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Finds of washed-out proteus from the Pivka intermittent lakes and the Pivka river

Najdbe naplavljenih proteusov s Pivških presihajočih jezer in reke Pivke

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The surface of the Upper Pivka area (SW Slovenia) can be divided into levelled bottom along the Pivka river and higher rocky terrace along the Javorniki mountains. The basins of the Pivka intermittent lakes are deepened into the terrace (Mulec et al. 2005). The area is characterized by close connection between its underground and surface waters. In the karst aquifer, water flows mostly underground, but after periods of more intensive or long-lasting precipitation the water table rises (Petrič & Kogovšek 2005). The underground waters from the shallow karst aquifer of the Upper Pivka pour over the surface and fill the Pivka riverbed and several small karst basins that change into intermittent lakes. The Pivka intermittent lakes constitute a unique hydrological system of 17 intermittent lakes, of which nine occur more frequently, while eight occur less frequently (Kovačič & Habič 2005). The majority of them (11) are located in Landscape Park of the Pivka Intermittent Lakes (also a Natura 2000 site) (Fig. 1).

The Pivka intermittent lakes are a complex hydrological system with different occurrence and duration of lakes, as well as a variety of karst inflows and outflows. The size of the majority of lakes is small (only two lakes larger than 50 ha) and their karst inflows/outflows are also smaller. The more frequently formed intermittent lakes (except Radohovsko jezero) have karst inflows or outflows in the form of springs, estavelles, ponors or swallow holes.

During several years of field observation (from December 2006 to December 2011) of almost all Pivka intermittent lakes (except lakes in Krajnikov dol and Jeredovce) and four selected Pivka springs we explored their geomorphological characteristics and dynamics of lake formation in relation to hydrological conditions of the Pivka river and precipitation in the observation period (Kirn 2016).

According to Sket (1997), some localities of proteus are recorded in the Upper Pivka area, such as Zagorje (the Podlaznica stream and residual pools), Pivka (factories water supply), Palčje with Matijeva jama, Jerinov mlin (near Žeje) and Prestranek (Pivka bed). The occurrence of proteus in Matijeva jama at the edge of Palško jezero and at the springs of the Pivka river (Kljunov ribnik) near Kalc Castle and the mill near Žeje has been confirmed (Polak 2005). Specifically, proteus are found not just in Matijeva jama, but also in the main Pivka spring in the Pivšce and also in the upper part of the Pivka riverbed when high karst waters eject them (Mulec et al. 2005). According to the Biology Department of the Notranjska Museum Postojna (Polak 2018), additional localities of proteus occurrence in the area are known, such as Jama v Mlaki, Petelinjsko jezero, Žeje spings, Tišlerjev mlin and Čadežev mlin (near Žeje). Some other past finds of washed-out proteus have also been reported by the locals (e.g. Parsko jezero (ponor) and Klenska Pivka near Mišnik (riverbed close to ruins of the mill); Irena Uršič, pers. comm.), but they are poorly documented. Here and there, finds of washed-out proteus have been published in the media (e.g. Pivka riverbed near Zagorje; Primorske novice, 15. 5. 2008).

During our study of the area focused on hydrology of the Pivka intermittent lakes and the Pivka springs, ten washed-out proteus were also found from 2008 to 2011 and in 2014 (Tab. 1). All finds were reported to Gregor Aljančič (Tular Cave Laboratory). He came to see almost all found proteus after our notice. Researchers at the Tular Cave Laboratory have documented nearly thirty cases of washed-out proteus in Slovenia and Bosnia and Herzegovina since 2008. All animals were found by chance after being reported by the locals (Aljančič et al. 2016).

We recorded proteus in the basins of three intermittent lakes that are formed more frequently (Kljunov ribnik, Kalsko jezero and Petelinjsko jezero), the main Pivka spring and two additional springs (springs near and behind Kljunov ribnik) and one Pivka tributary (Klenska Pivka near Mišnik) (Fig. 1). Most of these localities of washed-out proteus are situated in the Natura 2000 site: SAC Javorniki – Snežnik (except the Pivka spring and Kalsko jezero), as well as in Landscape Park of the Pivka Intermittent Lakes (except Kalsko jezero). Kalsko jezero is a new locality compared to the previously known proteus localities.

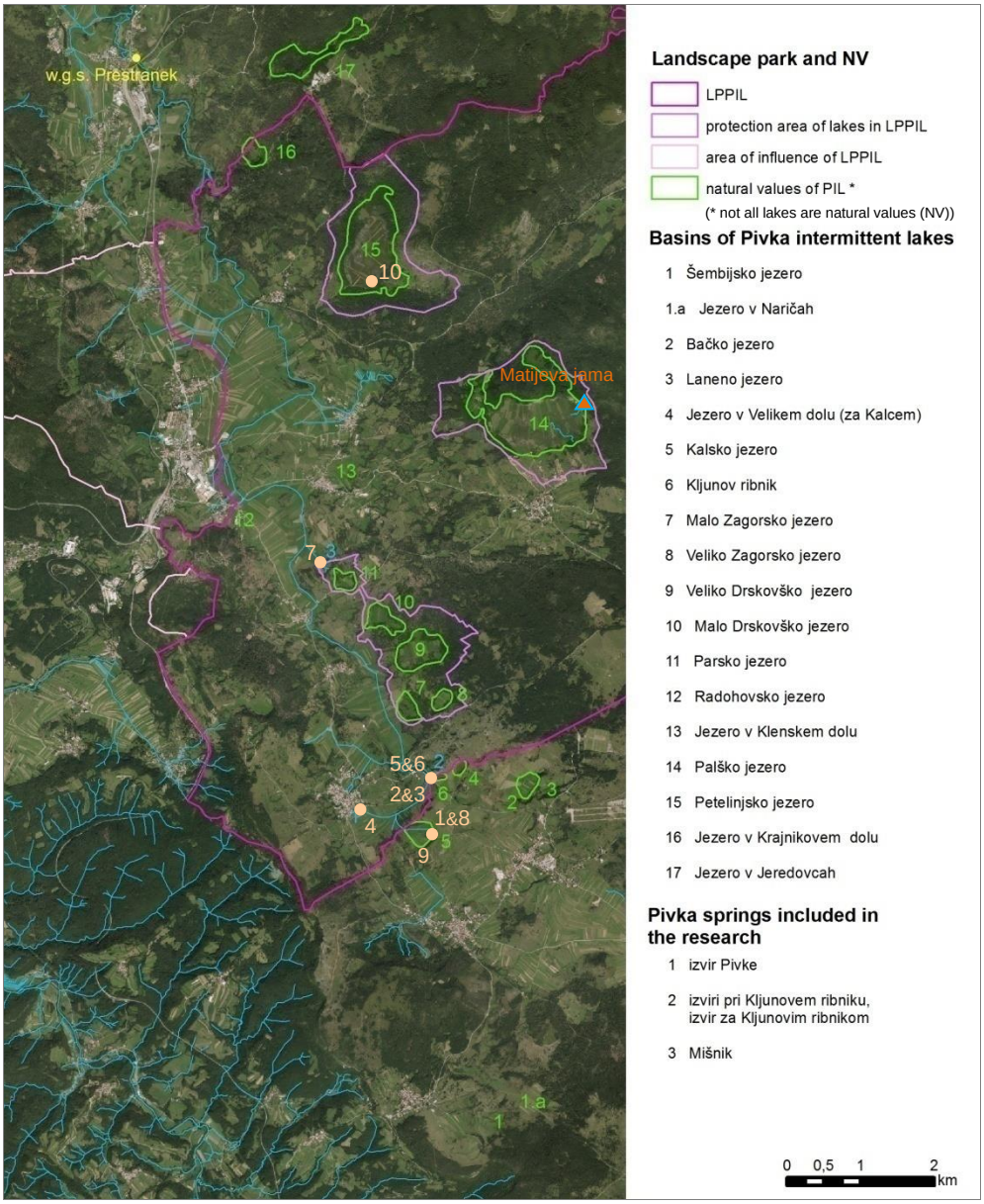

Figure 1. The area of the Pivka intermittent lakes and the Pivka river in Landscape Park of the Pivka Intermittent Lakes (LPPIL) and its surroundings with marked finds of washed-out proteus by localities (lake or Pivka spring/tributary). The finds are numerated as in Tab. 1. Matijeva jama as the release point for washed-out proteus is also presented. Data sources: GURS, ARSO.

Slika 1. Območje Pivških presihajočih jezer in reke Pivke v Krajinskem parku Pivška presihajoča jezera (KPPPJ) in njegovi okolici z označenimi najdbami naplavljenih proteusov po lokalitetah (jezero ali izvir/pritok Pivke). Najdbe so oštevilčene kot v Tab. 1. Prikazana je tudi Matijeva jama kot točka izpusta naplavljenih proteusov. Viri podatkov: GURS, ARSO.

Table 1. Finds of washed-out proteus from the Pivka intermittent lakes and the Pivka river. Coordinates in the Gauss-Krüger coordinate system (GKY and GKX) were read from digital orthophoto maps.
Tabela 1. Najdbe naplavljenih proteusov s Pivških presihajočih jezer in reke Pivke. Koordinate v Gauss-Krügerjevem koordinatnem sistemu (GKY in GKX) so bile odčitane z digitalnih ortofoto načrtov.

No.	Lake/ Pivka	Location	GKY, GKX	Date	State and salvaging of washed-out proteus
1	Kalsko jezero	spring at the northeastern edge of the current lake basin	441115, 54999	23.4.2008	The next day it was taken to the Tular Cave Laboratory where it died due to break of the spine (Aljančič 2009).
2	Kljunov ribnik	western edge part of the lake basin (in shallow water between the spring 4 and the springs near Kljunov ribnik)	441095, 55712	28.12.2008	The next day it was taken to the Tular Cave Laboratory where it died due to being exposed to frost on the back of the body in Kljunov ribnik (Aljančič 2009).
3	Kljunov ribnik	dried up ground along the large borehole (in the morning), while there was still a little water the day before (in the evening) after the water stopped flowing from the borehole on 9. 4. 2009	441119, 55712	11.4.2009	It was released into Matijeva jama on the same day as it was found just when the stream from the lake flowed into the shaft (Aljančič 2009).
4	izvir Pivke	rocks in front of the entrance to the shaft at the spring	440208, 55258	1.1.2010	It was kept one month in Vivarij in Postojnska jama, because Matijeva jama was flooded. It was released into its shaft when the water level was below the surface (Gregor Aljančič, pers. comm.).
5	izvir za Kljunovim ribnikom	dried up spring	441116, 55728	26.5.2010	Dead proteus (dried up)
6	izviri pri Kljunovem ribniku	edge of spring basin	441091, 55712	4.12.2010	It was released into Matijeva jama the next day when the water level was below the surface (in the shaft) (Gregor Aljančič, pers. comm.).
7	Klenska Pivka pri Mišniku	small basin at the bottom of the riverbed where the ditch enters the riverbed through the left embankment	439639, 58608	29.1.2011	It was left in the riverbed and was not noticed the next day.
8	Kalsko jezero	spring at the northeastern edge of the current lake basin	441115, 54999	22.2.2014	It was left at the spring (no photo is available) and was not noticed during the following visits of the lake.
9	Kalsko jezero	northeastern part of the dried up lake bottom	441075, 54977	22.3.2014	Dead proteus with a number of bruises along the body (Aljančič et al. 2015).
10	Petelinjsko jezero	estavelle 6 in the southeastern edge part of the lake basin when the water was only at the bottom of the estavelle	440339, 62461	11.5.2014	It was released into Matijeva jama the same day when the water level was below the surface (in the shaft) (Aljančič et al. 2015).

Figure 2. Photos of washed-out proteus from the area of the Pivka intermittent lakes and the Pivka river. They are numerated as in Tab. 1 (photo: Tina Kirn).
Slika 2. Fotografije naplavljenih proteusov z območja Pivških presihajočih jezer in reke Pivke. Najdbe so oštevilčene kot v Tab. 1 (foto: Tina Kirn).

We found one to three proteus per year (two in 2008, one in 2009, three in 2010, one in 2011, and three in 2014). The state of these animals is shown in Tab. 1 and Fig. 2 (including photos). Eight proteus were found alive, two of which later died due to injuries, one proteus was left in the riverbed and one in the spring, while four were rescued (Aljančič 2009, Aljančič et al. 2015, Aljančič, pers. comm.). Three of them were put into the bucket with water captured at the spring. They waited for the arrival of Gregor Aljančič, who then captured the last proteus by himself after our notice. He released these four proteus into Matijeva jama (an estavelle) in the basin of Palško jezero as the most appropriate release point for washed-out proteus since it is the longest water cave in the area of the Pivka intermittent lakes. The other two proteus were found already dead. Dead proteus are kept in the Study collection of proteus preparations, the Tular Cave Laboratory (Aljančič et al. 2015).

In the basin of Kalsko jezero three animals were found. The first proteus was found in the spring during regular larger lake formation in April 2008. The second proteus was found in the same spring in February 2014, when the extremely large lake formation was decreasing. We saw only a tail of proteus peeping out of the cracks and left it at the spring. After the end of this extremely large lake formation in March 2014 we noticed another proteus (already dead) on the dried up lake bottom.

Most proteus (four) were found in the basin of Kljunov ribnik and springs along it. Therefore, we assume that it is a locality where animals occur quite frequently. The first proteus was in shallow water in the marginal part of the lake basin during the very large lake formation in December 2008. The second proteus (being saved) was on dried up ground along the large borehole when the large lake formation was being discharged in April 2009.

The third find of proteus is from the spring behind Kljunov ribnik (izvir za Kljunovim ribnikom) in the bed of stream from Kljunov ribnik that flows into the Pivka river. Proteus was noticed after the end of regular larger lake formation of Kljunov ribnik in May 2010 when spring dried up. It was caught in the crack among rocks (already dead). The fourth find of proteus is from the springs near Kljunov ribnik (izviri pri Kljunovem ribniku) that flow into the Pivka river. It was during the very large lake formation of Kljunov ribnik in December 2010. The proteus (being saved) lay partially out of the crack at the edge of the spring basin.

One proteus (being saved) was found in the main Pivka spring (izvir Pivke) in January 2010 when the water level was about 30 cm. It was noticed among the rocks in front of the entrance to the shaft. One proteus was found in Klenska Pivka near the Mišnik spring at the end of the very large lake formation of Parsko jezero in January 2011. It was moving in quite deep water in small basin at the bottom of the riverbed. We wanted to capture (save) proteus on the next day, but was not to be seen anymore. The last (tenth) proteus was found in the basin of Petelinjsko jezero during the discharge of the extremely large lake formation in May 2014. It was noticed in almost dried up estavelle 6. The salvaging of this proteus was carried out in cooperation with the Ecomuseum of the Pivka intermittent lakes.

To conclude, the intermittent lakes are the groundwater dependent ecosystems and are therefore also interesting for observing subterranean animals like proteus. Dynamics of lake formation of the Pivka intermittent lakes in a particular year is primarily dependent on precipitation regime and the saturation of the underground (and soil) with water.

The research and monitoring of proteus is highly challenging due to the inaccessibility of its underground habitats. It is sensible to carry out monitoring of springs along the Pivka river and the Pivka intermittent lakes (Fučka et al. 2007). We believe that it is more likely to find proteus in small springs where the water discharge is not so high and proteus can resist the surface water flow after being washed out. With respect to monitoring of the washed-out proteus, special attention should therefore be given to small springs. Animals were found in winter or spring from regular larger to extremely large lake formation of intermittent lakes. We assume that finds of washed-out proteus are more likely when the extent of lake formation is greater since more animals were recorded during very large or extremely large lake formations.

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