exactly in the systematic intergation of subjects. Among others the GLOBE programme includes

jekti. Prezentacijom će biti navedena primjena programa GLOBE u nastavi botanike.

meteorological, hydrological, geological, pedological, biological subjects and topics. Botanical researches of the GLOBE programme cover phenology, types of land covers and distance researches, biomass and the MUC classification of habitat types, interpretation of satellite shots, projects. The implementation of the GLOBE programme in Botany teaching will be shown in a presentation.

"SCIENCE GOES TO SCHOOL": A NEW APPROACH TO TEACHING BIOLOGY IN SECONDARY SCHOOLS

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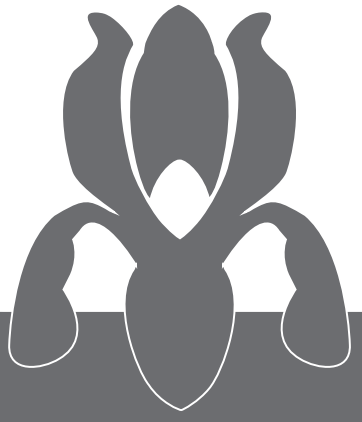
Recently, biology became the most rapidly developing natural science. Knowledge of biology is increasingly important for informed personal and social decision-making, which is also reflected in daily news coverage of topics such as biodiversity, climate change, environmental pollution and genetically modified organisms. In the 21st century, every citizen needs a basic understanding of the major biological concepts. Under these changing circumstances, biology teachers are facing the challenge of updating teaching content and changing their practices from teaching factual knowledge to conveying conceptual understanding. Teachers need support from scientists to achieve these new goals. In our project "Science Goes to School", we brought together the knowledge of scientists from the University of Ljubljana and experiences of teachers from 22 secondary schools (grades 9-12). At the introductory workshop, teachers and scientists discussed and defined biology topics for which there is an acute lack of reliable teaching materials in the Slovenian language. During the next stage of the project, scientists developed and tested new laboratory and field activities for students, and wrote supporting materials for teachers (theoretical background, worksheets for students with comments for teachers). A young scientist with a PhD in biology tested all new activities with students of partner schools, and served at the same time as a role model to stimulate the students to consider a career in the natural sciences. Teachers were present in the class during the test phase and were hence introduced the new activity in the authentic environment of their own classrooms. Both teachers and students contributed their comments and suggestions for improvement of new activities. The project results were collected in a manual for teachers and made available on the Internet (http://znanost-gre-v-solo.biologija.org). While teachers were relatively sceptical at the beginning, the partnership later developed into an enthusiastic exchange of information and experiences between the university and schools.
The project was partially supported by the EU.



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