Project Update: August 2021

During the year 2021 the project continued in April after the national government reduced measures and restrictions due to Covid-19. All research were finished as well as final reports for five main research groups: **botany, entomofauna, herpetofauna, ornitofauna and mammalia**. In total 13 researchers were conducting the field research and species determination during the implementation of the Pelobates project: Smiljan Tomić Msc and Nedim Jukić Msc (mycology), Sara Potkonjak Msc (botany), Dejan Kulijer, PhD Toni Koren, Mihailo Vujić, Jelena Šeat Msc, Slobodan Ivković Msc (entomofauna), Ana Ćurić Msc, Emina Šunje Msc, Adnana Zimić Msc (herpetofauna), Jovica Sjeničić (ornitofauna) and Dejan Radošević (mammalia) together with 14 students from Universities of Banja Luka and Sarajevo.

Mycology:
Fungi research was done during the camp in June 2020. Since the area does not contain characteristic habitat conditions for fungi growth, with poor forest diversity and meadow habitats, low humidity and high summer temperatures, the additional research were not priority at this part of the project. During the three-day camp research **15 species** from three phylum were found in the woodland area, near pond and near channels. Interesting species found were *Ganoderma lucidum* as appreciate mushroom used as immune system regulator, promising anti-cancer agent and stress reducer, and *Helvella elastica,* one of the interesting Ascomycota fungi and species that can perform fibrinolysis (Fig. 1). The small number of found species were due to summer period, high temperatures and poor humidity.

Botany:
The final report stands out that no literature data was found for the Čardak region. The total number of **15 invasive alien species** was found in the area of research, where we need to stress out surprisingly small number of individual plants: the annual fleabane (*Erigeron annuus*), a North American plant species, and black locust (*Robinia pseudoacacia*), also a North American tree species. The most important plant species determined at the Čardak region are water foxtail - *Alopecurus geniculatus*, butcher's-broom - *Ruscus aculeatus* and yellow flag - *Iris pseudacorus* (Fig. 2).

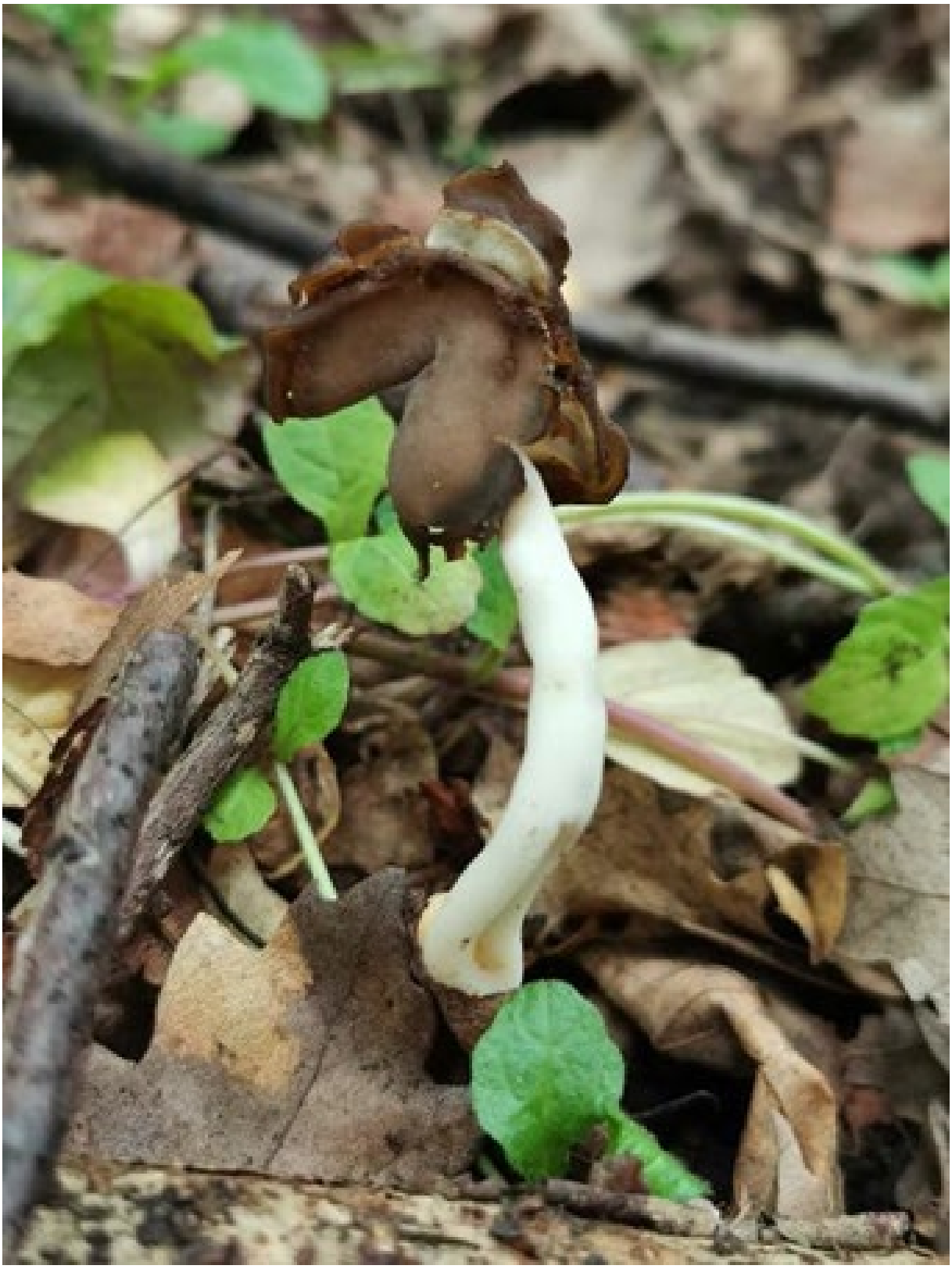

Figure 1. The elastic saddle (Helvella elastic)

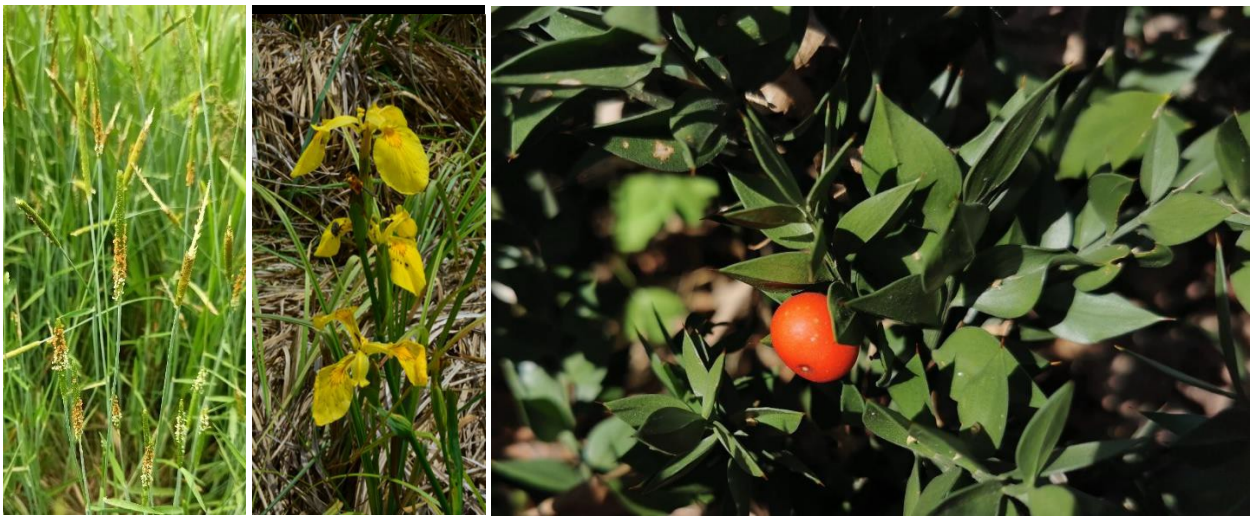

Figure 2. Important plant species at the research site of Čardak a) Water foxtail - *Alopecurus geniculatus,* b) butcher's-broom - *Ruscus aculeatus,* c) Yellow flag - *Iris pseudacorus.*

Total of found plant species at the researched region is 168. Also, ten different habitat types were determined:

- Surface standing water (temporary lakes, ponds and ponds),
- Rush group - Typhetum latifoliae Soó 1927,
- Medium high water coast communities - Oenantho-Rorippetum amphibiae Lohmayer 1950,
- Reed's habitats,
- Meadows in the steppe zone dominated by *Arrhenatherum elatius*,
- Anthropogenic habitats rich in herbaceous species,
- Shrubs and shrubby habitats,
- Forests and forest habitats,
- Cultivated agricultural, horticultural or domestic habitats,
- Structures, industrial and other artificial habitats.

Entomofauna:
In terms of insect diversity, the Posavina region is among the low explored in Bosnia and Herzegovina. Prior to 2013, Posavina dragonflies were almost completely unknown, and the only more specific data on the diversity of these insects in the area were data from the entomological collection of the National Museum in Sarajevo, which referred to the Derventa area. When it comes to other groups of insects, the state of research is similar, and the data mainly existed for certain locations that in the past were the subject of certain research projects by experts from the National Museum of BiH and the Biological Institute of the University of Sarajevo.

During 2020, field research of insects was conducted, which primarily included dragonflies and butterflies. This research registered a total of **16 species of dragonflies**, **82 species of butterflies**, as well as **58 species of beetles and other insects**. Three registered species are listed in Annexes II and / or IV of the European Union Habitats Directive, and six species are protected in the Republic of Srpska.

Many species of dragonflies today face threats to survival. Research conducted in Europe in recent decades shows a steady decline in the number of dragonfly species as well as a reduction in their range. According to the Red List of European Dragonflies, 15 % of species in Europe are endangered (EN), while an additional 11 % are almost endangered (NE). Almost a quarter of the species (24 %) of dragonflies in Europe have seen a decline in population numbers. The most significant reasons for the decrease in the number and disappearance of certain populations of dragonflies are the destruction and degradation of their habitats. The same thing goes to Coleoptera and Lepidoptera species, including urbanization, infrastructure development, forest degradation and removing of an old trees and tourism development.

Of the recorded butterfly species, significant finds are species of wetland habitats such as *Idaea muricata, Eucarta amethystina, Eucarta virgo* and *Mythimna turca*. These species are associated with wetland habitats and floodplain forests and are good indicators of the presence of preserved habitats of an area. From the recorded species of diurnal butterflies, it is necessary to single out the findings of the qualification species of the Natura 2000 Ecological Network: *Lycaena dispar* and *Euphydryas maturna* (Fig. 3).

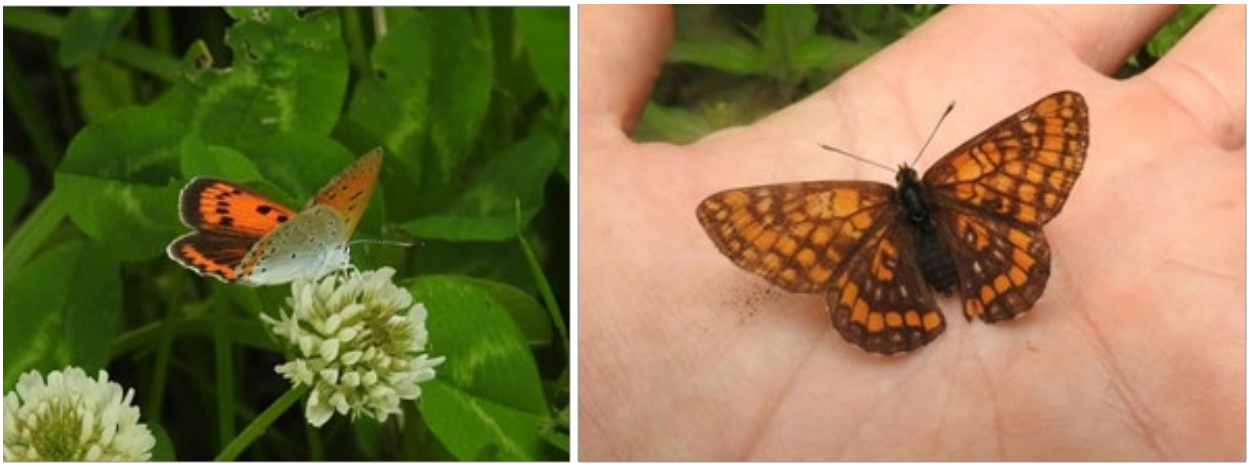

Figure 3. Identified butterfly species of international conservation importance, a) *Lycaena dispar*, b) *Euphydryas maturna*

During the field research in the Čardak area, one species listed in Annex II of the EU Habitats Directive was registered, the stag beetle - *Lucanus cervus*, and near this area another species, the great capricorn beetle - *Cerambyx cerdo*. When it comes to aquatic beetles, the species *Graphoderus bilineatus* has been registered in the wider region, however, in the area of Čardak there are currently no conditions for the survival of this species due to great eutrophication of the water habitats.

Regarding other insects, four groups (Orthoptera, Diptera, Coleoptera, Hemiptera) with 58 species in total were determined. Among the recorded species, there are several alien invasive insect species, such as *Harmonia axyridis*, *Halyomorpha halys*, *Nezara viridula* and *Corythucha arcuata*, whose abundance in the researched area is significant (Fig. 4).

Figure 4. Invasive species of insects in the area of Čardak: a) *Harmonia axyridis* (feeds on moths), b) *Halyomorpha halys* and c) *Corythucha arcuata*.

Herpetofauna:
The focus group of the Pelobates project are amphibians and reptilians, and so far, **the total of confirmed species at the Čardak area is 19**, which represents one third of all herpetofauna species in Bosnia and Herzegovina.

Our focus site - the Čardak locality, was mainly important for the biggest population of European common spadefoot toads in Bosnia and Herzegovina and rare wetland habitats that are in need of strict protection and revitalisation. According to the IUCN Red List of Threatened species, more than 37 400 species are threatened with extinction from which 41 % includes amphibian species. Aware of harsh anthropogenic pressure, climate change and high temperatures in last couple of years, we witness decreasing and disappearing of many local populations, mainly amphibians. At the site, most endangered reptilian species is European pond terrapin (*Emys orbicularis*), Natura2000 species and NT by IUCN Red List.

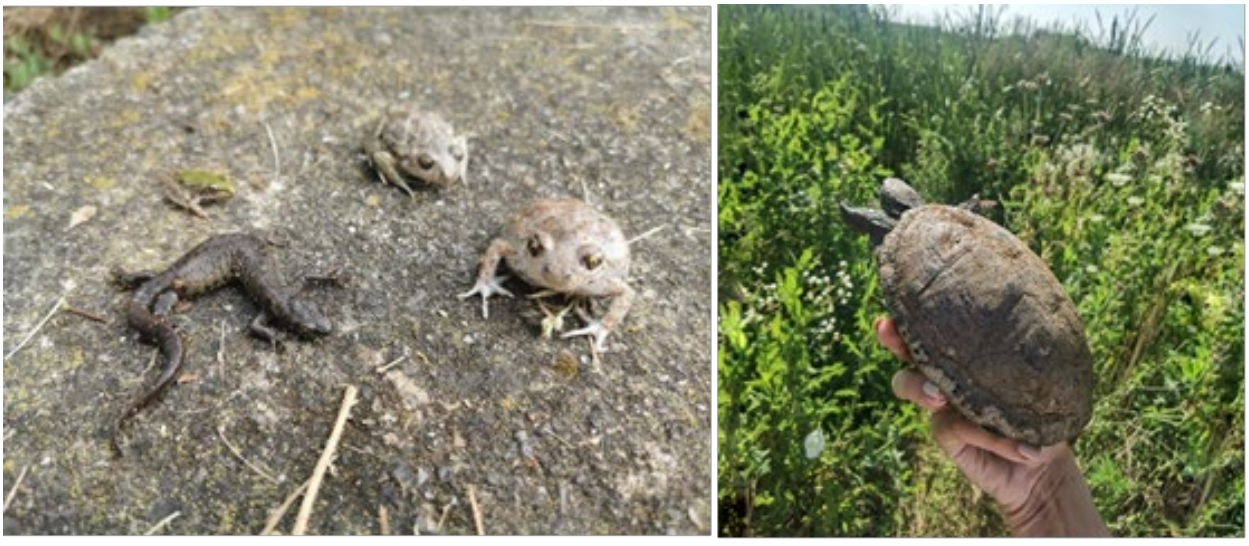

Figure 5. a) Edible frog (*Pelophylax kl. esculentus*), Danube crested newt (*Triturus dobrogicus*) and two individuals (smaller male, bigger female) of European common spadefoot toad (*Pelobates fuscus*) found together stuck in local manhole, b) European pond terrapin (*Emys orbicularis*).

Ornitofauna:
By collecting historical literature data and contemporary field data, we came to the number of **99 recorded bird species** on about 150 ha of the investigated area.

Species that have been recorded only in the past, according to known literature, *Milvus migrans*, *Aquila pomarina, Ardeola ralloides, Gallinago media, Locustella luscinoides*, etc. are mainly related to typical lowland wetlands. Some of them such as *Vanellus* or *Nycticorax* can still be seen today in the rainy periods of the year when the water level in the ponds are high (Fig. 6). Compared to the previous period and the data so far, it is evident that in the last few years no species that directly depend on water have been recorded (grebes, herons and storks, some species of ducks, snipes). Species that are currently appearing in smaller numbers testify to the potential of this bird habitat and the geological (and ecological) past of these terrains: significant more water, more diverse and lush vegetation, as well as certainly richer food sources.

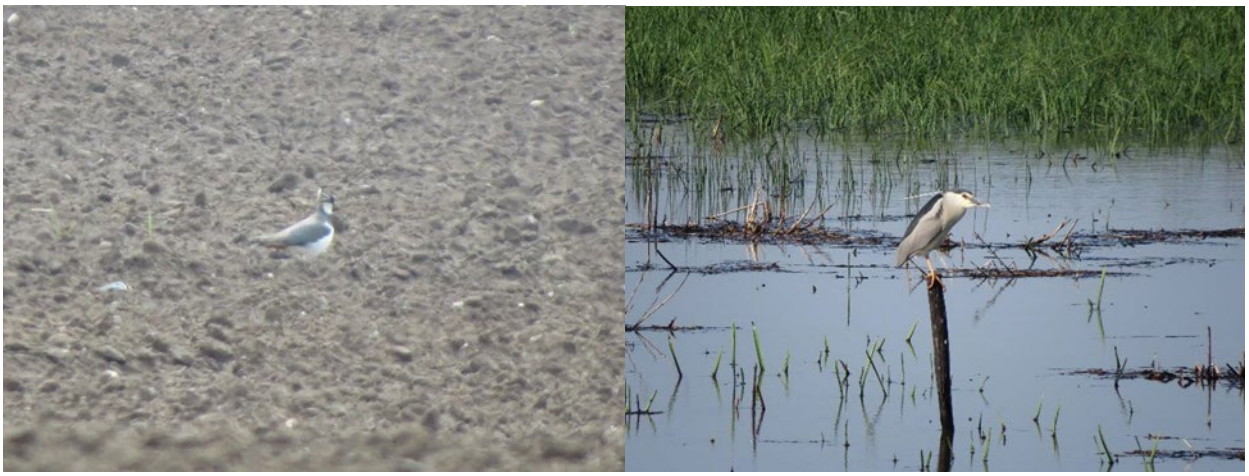

Figure 6. Typical wetland bird species: a) The northern lapwing (*Vanellus vanellus*), b) black-crowned night heron (*Nyctocorax nyctocorax*)

Characteristic bird species found at the Čardak locality belongs to families Phasianidae, Anatidae, Podicipedidae, Rallidae, Ciconidae, Ardeidae, Accipitridae, Falconidae and various families from order Charadrifomes and Passeriformes.

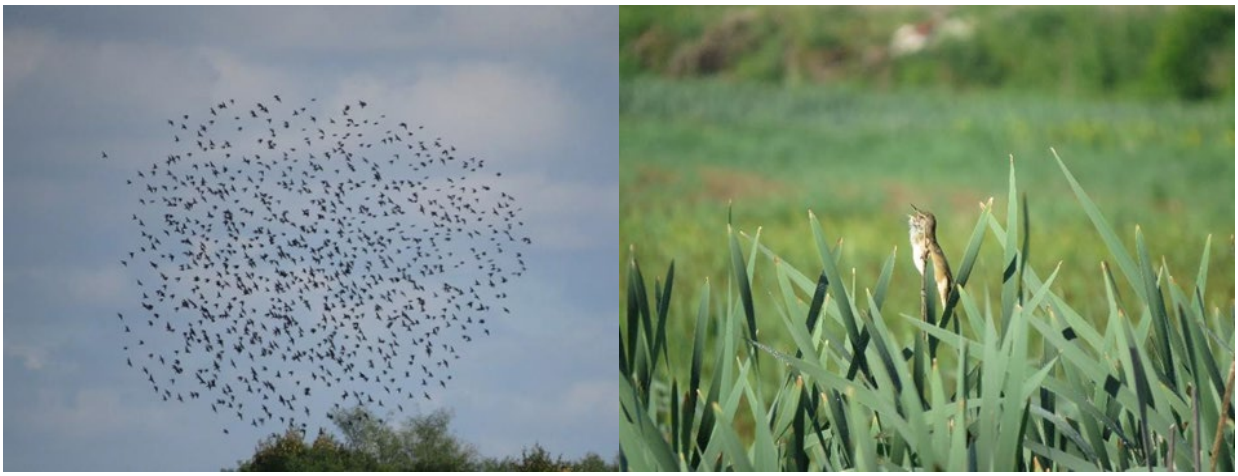

Figure 7. a) A great flock of common starling (*Sturnus vulgaris*), b) the marsh warbler (*Acrocephalus palustris*)

The final number of species cannot be commented on, because the bird fauna is not even close to exhaustion. Species diversity depends on yearly weather and hydrology conditions, fragmentation and degradation of habitats, which are unfortunately constant and changeable during each year.

Terifauna:
Regarding the research of small mammals, not many data is available in the literature for Čardak area. Observing even wider area along the Sava River which belongs to the continental biogeographical region of Bosnia and Herzegovina (Brod, Bardača, Gromiželj) there are 13 species of small mammals registered: *Ondatra zibethicus, Arvicola terrestris, Erinaceus concolor, Crocidura leucodon, Talpa europaea, Sciurus vulgaris, Microtus arvalis, Microtus agrestis, Myodes glareolus, Apodemus agrarius, Apodemus sylvaticus, Apodemus flavicollis, Mus musculus*).

Research in the area of Čardak included small mammals from the orders Rodentia - rodents, Eulipotyphla - insectivores, Chiroptera - bats, Lagomorpha - rabbits, Carnivora - carnivores and Artiodactyla - ungulates. Three species of small mammals were confirmed by the field research, two new species found, and six big mammal species confirmed. The presence of **11 species** were registered in the field research in the year 2020. One of the interesting species found is the Eurasian harvest mouse *Micromys minutus,* the smallest European rodent whose adult individuals' weight approx. 4 grams (Fig. 8). Species that are suspected to be find in the future reserches are *Neomys anomalus, Crocidura suaveolens, Microtus agrestis* and *Mus spicilegus.*

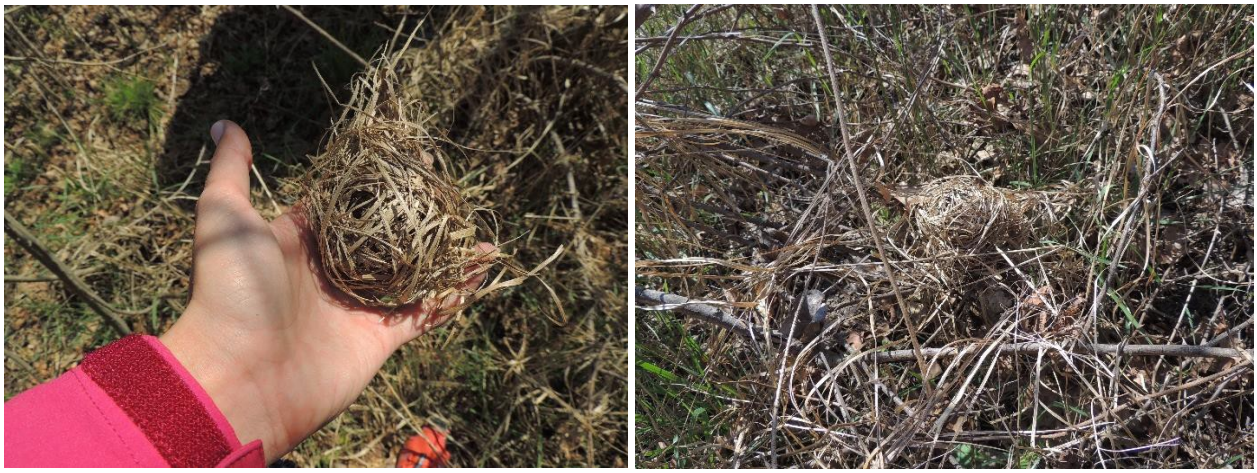

Figure 8. Eurasian harvest mouse (*Micromys minutus*) nest

Recognised habitat types according to Habitat directive (Annex I habitats for Natura 2000)

3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

3270 Rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation

6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)

9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli

91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)

91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (Ulmenion minoris)

Habitat restoration

After all planned flora and fauna research, gathering all physical and biological data and recommendations for the pond restoration, with many delays caused by pandemic, the final preparation and habitat restoration was done in June 2021. Since the temporary pond (restoration area) is under the water during spring, and also the soil is humid in the late spring, early summer, autumn and warm winter periods, we recognized that the best period for the restoration will be the middle of the summer. The land is then dry and there is a big chance for all fauna to be saved if dug up. Animals are in their summer dormancy period but still active during feeding period in early mornings or in the evening.

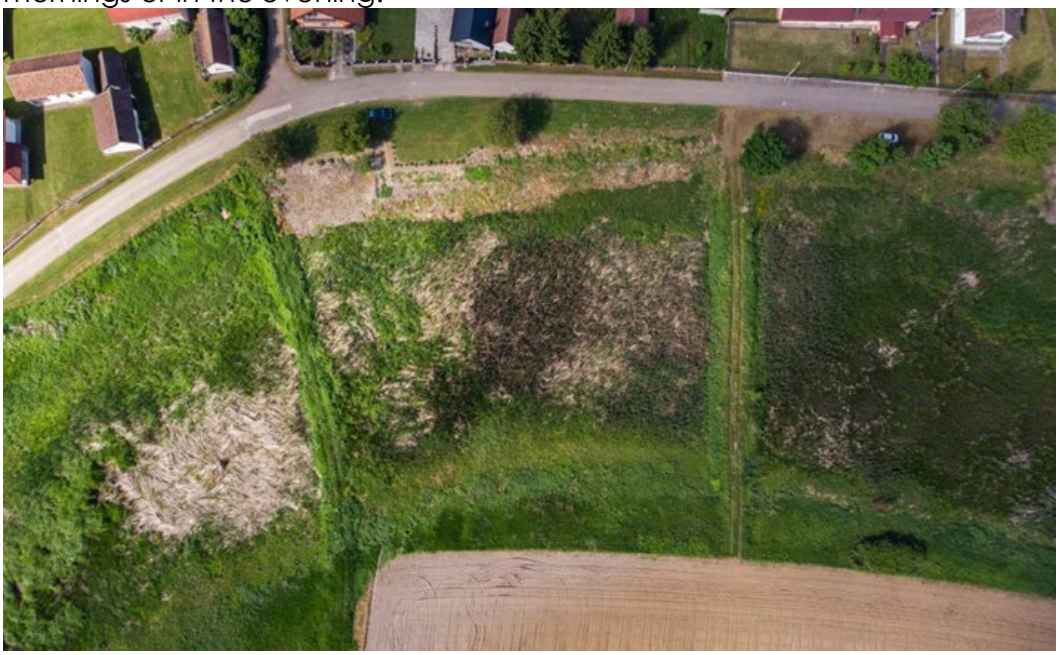

Figure 9. Three-hectare plot (pilot pond)

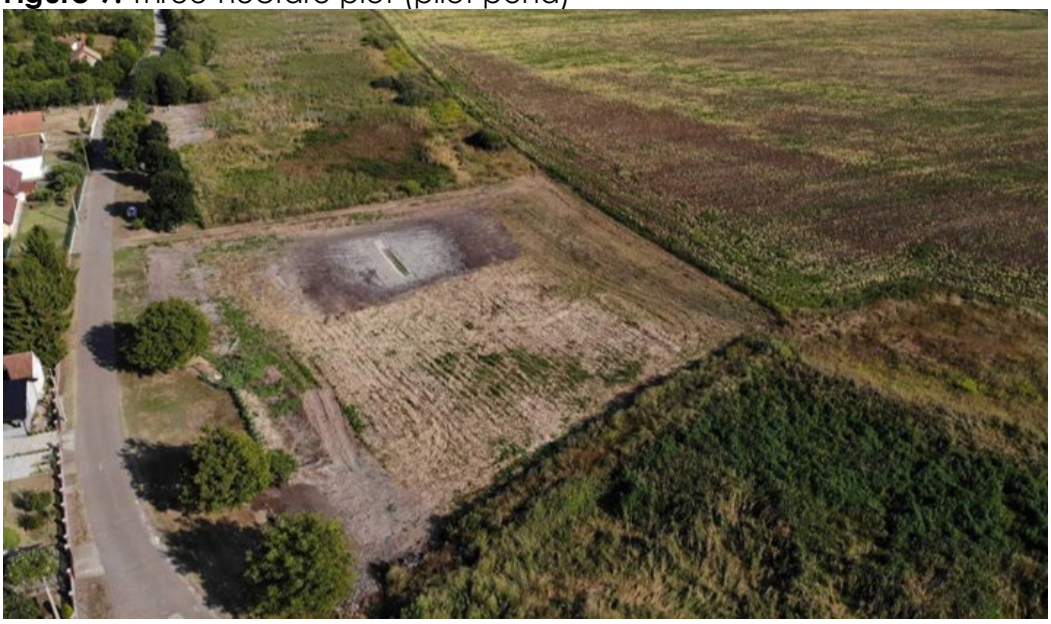

Figure 10. Restoration process of 1.5-hecate pond in 3 ha mulched pilot plot

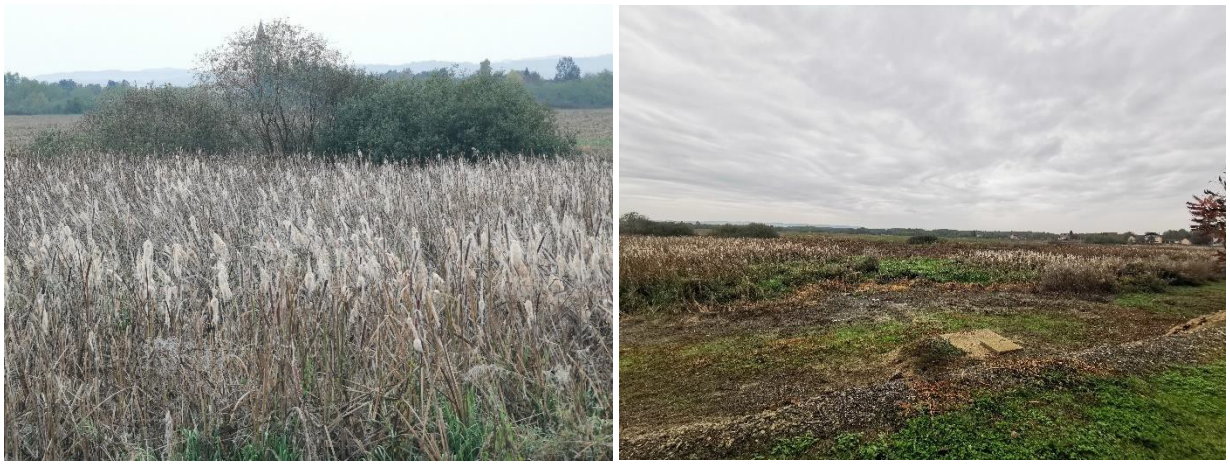

Figure 11. Restoration plot overgrown in *Typha latifolia*

A 3-hectare restoration plot (pilot pond) has been determined (Fig. 9) after gathering all necessary data, together with all formal and legal documentation. The constructer was given all necessary instructions for the depth and shape of the pond. Firstly, all 3 hectares of the plot has been mulched (Fig. 12), since the *Typha latifolia* (Fig. 11) occupied the whole pilot pond in 100 % density. After mulching, the procedure of restoration included digging the 1.5-hectare of pond with slight slope of terrain and depth difference from the edge to the center of about 2 – 2.5 meters (radius of 250 m) (Fig. 10, 13, 14). The central part of the pond was dug deeper to the clay soil layer, to ensure water presence as long as possible and to unable the *Typha* rhizome to spread (no adequate soil and deep water will unable rhizome spreading) (Fig. 10, 14). The upper humus soil was used for local agricultural land.

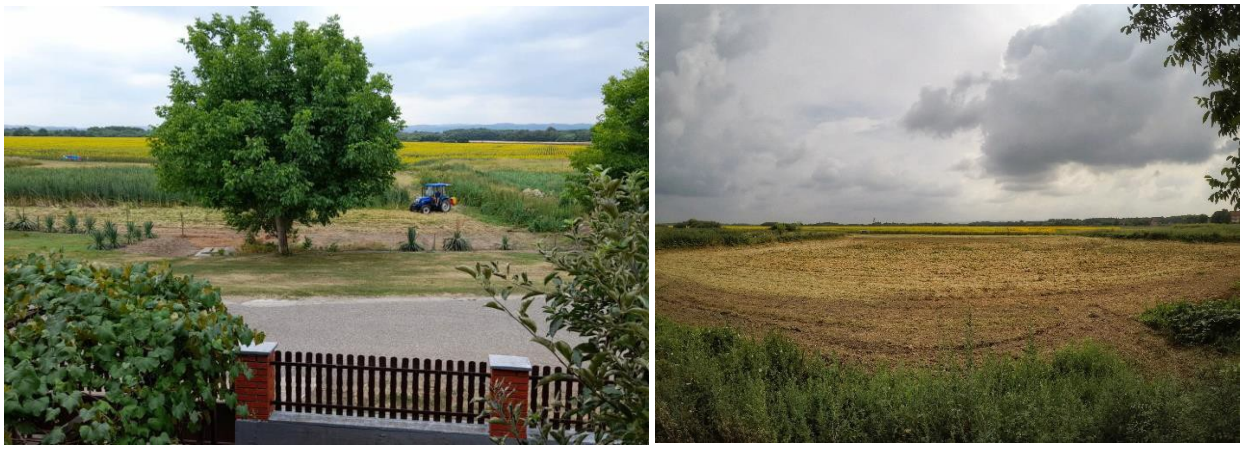

Figure 12. Mulching the pilot plot

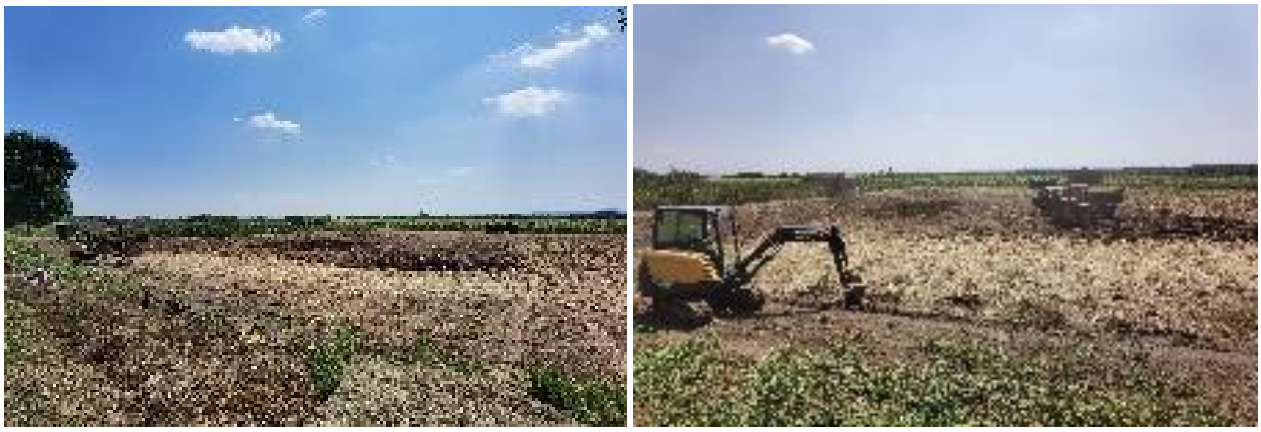

Figure 13. Restoration in process

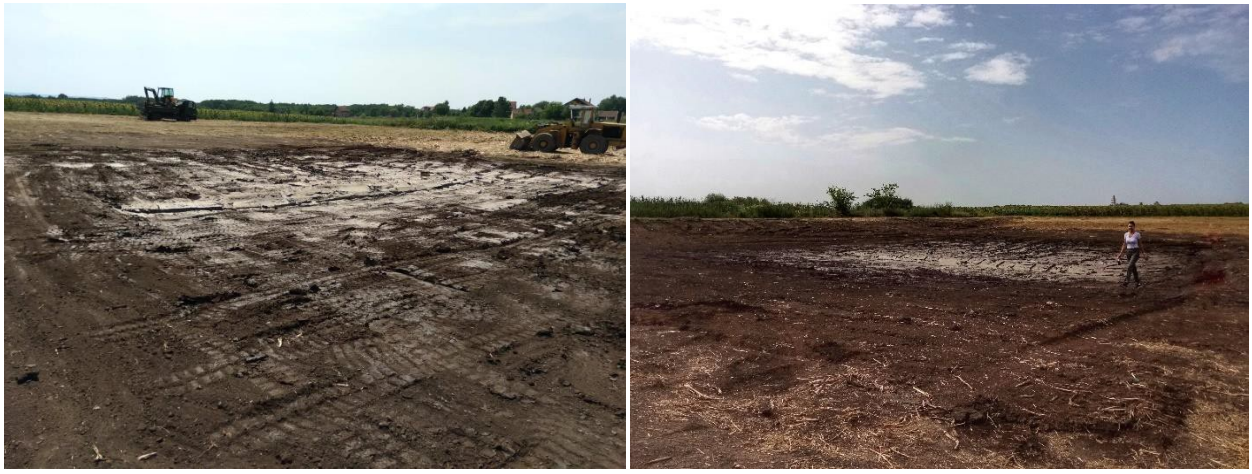

Figure 14. Finished restoration

One vernal pond has been dug in the woods, but wild boars used it as their mud pool (Fig. 15). This pond was predicted for Salamandridae and Ranidae amphibian species, with the focus species *Triturus dobrogicus* (IUCN – NT, Natura2000 species), as well as for dragonflies preferring sheltered freshwater habitats.

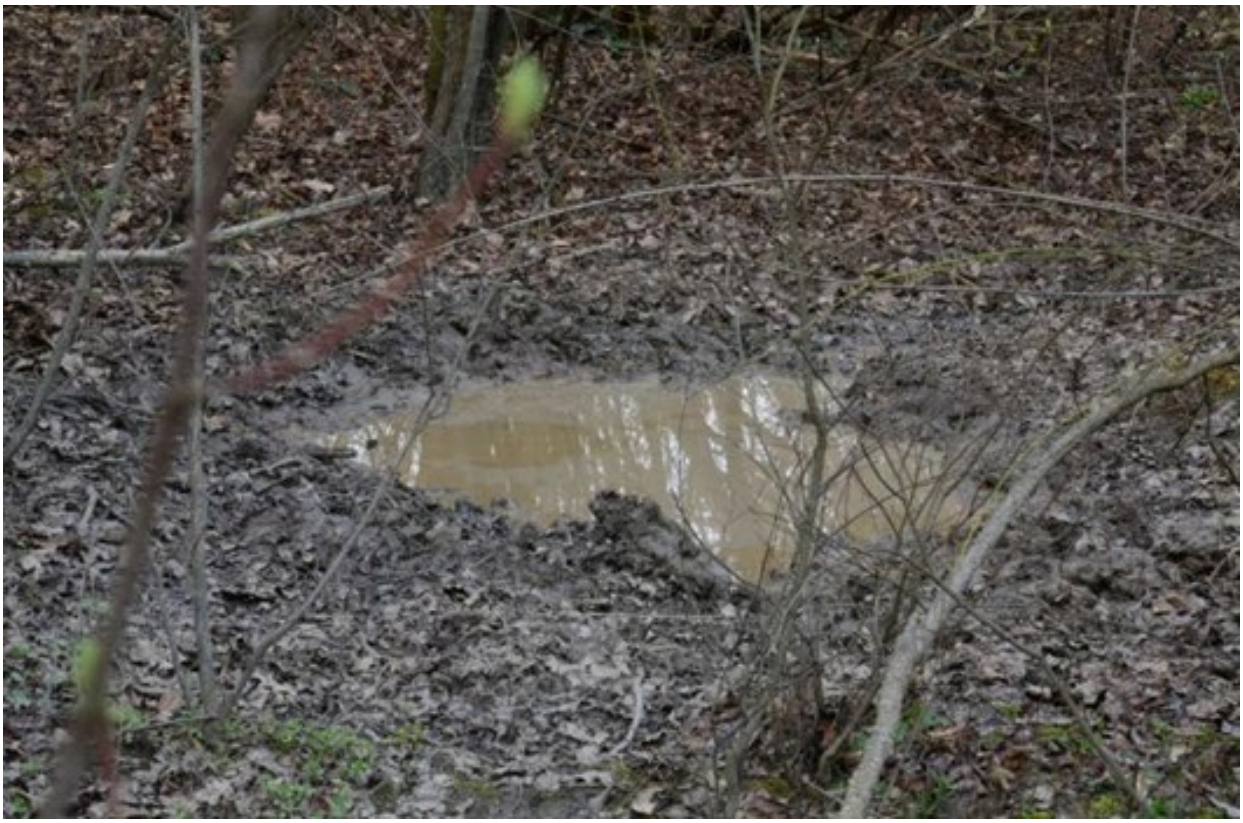

Figure 15. Vernal pond used by wild boars

The process of restoration took 5 days in total. The restoration plot is prepared for the next spring season and after the pond is formed is early spring, the data loggers will be installed for future monitoring. After the pond restoration, the constant monitoring needs to be done each season. We expect the first phase of habitat recovery and establishment in spring 2022.

Conclusion

The area of Posavina, Bosnia and Herzegovina, is under a great anthropological influence and a large number of temporary and permanent water bodies were destroyed and thus the habitat of numerous plants, insects, amphibians, reptiles, birds, mammals and all other fauna species which are permanently or periodically attached to them.

In the lowland area of Posavina there are three areas which are protected: The Una River as a Nature Park, the Tišina Pond as a Protected Habitat and the Gromiželj Wetland as a Protected Habitat. Unfortunately, many other areas and water habitats, such as floodplain forests, floodplain meadows, old tributaries/oxbows, ponds, have been drained and without heavy rainfall such habitats are without water, and they are losing their main purpose. As a result, many animal species have lost their habitats used for feeding, resting during migrations, and reproduction, all of which affect population decline and extinction.

Our main goal of the project was to go through all needed biological and ecological

research, and gather all necessary data through research and literature, physical data of water, soil and habitat in general, legal frames and procedures, analyze it and provide the best solution for restoring this particular freshwater habitat in Čardak.

This was the first step of *in situ* conservation of rare and endangered freshwater habitat and its species, whose existence depends on it. In the next period of active conservation there is a need for constant monitoring, maintenance of the restored pond, and further steps for Protected area proclamation. We made a great connection with locals, representatives of local municipality, students and researchers who will cooperate in further steps of preparing the needed data for the final study, governmental bodies in charge for legal procedure of Protected area proclamation, constructors who did an excellent and neat restoration of freshwater habitat.