

Detailed Final Report for Project:

**Turtles in Serbia – population status, conservation and distribution of
the understudied European Pond Turtle and Hermann’s tortoise**

by Ana Golubović



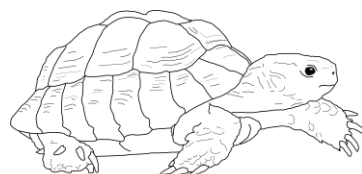
April 2017 to September 2018

Financed by

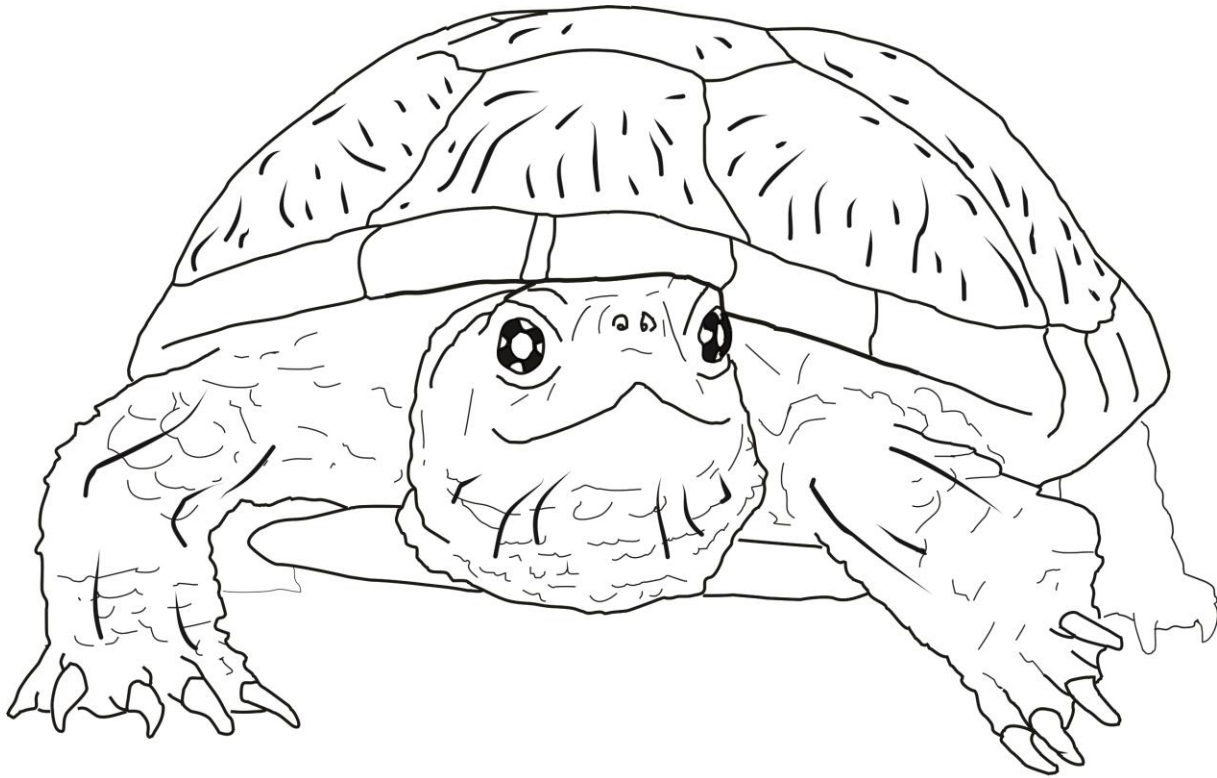


Contents

European Pond Turtle (<i>Emys orbicularis</i>) in Serbia.....	3
Distribution of European Pond Turtle in Serbia	5
Population studies on European Pond Turtles	6
Field work.....	9
Threatening factors.....	10
Research team	13
Hermann's tortoises (<i>Testudo hermanni</i>) in Serbia	15
Distribution of Hermann's tortoises in Serbia	16
Population studies on Hermann's Tortoises	17
Field work.....	21
Development of Biologer	22
Popularization of the Biologer	23
Growth of Biologer platform.....	24



European Pond Turtle (*Emys orbicularis*) in Serbia



European Pond Turtle is an understudied species in Serbia. As a result of limited data for the species at the national level, it was officially assigned Data Deficient (Krizmanić, Džukić 2015 in Red Book of Fauna of Serbia II – Reptiles: 137-143). This situation urged extensive research efforts, which were among primary goals of [my second](#) and [third \(booster\)](#) Rufford Small projects.

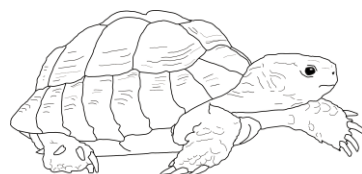
European Pond Turtles spend most of their active time in, or close to, water body. They prefer standing or slow moving fresh waters. Due to extensive agriculture in



lowlands in Serbia, most of natural standing waters, as ponds, marshes and oxbows, are eradicated. With loss of their natural habitats, turtles are adapting to life in anthropogenic habitats, such as in canals of irrigation systems in Vojvodina Province, and in deserted, overgrown gravel pits, which displaced natural oxbows along Velika Morava, Zapadna and Južna Morava Rivers.

The switch from natural to anthropogenic habitats, with different dynamics and fluctuations, probably affected populations of European Pond Turtles. The extent of these effects can only be hypothesized, since previous distribution and state of populations is unknown. Irrigation canal system probably connected many previously isolated populations, all across Vojvodina, as well as across rest of the Pannonian Plain. These canals might offer corridors for free migrations, which might result in shaping large metapopulation across this region.

Additionally the maintenance of the irrigation canal network, such as taking out of sludge and cutting the surrounding vegetation, is highly disturbing for inhabiting wildlife, including *Emys orbicularis* populations.



Distribution of European Pond Turtle in Serbia

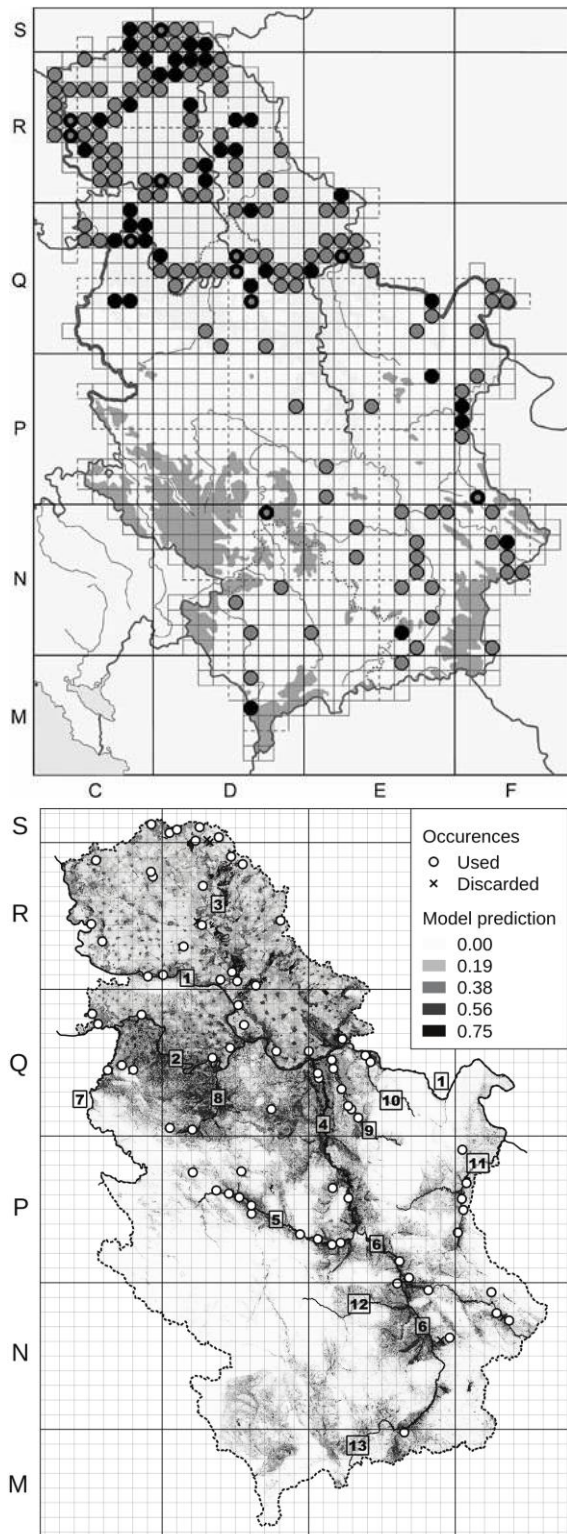


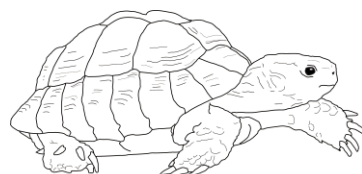
Figure 1. The maps comparatively show distributional data of European Pond Turtle in Serbia, with data available in 2015 (upper left, from Krizmanić et al. 2015), modelled prediction of distribution (down left, from Golubović et al. 2017) and recent observations gathered during my Rufford projects (on right, from [Biologer.org](https://www.biologer.org/), 2018).



Maps represented in the Figure 1. give an overview of previous knowledge on distribution of *Emys orbicularis* in Serbia. Map on the upper left includes previously published (grey circles), confirmed (black circles with grey dot) and novel findings (black circles), which were available until 2015 (published by Krizmanić et al. 2015, Arch. Biol. Sci. 67(3), 1043-1053). This data set was further used for assessment (Data Deficient) in Red Book of Fauna of Serbia II – Reptiles. Map on the right includes only recent observations with precise coordinates (map is available and regularly updated on [Biologer site](#)). The novel findings are in accordance with modeled distribution given in the lower left map (published in Golubović et al. 2017 Acta Zool. Bulg., Suppl. 10, 49-56). We are hoping that remaining gaps in distribution will be covered with wide usage of Biologer. The results of this part of project are already enabling reassessment of the species at national level, based on extent of occurrence and area of occupancy (IUCN Criterion B).

Population studies on European Pond Turtles

Population studies on European Pond Turtles are not common in Serbia. The longest one started in 2011, at Ludaš Lake, Northern Serbia. For other two populations, we could say we have just scratched the surface of population level research, lasting only for four years. Being long-lived, slow maturing reptiles, population studies of European Pond Turtles should last for decades to provide answers to crucial population ecology and life-history questions.



Site choice of the populations included in the Capture-Mark-Recapture studies (CMR), offers possibility to capture geographic variation, as well as habitat related differences among populations (Figure 2).

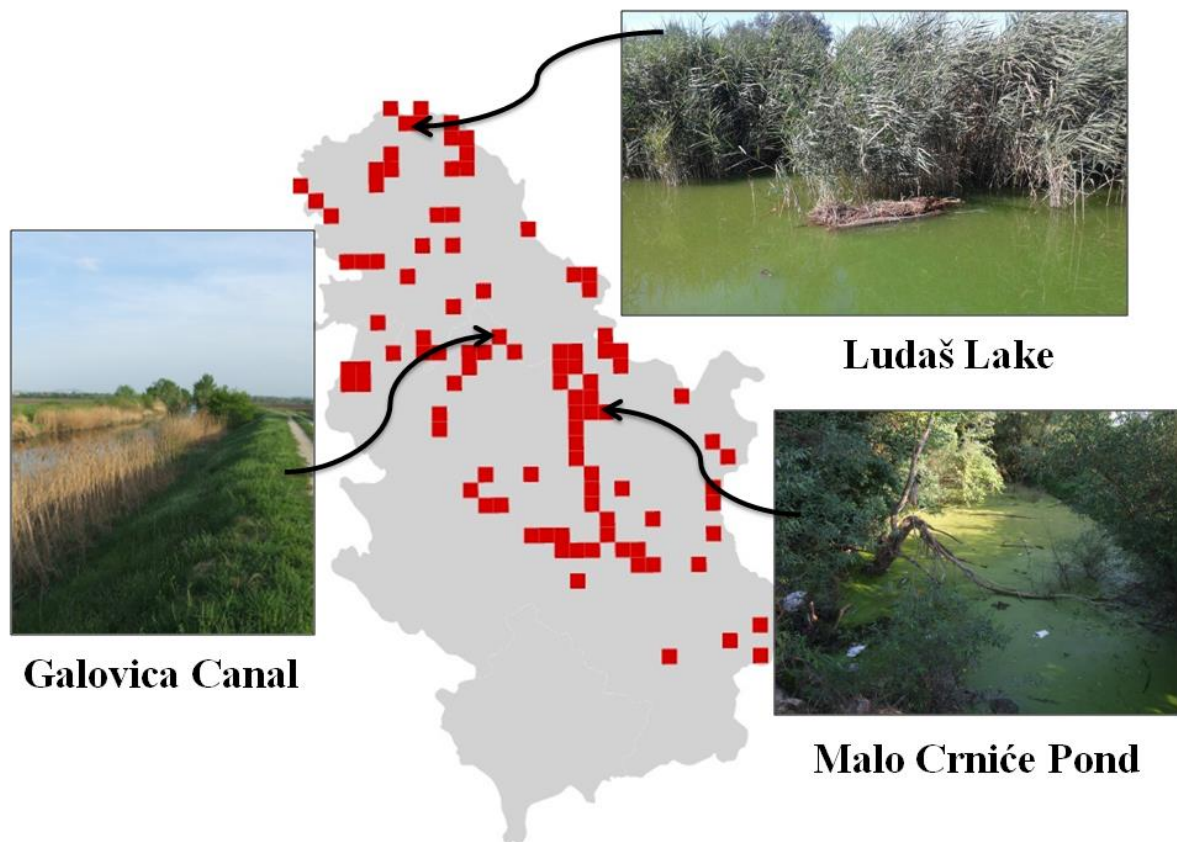


Figure 2. Map of Serbia with indicated locations and photographs of habitats where CMR studies on *Emys orbicularis* are conducted.

Ludaš Lake is a locality where the population studies on European Pond Turtles lasts the longest in Serbia, since 2011. Lake is connected with several canals, which are also suitable habitats for European Pond Turtles. The study is conducted on ~600 m long



area along water side of the reed belt. Our study area surely represents only a small part of the overall population at the Lake, nonetheless, recapture rate is showing that animals are partially sedentary, enabling us to gather good quality population data (Table 1).

Population at Galovica Canal is highly interesting because it shares habitat with population of Red-Eared Sliders (*Trachemys scripta*). Nonetheless, more field effort is necessary in order to obtain good quality data from this locality. Interestingly, the Red-Sliders do not enter baited funnel traps like European Pond Turtles do. Scarcity of the obtained data is also obvious from low recapture rate and male biased adult sex ratio (Table 1), which could be a result of seasonal differences between sexes in behaviour and habitat use in spring season, when CMR was performed. Although we haven't caught and marked any juveniles, several of them were observed basking.

At Malo Crniće Pond, old overgrown oxbow of Mlava River, we reached large recapture rate at relatively short research period (since 2015). Habitat is surrounded by agricultural land, mostly corn fields, and ~ 150 m apart from Mlava River, which offers less favourable habitat. So far gathered data indicate that population might be small.

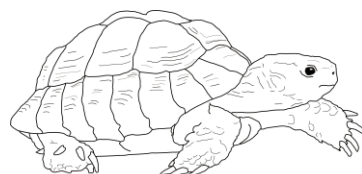


Table 1. Basic population data gathered for the three populations of *Emys orbicularis* in Serbia, and number of gathered tissue samples per locality.

	Ludaš Lake	Galovica Canal	Malo Crniće Pond
# of marked individuals	212	31	43
Recapture rate (%)	44.4	8.8	38.6
% of juveniles	2.8	0	4.6
Adult sex ratio	1.6 F : 1 M	1 F : 5.2 M	1 F : 1 M
Tissue samples	18	21	19

Sex ratio of populations of European Pond Turtles is close to equal, except of Galovica population which is characterised by small and probably biased sample. Low number of caught juvenile turtles indicates that funnel traps might be selective regarding size of turtles. Also, it might indicate differences in habitat use of juveniles comparing to adult European Pond Turtles.

Field work

Turtles were captured in funnel traps with baits. Lured turtles were marked and measured. The passive role of researchers in this kind of field work left us with less turtles than we hoped for. Nonetheless, the ongoing studies are slowly piling up the crucial data for population estimates on this Data Deficient, strictly protected species.



Threatening factors

During season 2018 we noticed drop of habitat quality at two of three habitats we are exploring. At Ludaš Lake the water level was considerably higher comparing to previous years, which resulted in submerging of natural basking places. Turtles which did not find way to get out of water and bask for long enough, had their skin and/or shell overgrown by bacteria and fungi (Figure 3). It was quite common this year, being found in 57% of all captured turtles! This phenomenon was not noticed in previous years.



Figure 3. Female European Pond Turtle with infected skin and shell.

This urged for action, and with support of the Public Enterprise Palić Ludaš we have made and set five artificial basking places (Figure 4). The basking places were left to be controlled by rangers of the Public Enterprise Palić Ludaš, and in case of good results, they will make and set 20 more artificial basking places.

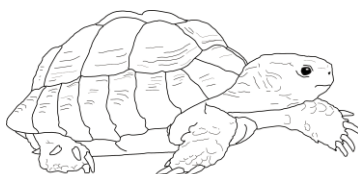




Figure 4. Artificial basking places set at Ludaš Lake.

Our field work on Ludaš Lake is organised at the same time as ecological-educational camp, which involves school children from Serbia. We seized opportunity to present our work to the kids, and involve them in some aspects of our work (Figure 5). Additionally the camp attracts attention of local media, and we managed to give interview both in [2017](#) and [2018](#) (available on link).



Figure 5. Popularization and education related activities at Ludaš Lake.



At another locality, Malo Crniće Pond, which is an old overgrown oxbow of Mlava River, we had another unpleasant surprise. An illegal dumping place abut habitat is thriving, expanding thus decreasing area of the pond (Figure 6). Unfortunately, this is very common practice across Serbia. It is clear that many municipalities are craving for better garbage disposal management. I will contact the municipal stakeholders from Malo Crniće and urge them to take actions for stopping devastation of the habitat of European Pond Turtle.



Figure 6. Bad practice of garbage disposal near water bodies: on the left Malo Crniće Pond, on the right Galovica Canal.

Although in much smaller degree, the garbage disposal is also affecting habitat at Galovica Canal. This locality is also characterised by the presence of Red-Eared Sliders, which share the habitat with European Pond Turtles (Figure 7).

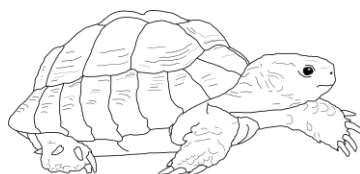




Figure 7. Group basking of 11 Red-Eared Sliders and one European Pond Turtles
(on the right-side branch) at Galovica Canal.

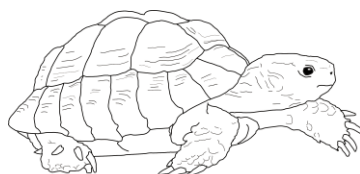
Research team

Although European Pond Turtles have long been neglected by herpetologists in Serbia, now we have a growing team of young biologists and ecologists which are trained to continue population studies on this strictly protected species (Figure 8). Furthermore, two of the students which were engaged in the population studies, will hopefully continue with the work on the *Emys orbicularis* populations, at least in season 2019 in order to gain their master degrees.

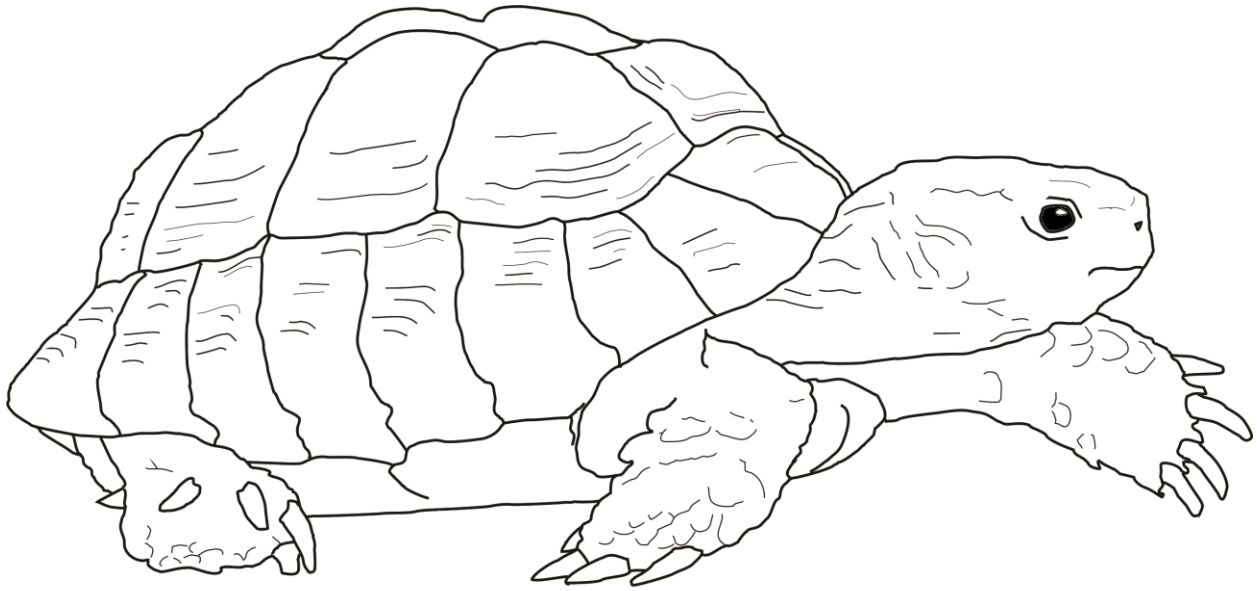




Figure 8. Fieldwork moments with students.



Hermann's tortoises (*Testudo hermanni*) in Serbia



[My first Rufford project](#) covered field season in year 2013. It was largely orientated towards exploration of distribution and collection of blood samples of Hermann's tortoises. The gathered distribution data, on Hermann's tortoise as well as of other reptile species we came across, were included in data used for preparation of Red Book of Reptiles (published in 2015). With my third project, distribution of Hermann's tortoise was additionally explored.

Strong anthropogenic pressure on these tortoises across Balkan Peninsula is related to illegal collecting of individuals from natural populations, along with habitat destruction. Collected animals are translocated either in small numbers, e.g. brought from summer vacation as pet, or in large numbers for illegal international trade. This pressure lasts for decades (Ljubisaviljević et al. 2011, North-West. J. Zool. 7 (2), 250-260)

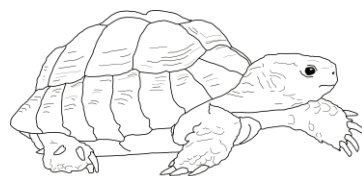


despite the legal actions at national level (it is listed on Ordinance on the control of use and trade in wild flora and fauna, Official Gazette of the Republic of Serbia, 2010) and international level (international trade is restricted by the CITES, Appendix II). Recent PVA analysis (Nikolić et al., accepted for publishing at Herpetol. Conserv. Biol.) alarm to the devastating effect which collecting of only 200 individuals from a wild population each three years (allowed quota in Serbia) could push prosperous populations towards inevitable extinction.

So far practice indicates necessity for further changes in national legislative, in Serbia and across Balkans, as well as better management of confiscated animals from the national borders (e.g. Nikolić and Golubović 2017, Acta Zool. Bulg., Suppl. 10: 115-120).

Distribution of Hermann's tortoises in Serbia

Naturally in Serbia Hermann's tortoises inhabit parts southern from Danube and Sava Rivers. Occasional findings of individuals in Vojvodina Province (north from Danube and Sava Rivers) are, unfortunately, the animals collected from natural populations and kept as pets. These occasions urge us to be cautious with distribution data collection and use. The cases of vagrancy should not be taken *per se* as proof of natural population presence in the area.



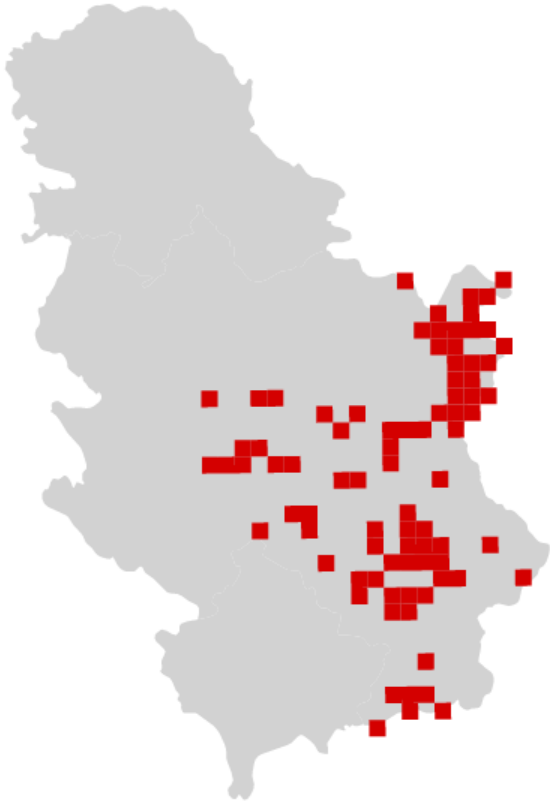


Figure 9. Novel and precise data of distribution of Hermann's tortoises in Serbia. The map is available and regularly updated on Biologer.org.

Typical habitats of the Hermann's tortoises in Serbia are slopes of hills with south-east exposition, under thermophilus *Quercus* forest. These hills are often used also by people, for weekend settlements and orchards.

Population studies on Hermann's Tortoises

Capture-Mark-Recapture studies (CMR) on Hermann's tortoise populations started on 2008. Since then, additional populations were included in the studies, while some were neglected, due to shortage of financial support and time of the trained researchers. With support from Rufford Foundation we managed to continue population studies at three remote populations of Hermann's tortoises (Figure 10).



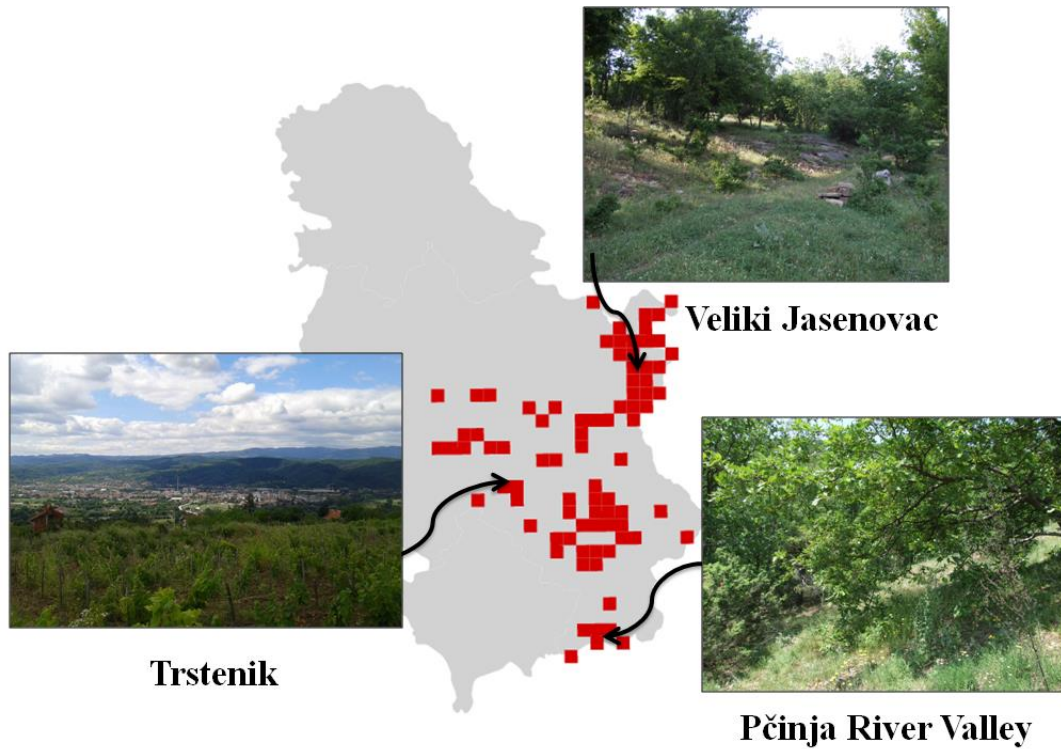
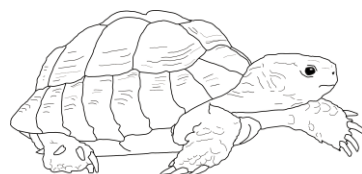


Figure 10. Map of Serbia with indicated locations and photographs of habitats where CMR studies on *Testudo hermanni* are conducted.

CMR study on Pčinja River Valley population lasts since 2008, with two pauses in research (six years were skipped in total). The population is characterised by sympatry with *Testudo graeca*, the rarest chelonian species in Serbia. Although at first period we covered large area for the study, during last two years (2017 and 2018) we decided to focus our field effort to three sublocalities. This approach promptly resulted in growth of recapture rate, and will soon allow good quality analysis from the CMR data.

CMR study at Trstenik locality started on 2009, and had two pauses in research (five years were skipped in total). The study also covered vast area, and during 2017 and



2018 we focused the field effort to one large but continuous area, in order to obtain good quality CMR data. The Trstenik population is characterised by close coexistence of tortoises and people, since tortoises use orchards during activity season. Female tortoises use the loose soil in south-east exposed vineyards for nesting (Figure 11). Furthermore, at western part of Serbia (Šumadija), Hermann's tortoises seem to be less abundant comparing to eastern and southern parts of Serbia (see also distribution map – Figure 10). This fact adds up the value of population studies at Trstenik locality. Considering recapture rate, it seems that population is in a good condition.



Figure 11. Nest of Hermann's tortoise at vineyard, Trstenik.

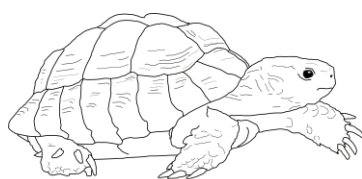


Table 2. Basic population data gathered for the three populations of *Testudo hermanni* in Serbia, and number of gathered tissue samples per locality. * - recapture rate is calculated exclusively for the chosen sublocality which was extensively worked at during seasons 2017/2018.

	Veliki Jasenovac	Trstenik	Pčinja River Valley
# of marked individuals	34	384	493
Recapture rate (%)	10.5	18 *	38.3 *
% of juveniles	2.9	32	11.5
Adult sex ratio	1.6 F: 1 M	1.7 F: 1 M	1 F : 1 M
Tissue samples	29	55	49

We started CMR studies at Veliki Jasenovac locality in 2015, and continued in 2017 and 2018. The population doesn't seem to be as prosperous as the other two populations included in the project.

In all populations adult sex ratio is close to equal, while at Trstenik and Veliki Jasenovac, it is slightly female orientated. Except in Trstenik, number of juveniles seems to be alarmingly small. We have to bear in mind that juvenile tortoises live secluded in first several years, and they are rather hard to be found. Thus percentage of juveniles in the populations is surely an underestimation.

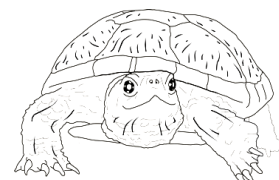


Field work

Hermann's tortoises are an excellent research model. They are easy to catch (when active) and process. They can be permanently marked, in an easy and cheap way, in large numbers. Additionally, markings stay visible for relatively long time after animal's death, if shell is in good condition. These are very convenient characteristics for long-term population studies.



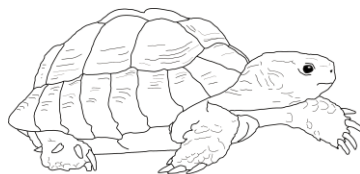
Figure 12. Moments from the field work on CMR of Hermann's tortoises.



Development of Biologer



In Serbia, as well as in most of the Balkan countries, citizen science is not well developed. This resulted in distribution maps restricted to some regions interesting for researchers, with many gaps in between. This is also truth for common species which are easy to distinguish, even for laics. Good example is European Pond Turtle, which is often encountered by hundreds of fisherman on riverbanks and ponds across Serbia. Nonetheless, their observations remained elusive for scientists. We tried to overcome this discrepancy between nature enthusiasts and scientists by developing a mobile phone application with web site, Biologer.org, for collecting precise distribution data, suitable for use of both, nature enthusiasts and expert field biologists.



Popularization of the Biologer

The first version of the Biologer website started collecting data since mid March 2018. This corresponded well with the beginning of the field season and our labours on popularization of the Biologer among biology and ecology students across Serbia (Figure 12).



Figure 12. Moments from the lectures at University of Belgrade (picture on the left) and University of Novi Sad (picture on the right).

Additionally, for the broad public we organised photo-contest via Biologer “[Photogenic snakes of Serbia](#)” during June and July regarding World Snake Day, 16th of July. With the contest we aimed to get general public more involved, and gather more distribution data with nice pictures of snakes. The contest had good Facebook coverage, and the news about existence of Biologer reached further into the public. As symbolic prizes we shared the project promotional T-shirts and books (donated by Miloš



Popović). We are very satisfied with the results of the contest, and will happily organize different Biologer-related contests again in years to come.

Growth of Biologer platform

With development of software under supervision of Miloš Popović, managed with a lot of enthusiasm of Nenad Živanović (web-site developer) and Branko Jovanović (mobile phone application developer), novel options were frequently added, and more people were attracted to use the software (Figure 13). First version of mobile phone application was publicly available in May 2018, while data view, with distribution maps given for the species followed in June.

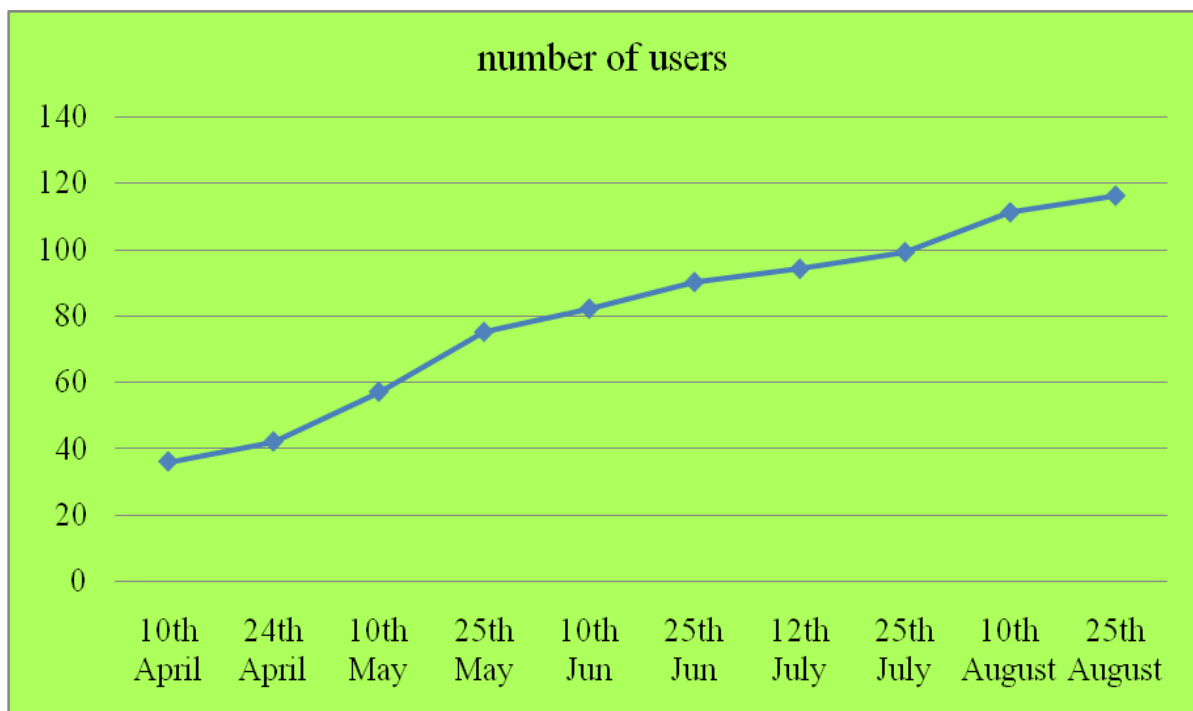
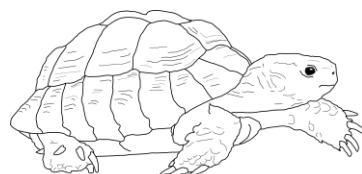


Figure 13. Temporal representation of encreas of number of Biologer users.



With very first publicly available versions of Biologer, colleagues became interested to help further development. In collaboration with [Association Hyla](#) from Croatia we continued development of Biologer further than just gathering distributional data, which was planned by this project. Furthermore, we are currently working on Biologer version for Croatia, which will be compatible with Serbian version, so they could, in future, be merged in pan-Balkan data platform.

In July, except for reptiles, amphibians and butterflies, dragonflies were added to Biologer, thankfully to project of [Aca Đurđević](#) supported by Rufford Small Gant Foundation. Including of novel animal groups covered by Biologer continued in August by adding few species of Crayfish (Decapods), also associated by [RSGF supported project](#). Soon, we are expecting to welcome Orthoptera and Hemiptera on Biologer, while taxonomic three for plants is also in preparation.

With increasing number of people involved, over one hundred for the first season (see dynamics in Figure 13) number of findings also rapidly increased (Figure 14). During only five months, we gathered over 17,000 distributional observations! Maps of distribution, with precision of 10x10 km², are available for each species on Biologer web-site.

With list of further goals for development of Biologer, it will continuously develop even after this project. This project goal was overachieved already from May 2018, and increasing number of enthusiastic people with great ideas are continuing to contribute.



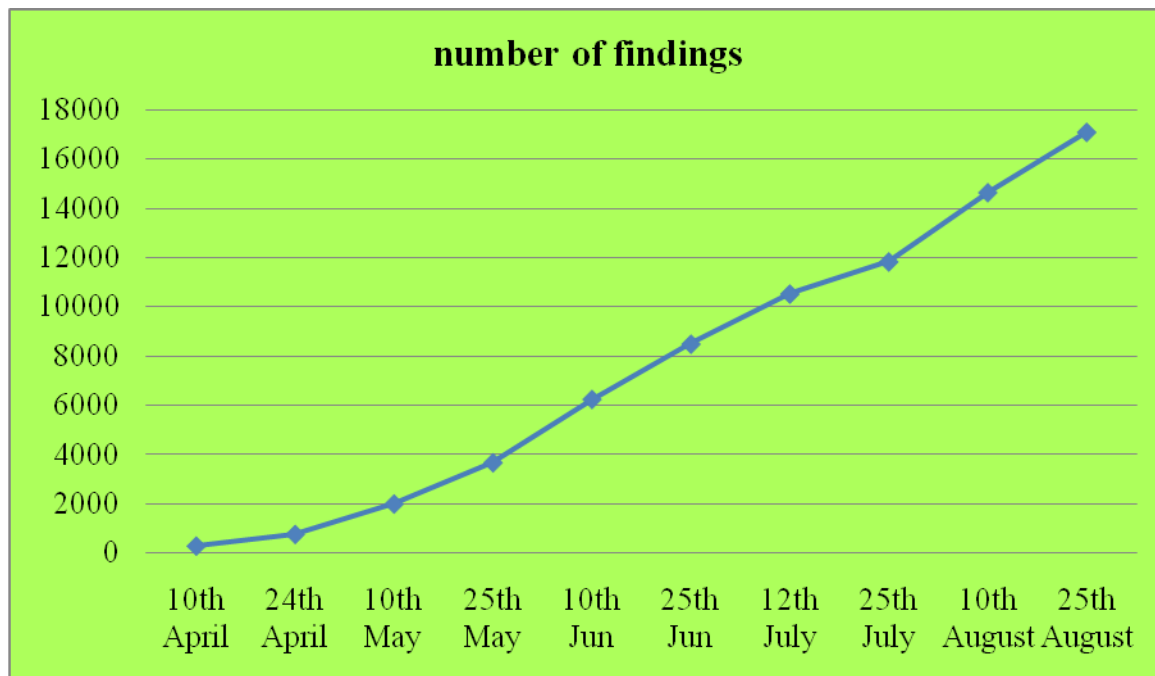


Figure 14. Temporal representation of encreas of number of observations in Biologer

The Biologer software is developing fast, it is only at the very first season of it's existence! We are expecting more taxa, people and geographical regions to be included. Furthermore, it is developed as open acsess software, and it is avaliabe for use and further development at [GitHub](#).

