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PROPOSED RE-INTRODUCTION OF THE ENDANGERED BLACK NERITE, *THEODOXUS PREVOSTIANUS* (MOLLUSCA, NERITIDAE) IN HUNGARY

By Zoltán Fehér, Gábor Majoros, Sándor Ötvös & Péter Sólymos

Theodoxus prevostianus (C. Pfeiffer, 1828) is a rare and endangered neritid species (Fig. 1.) occurring in hypothermal springs in the Pannonian biogeographical region (Fehér *et al*., 2009). Once, 15-20 populations were known (Fig. 2), but the majority have become extinct in the past 50 years (Gagiu, 2004; Jurcsák, 1969; Kormos, 1905, 1906; Piringer, 2001; Schréter, 1915; Sîrbu & Benedek, 2009; Soós, 1943; Vásárhelyi, 1957; Wagner, 1927, 1937). Now, only four remaining populations are known: two in Austria (Bad Vöslau and Bad Fischau), one in Slovenia (Bušeča vas) and one in

Fig. 1. A black nerite (*Theodoxus prevostianus*) specimen in Kács, Hungary.

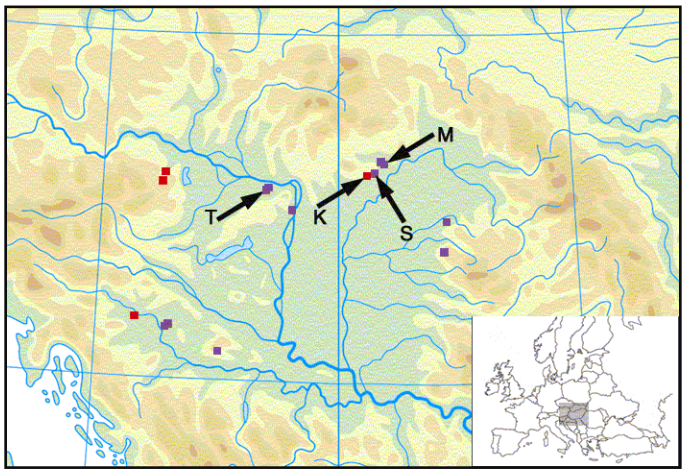

Fig.2. Location of existing (red) and extinct (purple) *Theodoxus prevostianus* populations in the Pannonian biogeographical region. K: Kács, T: Tata, S: Sály, M: Miskolctapolca.

Hungary (Kács). Therefore, the species is of high conservation concern; it is legally protected in Hungary, listed in Annex IV of the European Habitats Directive and categorized as endangered (EN), according to IUCN categories (IUCN, 2010).

In Kács, two groups of springs can be found; one of them has cool water (~15.4 °C) and is controlled by North Hungarian Regional Waterworks Ltd., with only a part of the capacity allowed to run freely. A group of hypothermal springs (22 °C) emerges nearby. A Benedictine monastery was built 700 years ago over the main spring (mean flow rate 44 liters s^{-1} (Savanyú *et al*., 1986)), with the stream emerging from beneath the monastery building (Figs. 3, 4). The hypothermal branch is bordered by five to six additional seepage springs (also hypothermal). Both the cool and the hypothermal branches are ~100 m long before their confluence. The *T. prevostianus* population occurs in the hypothermal section and in the combined section, ~800 m down from the confluence. The total population size is estimated ato be 3-3.2 million specimens, 800,000 in the hypothermal branch and 2.2-2.4 million in the joint section (Varga *et al*., 2007). Despite the legal protection, the species' conservation status in Kács seemed unsatisfactory, most of all because the population is located within private property, outside of the territory of the Bükk National Park. The vulnerability of this remnant black nerite population in Hungary is well illustrated by the events that occurred in April 2010.

In the middle of April 2010, an unusually large amount of rainfall fell in the vicinity of Kács village. Due to the nature of the land relief, the poor rainfall retention ability of the local

Fig. 3. The outflow of the main hypothermal spring in Kács, Hungary, with the Benedictine monastery in the background.

Fig. 4. The upper section of the hypothermal branch of the stream in Kács. The picture was taken before the flood in April 2010. The stream bed is covered by pebbles and gravel.

vegetation and the lack of protecting structures around the spring, a large quantity of water carrying a large sediment load got into the stream. Water volume in the upper stream section increased 10-15 times the usual amount. After this flood, the streambed was covered by a 30-50 cm thick silt layer (Fig. 5), which made almost the whole biotope unsuitable for this species, as it needs solid surfaces. According to our estimation, in the the upper stream section, 99 % of the animals died and only a few thousand speciemens survived in the seepage springs bordering the hypothernal branch, whereas in the joint section ~50 % were extirpated. In order to eliminate the consequences of such floods in the future, the stream has been dredged out and a concrete streambed has been built by North Hungarian Regional Waterworks Ltd. (Figs. 6-7). Though conservation considerations did not play any role in this construction, the concrete streambed seems suitable for *T. prevostianus*; the population seems to have recovered and populated the newly built structures.

The vulnerability of the Kács population was so obvious that the idea of creating insurance populations had long been considered prior to these alarming events. It was first proposed by one of us (GM) in 1999. The plan took the form of a proposal during the Annual Meeting of Hungarian Malacologists in 2009. We proposed to re-introduce black nerites to certain places in Hungary, from which it had become extinct in the past decades. Preliminarily, three sites were

Fig. 5. The confluence of the hypothermal (on the left) and the cold (on the right) branches of the stream in Kács. The picture was taken after the flood in April, 2010, the streambed of the hypothermal branch is covered by thick silt layer.

Fig. 6. The stream in Kács was dredged out after the flood in April 2010 and a concrete streambed has been built. The picture was taken on 21 August 2010.

Fig. 7. The newly built concrete streambed of the stream in Kács. The picture was taken on 14 November 2010.

considered: Fényes Springs in Tata, Csónakázó-tó in Miskolctapolca and Vízfő Spring in Sály. In Tata, the springs had dried out in the 1960s due to groundwater extraction in connection with coal mining. In Miskolctapolca, the extinction of the population was connected to the reconstruction of the Cave Bath, which is fed by the same springs as the Csónakázó-tó. Vízfő Spring in Sály was captured in the 1970s and there were periods when the outflow completely dried up, causing the extinction of that population. Now, all three locations seem to be suitable to host black nerites again.

Fig. 8. The outflow of the Vízfő Spring and concrete covered uppermost section of the stream in Sály.

Fig. 9. The stream of the Vízfő Spring in Sály with natural streambed.

There was a reported case of a benign introduction of this species that gave us hope. In 1909, Lajos Soós introduced some speciemens from Tata to Budapest (Római-fürdő). That population successfully established there and existed for decades (Soós, 1943).

In March 2010, we analyzed the water quality in the three proposed sites. Regarding Ca and Mg content, Vízfő Spring is closest to the hypothermal spring of Kács. Fényes Springs have the same Ca content but three times higher Mg content. In the outflow of Csónakázó-tó in Miskolctapolca, we measured hardly any Mg but high Ca content. The concentration of organic matters seemed to be sufficiently low in each site, except in Miskolctapolca, where it was slightly higher than optimal. Sulphide, an indicator of anaerobic processes like rotting, could not be detected in any of the analyzed locations. We proposed to introduce 200 *T. prevostianus* specimens per year for a period of 3 years to each locations (1800 specimens altogether). We applied for permission to the National Inspectorate for Environment, Nature and Water in March 2010. After a long procedure, we got permission to re-introduce black nerites to Miskolctapolca and Sály but not to Tata, and we are allowed to collect only 200 specimens per year between 2010 and 2012 (600 specimens altogether).

Because of the low number of specimens we are allowed to collect, we decided to start with one location only in the first year. We chose Vízfő Spring, which seemed to be the most promising on the basis of water quality data. Similarly to the cold spring in Kács, this spring has been captured by North

Fig. 10. To avoid immediate drifting away of the re-introduced specimens caused by the strong water current, they were placed out in small flowerpots in the stream of the Vízfő Spring in Sály.

Hungarian Regional Waterworks Ltd. and only a part of the capacity is allowed to run naturally. In the uppermost 10 m section, the stream flows in a concrete basin (Fig. 8.), while downstream it looks more natural with pebbles and gravel in the streambed (Fig. 9). During our first attempt, 200 specimens were transferred from Kács to Sály on 4 November 2010. The duration of the transport was less then 30 minutes. Animals were carried between wet tissue paper and were released in two spots ~15 m apart: one in the concrete section and one in the natural section of the stream. To avoid immediate drifting away of the withdrawn specimens caused by the strong water current, they were placed out in small flowerpots (Fig. 10).

We propose to monitor the re-introduced population three-four times per year in the coming years. Depending on the success of this first re-introduction attempt, we will consider how to use the permitted quota in the next two years (shall we try the re-introduction to Miskolctapolca or supplement the population in Sály?) and we might apply for further permits (either re-inroductions or benign introductions to other hypothermal springs in Hungary).

We thank Erika Bagladi and Szabolcs Mosonyi for making available their picture (Fig. 6). ZF received support from the Hungarian Scientific Research Fund (OTKA-NNF 78185) and the János Bolyai Research Scholarship of the Hungarian Academy of Sciences. PS was supported by a postdoctoral fellowship from the NSERC and the Alberta Biodiversity Monitoring Institute.

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FRESHWATER BIVALVES IN NORTH AMERICA

In addition to the following articles, see the article by Robert Forsyth and Dwayne Lepitzki about conservation assessments of molluscs in Canada in 2010 (p. 31-33), which includes both a terrestrial species and freshwater bivalves.

A new threat to conservation of North American freshwater mussels: Chinese Pond Mussel (*Sinanodonta woodiana*) in the United States

By Arthur E. Bogan, Jeanette Bowers-Altman & Morgan E. Raley

North America is home to a very diverse unionid fauna (Bogan & Roe, 2008). This fauna is being threatened by pollution and habitat modification as well as the continued introduction of freshwater bivalves including the Asian clam (*Corbicula fluminea*), zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*) (Ricciardi *et al*., 1996, 1998). Each of these species exhibit a different threat to the health and conservation of native unionoid species: competing for space, food and/or encrusting shells of native species.

Fig. 1. The shell of one of the specimens collected from fish ponds, Hunterdon County, New Jersey. NCSM 46965-3.

The Chinese pond mussel, *Sinanodonta woodiana* (Lea, 1834), is probably the most widely introduced unionid around the world. Watters (1997), and see numerous publications by H.K. Mienis in *Ellipsaria* (1987-2010), surveyed the countries in which this invasive species had been documented as established, reporting them from 15 countries in Europe, as well as Indonesia, Costa Rica and the Dominican Republic, but reported no records from the United States. The native range of this species was considered to be eastern Russia and China.

Watters (1997) observed that 'it is likely that *A. woodiana* eventually will invade North America and other countries.' This species apparently has been introduced as a byproduct of the import of its commercially sold host fish.

Three live specimens of an anodontine bivalve subsequently identified as *Sinanodonta woodiana* were collected from the New Jersey Conservation Foundation's fish ponds, Franklin Township, Hunterdon County, New Jersey by the New Jersey Endangered and Nongame Species Program staff on 7 June 2010 (Fig. 1). These specimens were sent to the North Carolina State Museum of Natural Sciences, Raleigh, and cataloged (number NCSM 46965) into the Mollusc Collection. These specimens were identified as *Sinanodonta woodiana* based on shell characters. Identification was confirmed based on a comparison of cytochrome oxidase subunit 1 (CO1) DNA sequences (Bogan *et al*., 2011).

New Jersey Conservation Foundation staff lowered the ponds, fish were killed with Rotenone and all fish have been removed from the ponds. Shells of the Chinese Pond Mussel have also been found in Wickecheoke Creek downstream of the ponds. This creek is a tributary of the Delaware River. The extent of the invasion is unclear at this time.

Future conservation impacts of this species on native freshwater mussels are unclear. *Sinanodonta woodiana* grows to large size and will be a competitor for food and may compete for space at least in lakes and ponds.