



University of Belgrade, Technical Faculty in Bor



ECO TRUTH

**30th International Conference Ecological Truth
& Environmental Research
2023**

Proceedings

**Editor
Prof. Dr Snežana Šerbula**





University of Belgrade, Technical Faculty in Bor



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30th INTERNATIONAL CONFERENCE

ECOLOGICAL TRUTH AND ENVIRONMENTAL RESEARCH – EcoTER'23

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PREFACE

The 30th international conference Ecological Truth & Environmental Research – EcoTER'23 kept three areas in focus: ecology, environmental protection and sustainable development. The conference will be held on Mt Stara Planina in hotel Stara Planina, Serbia, 20–23 June 2023. The monograph is published on the occasion of the 30th anniversary of the conference. On behalf of the scientific and organizing committee, it is a great honor and pleasure to wish all the participants a warm welcome to the conference.

The monograph is published on the occasion of the 30th anniversary of the conference.

We hope to convey the message of the conference, which is that a transformation of attitudes and behavior would bring the necessary changes. This is also an opportunity for the participants who are experts in this field to exchange their experiences, expertise and ideas, and also to consider the possibilities for their collaborative research.

The 30th international conference Ecological Truth & Environmental Research – EcoTER'23 is organized by the University of Belgrade, Technical Faculty in Bor, and co-organized by the University of Banja Luka, Faculty of Technology, the University of Montenegro, Faculty of Metallurgy and Technology – Podgorica, the University of Zagreb, Faculty of Metallurgy – Sisak, the University of Pristina, Faculty of Technical Sciences – Kosovska Mitrovica and the Association of Young Researchers, Bor.

These Proceedings 103 papers from the authors coming from the universities, research institutes and industries in 11 countries: Australia, USA, Brazil, Spain, Portugal, Libya, Italy, Bulgaria, Bosnia and Herzegovina, North Macedonia, and Serbia.

As a part of this year's conference, the 5th Student Session – EcoTERS'23 is being held. We appreciate the contribution of the students and their mentors who have also participated in the conference.

The support of the Gold donor and their willingness and ability to cooperate has been of great importance for the success of the EcoTER'23. The organizing committee would like to extend their appreciation and gratitude to the Gold donor of the conference for their donation and support.

We appreciate the effort of all the authors who have contributed to these Proceedings. We would also like to express our gratitude to the members of the scientific and organizing committees, reviewers, speakers, chairpersons and all the conference participants for their support to the EcoTER'23. Sincere thanks go to all the people who have contributed to the successful organization of the EcoTER'23.

Prof. Snežana Šerbula,

President of the scientific and organizing committee

TABLE OF CONTENTS

Plenary Lecture

- Lidija Mančić, M. E. Rabanal, B. Marinković*
OPTICALLY ACTIVE NANOMATERIALS FOR ENVIRONMENTAL
REMEDICATION 2

Invited Lectures

- Aleksandra A. Jovanović*
THE EXTRACTION OF ACTIVE COMPOUNDS FROM PLANT WASTE:
THE POTENTIAL IN HUMAN AND INDUSTRIAL APPLICATIONS AS
THE CONCEPT OF ZERO WASTE IN THE CIRCULAR ECONOMY 7
- Tanja Brdarić*
ELECTROCHEMICAL ADVANCED OXIDATION PROCESSES FOR
WASTEWATER TREATMENT: RECENT ADVANCES AND
PERSPECTIVES 18
- Mirjana Marković, S. Radmanović, Đ. Čokeša, N. Potkonjak*
HUMIC ACIDS IN THE ENVIRONMENT 30
- Mira Stanković, M. Prokopijević, D. Bartolić, J. Stevanović, F. Andrić, K. Radotić*
ADVANCED OPTICAL TOOLS APPLIED ON HONEY SAMPLES FOR
BEE HEALTH STATUS MONITORING 40
- Dragana Bartolić, M. Nikolić, M. Stanković, M. Prokopijević, M. Algara,
S. Stanković, K. Radotić*
ESTIMATION OF THE ANTIFUNGAL ACTIVITY OF THE TWO
DIFFERENT CARBON DOTS AGAINST *Aspergillus flavus* 47

Conference Papers

Environmental monitoring and impact assessment

- Ana Čučulović, J. Stanojković, R. Čučulović, M. Stanković*
RADIOACTIVITY IN SOIL AND MOSSES FROM THE SPECIAL
NATURE RESERVE OF ZASAVICA IN 2021 56
- Djurdja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić, I. Simović*
Chaenomeles × *superba* 'PINK LADY' IN DESIGNING PRIVATE
GARDENS IN CONDITIONS OF CLIMATE CHANGE 62

Mirjana Đurašević, I. Čeliković, I. Kandić, T. Milanović, A. Samolov, N. Mladenović Nikolić, A. Kandić	
ACTIVITY CONCENTRATIONS OF ^{210}Pb , ^{137}Cs , AND ^{40}K IN WILD MUSHROOMS FROM SERBIA AND THEIR EFFECTIVE DOSE TO INGESTION	69
Jelena Čović, M. Z. Momčilović, M. Randelović	
LANTHANUM IMMOBILIZED ONTO GRAPHENE AS A CATALYST DESIGNED FOR ELECTROCHEMICAL APPLICATIONS	75
Jelena Čović, M. Z. Momčilović, M. Randelović	
NITROGEN DOPED CARBON MICROSPHERES SUPPORTED ONTO MWCNT AS NOVEL ELECTRODE MATERIAL	82
Aleksandra Nesic, S. Meseldzija, M. Momcilovic	
SUSTAINABLE PECTIN MONOLITH CRYOGELS	88
Daniela Djikanović, O. Prodanović, J. Dragišić Maksimović, J. Jovanović, A. Kalauzi, D. Spasojević, K. Radotić	
INVESTIGATION OF SILICA-LIGNIN INTERACTION. APPLICATION OF AFM AND FLUORESCENCE TECHNIQUES	94
Vesna Djikanović, J. Čanak Atlagić, K. Zorić, S. Andjus, M. Ilić, V. Nikolić, K. Jovičić	
COMPOSITION OF THE FISH COMMUNITY OF THE RIBNICA RIVER WITH RESPECT TO THE CONSERVATION STATUS	99
Nikola Marinković, B. Tubić, A. Atanacković, N. Popović, J. Tomović, M. Raković, M. Paunović	
INDICATIVE ECOLOGICAL STATUS ASSESSMENT OF RIBNICA RIVER (KOLUBARA BASIN) BASED ON AQUATIC MACROINVERTEBRATES	104
Tamara Petronijević, I. Kostić Kokić, T. Anđelković, B. Zlatković, K. Kitanović, D. Bogdanović, N. Stanković	
INFLUENCE OF FREEZING ON NITRATE AND NITRITE CONTENT IN RADISH, PARSLEY LEAF AND CELERY ROOT	109
Marija Matić, D. Pavlović, V. Perović, D. Sekulić, N. Radulović, M. Mitrović, P. Pavlović	
DETERMINATION OF PTEs CONTENT IN LIVESTOCK FODDER AND SOIL IN THE VICINITY OF THERMAL POWER PLANTS AND ASH DISPOSAL SITES	115
Sonja Veljović Jovanović, S. Milić Komić, B. Živanović, A. Sedlarević Zorić, N. Šušić	
LEAF NITROGEN BALANCE INDEX USED TO MONITOR STRESS RESPONSE TO AIR POLLUTION OF DECIDUOUS TREE SPECIES GROWN IN URBAN ZONE OF BELGRADE	122

Bojana Živanović, S. Milić Komić, A. Sedlarević Zorić, A. Jelušić, N. Šušić, S. Marković, S. Veljović Jovanović	
USE OF BIOCHEMICAL METHODS FOR ASSESING OXIDATIVE STRESS IN TREES IN URBAN AREA DURING GROWING SEASON	129
Nikola Šušić, S. Milić Komić, B. Živanović, A. Jelušić, S. Marković, A. Sedlarević Zorić, S. Veljović Jovanović	
ACCLIMATION OF PEDUNCULATE OAK SEEDLINGS TO DIFFERENT LIGHT CONDITIONS IN THE FIRST MONTHS AFTER GERMINATION	135
Božica Vasiljević, J. Đuknić, N. Marinković	
BENTHIC DIATOMS AS PROXY FOR THE ECOLOGICAL CONDITIONS OF THE RIBNICA RIVER, SERBIA	141
Milanka Negovanović, L. Kričak, S. Milanović, J. Marković, N. Simić, S. Ignjatović	
BLASTING MATS FOR THE PROTECTION OF PEOPLE, STRUCTURES AND THE ENVIRONMENT IN PROXIMITY TO THE BLAST SITE	147
Aleksandra Kolarski, V. Srečković, Z. Mijić	
INFLUENCES OF EXTREME SOLAR ACTIVITY ON EARTH ENVIRONMENT – CASE STUDY	154
Maja Poznanović Spahić, A. Gulan, D. Spahić, P. Tančić, S. Sakan, S. Petrović	
AVAILABILITY OF TOXIC ELEMENTS IN ROADSIDE SOILS (HIGHWAY 75, VOJVODINA, SERBIA): IS THERE ANY SIGNIFICANT CONTAMINATION RISK?	160
Tanja Kalinović, A. Radojević, J. Kalinović, J. Milosavljević, S. Šerbula	
MULTICRITERIA EFFICIENCY ASSESSMENT OF THE PINE TREE POTENTIAL FOR THE PHYTOREMEDIATION OF COPPER	167
Žaklina Tasić, M. Petrović Mihajlović, A. Simonović, M. Radovanović, M. Antonijević	
ELECTROCHEMICAL SENSING OF FOLIC ACID	173
Vanja Trifunović, S. Milić, Lj. Avramović, M. Antonijević, M. Radovanović	
POTENTIAL ENVIRONMENT POLLUTANT – INTERMEDIATE PRODUCT OF THE STEEL PRODUCTION PROCESS	179
Natalija Ognjanović, V. Nedelkovski, S. Stanković, S. Milić	
BIOPESTICIDES IN THE ENVIRONMENT	185
Urban and industrial ecology	
Goran Milentijević, M. Agatonović, M. Rančić, M. Milosavljević	
ENVIRONMENTALLY ACCEPTABLE PROCEDURE FOR THE SYNTHESIS OF TETRAETHYLTHIURAMMONOSULFIDE TETS	191

<i>Anđela Stojić, D. Tanikić, E. Požega</i>		
TECHNOLOGICAL PROCESSES AS SOURCES OF POLLUTION IN THE ENVIRONMENT		198
<i>Aleksandar Lisica, N. Stojanović, M. Veselinović, J. Petrović, N. Stavretović, M. Tešić</i>		
LONDON PLANE (<i>Platanus × acerifolia</i> (Aiton) Willd.) IN THE STREET TREE LINES OF THE OLD TOWN IN BELGRADE		203
<i>Djordja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić</i>		
APPLICATION OF SPECIES OF THE GENUS <i>Parthenocissus</i> L. IN URBAN GREEN INFRASTRUCTURE – STATE AND PERSPECTIVES		210
<i>Djordja Petrov, M. Ocokoljić, N. Galečić, D. Skočajić, I. Simović</i>		
SECOND FLOWERING OF <i>Philadelphus coronarius</i> L. IN GREEN-BLUE INFRASTRUCTURE OF BELGRADE		216
<i>Dragana Pavlović, M. Matić, V. Perović, O. Kostić, D. Sekulić, M. Mitrović, P. Pavlović</i>		
EFFECTS OF SO ₂ AND NO ₂ ON THE PHOTOSYNTHETIC EFFICIENCY AND CATALASE ANTIOXIDATIVE ENZYME ACTIVITY IN <i>Betula pendula</i> Roth		222
<i>Ermenegilda Vitale, P. Napoletano, C. Arena, A. De Marco</i>		
PLANT-SOIL RELATIONSHIPS IN MEDITERRANEAN SPECIES GROWN ON TECHNOSOLS ENRICHED WITH COMPOST		228
Air, water and soil pollution, prevention and control		
<i>Milica Blažić, M. Milovanović, T. Sekulić, V. Stupar, Z. Živković</i>		
IMPACTS OF PESTICIDE APPLICATION ON THE ENVIRONMENT		235
<i>George Vuković, D. Kovačević, N. Đorđević, M. Perić, S. Knežević, M. Nikolić, B. Vlahović, V. P. Pavlović, G. Rašić, S. Nenadović, M. Ivanović, M. Mirković, V. B. Pavlović</i>		
GREEN SYNTHESIS OF GEOPOLYMER-POLYURETHANE COMPOSITES FOR EM SHIELDING		241
<i>Ana Vukmirović, B. Obrovski, S. Vukmirović, I. Mihajlović</i>		
APPLICATION OF STATISTICAL METHODS FOR THE ANALYSIS OF WASTEWATER TREATMENT PLANT EFFICIENCY		247
<i>Ivana Mihajlović, A. Hgeig, N. Živančev, M. Petrović, M. Novaković</i>		
COMPARISON OF DIFFERENT SORBENTS IN THE HERBICIDE REMOVAL FROM WATER		251
<i>Aleksandar Krstić, I. Bracanović, D. Vasić Anićijević, A. Kalijadis</i>		
VALLME PREPARATION METHOD FOR THE DETERMINATION PHARMACEUTICALS IN WATER		256

Marija Koprivica, J. Petrović, J. Dimitrijević, M. Ercegović, M. Simić, M. Grubišić REMOVAL EFFICIENCY OF HEAVY METAL IONS FROM AQUEOUS SOLUTION WITH WASTE TREE BIOMASS HYDROCHARS	261
Nevena Surudžić, D. Spasojević, M. Stanković, M. Spasojević, R. G. A. Elgahwash, R. Prodanović, O. Prodanović HORSE RADISH PEROXIDASE IMMOBILIZATION WITHIN MICRO-BEADS OF OXIDIZED TYRAMINE-ALGINATE FOR PHENOL REMOVAL FROM WASTEWATER	267
Dragica Spasojević, O. Prodanović, N. Surudžić, D. Djikanović, J. Simonović Radosavljević, K. Radotić, R. Prodanović WASTEWATER TREATMENT BY AMINATED PEROXIDASE IN ALGINATE HYDROGEL	272
Branislava Matić, M. Milić CONTRIBUTION OF INSTITUTE OF PUBLIC HEALTH OF SERBIA IN MONITORING TRAFFIC-INDUCED AIR POLLUTION IN BELGRADE	276
Nenad Malić, U. Matko, M. Trbić, R. Pijunović, M. Marković ALTERNATIVE METHODS OF REHABILITATION (SOIL RECOVERY), RECLAMATION AND REMEDIATION OF MINE TECHNOSOLS	283
Snežana B. Simić, K. A. Markeljić PRELIMINARY ECOLOGICAL STATUS ASSESSMENT OF THE GROŠNICA RIVER BASED ON PHYTOBENTHOS	289
Snežana B. Simić, N. B. Đorđević AN ASSESSMENT OF THE ECOLOGICAL POTENTIAL OF ŠUMARICE RESERVOIRS (CENTRAL SERBIA) BASED ON PHYTOPLANKTON	295
Miloš Prokopijević, M. Stanković, D. Bartolić, A. Lj. Mitrović, K. Radotić FLUORESCENCE CHARACTERISATION OF BISPHEENOL A IN VARIOUS SOLVENTS AND DRINKING WATER	302
Slobodan Ničković, L. Ilić, S. Petković, G. Pejanović, A. Huete, Z. Mijić NOVEL APPROACH IN AIRBORNE POLLEN DISPERSION MODELLING	306
Nena Velinov, S. Najdanović, M. Petrović, M. Radović Vučić, M. Kostić, J. Mitrović, A. Bojić THE APPLICATION OF SORBENT SYNTHESIZED USING ULTRASOUND FOR REMOVAL OF TEXTILE DYE	312
Milica Petrović, S. Najdanović, N. Velinov, S. Rančev, D. Radivojević, M. Radović Vučić, A. Bojić ATMOSPHERIC PRESSURE CORONA PLASMA DEGRADATION OF REACTIVE ORANGE 4 IN DEIONIZED AND RIVER WATER	318

Slobodan Najdanović, M. Petrović, N. Velinov, M. Kostić, J. Mitrović, D. Bojić, A. Bojić	
THE INFLUENCE OF TYPE OF SOLVENT ON THE ELECTROCHEMICALLY SYNTHESIZED SORBENTS BASED ON BASIC BISMUTH NITRATES	324
Milena Dimitrijević, S. Kovačević, U. Jovanović, M. Stanić, M. Opačić, I. Santrač, M. Tanović, V. Čurić, I. Spasojević	
APPLICATION OF MICROALGA <i>Chlorella sorokiniana</i> IN WASTEWATER BIOREMEDIATION – CASE OF LAKE ROBULE	330
Milan Gorgievski, M. Marković, N. Štrbac, V. Grekulović, M. Zdravković	
ADSORPTION ISOTHERMS FOR COPPER IONS BIOSORPTION ONTO ONION PEELS	335
Sonja Stanković, V. Nedelkovski, M. Radovanović, S. Milić	
MECHANISM AND KINETICS OF ELECTROCATALYTIC OXIDATION OF PHENOL	341
Jelena Milosavljević, S. Šerbula, A. Radojević, T. Kalinović, J. Kalinović	
ECOENZYMATIC STOICHIOMETRY AS AN EMERGING METHOD IN THE ASSESSMENT OF SOIL HEAVY METAL POLLUTION	348
Protection and preservation of natural resources	
Mihajlo Stanković	
ORCHIDS OF THE ZASAVICA SPECIAL NATURE RESERVE	354
Gordana Šekularac, M. Aksić, T. Dimitrijević (ex. Ratknić), M. Vranešević, N. Gudžić, M. Ratknić	
CLIMATIC BALANCE OF THE WATER FOR THE SOIL OF THE KRUŠEVAC REGION IN CENTRAL SERBIA	361
Gordana Šekularac, M. Aksić, T. Dimitrijević (ex. Ratknić), M. Vranešević, S. Gudžić, N. Gudžić, M. Ratknić	
INFLUENCE OF IRRIGATION METHOD ON THE OCCURRENCE AND INTENSITY OF THE GRAY MOLD OF LETTUCE	367
Aleksandar Stevanović, T. Sekulić, M. Blažić, N. Radić, A. Popović, V. Stupar	
THE IMPACT OF IRRIGATION ON THE QUALITY OF THE ENVIRONMENT AND WATER RESOURCES	373
Aleksandar Stevanović, M. Saulić, M. Blažić, V. Stupar, D. Stojićević, Z. Živković	
BIOPREPARATIONS IN THE FUNCTION OF ORGANIC AGRICULTURE IN FRUIT GROWING AND VITICULTURE	379
Vladanka Stupar, T. Sekulić, M. Blažić, N. Radić, A. Popović, A. Stevanović	
IRRIGATION – IMPACT ON SOIL AS AN ENVIRONMENTAL FACTOR	385

Milan Nedeljković, S. Mladenović, J. Petrović

A RENEWABLE ENERGY SOURCES AND SUSTAINABLE DEVELOPMENT EQUATION

391

Ecological ethics and environmental education

Tatjana Miljojčić

FORGING A SUSTAINABLE FUTURE: THE CIRCULAR ECONOMY IN THE FASHION INDUSTRY

396

Ecotoxicology and environmental safety

Darko Anđelković, M. Branković

CITRATE BUFFERED QuEChERS vs SIMPLIFIED SAMPLE PREPARATION METHOD: COMPARATIVE LC/MS ANALYSIS OF PESTICIDES IN APPLES

402

Darko Anđelković, M. Branković

APPLICABILITY OF THE QuEChERS IN NON-CHROMATOGRAPHY-BASED PESTICIDE ANALYSIS IN APPLES

407

Darko Anđelković, M. Branković

ESI vs APCI IN SELECTED PESTICIDES MS DETECTION IN APPLES

413

Tamara Petronijević, I. Kostić Kokić, Dj. Milošević, M. Stojković Piperac, N. Stanković, T. Anđelković

DIFFERENT GROWTH RESPONSES OF SELECTED REPRESENTATIVES OF PHYTOPLANKTON TO THE PRESENCE OF THE ANTIBIOTIC VANCOMYCIN

420

Tamara Petronijević, I. Kostić Kokić, T. Anđelković, B. Zlatković, D. Stajić, D. Bogdanović, N. Stanković

DETERMINATION OF SEVEN ANIONS IN WATER LETTUCE GROWN IN A NATURAL UNPOLLUTED HABITAT BY ION CHROMATOGRAPHY

426

Milica Zdravković, V. Grekulović, N. Štrbac, J. Suljagić, I. Marković, M. Gorgievski, M. Marković

THE COPPER CORROSION IN CHLORIDE MEDIUM WITH ADDITION OF BLACKBERRY LEAF EXTRACT

432

Hazardous materials and green technologies

Aleksandra A. Jovanović, M. R. Elferjane, M. Gnjatović, B. Bugarski, A. Marinković

PHOSPHOLIPID LIPOSOMES AS A CARRIER FOR ALOE VERA WASTE EXTRACT

438

Aleksandra A. Jovanović, M. R. Elferjane, M. Milošević, M. Gnjatović, A. Marinković	
Vaccinium myrtillus LEAF WASTE EXTRACTS WITH NATURAL DEEP EUTECTIC SOLVENT	444
Danijela Kovačević, N. Đorđević, S. Glišić, B. Vlahović, V. B. Pavlović	
MORPHOLOGICAL INVESTIGATION OF PVDF/MAGNETITE@NC/BaTiO ₃ SEMI-SPHERICAL COMPOSITE MATERIALS FOR OIL REMOVAL	450
Branislava Savić, D. Aćimović, M. Ječmenica Dučić, M. Simić, D. Vasić Anićijević, T. Brdarić	
DEGRADATION OF PHENOL AND SUBSTITUTED PHENOLS: INFLUENCE OF APPLIED POTENTIAL	456
Marija Ječmenica Dučić, D. Aćimović, B. Savić, M. Simić, A. Krstić, D. Vasić Anićijević, T. Brdarić	
DEGRADATION OF DYES MIXTURE BY ELECTROCHEMICAL OXIDATION USING STAINLESS STEEL ELECTRODE	460
Marija Simić, D. Aćimović, B. Savić, M. Ječmenica Dučić, I. Perović, D. Vasić Anićijević, T. Brdarić	
THE OXYGEN EVOLUTION REACTION AT TIN DIOXIDE-CARBON-BASED ELECTRODES	465
Drita Abazi Bajrami, M. Marinkovski, K. Lisichkov, S. Kuvendziev	
OPTIMIZATION OF THE <i>Helichrysum arenarium</i> EXTRACT OBTAINED WITH ULTRASOUND-ASSISTED EXTRACTION	469
Berina Sejdinović	
VIBRATION ISOLATION	475
Uroš Stamenković, I. Marković	
THE INFLUENCE OF AGEING ON THE THERMAL PROPERTIES AND MICROSTRUCTURE OF THE EN AW-6082 GREEN ALUMINIUM ALLOY	482
Ljubiša Balanović, D. Manasijević, I. Marković, U. Stamenković, M. Petrić	
MICROSTRUCTURAL AND THERMAL CHARACTERIZATION OF Bi-Sb-Sn ALLOYS FOR ECOLOGICAL APPLICATION	488
Vladan Nedelkovski, S. Stanković, M. Radovanović, Ž. Tasić, S. Milić	
OPTIMIZATION OF PHENOL ELECTROCHEMICAL OXIDATION USING MODIFIED Ti/SnO ₂ -TYPE ANODES	494
Aleksandar Cvetković, Ž. Tasić, M. Petrović Mihajlović, A. Simonović, M. Radovanović, M. Nujkić, M. Antonijević	
INFLUENCE OF SUBSTITUTES ON THE EFFICIENCY OF ORGANIC CORROSION INHIBITORS	500

Sonja Stanković, M. Nujkić, Ž. Tasić, D. Medić, A. Papludis, S. Milić	
MODIFIED MEMBRANES WITH GRAPHENE OXIDE – REMOVAL OF DYES FROM WASTEWATER	506
Human and ecological risk assessment	
Olga Kostić, D. Pavlović, M. Marković, Z. Miletić, N. Radulović, M. Mitrović, P. Pavlović	
HUMAN HEALTH RISK ASSESSMENT OF PTE _s IN ELECTROFILTER ASH AND CHRONOSEQUENCE FLY ASH FROM “TENT A” DISPOSAL SITES	512
Agriculture: nutrition, organic food and health impacts	
Markola Saulić, V. Trajić, D. Stojićević, A. Stevanović, Z. Živković	
EFFECT OF EXTRACT <i>Ecklonia maxima</i> ON CONDITION OF AGRICULTURAL CROPS	519
Metodi Mladenov	
SUITABILITY OF THE SOILS IN THE MUNICIPALITY OF KOVACHEVTSI, BULGARIA FOR GROWING ON EINKORN WHEAT (<i>Triticum monococcum</i>)	524
Gorica Cvijanović, V. Stepić, M. Bajagić, V. Cvijanović, J. Marinković, N. Đurić	
INFLUENCE OF EFFECTIVE MICROORGANISMS ON THE BASIC PARAMETERS OF SOIL BIOGENICITY IN THE PRODUCTION OF WHEAT AND CORN	529
Vojkan Miljković, R. Ljupković, M. Miljković	
APPLICATION OF CLASSIC THIN LAYER CHROMATOGRAPHY METHOD FOR QUALITATIVE DETERMINATION OF SYNTHETIC FOOD COLORS	535
Alternative energy: efficiency and environmental policy	
Snežana Brković, N. Zdolšek, I. Perović, G. Tasić, M. Seović, S. Mitrović, J. Georgijević	
NOVEL CARBON MATERIAL FOR OER IN VARIOUS ELECTROLYTE SOLUTIONS	540
Nikola Zdolšek, I. Perović, S. Brković, M. Seović, J. Georgijević, S. Mitrović, P. Laušević	
THE EFFECT OF DIFFERENT TYPE OF ELECTROLYTES ON THE DISCHARGE CAPACITY OF Zn-AIR BATTERIES	545
Jelena Georgijević, J. Milikić, N. Zdolšek, I. Perović, S. Brković, S. Mitrović, B. Šljukić	
IRON, COBALT DUAL DOPED CARBON ELECTROCATALYST FOR EFFICIENT WATER SPLITTING	550

Greenhouse effect and global climate change

- Tatjana Dimitrijević, G. Šekularac, M. Ratknić, M. Aksić**
EFFECTS OF CLIMATE CHARACTERISTICS ON THE DIAMETER INCREMENT OF RED OAK IN THE CITY OF BELGRADE (SERBIA) 555
- Milica Blažić, T. Sekulić, V. Stupar, Z. Živković**
GREENHOUSE EFFECT AND GLOBAL CLIMATE CHANGE – IMPACT ON AGRICULTURE 561
- Vojkan Miljković, I. Gajić, Lj. Nikolić**
GLOBAL CLIMATE CHANGES: GREENHOUSE GASSES, CITIES AND PLASTICS 567

Sustainable development and green economy

- Zlata Živković, M. Saulić, D. Stojićević, M. Jevtić, V. Stupar**
ROLE OF NUTRIENTS IN CONTROLLING PLANT DISEASES AND PATHOPHYSIOLOGICAL ALTERATIONS IN PLANTS IN SUSTAINABLE AGRICULTURE. A REVIEW 572
- Zlata Živković, M. Saulić, D. Stojićević, M. Jevtić**
THE WAY OF MANAGING PLANT DISEASES IN SUSTAINABLE AGRICULTURE 578
- Dragan Ugrinov, M. Nikolić**
THE ROLE OF PLANTS IN BIOECONOMY AND CIRCULAR ECONOMY 584
- Vojkan Miljković, I. Gajić, Lj. Nikolić**
AGRICULTURAL WASTE IN SUSTAINABLE AGRICULTURE 589
- Ana Radojević, J. Milosavljević, S. Šerbula, T. Kalinović, J. Kalinović**
RECYCLING OF Li-ION BATTERIES FROM THE END-OF-LIFE VEHICLES: OPPORTUNITY OR LIABILITY IN THE FUTURE? 593

Environmental biology

- Vladimir Topalović, S. Matijašević, V. Savić, J. Nikolić, J. Stojanović, S. Zildžović, S. Grujić**
CRYSTALLIZATION CHARACTERISTICS OF BIOACTIVE POLYPHOSPHATE GLASSES 599

Environmental and material flow management

- Isidora Berežni, T. Marinković, B. Batinić**
ASSESSING THE COMPOSITION OF MUNICIPAL SOLID WASTE IN ŠID 605

Ivan Bracanović, A. Krstić, A. Kalijadis

SYNTHESIS AND CHARACTERISATION OF CARBON NANOMATERIAL USING HYDROTHERMAL CARBONISATION METHOD

612

Hamid Husić, S. Čerčić, V. Aganović

RETROSPECTIVE OF THE PLANNED ACTIVITIES FOR THE REHABILITATION OF THE DAMAGED AREA OF THE FORMER SURFACE MINE ČUBRIĆ

617

Student Section

Students: Ana Smiljković, Isidora Sujčić (Serbia)

Mentor: Maja Nujkić (Serbia)

ENVIRONMENTAL AND HEALTH RISK OF CO₂ IN INDOOR ENVIRONMENTS

624

Student: Avram Kovačević (Serbia)

Mentor: Uroš Stamenković (Serbia)

ANTHROPOGENIC MERCURY IN THE ENVIRONMENT: GLOBAL EMISSIONS AND RECYCLING POSSIBILITIES

626

Student: Petar Milanović (Serbia)

Mentors: Uroš Stamenković, Avram Kovačević (Serbia)

THE INFLUENCE OF COOLING RATE ON MECHANICAL PROPERTIES AND MICROSTRUCTURE OF C45 CARBON STEEL

628

Student: Milica Denić (Serbia)

Mentor: Jelena Kalinović (Serbia)

AIR POLLUTION WITH CARCINOGENIC SUBSTANCES

630

Student: Gordan Mišić (Serbia)

Mentor: Jelena Kalinović (Serbia)

ACID RAIN AND SMOG – CHEMICAL REACTIONS

632

Student: Milica Denić (Serbia)

Mentor: Ana Radojević (Serbia)

MEDICAL WASTE MANAGEMENT

634

Student: Gordan Mišić (Serbia)

Mentor: Ana Radojević (Serbia)

ENVIRONMENTAL POLLUTION BY PET PACKAGING

636

Student: Marija Stanković (Serbia)

Mentor: Ana Simonović (Serbia)

COPPER CORROSION IN ARTIFICIAL ACID RAIN SOLUTION IN PRESENCE OF 5-PHENYL-1-TETRAZOLE

638

BENTHIC DIATOMS AS PROXY FOR THE ECOLOGICAL CONDITIONS OF THE RIBNICA RIVER, SERBIA

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Abstract

*Benthic diatoms of the Ribnica River situated in Valjevo karst area were not studied so far. The objective of this paper is to provide base data on diatom community of the Ribnica River, through diversity, abundance, diatom ecological guilds, and to estimate its preliminary ecological status according to national regulations. Phytobenthos sampling and laboratory work was done by national standards. Analysis of diatom community was based on identification, enumeration, and classification into ecological guilds. Indicative ecological status was assessed according to IPS and CEE diatom indices. At the Ribnica River in total 52 diatom taxa were recorded, and also high taxa richness at each locality. The most frequent and numerous were diatoms *Achnantheidium minutissimum*, *A. pyrenaicum* and *Encyonopsis subminuta*. Low profile ecological guild, typical for fast flowing streams with lower nutrient concentrations was dominant in the Ribnica River. Diatom indices IPS and CEE revealed excellent ecological status.*

Keywords: epilithic diatoms, ecological guilds, hilly-mountain river, ecological status.

INTRODUCTION

The Ribnica River is located in the western Serbia, and belongs to the Kolubara River basin. It originates at altitude of 300m in the village Brežđe, and after 22 km flows into the Kolubara River, near Mionica. The Ribnica River is an allogeneic watercourse of the Valjevo karst zone. Its river valley consists of canyons and gorges, with erosive widenings occurring [1]. It is positioned in the area where mountainous shifts to hilly region.

Previous data on diatoms of the Ribnica River refer to cave biofilms. Being part of karst relief, the Ribnica River has 12 caves, of diverse sizes and located at different altitudes [1]. Diatom taxa *Nitzschia* Hassall spp. and aerophilous *Hantzschia amphyois* (Ehrenberg) Grunow were found only on the entrance of Ribnica Cave floor, in accumulated soil and mud [2], as well as *Humidophila contemnata* (E. Reichardt) Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová and *H. paracontenta* (Lange-Bertalot & Werum) Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová [3].

The objective of this paper is to provide starting point on benthic diatom community of the Ribnica River, through diversity, abundance, diatom ecological guilds, and to estimate its preliminary ecological status according to national regulations.

MATERIALS AND METHODS

Epilithic phytobenthos samples at the Ribnica River were collected from the four localities (Figure 1) [4]. Samples were cleaned in the laboratory using a hot acid method; afterwards permanent slides were prepared [4]. Diatom taxa on slides were observed and photographed using light microscope Zeiss Axio Lab1 with Axiocam ERc 5s camera and ZEN software. Identification was done according to standard taxonomy literature and relative abundance by counting 400 diatom valves at each slide [5]. Identified diatoms were grouped in ecological guilds [6,7]. Indices Shannon diversity index [8], IPS diatom index [9] and CEE diatom index [10] were calculated in OMNIDIA software [11]. Ecological status classes based on IPS and CEE were determined by the guidance of national laws [12,13,14].

RESULTS AND DISCUSSION

During phytobenthos survey at the Ribnica River, 52 diatom taxa were recorded. The greatest number of taxa was identified among genera *Cymbella* (11) and *Nitzschia* (9).

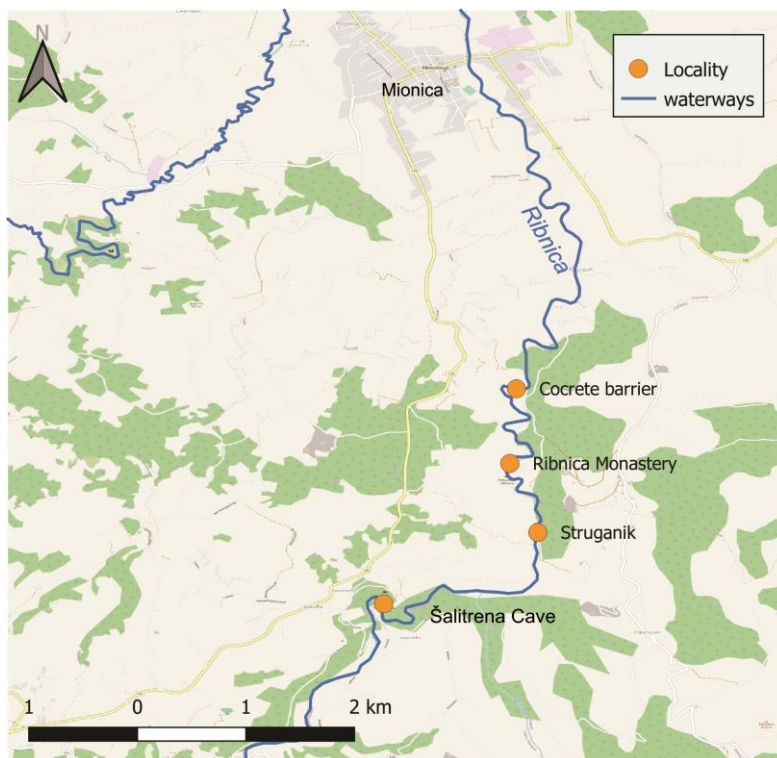


Figure 1 Phytobenthos sampling sites at the Ribnica River

Biological integrity status of the Ribnica River was assessed by taxa richness and Shannon diversity index. The highest taxa richness was recorded at the localities Concrete barrier (41) and Struganik (38), with highest values of Shannon diversity index (4.04 and 3.94, respectively). High taxa richness was also noted at locality Šalitrena Cave (35) and Ribnica Monastery (31), nevertheless values of Shannon diversity index were lower (2.82 and 3.06, respectively), due to the uneven distribution of taxa – dominance of two or three species which together attributed with abundance of nearly 70% (Figure 2).

The most frequent diatom taxa, recorded in all samples collected from the Ribnica River were *Achnantheidium minutissimum* (Kützing) Czarnecki, *A. pyrenaicum* (Hustedt) H.Kobayasi, *Cocconeis euglypta* Ehrenberg, *Cymbella compacta* Oestrup, *C. neolanceolata* W. Silva, *Diatoma moniliformis* (Kützing) D.M.Williams, *Encyonema auerswaldii* Rabenhorst, *Encyonopsis subminuta* Krammer & E.Reichardt, *Gomphonema parvulum* (Kützing) Kützing, *Navicula capitatoradiata* Germain, *Navicula cryptotenella* Lange-Bertalot, *Navicula tripunctata* (O.F.Müller) Bory, *Nitzschia dissipata* (Kützing) Grunow, *N. lacuum* Lange-Bertalot and *Ulnaria acus* (Kützing) Aboal. The most abundant species during investigation at the Ribnica River were *Achnantheidium minutissimum* and *A. pyrenaicum* (Figure 2). *A. minutissimum* is generally one of the most frequent diatoms, with very wide ecological amplitude. *A. pyrenaicum* can be found in high numbers in hilly-mountain, calcium-bicarbonate rich, oligotrophic and mesotrophic rivers [15]. Species *Encyonopsis subminuta* and *E. minuta* Krammer & Reichardt, with ecological preferences similar as *A. pyrenaicum*, were also very abundant in the Ribnica River during sampling in 2022 (Figure 2). *Cymbella affinis* Kützing, was the most abundant at the locality Ribnica Monastery (Figure 2). It is common epiphytic species in hilly-mountain, usually mesotrophic watercourses.

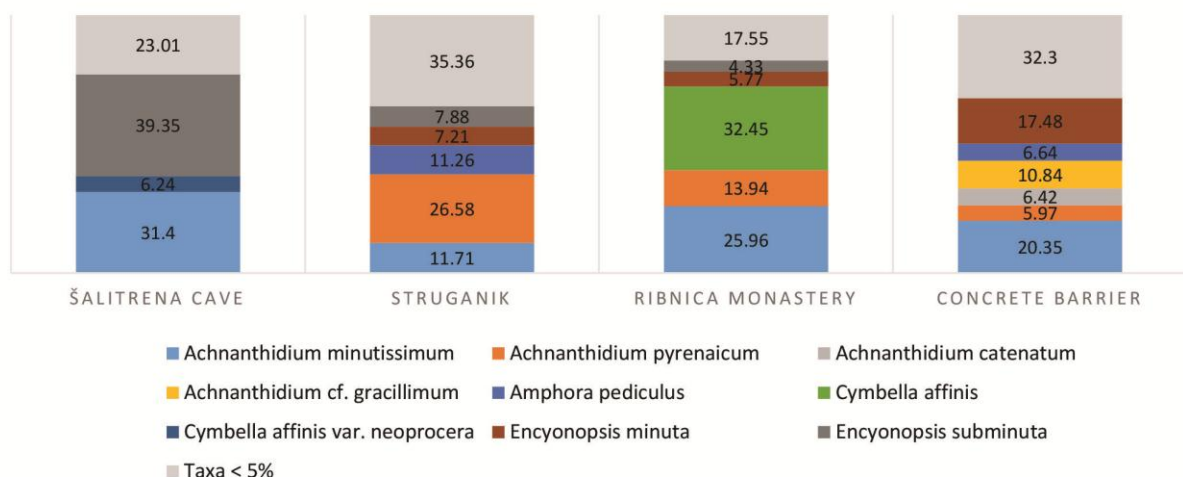


Figure 2 Relative abundance (%) of diatoms recorded in more than 5% at surveyed localities of the Ribnica River

Trait-based approaches are useful tool for complementing ecological studies [16], as they provide valuable information on changes in aquatic environment [17]. One of the metrics are ecological guilds – groups of diatom taxa that live in the same habitat, nonetheless they adapt in different ways to predominant abiotic conditions [6,7,17]. In the Ribnica River, the dominant ecological guild was low profile (Figure 3), represented by genera *Achnantheidium*, *Amphora*, *Cocconeis*, *Encyonopsis*, *Reimeria*, *Rhoicosphenia*, smaller *Cymbella* species and *Encyonema procerum* Krammer. This guild includes taxa of short stature, adhering to the substrate with entire valve surface, apically attached parallel or perpendicular to the substrate, as well as slow moving taxa, adapted to high current velocities, and low nutrients concentrations [6,7]. High profile guild comprises large stalked species, or species that form

colonies. These taxa are susceptible to water turbulence, and prefer increase of nutrients concentrations. At the Ribnica River high profile guild is represented by genera *Amphiptera*, *Diatoma*, *Encyonema*, *Gomphonella*, *Gomphonema*, *Fragillaria*, *Ulnaria*, large *Cymbella* species, and *Achnanthisidium catenatum* (Bily & Marvan) Lange-Bertalot. Motile guild consists of fast moving species, which are adapted to finer substrate granulation and higher nutrient concentrations [6]. Motile diatoms in the samples from the Ribnica River were *Fallacia* sp., and species belonging to genera *Navicula* and *Nitzschia*. Increased percentage share of high profile and motile guild in diatom community was recorded at locality Concrete barrier (Figure 3). Sample was taken from the part of the watercourse above the barrier, which caused slower current velocity and partly blocked transport of fine fraction substrate, resulting in ecological conditions favorable to diatoms belonging to high and motile guild.

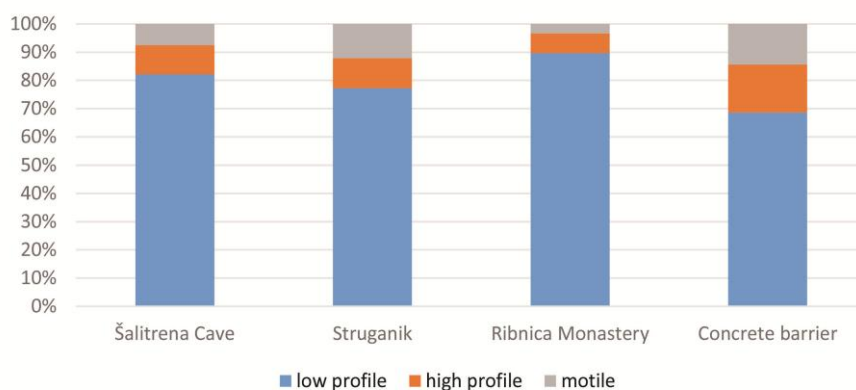


Figure 3 Percentage share of diatom ecological guilds at surveyed localities of the Ribnica River

According to national typology [13,14], the Ribnica River belongs to type 3 watercourse, thus ecological status classes are determined by IPS and CEE indices. Both indices values were higher than boundary values set between first and second ecological status classes (Figure 4), and revealed excellent preliminary ecological status at all investigated localities, based on benthic diatom community.

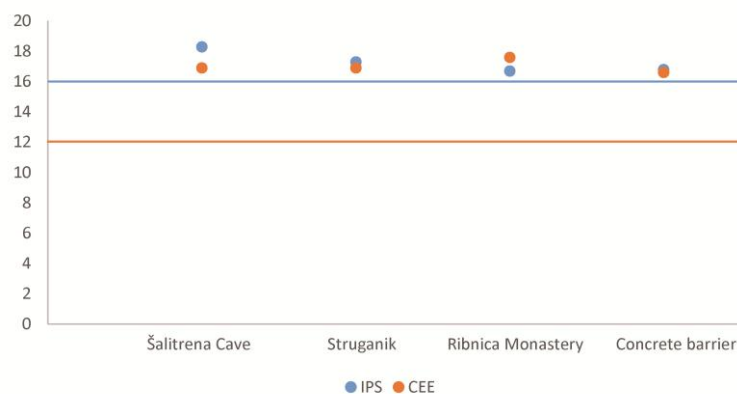


Figure 4 Values of diatom indices IPS and CEE at surveyed localities of the Ribnica River (dots). Lines represent boundary values between first and second ecological status class [14], for IPS (blue line), and CEE (orange line)

CONCLUSION

Conducted study mainly included localities in the middle stretch of the Ribnica River. Composition of the benthic diatom community indicated high taxa richness. Classification of diatom ecological guilds clearly described existing ecological conditions. Dominance of low profile guild is typical for fast flowing streams with lower nutrients concentrations. In the part of the flow immediately upstream barrier, rise in the species share belonging to high and motile guild was noted, due to slower water velocity, presence of smaller substrate fractions, and slight increase in nutrient concentrations. Diatom indices IPS and CEE revealed excellent preliminary ecological status.

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Author index

A

Abazi Bajrami, D. 469
 Aćimović, D. 456, 460, 465
 Aganović, V. 617
 Agatonović, M. 191
 Aksić, M. 361, 367, 555
 Algara, M. 47
 Anđelković, D. 402, 407, 413
 Anđelković, T. 109, 420, 426
 Andjus, S. 99
 Andrić, F. 40
 Antonijević, M. 173, 179, 500
 Arena, C. 228
 Atanacković, A. 104
 Avramović, Lj. 179

B

Bajagić, M. 529
 Balanović, Lj. 488
 Bartolić, D. 40, 47, 302
 Batinić, B. 605
 Berežni, I. 605
 Blažić, M. 235, 373, 379, 385, 561
 Bogdanović, D. 109, 426
 Bojić, A. 312, 318, 324
 Bojić, D. 324
 Bracanović, I. 256, 612
 Branković, M. 402, 407, 413
 Brdarić, T. 18, 456, 460, 465
 Brković, S. 540, 545, 550
 Bugarski, B. 438

C

Cvetković, A. 500
 Cvijanović, G. 529
 Cvijanović, V. 529

Č

Čanak Atlagić, J. 99
 Čeliković, I. 69
 Čergić, S. 617
 Čokeša, Đ. 30
 Čović, J. 75, 82
 Čučulović, A. 56
 Čučulović, R. 56

Ć

Ćurić, V. 330

D

De Marco, A. 228
 Denić, M. 630, 634
 Dimitrijević, J. 261
 Dimitrijević, M. 330
 Dimitrijević (ex. Ratknić), T. 361, 367
 Dimitrijević, T. 555
 Djikanović, D. 94, 272
 Djikanović, V. 99
 Dragišić Maksimović, J. 94

Đ

Đorđević, N. 241, 450

Dorđević, N.B. 295
 Đuknić, J. 141
 Đurašević, M. 69
 Đurić, N. 529

E

Elferjane, M.R. 438, 444
 Elgahwash, R.G.A. 267
 Ercegović, M. 261
 Ermenegilda, V. 228

G

Gajić, I. 567, 589
 Galečić, N. 62, 210, 216
 Georgijević, J. 540, 545, 550
 Glišić, S. 450
 Gnjatović, M. 438, 444
 Gorgievski, M. 335, 432
 Grekulović, V. 335, 432
 Grubišić, M. 261
 Grujić, S. 599
 Gudžić, N. 361, 367
 Gudžić, S. 367
 Gulan, A. 160

H

Hgeig, A. 251
 Huete, A. 306
 Husić, H. 617

I

Ignjatović, S. 147
 Ilić, L. 306
 Ilić, M. 99
 Ivanović, M. 241

J

Ječmenica Dučić, M. 456, 460, 465
 Jelušić, A. 129, 135
 Jevtić, M. 572, 578
 Jovanović, A.A. 7, 438, 444
 Jovanović, J. 94
 Jovanović, U. 330
 Jovičić, K. 99

K

Kalauzi, A. 94
 Kalijadis, A. 256, 612
 Kalinović, J. 167, 348, 593, 630, 632
 Kalinović, T. 167, 348, 593
 Kandić, A. 69
 Kandić, I. 69
 Kitanović, K. 109
 Knežević, S. 241
 Kolarski, A. 154
 Koprivica, M. 261
 Kostić Kokić, I. 109, 420, 426
 Kostić, M. 312, 324
 Kostić, O. 222, 512
 Kovačević, A. 626, 628
 Kovačević, D. 241, 450
 Kovačević, S. 330

Kričak, L. 147
Krstić, A. 256, 460, 612
Kuvendzjev, S. 469

L

Laušević, P. 545
Lisica, A. 203
Lisichkov, K. 469

Lj

Ljupković, R. 535

M

Malić, N. 283
Manasijević, D. 488
Mančić, L. 2
Marinković, A. 438, 444
Marinković, B. 2
Marinković, J. 529
Marinković, N. 104, 141
Marinković, T. 605
Marinkovski, M. 469
Markeljić, K.A. 289
Marković, I. 432, 482, 488
Marković, J. 147
Marković, Mihajlo 283
Marković, Milica 512
Marković, Miljan 335, 432
Marković, Mirjana 30
Marković, S. 129, 135
Matić, B. 276
Matić, M. 115, 222
Matijašević, S. 599
Matko, U. 283
Medić, D. 506
Meseldzija, S. 88
Mihajlović, I. 247, 251
Mijić, Z. 154, 306
Milanović, P. 628
Milanović, S. 147
Milanović, T. 69
Milentijević, G. 191
Miletić, Z. 512
Milić Komić, S. 122, 129, 135
Milić, M. 276
Milić, S. 179, 185, 341, 494, 506
Milikić, J. 550
Miljković, M. 535
Miljković, V. 535, 567, 589
Miljojić, T. 396
Milosavljević, J. 167, 348, 593
Milosavljević, M. 191
Milošević, Dj. 420
Milošević, M. 444
Milovanović, M. 235
Mirković, M. 241
Mišić, G. 632, 636
Mitrović, A. Lj. 302
Mitrović, J. 312, 324
Mitrović, M. 115, 222, 512
Mitrović, S. 540, 545, 550
Mladenov, M. 524

Mladenović Nikolić, N. 69
Mladenović, S. 391
Momčilović, M. 88
Momčilović, M. Z. 75, 82,

N

Najdanović, S. 312, 318, 324
Napoletano, P. 228
Nedeljković, M. 391
Nedelkovski, V. 185, 341, 494
Negovanović, M. 147
Nenadović, S. 241
Nešić, A. 88
Ničković, S. 306
Nikolić, J. 599
Nikolić, Lj. 567, 589
Nikolić, Magdalena 584
Nikolić, Milan 241
Nikolić, Milica 47
Nikolić, V. 99
Novaković, M. 251
Nujkić, M. 500, 506, 624

O

Obrovski, B. 247
Ocololjić, M. 62, 210, 216
Ognjanović, N. 185
Opačić, M. 330

P

Papludis, A. 506
Paunović, M. 104
Pavlović, D. 115, 222, 512
Pavlović, P. 115, 222, 512
Pavlović, V.B. 241, 450
Pavlović, V.P. 241
Pejanović, G. 306
Perić, M. 241
Perović, I. 465, 540, 545, 550
Perović, V. 115, 222
Petković, S. 306
Petrić, M. 488
Petronijević, T. 109, 420, 426
Petrov, Dj. 62, 210, 216
Petrović Mihajlović, M. 173, 500
Petrović, Jasmina 391
Petrović, Jelena 261
Petrović, Jovana 203
Petrović, Maja 251
Petrović, Milica 312, 318, 324
Petrović, S. 160
Pijunović, R. 283
Popović, A. 373, 385
Popović, N. 104
Potkonjak, N. 30
Poznanović Spahić, M. 160
Požega, E. 198
Prodanović R. 267, 272
Prodanović, O. 94, 267, 272
Prokopijević, M. 40, 47, 302

R

Rabanal, M.E. 2

Radić, N. 373, 385
Radivojević, D. 318
Radmanović, S. 30
Radojević, A. 167, 348, 593, 634, 636
Radotić, K. 40, 47, 94, 272, 302
Radovanović, M. 173, 179, 341, 494, 500
Radović Vučić, M. 312, 318
Radulović, N. 115, 512
Raković, M. 104
Rančev, S. 318
Rančić, M. 191
Randelović, M. 75, 82
Rašić, G. 241
Ratknić, M. 361, 367, 555

S

Sakan, S. 160
Samolov, A. 69
Santrač, I. 330
Saulić, M. 379, 519, 572, 578
Savić, B. 456, 460, 465
Savić, V. 599
Sedlarević Zorić, A. 122, 129, 135
Sejdinović, B. 475
Sekulić, D. 115, 222
Sekulić, T. 235, 373, 385, 561
Seović, M. 540, 545
Simić, Marija 261
Simić, Marija 456, 460, 465
Simić, N. 147
Simić, S.B. 289, 295
Simonović Radosavljević, J. 272
Simonović, A. 173, 500, 638
Simonović, J. 272
Simović, I. 62, 216
Skočajić, D. 62, 210, 216
Smiljković, A. 624
Spahić, D. 160
Spasojević, D. 94, 267, 272
Spasojević, I. 330
Spasojević, M. 267
Srećković, V. 154
Stajić, D. 426
Stamenković, U. 482, 488, 626, 628
Stanić, M. 330
Stanković, Marija 638
Stanković, Mihajlo 56, 354
Stanković, Mira 40, 47, 267, 302
Stanković, N. 109, 420, 426
Stanković, Slavica 47
Stanković, Sonja 185, 341, 494, 506
Stanojković, J. 56
Stavretović, N. 203
Stepić, V. 529
Stevanović, A. 373, 379, 385, 519
Stevanović, J. 40
Stojanović, J. 599
Stojanović, N. 203
Stojić, A. 198
Stojićević, D. 379, 519, 572, 578
Stojković Piperac, M. 420

Stupar, V. 235, 373, 379, 385, 561, 572
Sujčić, I. 624
Suljagić, J. 432
Surudžić, N. 267

Š

Šekularac, G. 361, 367, 555
Šerbula, S. 167, 348, 593
Šljukić, B. 550
Štrbac, N. 335, 432
Šušić, N. 122, 129, 135

T

Tančić, P. 160
Tanikić, D. 198
Tanović, M. 330
Tasić, G. 540
Tasić, Ž. 173, 494, 500, 506
Tešić, M. 203
Tomović, J. 104
Topalović, V. 599
Trajić, V. 519
Trbić, M. 283
Trifunović, V. 179
Tubić, B. 104

U

Ugrinov, D. 584

V

Vasić Aničijević, D. 256, 456, 460, 465
Vasiljević, B. 141
Velinov, N. 312, 318, 324
Veljović Jovanović, S. 122, 129, 135
Veselinović, M. 203
Vlahović, B. 241, 450
Vranešević, M. 361, 367
Vukmirović, A. 247
Vukmirović, S. 247
Vuković, G. 241

Z

Zdolšek, N. 540, 545, 550
Zdravković, M. 335, 432
Zildžović, S. 599
Zlatković, B. 109, 426
Zorić, K. 99

Ž

Živančev, N. 251
Živanović, B. 122, 129, 135
Živković, Z. 235, 379, 519, 561, 572, 578

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