

## **Project Update: September 2022**

### **INTRODUCTION**

Thanks to the grant, which was awarded by The Rufford Foundation, we started the implementation of the project which is primarily focused on different freshwater oligotrophic habitat types on Vranica mountain and on rich algal biodiversity, especially diatoms, and on another freshwater oligotrophic habitat types distributed in the area of Dinaric Alps.

We owe a great deal of gratitude to The Rufford Foundation, which for the second time supported the project proposal and awarded a significant grant, which was primarily aimed at equipping the laboratory, and then at studious and detailed scientific research work. Without the support of The Rufford Foundation, this complex project could never have been realised.

In addition to the detailed fieldwork that was carried out in the previous period (2021-2022), and the collection of samples of cyanobacteria and algae from different freshwater oligotrophic habitat types, water samples, sampling of phytoplankton, a detailed qualitative and quantitative analysis of phytoplankton and phytobenthos was carried out in laboratory conditions.

With the help of the Üthermol method and an inverted microscope, a quantitative analysis of the phytoplankton of three glacial lakes was performed and their ecological status was assessed.

During the entire duration of the project, continuous promotion was carried out through social networks, and students also had the opportunity to become familiar with the individual phases of this project.

During the previous months, various project activities were realised, followed by the dynamic plan of our project.

It is important to note that all project activities were realised according to the dynamic plan and until now we have not encountered any problems that would prevent the implementation of the proposed project.

In the continuation of the current fifth project update, all realised activities will be described in detail with outputs and foundation for our future projects.

## OVERVIEW OF REALISED ACTIVITY

Through our Fifth project update, several realized activities were presented as follows:

<b>Activity 1.</b>	Bibliographic review of algological works of B&H (1849 – 2022)
<b>Activity 2.</b>	Promotion of our project through social media
<b>Activity 3.</b>	Education and work with students in the laboratory and field
<b>Activity 4.</b>	Establishment of international collaboration
<b>Activity 5.</b>	Additional activities

### **Activity 1.** *Bibliographic review of algological works of B&H (1849 – 2022)*

During the implementation of the 1<sup>st</sup> and currently, the 2<sup>nd</sup> Rufford Project, all scientific papers related to the research of algae in Bosnia and Herzegovina were collected. Based on the available scientific papers, the first review of the literature on algae diversity was prepared. During the past period, a significant number of original scientific papers in the field of algology have been published and included in our database, and in the next period, the second review of algological works for the territory of Bosnia and Herzegovina will be prepared. Currently, our database contains 102 original scientific papers. Papers from Scientific Symposium were not included in our database, but in the next period of time, they will be included, respectively.

The first bibliographic review of algological works is available at the following link: [https://www.researchgate.net/publication/348408719\\_Bibliography\\_of\\_phycological\\_research\\_in\\_Bosnia\\_and\\_Herzegovina\\_1849-2019](https://www.researchgate.net/publication/348408719_Bibliography_of_phycological_research_in_Bosnia_and_Herzegovina_1849-2019)

### **Activity 2.** *Promotion of our project through social media*

To raise ecological awareness about the importance of freshwater oligotrophic habitat types, during the current phases, continuous promotion of our project was carried out. For the promotion of results and current activities, we relied on social media as follows: Facebook (Cijanobakterije i alge Bosne i Hercegovine), Instagram (AlgBiH) and YouTube (Ermin Mašić). We also prepared two types of Cards (Dissemination of information about freshwater oligotrophic habitats) as follows: 1. *Did you know card* and 2. *Interesting facts about freshwater oligotrophic habitats generally*.

Photo albums and other information about current project activities are available at the following links:

Link 1: <https://sway.office.com/PqzMm8lrVF92OfAt?ref=Link>

Link 2: <https://sway.office.com/wcwYg2saLVhGqpF3?ref=Link>

Link 3: <https://sway.office.com/JtVgM6YS0TsvfKBw?ref=Link>

Link 4: <https://sway.office.com/KcY3bC8g2afOxvo7?ref=Link>

Link 5: <https://sway.office.com/iYhRQbYpp4mmE5bm?ref=Link>

Link 6: <https://sway.office.com/tp2kYcb1dUz1Zakw?ref=Link>

Link 7: <https://sway.office.com/JWYzl7mJmmHS3pD?ref=Link>

Link 8: <https://sway.office.com/zdBG4icDvzia0DMA?ref=Link>

Link 9: <https://sway.office.com/kOcTAznST3x57oTd?ref=Link>  
Link 10: <https://sway.office.com/FKBvgJeXjHJQP2tr?ref=Link>  
Link 11: <https://sway.office.com/Y8jjEmlpPp2jWXew?ref=Link>  
Link 12: <https://sway.office.com/VLGGqul9i8RmFone?ref=Link>  
Link 13: <https://sway.office.com/EwUhvESlvCCfw5H1?ref=Link>  
Link 14: <https://sway.office.com/DYGmbjOpQecoLif1?ref=Link>  
Link 15: <https://sway.office.com/JC1AhrCwREombmM?ref=Link>  
Link 16: <https://sway.office.com/LNnccPHMO4CgAeyR?ref=Link>

**INTERESTING FACTS ABOUT PHYTOPLANKTON** card are available at the following links:

Link 1: <https://sway.office.com/V3WshXc45zNrhYz7?ref=Link>  
Link 2: <https://sway.office.com/Hv3mGUOke72b05nS?ref=Link>  
Link 3: <https://sway.office.com/dqCV0onh2GfV4QnF?ref=Link>  
Link 4: <https://sway.office.com/oEF4z2Nanf0uKFC6?ref=Link>  
Link 5: <https://sway.office.com/UvhP5xJRfR3Cg74f?ref=Link>  
Link 6: <https://sway.office.com/YFQ675quQwSNkXRH?ref=Link>  
Link 7: <https://sway.office.com/XHOjLQyUGRxCRFGb?ref=Link>  
Link 8: <https://sway.office.com/l0ZujSmRLsnCiFVv?ref=Link>  
Link 9: <https://sway.office.com/jwO3MYITTDIVYhwR?ref=Link>  
Link 10: <https://sway.office.com/Dva0QBNUYLFd7lj9?ref=Link>

**DID YOU KNOW** card are available at the following links:

Link 1: <https://sway.office.com/uof0ZsfcGSqLQxxQ?ref=Link>  
Link 2: <https://sway.office.com/EMd8gTW4jjLZ3COB?ref=Link>  
Link 3: <https://sway.office.com/YESyh2CiBoC4mQdm?ref=Link>  
Link 4: <https://sway.office.com/tJPCsdLzBjJBIDGn?ref=Link>  
Link 5: <https://sway.office.com/Zmd9ZMGPDhLEA0vJ?ref=Link>  
Link 6: <https://sway.office.com/tBbGcRhW6e9DMqJS?ref=Link>  
Link 7: <https://sway.office.com/lLAVD74AeC41LDxR?ref=Link>  
Link 8: <https://sway.office.com/6Cby5Fqda0UU7ddc?ref=Link>  
Link 9: <https://sway.office.com/vvm1RmPk8mw1DHFx?ref=Link>  
Link 10: <https://sway.office.com/qKhDrWkt5qUWVivm?ref=Link>

### **Activity 3. Education and work with students in the laboratory and field**

During all phases of the project, students from the University of Sarajevo were involved. Primarily students from the Faculty of Natural Sciences and Mathematics and the Faculty of Pharmacy. Students are introduced to the main goals of the project, but also to the final outcomes. In addition to the theoretical part of the project, which was presented in detail, students had the opportunity to get acquainted with the equipment and work in the algology laboratory. In addition to the laboratory part, fieldwork was also realised. In the field, students had the opportunity to get acquainted with the equipment for measuring the basic physical and chemical parameters of water, and equipment for phytoplankton sampling. A special focus of our workshop was a qualitative and quantitative analysis of phytoplankton and phytobenthos. Eleven students from the Faculty of Science, Department of Biology are selected and trained in the field of systematics and taxonomy of algae, ecology of algae, restoration ecology and conservation ecology. Five master's students defended diploma theses, three bachelor students defended diploma thesis and

three students actively worked with me as a mentor in the laboratory and field. They contributed to the Scientific Symposium in Serbia with two works. Approximately 200 students from the University of Sarajevo are indirectly included in this project.

A list of papers which are produced during this period of time are listed in the continuation of this report:

#### **Master thesis:**

Nešust, A. & Mašić, E. (2022). *Distribucija vrsta cijanobakterija i algi duž pH i temperaturnog gradijenta u rijeci Plivi / **Distribution of cyanobacteria and algae species along the pH and temperature gradient in the Pliva River.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. pp 1-94. Mentor: Doc. dr. Ermin Mašić.

Kahriman, I. & Mašić, E. (2022). *Diverzitet algi i ekološke karakteristike Kukavičkog jezera na Kupresu / **Algae diversity and ecological characteristics of the Kukavičko Lake in Kupres.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. pp 1-75. Mentor: Doc. dr. Ermin Mašić.

Likić, N. & Mašić, E. (2021). *Diverzitet algi u kopovskim jezerima na području općine Vareš / **Algae diversity in mine pit lakes in the area of Vareš municipality.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. pp 1-92. Mentor: Doc. dr. Ermin Mašić.

Pašić, S. & Mašić, E. (2020). *Istraženost invazivnih vrsta kao direktnih pritisaka na biodiverzitet BiH / **Investigation of invasive species as direct pressures on the biodiversity of Bosnia and Herzegovina.*** Univerzitet u Sarajevu, Prirodno- matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. pp 1-75. Mentor: Doc. dr. Ermin Mašić.

Sarajlić, A. & Mašić, E. (2020). *Diverzitet cijanobakterija i algi Prokoškog jezera / **Diversity of cyanobacteria and algae of Prokoško Lake.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. pp 1-78. Mentor: Doc. dr. Ermin Mašić.

#### **Diploma thesis:**

Rizvanović, E. & Mašić, E. (2022). *Poređenje sastava algi u planinskim potocima na području planine Vranice / **Comparison of algae composition in mountain streams in the Vranica area.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. Mentor: Doc. dr. Ermin Mašić.

Rosić, Ž. & Mašić, E. (2022). *Poređenje sastava algi u planinskim izvorima na području planine Vranice / **Comparison of algae composition in mountain springs in the Vranica area.*** Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Ekologija. Mentor: Doc. dr. Ermin Mašić.

Koštrebić, S. & Mašić, E. (2022). *Diverzitet cijanobakterija i algi u biofilmu pećina na području Zaštićenog pejzaža „Bijambare“ / **Diversity of cyanobacteria and algae in***

**the biofilm of caves in the area of the Protected Landscape "Bijambare"**. Univerzitet u Sarajevu, Prirodno-matematički fakultet, Odsjek za biologiju, II Ciklus studija - Smjer Nastavnički. Mentor: Doc. dr. Ermin Mašić.

#### **Conference papers:**

Pašanbegović, A., Zildžić, A., Zimić, A., & Mašić, E. (2022). First records of freshwater epizoic cyanobacteria and algae on two turtles *Trachemis scripta* Thunberg and Schoepff, 1792 (Reptilia, Emydidae) and *Emys orbicularis* Linnaeus, 1758 (Reptilia, Emydidae) identified in selected artificial ponds from Bosnia and Herzegovina. 14<sup>th</sup> Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Kladovo, 2022, pp 21.

Markanović, N., Pašanbegović, A., Zildžić, A., & Mašić, E. (2022). Diversity and ecological properties of epiphytic algae identified from selected macroalgae and aquatic macrophytes in Bosnia and Herzegovina. 14<sup>th</sup> Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Kladovo, 2022, pp 22.

#### **Activity 4. Establishment of international collaboration**

During work on this very interesting project, several colleagues from another institution are included. This collaboration resulted in the publication of several papers with high-impact factors.

The list of papers prepared in collaboration with colleagues from other institutions is listed below in this report:

Mašić, E., Zaova, D., Barudanović, S., Ognjanova-Rumenova, N., & Levkov, Z. (2022). *Rimocostatus bugojnicus* gen. et. sp. nov. (Coscinodiscophyceae, Bacillariophyta) – a new fossil diatom genus from Gračanica, Bugojno paleolake in Bosnia and Herzegovina. *Diatom Research* (in print).

Šovran, S., & Mašić, E. (2022). Diversity of freshwater red algae (Rhodophyta) in Bosnia and Herzegovina. 14<sup>th</sup> Symposium on the Flora of Southeastern Serbia and Neighboring Regions, Kladovo, 2022, pp 20.

Smječanin, N., Bužo, D., Mašić, E., Nuhanović, M., Sulejmanović, J., Azhar, O., & Sher, F. (2022). Algae based green biocomposites for uranium removal from wastewater: Kinetic, equilibrium and thermodynamic studies. *Materials Chemistry and Physics*, 283, 125998.

Hájek, M., Jiménez-Alfaro, B., Hájek, O., Brancaloni, L., Cantonati, M., Carbognani, M., Dedić, A., Dítě, D., Gerdol, R., Hájková, P., Horsáková, V., Jansen, F., Kamberović, J., Kapfer, J., Kolari, T., Lamentowicz, M., Lazarević, P., Mašić, E., Moeslund, J. E., Pérez-Haase, A., Peterka, T., Petraglia, A., Pladevall-Izard, E., Plesková, Z., Segadelli, S., Semeniuk, Y., Singh, P., Šimová, A., Šmerdová, E., Tahvanainen, T., Tomaselli, M., Vystavna, Y., Biță-Nicolae, C., & Horsák, M. (2021). A European map of groundwater pH and calcium. *Earth Syst. Sci. Data*, 13, 1089- 1105.

### **Activity 5. Additional activities**

In addition to the planned activities, some additional ones were realised that imposed themselves and resulted from the dedicated and creative work, not only of the project leader but also of all colleagues and students, whom I would like to thank on this occasion. First of all, I would like to thank the professors for their previous knowledge and useful advice, namely: Prof. dr. Helmut Mayrhofer, Prof. dr. Zlatko Levkov, Prof. dr. Senka Barudanović, Prof. dr. Marko Sabljojević, Prof. dr. Michal Hájek, Prof. dr. Martin Magnes and Prof. dr. Jürgen Dengler. Furthermore, I sincerely thank to my colleagues and collaborators on the second Rufford project, namely: Dr. Adi Vesnić, Dr. Armin Macanović, Dr. Sabina Žero, Dr. Narcisa Smiječanin, Dr. Mubina Čutura-Mašić, Dr. Nadja Ognjanova-Rumenova, Dr. Sanja Šovran, Dr. Slađana Popović, Dr. Marija Gligora-Udović, Mr. Dušica Zaova, Mr. Danijela Mitić-Kopanja, Mr. Amela Sarajlić, Mr. Nadira Likić, Mr. Selma Pašić, Mr. Ilma Kahriman, Mr. Amila Nešust, Mr. Adnan Zimić and my students Koštrebić Sara, Ena Rizvanović, Žana Rosić, Amina Pašić, Alma Zildić i Nora Markanović.

Additional activities are reflected in the following:

1. Establishment of a collection of permanent slides within the laboratory for the systematics of algae and fungi at the faculty of science.
2. Establishment of a collection of micro- and macro- cyanobacteria and algae within the laboratory for the systematics of algae and fungi at the faculty of science.
3. Preparation of rich educational material for students (brochures, colour book of cyanobacteria and algae, models of diatoms, etc.).
4. The establishment of a digital database of cyanobacteria and algae of Bosnia and Herzegovina, which resulted from active work both during the first and second Rufford projects.
5. Thanks to The Rufford Foundation, which financed this project, a book on the diatoms of the Vranica mountain was also prepared, entitled "*Vranica Mountain - Source of diatom diversity*".
6. After synthesis of all obtained results, original scientific papers were prepared. In our papers, we indicated the presence of rare and endangered species of cyanobacteria and algae, and also highlight the state of freshwater oligotrophic habitat types in the Dinaric Alps. A bibliographic review of all published papers is also prepared and presented in this fifth project report.

### **Plans for the future**

In future, I plan to work with students at the University of Sarajevo. My research topic will be the taxonomy and ecology of cyanobacteria, algae and vascular plants. Besides fundamental, applicative research will be also done using this group of organisms. Also, I want to encourage young researchers to begin their own investigation and collecting data about the biodiversity of this very important and interesting group of organisms.

Also, I want to increase my knowledge in all aspects of restoration and conservation ecology and also applicative ecology. I continued also with the promotion of our work to the broad range of public through very popular media as follows: **iNaturalist**<sup>1</sup> and **YouTube**<sup>2</sup>. 

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More information about progress dealing with planned activities will be presented in our **final project update which is still in progress and in additional material which are also prepared.**

Progress about our project is also available on [ResearchGate](#).

On the next pages of our **Fifth project update**, we present our activities through some very interesting pictures.

#### *Acknowledgements*

I sincerely thank The Rufford Foundation for supporting my 2<sup>nd</sup> project.

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<sup>1</sup><https://www.inaturalist.org/projects/conservation-of-freshwater-oligotrophic-habitats-on-vranica-mountain?tab=about>

<sup>2</sup>[https://www.youtube.com/channel/UCSZBVEUVQG04oETRFVyGieA?view\\_as=subscriber](https://www.youtube.com/channel/UCSZBVEUVQG04oETRFVyGieA?view_as=subscriber)



























