

ENDANGERED FRESHWATER MOLLUSC SPECIES FROM THE EASTERN TRIBUTARIES OF THE TISA RIVER (ROMANIAN TERRITORY)

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Abstract

Based on long-term research this paper aims to reveal the status of 10 highly endangered freshwater mollusc species from the eastern Tisa River Basin. In all cases the adverse human pressure (pollution, hydrotechnical works and drastic reduction of wetlands) is responsible for the present-day status of this fauna, several species having a highly patchy distribution, some became rare or even extinct. Despite these facts some trends of recovery are also registered on the main rivers in Transylvania.

Keywords: human impact, biodiversity, pollution ecology, malacology

Introduction

The freshwater molluscs are relatively easy to be used in a biomonitoring system, because they respond in a short time, and a very specific manner, to the changes in the environmental conditions. This synthesis refers to the most endangered mollusc species from the eastern tributaries' hydrographical basins of the Tisa River (Romanian territory). Its aim is also to draw attention upon some species that need special protection in the near future. Because of the long history (almost two centuries) of malacological research in Transylvania, it is possible today to trace the changes regarding the mollusc fauna that have occurred both in time and space. We consider in this paper those species that were once wide spread (according to the references), but became, because of human pressure (mainly pollution, habitat degradation, hydrotechnical works, desiccation of wetlands etc.) very rare (living in a very few habitats), surviving through small-sized, highly patchy, scattered populations. The fact that a species is rare (i.e. seldom quoted) is not an enough criteria to consider a species as endangered, because (as it happens with most clams, spring-snails and cave-snails from Romania) their rarity is sometimes linked to subjective causes (lack of information from the past, insufficient present-day research etc.).

The first more comprehensive list of autochthonous mollusc species was published in 1843 by Michael Bielz, and was followed by a catalogue published in 1851. Among the naturalists from the Transylvanian Society for Natural Sciences in Sibiu, which was founded in the middle of the past century, we highlight Albert E. Bielz, as one of the most remarkable malacologists of that time. He published the first monography regarding the malacofauna from this territory in 1862. Another great malacologist was Mauritius von Kimakowicz, from the same society in Sibiu, but he was focused mainly on terrestrial snails, and less on freshwater species, having in this respect only a few contributions (e.g. his paper published in 1885). Other contributions to the knowledge of the freshwater mollusc fauna from the tributaries of the Tisa River were provided by C.A. Westerlund (1886), S. Clessin (1887), C.F. Jikeli (1878), M. Rotarides (1930), L. Soós (1942) and by A.V. Grossu (1941, 1962, 1986, 1987, 1993). Most of these authors have quoted the species and the sampling points, as A.E. Bielz mentioned them, without verifying if the species still live in the specified habitats and places. The mollusc fauna from Banat is better known through the works of A.V. Grossu (1942, 1976 and others) and researches accomplished along the main rivers in the past years.

Research background

A. Sárkány-Kiss performed an intensive research activity on the Mureş River, beginning with 1969 in some areas, and later, in 1978 and 1989 he extended the investigations on the whole river. In the frame of several Romanian-Hungarian multidisciplinary projects, organised by Liga Pro Europa, Târgu Mureş and Tisza Klub, Szolnok with the participation from different universities and institutes of both countries, further investigations of the freshwater mollusc fauna were made, as it follows: 1991 Mureş, 1992 Someş, 1993 Mureş - the middle part and Târnava Mică, 1994 Crişul Alb and Crişul Negru, 1995 - Crişul Repede, Barcău and Tisa, 1996 - Someş and Lăpuş Rivers. Both authors of this paper have worked together in the Someş, Olt and Mureş rivers basins (1996 - 2000), and separately in the rivers from Maramureş (1999 - 2001), namely Iza, Mara, Vişeu and Vaser rivers. They investigated also the wetlands from the Transylvanian Plain, during another research project. I. Sirbu has completed the knowledge regarding the freshwater molluscs by several field-investigations in Banat. In 1998 the Nera, Caraş and Danube rivers were researched, followed in 2000 by Bega, Timiş and Cerna rivers and other wetlands from this region, in 2002 (together with Monica Sirbu) the Danube sector from Banat, once again Cerna, Timiş and Bega Rivers, and also the lowland sectors of the Criş rivers. Besides, after 1996 I. Sirbu gathered data on the specified group from glacial lakes (Retezat, Făgăraş and Rodnei Mountains), from different other wetlands and rivers (like the Ier River, wetlands in the Criş Rivers Basin, Râul Negru, tributaries from the Olt and Mureş rivers basin, and others). In this paper we consider also some rivers that do not flow into the Tisa, like the Olt River and some rivers from the southern Banat, in order to obtain a sounder image of the present-day status of the endangered species. Besides this, some rivers, like Bega and Timiş, which were

originally ascribed to different basins, are connected through channels, leading to the possibility of fauna exchange.

The sampling points have been selected in order to cover the whole area, to find and evaluate the effects of the human impact sources, and to identify the zones that still shelter a high diversity or some rare species. The adverse human impact was followed both in space and time, the latter by comparing the present-day diversity and chorology with all the available data from references.

Results and discussion

In the area that could be ascribed to Transylvania, the Criş Rivers basin (Crişana), Maramureş and Banat 74 species of freshwater molluscs have been found until now (according to I. Sirbu 2001; 51 species of gastropods and 23 of bivalves), and for the first time dispersal maps have been plotted for these areas, namely for the Unionidae (A. Sárkány-Kiss and I. Sirbu, 2001), for clams and prosobranchs (I. Sirbu, unpubl. data). The present-day status of the freshwater mollusc fauna proves the great habitat changes of the last decades, mainly caused by pollution of large river sectors, by hydrotechnical works and the drastic reduction of wetland areas.

Among gastropods, the prosobranch snails group the most exacting species of this Class. The genus *Theodoxus* comprised 3 species in the Romanian Eastern tributaries of the Tisa River, namely: *Theodoxus transversalis* C. Pfeiffer, 1828, *T. danubialis* C. Pfeiffer, 1828 and *T. prevostianus* C. Pfeiffer, 1828. All these are exacting, rheophyllous, mostly lithophyllous elements, with high oxygen demands. Some authors are quoting also *T. fluviatilis* Linnaeus, 1758 but in the Tisa River basin from Romanian territory this species was not ever found, and it is a matter of future to establish its status on the Hungarian territory. Although it was several times quoted by different authors (in Tisa, Criş Rivers, Mureş River), it is almost surely mistaken with other congeners, at least in the last two cases. *T. transversalis* had in the past the most extensive range in the Tisa Basin among the species belonging to this genus. E. A. Bielz (1867) quoted it in several localities from the Mureş and Someş Rivers and their tributaries and also from the Olt River (mostly in the middle sectors of these rivers). L. Soós (1943), K. Bába (1958), A. Grossu (1974, 1966) still found this species in several localities from the specified area in the middle of the XXth century. The investigations accomplished in the past 20 years have shown the disappearance of this species from the whole length of the Olt, Mureş and Someş rivers, their tributaries, and from all quoted localities in Transylvania. Besides, it was not found in the Criş Rivers basin and in Maramureş region, being a matter of question if it still lives in the southern Banat, in the Danube and some of its tributaries that did not belong to the Tisa Basin. *Theodoxus prevostianus* is a termophyllous relict species with a highly patchy distribution in Central and Eastern Europe. In the Danube basin it lives in some scattered sites, like Bad Vöslau and Bad Fischau (Austria), several places in Hungary (Soós, 1943; Richnovsyki and Pintér, 1979), and one certain place in Romania, at Răbăgani (Bihor county; Crişul Negru River Basin). In the last place it still lives only in a short sector of a rivulet, with mesothermal water. This rivulet is used by the

inhabitants as cleaning source for the laundry and carpets and the source is also captured in a swimming pool, all these making it a highly endangered habitat. It is also to be noticed that *T. prevostianus* appears together with a melanic form of *Esperiana acicularis* (Férussac, 1823) syn. *Fagotia (Microcolpia) daudebartii acicularis* (as it happens in Austria as well), and some other more exacting species. The latter species appears here in the single point from the Romanian Criș Rivers basin. Some papers pointed out the presence of *T. prevostianus* also in other sites from Romania, like the flowing mouths of the Danube branches in the Black Sea, some few places in the Danube Delta, and another very important site, namely the Pețea lake (Băile Episcopopești, hun. Püspökfürdő). The material I. Sîrbu has verified in the collections of "Grigore Antipa" Natural History Museum proved that the individuals sampled from the Danube Delta and ascribed to *T. prevostianus* are most likely melanian forms of *T. danubialis*. In the last case, several papers written by different authors ascribed the neritids found in Pețea Lake some to *T. prevostianus*, to *T. transversalis*, *T. danubialis* or - even - to some other species. In fact the species died out in this water a long time ago, it appears only as subfossil shells, that can be ascribed to *T. danubialis*, as it was correctly done by M. Paucă (1936) and later by A. Grossu (1986, as the form *serratilinea*). L. Soós raised another problem, by quoting *T. prevostianus* from the Secu rivulet, in the Călimani Mountains (one individual sampled by E. Gyula), although he recognised the possibility of an error. The authors of this paper have searched two times, independently, the cited region without finding the species. All this information draws to the conclusion that Răbăgani is the single point in Romania where *T. prevostianus* surely still lives, and because of the misusing of the water source, it should be included in the Red List as a highly endangered species. *T. danubialis* was not ever found in the Transylvanian tributaries or in the Romanian Criș Rivers Basin. It lived in northern Banat, in Bega channel near Timișoara (A. Grossu, 1941) but is in present probably extinct in the Tisa tributaries from this region (I. Sîrbu, unpubl. data). It still lives in the southern part of Banat, in the rivers that flow into the Danube (Nera, Caraș), and is absent from the Timiș and Bârzava rivers (I. Sîrbu and Monica Sîrbu, 1998). The problematic status of *T. fluviatilis* in the Tisa area has to be solved in the future.

Regarding the Pețea thermal lake (near the town of Oradea) another problem has to be raised. In this water lives an endemism, namely *Melanopsis parreyssi* Philippi, 1847. Originally this pliocenic relict survived only in this place, but it was artificially carried in several other places and countries (like Hungary and Germany). In Pețea Lake there still lives an endemic fish subspecies and a variety of *Nymphaea lotus* (var. *termalis*). This site should be, and legally or formally it surely is, strictly protected. As it was revealed in a field trip, that is not the case (I. Sîrbu, 2001). For instance, the guardian is either not present or too tolerant with the intruders, inhabitants are using the water in different purposes, scientists from the whole Europe sample material, too many researches and researchers working in the lake, too much interest etc. Because it was obvious that alien plants brought by aquarists are in full expansion, non-governmental organisations carried out cleaning actions by cutting and uproot the invasive species using large amounts of volunteers, that disturb the habitat. These

sites, and species, are endangered because of too much "scientific" interest and lack of sound legal protection.

Another endangered prosobranch gastropod is *Valvata cristata* O.F. Müller, 1774. The authors of the present paper checked out all the Transylvanian quoted sampling points from the past. E.A. Bielz (1867) found the species in several sites from Braşov, Sibiu and Mureş counties (middle Olt River Basin and Târnava Basin), L. Soós (1943) quoted the species from the middle Someş Basin (Cluj-Napoca county), Mureş River Basin (Alba county), A. V. Grossu (1974) sampled it from several lakes and ponds from northern Banat. In the past 20 years this species was not ever found in Transylvania, and the presence in Banat is doubtful.

Shrinking habitats, reduced ranges and patchy distribution are common patterns also for other prosobranch snails. It is hard to say if the threat is greater in stagnant ecosystems than in lotic environment. The most obvious examples in the former category are *Viviparus contectus* Millet, 1813, *Valvata pulchella* Studer, 1820, *Valvata naticina* Menke, 1845, *Bithynia leachi* Sheppard, 1823 and in the latter is *Lithoglyphus naticoides* C. Pfeiffer, 1828. The last species has almost totally disappeared from Transylvania, but it still lives in high numbers in Criş Rivers, Bega, Timiş, and the southern rivers from Banat and in the Danube.

Habitats' destruction affects also some more exacting basommatophoran pulmonates in the same way. *Anisus rotundatus* Poirer, 1801 was quoted once in Transylvania, near Braşov (E. A. Bielz collection XIXth century, in "Grigore Antipa" Natural History Museum in Bucharest) and found in very few sites in Banat, in swamps near Timişoara town (A.V. Grossu, 1941) and in the Danube valley. It was not recovered again. *Anisus vorticulus* Troschel, 1852 was quoted near Timişoara (A.V. Grossu, 1941), in southern Banat (1972, 1974), and it still lives in some small-sized, scattered wetlands from the middle Olt River Basin (I. Sirbu et al., 1999), and near the Ier River at Răduleşti (Criş Rivers Basin; I. Sirbu, 2001). *Bathyomphalus contortus* Linnaeus, 1758 was once widely spread in ponds and other stagnant wetlands, with rich vegetation, in the middle basins of the Olt and Mureş rivers (E. A. Bielz, 1867, M. Kimakowicz, 1883). As it happened in other cases further papers have quoted this old records without verifying if the species still lives in that sites. In Transylvania there are only a very few sure records from the XXth century, namely at Răstoliţa (Mureş River Basin), a single individual sampled once in a pond with vegetation (A. Sárkány-Kiss, 1989), and two sites (a marsh and a dead branch) in the middle Olt River Basin (I. Sirbu et al., 1999). The same pattern is valid also for *Armiger crista* (Linnaeus, 1758). Often sampled in the XIXth century, it became very rare in the past decades in Transylvania. In the last years it was quoted once at Ungheni in some ponds that were soon after desiccated (A. Sárkány-Kiss, 1989). It still lives in two wetlands in the Cibin River Basin (tributary of the Olt River) in Sibiu and Şelimbăr (I. Sirbu and A. Curtean-Bănăduc, 2002). It was quoted in Banat, near Timişoara (Bega River), in Aranca River, several ponds in northern Banat, and Criş Rivers Basin (A.V. Grossu, 1941; L. Soós, 1943).

The most often encountered mollusc association in the Transylvanian reaches of the major rivers, is formed today by some few highly eurybiotic basommatophoran snails. The prosobranchs usually inhabit stable and larger habitats, being far less

tolerant to environmental fluctuations than the basommatophoran pulmonate gastropods. The species from the last group tend to have a worldwide distribution and to be ubiquitous, a lot of them being highly eurybiotic species inhabiting a broad range of habitats (R. MacMahon, 1983). When the life conditions are going down there is a switch from prosobranch-basommatophoran communities to pulmonate eurybiotic species domination.

The bivalves (naiads and clams) show different patterns as answers to degraded and/or polluted environment. The Unionidae need more stable and larger habitats with a certain quality of the abiotic factors, while the pisiids tend to group more tolerant, some even ubiquitous and eurybiotic, species, capable to inhabit all kind of habitats, from glacial lakes and springs to lowland temporary pools or - on the other side - great deltas and estuaries. The apparent rarity of some clams in the area of reference is mostly idle. Almost all species that were rarely found in the past are considered today much more frequent than it was assumed, because of better coverage of the field investigations and better research plans. Most old references concerning the Unionidae from the eastern tributaries of the Tisa River are out of date, because long sectors of all rivers were exposed to a severe human impact. The Unionidae and some freshwater prosobranch gastropods are more sensitive to pollution than most other systematic groups inhabiting the middle and lower rivers' sectors. When the mussels disappear, it means a serious damage of the self-supporting and self-cleaning capacities of the rivers and the debasement of life-condition and community fitness. A synthesis regarding the Unionidae from the Transylvanian tributaries of the Tisa River was published by A. Sárkány-Kiss (1997) and the first UTM distribution maps, highlighting the past and present-day distribution of these species were plotted last year (A. Sárkány-Kiss and I. Sirbu, 2001). It was pointed out that in all cases, the communities were forced to reduce their range and richness. Anyhow, in the past 10 years a trend of recovery was also noticed.

The temporal and spatial molluscs communities' dynamics from the Mureş River can be used as a case study. Until the 80's some Unionidae populated the whole river length (except the source region and one short hydro-geo-chemical barrier in the Gheorgheni Depression). In the upper river's basin *Unio crassus* Philipsson, 1788 and *Anodonta anatina* Linnaeus, 1758 were the dominant benthic species. In the middle and lower course there prevailed *Unio pictorum* Linnaeus, 1758, *Unio tumidus* Philipsson, 1788, *Anodonta cygnaea* Linnaeus, 1758 and - in a lesser extent - *Pseudanodonta complanata* Rossmässler, 1835. During the expedition in 1991 not a single individual was found downstream the point where the Târnava River flows into the Mureş. The heavy metals originated from Copşa Mică and discharged by this tributary represented the limiting factor that made the environment unsuitable for this species and a lot of other systematic groups. This caused the extinction of *Pseudanodonta complanata*, species that inhabited the river's middle and lower course. Downstream the confluence there were registered high concentrations of Cd (2 mg/l), Zn (147 mg/l), Pb (30 mg/l), Cr (75 mg/l) in the water and also high contents in sediments (Waijandt, 1995). This point was also the threshold for several other mollusc species mainly prosobranch gastropods. In the same period the debasement of Unionidae communities was also registered downstream the town of Tg. Mureş to the

confluence with Târnava River, mainly because of wastewater discharges. The absence of Unionidae was considered a major proof of human impact on the river's ecological state. In the years 1999 and 2000 the authors have found a new spatial dynamics of the Unionidae species. In the upper course *U. crassus* is still present with low densities, and - downstream Tg. Mureş, several other species like *A. cygnaea*, *A. anatina* and *U. pictorum*. These Unionidae have today a patchy distribution, in a spatial aggregate dispersal, both because of the availability of specific habitats and of the pollution and ballast excavations. In 2000 there were found Unionidae downstream the point where the Târnava River flows into Mureş. At Sântimbru and Vinţu de Jos, some few scattered individuals of *Unio pictorum* and *Anodonta cygnaea* have been found near the river-banks, proving a significant increase in both water and sediment quality. In the river's lower course one single individual of *A. cygnaea* was sampled near the town of Arad (leg. Doru Bănăduc), and it is highly probable that in the future the populations will regain some of their past range if the conditions are going to improve further.

Regarding the Unionidae communities, however, shrinking ranges and patchy distributions are still the most characteristic trends. The most threatened species is *Pseudanodonta complanata*, which has disappeared from the main part of the investigated area. It was quoted by E.A. Bielz (1853) in dead-branches in the Turnu-Roşu Gorges (Olt River) that have disappeared in time. It is considered extinct in Transylvania (in both Someş and Mureş basins), it is still present in the Criş Rivers Basin (A. Sárkány-Kiss et al., 1997), in the Tur River at the dam lake from Călineşti-Oaş (A. Sárkány-Kiss and I. Sîrbu, 1998), and in some rivers of the northern Banat, some belonging to the Tisa River Basin and some tributaries of the Danube (A. Grossu, 1941; P. Bănărescu and I. Sîrbu, 2002). Among the clams, the single seriously endangered species is *Sphaerium riviculum* (Lamarck, 1818). It is not known from the Someş and Olt rivers basins, and is extinct in the Mureş River (last quoted at Gălăuţuş, Subcetate; A. Sárkány-Kiss, 1989). In the Criş rivers basin it is still present in some few, scattered areas (A. Sárkány-Kiss et al., 1997) and the same is valid for Banat (I. Sîrbu, unpubl. data).

Conclusions

The poor mollusc fauna, indicating degraded environmental quality, was registered in the riverbeds of some sectors of the main rivers from Transylvania (especially in the upper course of the Olt River, the middle and lower courses of the Mureş and Someş rivers). The best ecological state was encountered in Banat, and also in the springs, rivulets and glacial lakes from the Carpathian Mountains. Despite the human impact, some scattered, small-sized wetlands have preserved their natural status, sheltering remnant mollusc communities that should be protected and that can serve in the future as natural sources for repopulation.

The present-day status of the freshwater mollusc fauna proves the great changes that have occurred in the past time, regarding the specific habitats and the quality of the freshwaters, in comparison with the situation registered by the malacologists from

the XIXth and the middle of the XXth Century. It is definite that the pollution and the hydrotechnical works, during the last 40 years, determine these changes. The aquatic molluscs have responded to environmental changes in several forms. Many species have a patchy distribution; some became rare or have disappeared from the main part of their former range. In these areas, the main trend is the prevailing of some eurybiotic basommatophoran pulmonates in correlation with the debasement of most prosobranch snails and of the Unionidae assemblages. However, in the past 10 years we have encountered a trend of recovery, because of pollution reduction.

Some species, namely *Theodoxus transversalis* C. Pfeiffer, 1828, *T. prevostianus* C. Pfeiffer, 1828, *Valvata cristata* O.F. Müller, 1774, *Melanopsis parreyssi* Philippi, 1847, *Anisus rotundatus* Poirer, 1801, *A. vorticulus* Troschel, 1852, *Bathyomphalus contortus* Linnaeus, 1758, *Armiger crista* (Linnaeus, 1758), *Pseudanodonta complanata* Rossmässler, 1835 and *Sphaerium riviculum* (Lamarck, 1818), are highly endangered, and need special attention and protection in the future.

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