

NEW DATA CONCERNING THE FRESHWATER MOLLUSCS FROM THE ROMANIAN SECTOR OF TIMIȘ RIVER (BANAT, ROMANIA)

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ABSTRACT

In the Romanian sector of the Timiș River, 31 species of freshwater molluscs have been found up to the present. Among them are 17 gastropod and 14 bivalve species (including all seven species of Unionidae that live in Romania, these found in the lower sector of the river – something that is extremely rare in our waters). The present synthesis used the results of a screening type field investigation carried out in 2011, as well as all the available data from the literature and our previous studies. All these data prove the ongoing degradation of the river's ecological state and its sheltered communities. This paper presents the annotated systematic and chorological checklist of the mollusc species from this area, some of its ecological characteristics and the main environmental issues related to human impact. Changes in species distribution and the structure of communities as an answer to increased human pressure during the last decades are also thus demonstrated. New data about some alien invasive species are given, including the first encounter with *Corbicula fluminea*, a species formerly known only in Romanian inland waters from the Danube, in the Timiș River lower sector.

RÉSUMÉ: Nouvelles données sur les mollusques d'eau douce du secteur roumain de la rivière Timiș (Banat, Roumanie).

Dans le secteur roumain de la rivière Timiș, 31 espèces de mollusques d'eau douce ont été trouvées jusqu'à présent. Parmi celles-ci se trouvent 17 espèces de gastéropodes et 14 espèces de bivalves (y compris les sept espèces d'unionidae roumaines se trouvant dans le secteur inférieur de la rivière - ce qui est extrêmement rare dans nos eaux). Dans la présente synthèse, les résultats d'une campagne de terrain faite en 2011, les résultats de nos études antérieures et toutes les données disponibles dans la littérature ont été utilisés. Toutes ces données confirment la dégradation continue de l'état écologique de la rivière ainsi que de ses communautés. Cet article présente la liste systématique et chorologique des espèces de mollusques de cette zone, certaines de leurs caractéristiques écologiques et les principaux problèmes environnementaux liés à l'impact des activités humaines. Les changements de la distribution des espèces et de la structure des communautés, comme une réponse à l'augmentation de la pression humaine au cours des dernières décennies, sont également indiqués dans cette synthèse. De nouvelles données sur certaines espèces exotiques invasives sont présentées, y compris le premier relevé de *Corbicula fluminea* dans le secteur inférieur de la rivière Timiș, une espèce autrefois connue dans les eaux intérieures roumaines du Danube.

REZUMAT: Noi date cu privire la moluștele dulcicole din sectorul românesc al râului Timiș (Banat, România).

În sectorul râului Timiș din Banat, România, au fost identificate până în prezent 31 de specii de moluște dulcicole, dintre care 17 specii de gastropode și 14 de bivalve (inclusiv toate cele șapte specii de Unionidae care trăiesc în România au fost identificate în sectorul inferior al râului, fapt care se constată extrem de rar în apele noastre). În sinteza de față sunt utilizate toate datele originale și bibliografice, la care se adaugă rezultatele unei campanii de cercetare desfășurate în 2011, toate acestea demonstrând continua degradare a stării ecologice a râului și a comunităților adăpostite de acesta. Lucrarea de față prezintă o listă actualizată sistematică și corologică a speciilor, unele observații cu privire la ecologia lor, precum și principalele probleme legate de impactul antropic în aria de referință. Modificări spațiale și temporale ale distribuției speciilor și ale structurii comunităților, ca răspuns la presiunile antropogene, sunt de asemenea prezentate. Noi date privind unele specii alohtone invazive sunt prezentate, inclusiv prima semnalare a speciei *Corbicula fluminea* în sectorul inferior al Timișului, cunoscută anterior în România numai din apele Dunării.

INTRODUCTION

The Banat is the southwestern province of Romania, bordered by the Mureș River in the North, the Danube in the South and the Southern Carpathian mountains in the East. The Timiș River drains a significant part of its central and northern area. It is the largest interior river from Banat, originating from Semenic Mountains, with a length of 339.7 km (241.2 km on Romanian territory) and a surface of the hydrographic basin of 13.085 km². It passes outside the Romanian border at Grăniceri locality, which is the last sampling station concerning the present paper. The remaining 100 km are on Serbian territory and at the level of the Pančevo locality it flows into the Danube. Some scattered material and information regarding the freshwater Mollusca from Banat date back to the XIXth Century. Most naturalists studied terrestrial molluscs, especially from mountain areas, the aquatic species being only seldom quoted. The few mentions usually give no exact toponyms. However, some data are available from the collections of Bielz, Kimakowicz, Licherdopol, Grossu, and others. These collections are preserved mainly in the Museum of Natural History in Sibiu and the “Grigore Antipa” National Museum of Natural History in Bucharest. Some published historical data are available from Bielz (1867), Kimakowicz (1883-1884), and Clessin (1887). In the XXth Century, the faunistical data become more numerous. Most papers from the middle part of the century, concerning also the freshwater Mollusca, belong to Grossu and were synthesized in his tomes concerning the bivalves (1962) and the gastropods (1986, 1987) from Romania. Beginning with 1998 the authors of the present paper organized several sampling trips in the Romanian Banat, inclusively the Timiș River, which was researched three times along its entire Romanian course, from the source area down to the point it passes outside the border. Some published papers, with references to this subject and area, dealt with the distribution of the *Pisidium* species in Banat (Sîrbu, 2002; Sîrbu and Benedek, 2004), data regarding the diversity of the freshwater species from Banat (Bănărescu and Sîrbu, 2002), the Mollusca fauna from Timiș River (Sîrbu, 2004), data regarding the distribution and ecology of several groups from the regional molluscs' fauna (Sîrbu et al., 2006; Sîrbu et al., 2010; Sîrbu, 2011). The freshwater molluscs from this river are better known compared to those from most of the Romanian running waters. However, during the screening type field survey, carried out by the authors in 2011, some new and remarkable features of mollusc communities have been discovered. Among them, the propagation of a new invasive species, changes in the longitudinal species distribution and in communities structure, in the presence and magnitude

of the human impact. Thus, based on new evidence, the authors highlight the changes that occurred in the ecological state of the river and its freshwater molluscs during the last decade. The field survey from August 2011 was done in the frame of a study concerning the quality of the Timiș River, from the springs down to the border with Serbia, as a part of a Romanian-Serbian partnership program.

STUDY AREA AND METHODS

The annotated checklist of freshwater molluscs from the Timiș River (Romanian territory) is based on all available references and collections, as well as on the authors' research accomplished since 1998. The new data are coming from a field survey, carried on in August 2011. The sampling sites were selected according to geomorphologic and hydrologic features, but also to the presence of human impact sources. The molluscs were sampled by hand, by sieves or dredges. The naiads (Unionidae bivalves) were random sampled, studied, measured, weighted and released in their natural habitat. Experimental and sampling designs were adapted adequately to the local features of each station.

The sampling stations from 2011 are localized, codified and characterized according to table 1 (the GPS coordinates are given in terms of degrees and decimal minutes).

Table 1: Sampling stations along the Timiș River, during August 2011 field survey.

Code	GPS coordinates	Sampling station's toponime and features
S1	45°11.994' N/ 22°08.408' E Elevation = 862 m	Timiș riverbed (Semenic Valley), as well as ponds and brooks in the flood area.
S2	45°13.139' N/22°06.204' E Elevation = 850 m	Grădiște brook tributary of the Trei Ape Lake, between the villages of Gărâna and Brebu Nou, as well as brooklets and helokrenik springs.
S3	45°13.679' N/ 22°08.904' E Elevation = 847 m	Brook tributary of the Trei Ape Lake, 100 m upstream its flow, at the level of Brebu Nou Village.
S4	45°12.648' N/22°08.879' E Elevation = 847 m	Brooklets and springs near the banks of the Trei Ape Lake.
S5	Transect between: 45°13.137' N/22°07.688' E and 45°12.914' N/22°08.693' E Elevation = 847 m	The Trei Ape Lake (artificially built dam-lake; transect done by boat and dredging)
S6	45°12.823' N/ 22°09.204' E Elevation = 819 m	Timiș River, downstream the Trei Ape Lake
S7	45°09.595' N/ 22°16.528' E Elevation = 436 m	Timiș River, upstream the Teregova locality, close to the exit from the mountains narrows, upstream its entrance in the Timiș-Cerna corridor.
S8	45°13.101' N/ 22°18.277' E Elevation = 333 m	Timiș River in the Timiș-Cerna corridor, close to the Piatra Scrisă Monastery.
S9	45°22.494' N/ 22°13.580' E Elevation = 234 m	Timiș River, upstream the town of Caransebeș, at Buchini Village.
S10	45°29.129' N/ 22°11.070' E Elevation = 177 m	Timiș River 9 km downstream the town of Caransebeș
S11	45°40.239' N/21°58.064' E Elevation = 128 m	Timiș River at Lugojel Village
S12	45°44.290' N/ 21°51.263' E Elevation = 117 m	Entrance in the Timiș-Bega channel, about 300 - 400 m along the banks, downstream the dam, at Coșteiu..

Table 1 (continuing): Sampling stations along the Timiș River, during August 2011 field survey.

Code	GPS coordinates	Sampling station's toponime and features
S13	45°44.290' N/ 21°51.263' E Elevation = 117 m	Timiș riverbed, downstream the dam at Coșteiu locality.
S14	45°43.682' N/ 21°31.678' E Elevation = 99 m	500 m sector of the Timiș River, centered in the specified coordinates, at the bridge between Topolovățu Mare and Hitiaș localities.
S15	45°42.702' N/ 21°24.555' E Elevation = 91 m	Timiș River at the bridge towards Albina Village; about 500 m researched sector of the riverbed.
S16	45°38.661' N/ 21°11.035' E Elevation = 88 m	Timiș River at Șag, upstream the dam.
S17	45°29.508' N/ 21°00.995' E Elevation = 76 m	Timiș River at Rudna Village
S18	45°26.843' N/ 20°53.289' E Elevation = 73 m	Timiș River at the bridge from Grănceri Village, upstream the border with Serbia.

The systematics is given according to Glöer (2002), Glöer and Meier-Brook (2003), than to Fauna Europaea v. 2.6.2, namely the lists compiled by Bank (v. 2.4, updated on 27 January, 2011) for gastropods, and by Araujo (v. 2.0, updated on 10 December 2009) for bivalves, as well as Welter-Schultes (2012). The aim of both the field investigations carried out in 2011 and this paper is to trace the recent changes in environmental quality and human pressure, by using the freshwater molluscs as bioindicators of the river's ecological state

The annotated checklist of freshwater molluscs from the Timiș River (Romanian sector) is given below. Only the new data (i.e. from the investigation carried out in 2011) are explicitly detailed, the former information from references have already been gathered and published in the synthesis of Sîrbu et al. (2010). Thus, only the related sources of older data are given. If only the paper published by Sîrbu et al. (2010) is quoted, this mean that the species was found during the field investigations carried out between 1998 and 2002, and more information is available in that synthesis only (available on www.travaux.ro).

The annotated checklist of the freshwater molluscs' species found in the Timiș River

Classis Gastropoda Cuvier, 1795

Ordo Architaenioglossa Haller, 1890

Familia Viviparidae J. E. Gray, 1847 (1883)

1. *Viviparus acerosus* (Bourguignat, 1862)

References: Sîrbu et al. (2010).

Ordo Neotaenioglossa Haller, 1892

Familia Hydrobiidae Troschel, 1857

2. *Lithoglyphus naticoides* (Pfeiffer, 1828)

References: Bănărescu leg. (in the years of 1980), Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): in the Timiș riverbed at Hitiaș (S14), downstream of Albina (S15), Șag (S16), Rudna (S17) downstream to Grădinari (S18).

3. *Bythinella dacica* Grossu, 1946

References: Grossu (1946, 1986).

New data (leg. Sîrbu I. and Sîrbu M., 2011): brooks in the Semenici Valley (S1), springs and brooks close to the Trei Ape (S4), and springs near the riverbed, in the valley, upstream Teregova (S7).

Ordo Ectobranhia P. Fischer, 1884**Familia Valvatidae J. E. Gray, 1840**

4. *Valvata piscinalis* (Müller, 1774)

References: Sîrbu et al. (2010).

Ordo Pulmonata Cuvier in Blainville, 1814**Familia Lymnaeidae Lamarck, 1812**

5. *Galba truncatula* (Müller, 1774)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): along the Timiș riverbanks at Grăniceri (S18).

6. *Radix auricularia* (Linnaeus, 1758)

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș River at Hitiaș (S14) and Rudna (S17).

7. *Radix labiata* (Rossmässler, 1835)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): brook at Brebu Nou (S3), brooks and puddles near the Trei Ape Lake (S4), Timiș River downstream Trei Ape Lake (S6); brooks and springs upstream Teregova (S7);

8. *Radix balthica* (Linnaeus, 1758)

New data (leg. Sîrbu I. and Sîrbu M., 2011): Trei Ape Lake (S5).

9. *Lymnaea stagnalis* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

Familia Physidae Fitzinger, 1833

10. *Physella acuta* (Draparnaud, 1805)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș River at Piatra Scrisă Monastery (S8)

Familia Planorbidae Rafinesque, 1815

11. *Planorbarius corneus* (Linnaeus, 1758)

References: Clessin (1887), Sîrbu et al. (2010).

12. *Planorbis planorbis* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

13. *Anisus spirorbis* (Linnaeus, 1758)

References: Bielz (1867).

14. *Anisus vortex* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

15. *Gyraulus albus* (Müller, 1774)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Trei Ape Lake (S5).

16. *Ferrissia wautieri* (Mirolli, 1960)

New data (Sîrbu I. and Sîrbu M., 2011): Trei Ape Lake (S5).

17. *Ancylus fluviatilis* Müller, 1774

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Semenicultui Valley (S1), Grădiște brook (S2), brook at Brebu Nou (S3), Timiș riverbed downstream Trei Ape Lake (S6), along its course further to Teregova (S7), in the Timiș-Cerna corridor up to the Piatra Scrisă Monastery. In the rest of its flow, the species was no longer found due to the mechanical damage of the riverbed, caused by anthropic activities.

Classis Bivalvia Linnaeus, 1758
Ordo Unionoida Stoliczka, 1871
Familia Unionidae Rafinesque, 1820

18. *Unio pictorum* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): empty shells at Hitiaș (S14), living individuals at Albina (S15), Șag (S16), shells at Rudna (S17), scattered individuals at Grăniceri (S18).

19. *Unio tumidus* Philipsson, 1788

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș riverbed at Șag (S16).

20. *Unio crassus* Lamarck, 1819

References: Grossu (1962), Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): few individuals downstream Caransebeș (S10), at Lugojel (S11), increased number at Hitiaș (S14), highly abundant at Albina (S15) and Șag (S16), only empty shells at Rudna (S17) and several scattered individuals at Grăniceri (S18). Discontinuous distribution along the lower sector of the river.

21. *Anodonta cygnaea* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș River at Hitiaș (S14), Albina (S15), Șag (S16) and Grăniceri (S18);

22. *Anodonta anatina* (Linnaeus, 1758)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș River at Albina (S15) and Grăniceri (S18)

23. *Sinanodonta woodiana* (Lea, 1834)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Timiș River at Hitiaș (S14), Albina (S15), Șag (S16) and Grăniceri (S18);

24. *Pseudanodonta complanata* (Rossmässler, 1835)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): only empty shells at Hitiaș (S14), living individuals at Albina (S15) and Șag (S16).

Ordo Veneroida H. and A. Adams, 1856

Familia Corbiculidae J. E. Gray, 1874

25. *Corbicula fluminea* (O. F. Müller, 1774)

New data (leg. Sîrbu I. and Sîrbu M., 2011): alien invasive species; until the 8th of August 2011 it was known in Romania inhabiting only the Danube River. This is the first finding in other inland waters of the country. Timiș River at Rudna (S17) and Grăniceri (S18).

Familia Sphaeriidae Deshayes, 1855 (1820)

26. *Musculium lacustre* (O. F. Müller, 1774)

New data (leg. Sîrbu I. and Sîrbu M.): Trei Ape Lake (S5);

27. *Pisidium amnicum* (O. F. Müller, 1774)

References: Sîrbu et al. (2010).

28. *Pisidium casertanum* (Poli, 1791)

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): brooks and puddles in the Semenice Valley (S1), brooks and springs near Brebu Nou (S3), brooks close to Trei Ape Lake (S4), Timiș River downstream the Trei Ape Lake (S6), brooks close to Teregova (S7).

29. *Pisidium personatum* Malm, 1855

References: Sîrbu et al. (2010).

30. *Pisidium milium* Held, 1836

References: Sîrbu et al. (2010).

31. *Pisidium subtruncatum* Malm, 1855

References: Sîrbu et al. (2010).

New data (leg. Sîrbu I. and Sîrbu M., 2011): Trei Ape Lake (S5), Timiș River downstream Caransebeș (S10).

Up to the present there are 31 species of aquatic molluscs known from the Romanian sector of the Timiș River. Among them are 17 species of gastropods and 14 of bivalves. The main feature of the mollusc communities in this river is the presence in the lower sector of all the seven naiads species that live in our freshwaters, something that is extremely rarely found in Romania. Before 1998, when the authors begun their research, only five species of freshwater molluscs have been quoted in the Timiș River basin. Between 1998 and 2002, 24 species have been found and their location as well as distribution on longitudinal gradient was documented (Sîrbu et al., 2010). In the last field investigation in August 2011, 22 species were found. Among them five are new findings in this basin. Considering the past and new data about the Mollusca and the observations on the ecological state of the river and its surroundings, several sectors can be distinguished along its longitudinal gradient, characterized by specific composition and communities' structure, environmental features, human impact sources and related issues. The changes occurred across time and space, as well as the characterization of the mentioned sectors are discussed below.

Temporal and spatial changes of freshwater molluscs' populations and communities along the Timiș River, due to environmental features and human impact issues. Ecological classification of the Timiș River sectors.

In order to establish a realistic classification of the Timiș River sectors based on reliable basis, a multicriterial system has to be considered. This is based on temporal and spatial (longitudinal gradient analysis) changes in specific composition of freshwater molluscs communities, specific diversity, the type and state of specific habitats, bioindication value of some species, water flow features, Unionidae communities structure and changes in relation to anthropic activities, as well as the placement, types and pressure of impact sources. Based on these criteria and all the available information that could be gathered in the field researches, as well as from references, the main ecological classification of the river sectors' and their specific features and issues are given below.

Sector 1. The mountains sector, between the springs and the Trei Ape Lake

It is inhabited by a characteristic flowing, well oxygenated waters, hard substratum, confined Mollusca fauna, with rheophyllic (*Ancylus fluviatilis*) or krenbiotic species (*Bythinella dacica*), and some species adapted to small stagnant or flowing waters, which can be frozen or dried out most part of the year. The human impact in this sector is generally reduced, being caused by collateral effects of forest exploitation, road developments, tourism facilities, and traditional economical activities.

Sector 2. The Trei Ape Lake

This is an artificial lake, formed by the building of a dam in the spring area, for economic purposes. The main three rivulets that flow together and form the Timiș River supply it. Being a new, atypical habitat for the surrounding mountain landscape, it was surely colonized from outside, by some lentic, psamo-pelophylic and macrophytophylic freshwater mollusc species. It causes also physical and chemical changes in the water features downstream, as well as a fragmentation of the longitudinal distribution of some native species. Some species have been found only in this sector, like *Radix balthica*, *Ferrissia wautieri*, and *Musculium lacustre*. During the past decades, but especially in the last few years, the tourism has flourished in the area, the high number of facilities and humans, especially during holidays, represent obvious sources of impact, especially linked to habitat degradation, hips of wastes found everywhere, bathing and overfishing, household wastewater discharges in the lake and tributaries from an accelerated growing number of buildings and villas, etc.

Sector 3. The Timiș River between the Trei Ape Lake and Teregova (entrance in the Timiș-Cerna corridor)

This sector is the remaining part of its mountain course, behaving like a typical river for this elevation and landscape, and sheltering the characteristic Mollusca fauna. Downstream the lake its impact is obvious. However, the steep slope and velocity of the water help the self-cleaning processes, and after a short sector it has all the features of a mountain river, sheltering once again the specific Mollusca fauna.

Sector 4. The Timiș River sector in the Timiș-Cerna corridor, downstream to the town of Caransebeș.

Comparing the state of the river witnessed in 2011 to that observed during the 1998 - 2002 field campaigns, a debasement of its ecological state is obvious along this sector. The main cause is the destruction of the riverbed caused by the so-called recalibration of the valley, and the many ballast excavations along the river's course. The bulldozers, excavators, and shovels operate within the riverbed, and the whole riverscape is destroyed. The trucks are loaded on both sides of the river and displace huge amounts of sediments and ballast. The working points are frequently found along the main part of the lower stretch of this sector. In some areas, there are no living molluscs at all, and most benthic groups are absent, because the whole substratum is or was rummaged and there is no more natural habitat. The rheo-oxyphylic species *Ancylus fluviatilis* inhabits a much shorter sector than it used during the beginning of this century, and its distribution is discontinuous along the sector where it still lives. Its last sampling point in 2011 along the river was in the Timiș-Cerna corridor at Piatra Scrisă (S8) Monastery. The anthropic destruction of the entire rivers' ecosystems are outraging.

Sector 5. The Timiș River between the town of Caransebeș and Coșteiu Village

This sector is delimited by the main locality of the entire region, Caransebeș town, and the location where the river's water is drained towards the river Bega, by the artificial Timiș-Bega canal. The ecological state of this sector was significantly degraded in 2011 compared to the status recorded in 1998-2002, the causes being the same as those mentioned for the previous sector. The riverbed and its specific habitats are severely denaturalized by ballast excavations and hydrotechnical works, the sedimentation is excessive, communities are poor and the longitudinal range of most mollusc species are highly fragmented. There are some patches inhabited by *Unio crassus*, but their number, as well as the abundance of the species, are lower than it was noticed one decade before.

Sector 6. Downstream the dam from Coșteiu Village

The dam was built here in order to capture the water and lead it through the Timiș-Bega canal. The sector downstream this dam, is the most destroyed and degraded, compared to all the other sectors, because the physical damage of the riverbed. No natural features of the valley's river are present. Not a single mollusc species has been found in the river, a fact that proves the extreme damage of the ecosystem.

Sector 7. The Timiș River sector between Hitiaș and Șag villages

An improvement of the ecological status is recorded, proving the river's capacity of self-cleaning and recovering. Although ballast excavations and hydrotechnical works are still present and interrupt the continuity of specific habitats as well as the river's continuum, the mollusc communities are still capable to adequate to this fluctuant environment and to colonize the microhabitats available during the periods of relative stability. The Mollusca fauna and communities' structure indicate a more altered state than one decade before, but the improvement, considering the status of the upstream, as well as the downstream sector, is obvious. In present, it is still the best-preserved sector, in the middle and lower Timiș River.

At Hitiaș the authors sampled in 2011, by simple randomized sampling, 63 individuals of Unionidae, from a sandy layer, close to the riverbank, the specific habitat. The community structure in terms of relative abundance (RA%), as well as relative dominance - ratio of weight (RD%), considering the total mass of living individuals, are given in figure 1, respectively in figure 2. *Unio crassus* is prevailing in terms of abundance (81%), while the alien invasive species *Sinanodonta woodiana* is the dominant species in terms of weight (66%).

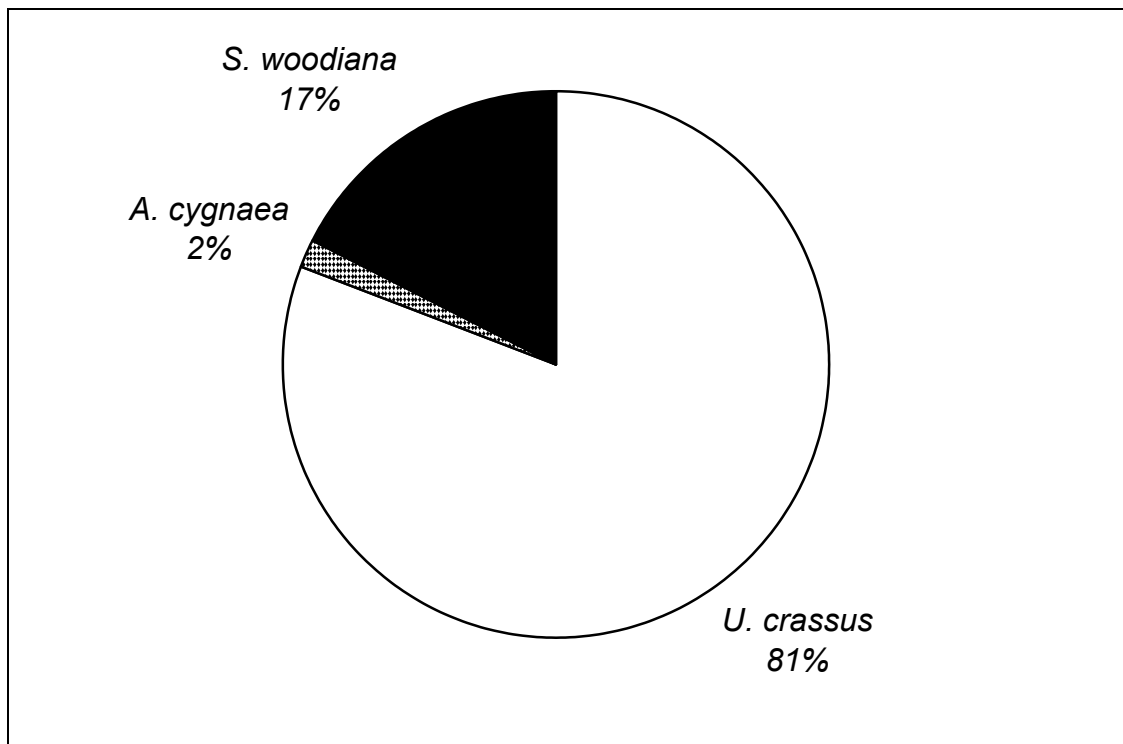


Figure 1: The Unionidae community structure in the Timiș River at Hitiaș (S14), in terms of relative abundance (RA%); 63 individuals were randomized sampled in August 2011.

In the year 2002, at the same level, there were values of 60% RA and 55% RD for *Sinanodonta woodiana*, while for *Unio crassus* the values were of 20% RA and 15% RD (Sirbu et al., 2006). Comparing the two structures, it is possible that, in time, *U. crassus* became more abundant, while *S. woodiana* is represented by fewer individuals, but these are heavier, consolidating its dominance within the community. This fact might suggest a new phase in the colonizing strategy of the alien invasive species, maybe a switch from the former r-selected invasive level (in 2002 there were many young individuals), towards a K-selection trend of population dynamics.

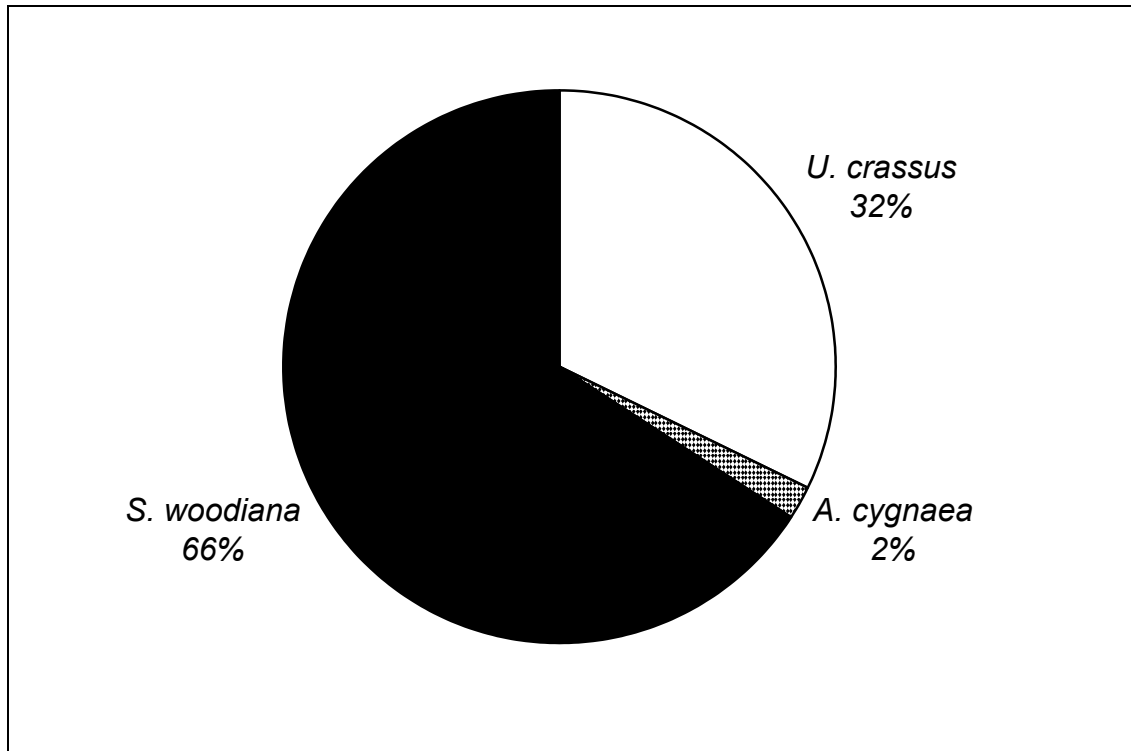


Figure 2: The Unionidae community structure in the Timiș River at Hitiaș (S14), in terms of relative dominance (RD%); the total weight of the 63 sampled individuals was 3876.5 g.

In August 2011, the Unionidae community structure was also studied downstream, close to the village of Albina (S15), by the same means. 95 individuals were randomly sampled. They belong to five species. The relative abundance structure is given in Figure 3 and the relative dominance in Figure 4. Once again, *Unio crassus* is prevailing in terms of individuals' number, while in terms of dominance *U. crassus* and *S. woodiana* are co-dominant (39% and, respectively 37%). The difference between the structures of the last two sampling stations is most probably linked to the river's habitat features, but also to the human impact. At Hitiaș, the river was broad and disturbed by a ballast excavation, while at Albina there are no traceable human activities, at least not in the last few years, and the river is in a more natural condition.

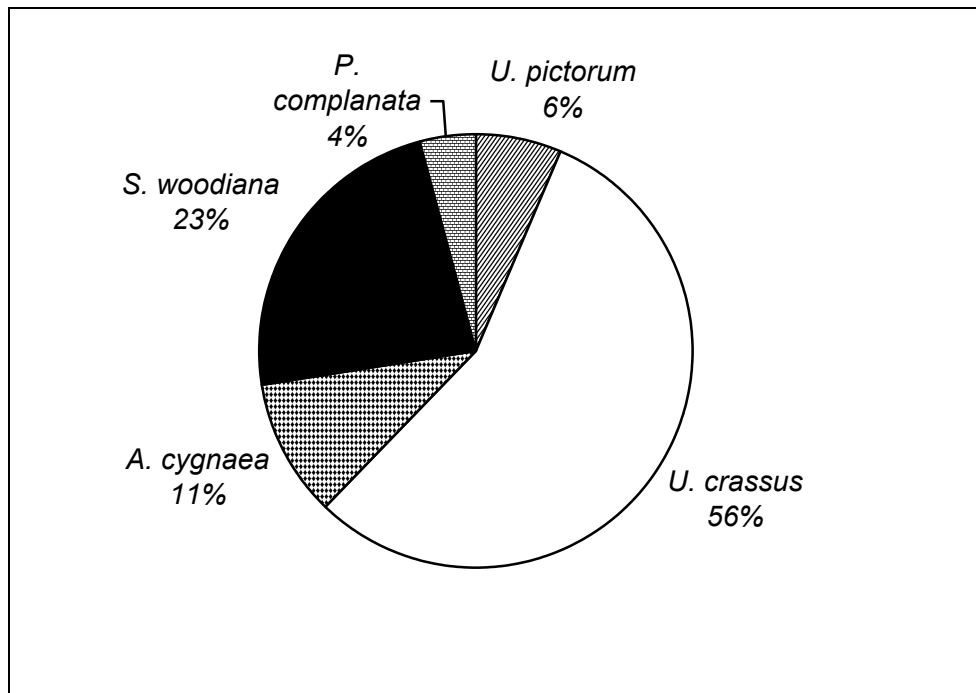


Figure 3: The Unionidae community structure in the Timiș River at Albina (S15) in terms of relative abundance (RA%) - 95 individuals have been randomly sampled in August 2011.

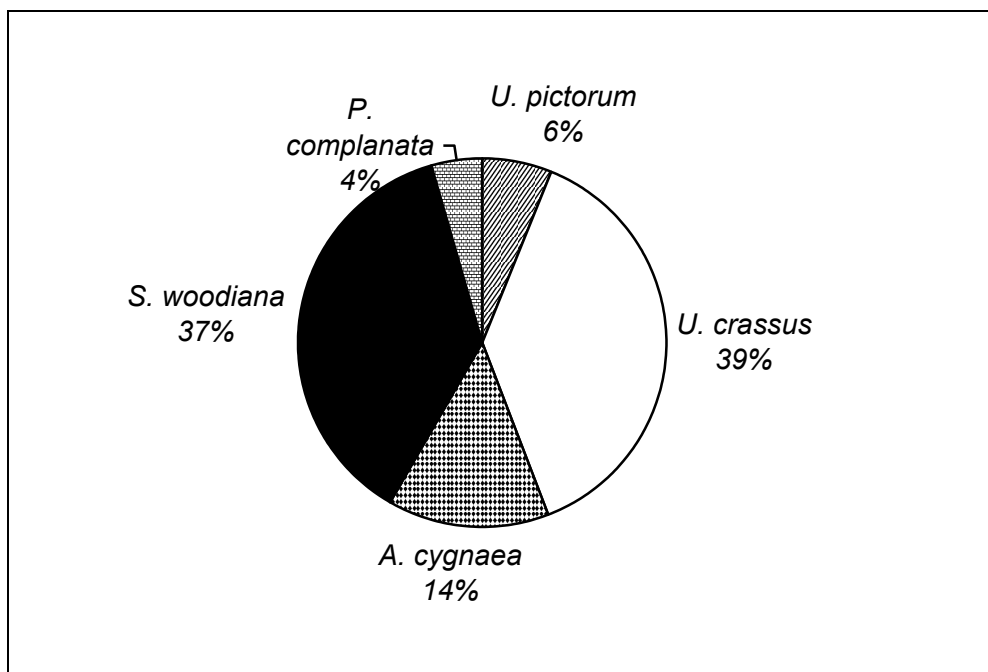


Figure 4: The relative dominance (RD%) structure of the Unionidae community at Albina (S15); the total weight of the 95 individuals was 3622.7 g.

Sector 8. The last sector on Romanian territory, between Șag and Grăniceri.

In this sector occurs a new degradation of the river's ecological state, compared to the upstream adjacent sector. Both the riverbanks and the riverbed are artificially changed, ballast excavations are, or were in the past, placed too close, the hydrotechnical works, channeling and embankments destroy a large part of the river's structure and functions. In most parts, this sector looks almost like a human-made canal. A mass mortality of bivalves was observed, especially in the lower stretch, where specific habitats are scarce, and stable sediments are in small and rare patches distributed along and close to the riverbanks. Still, there are some areas with a relatively high diversity and abundance of molluscs, inclusively Unionidae and prosobranch gastropods. This is the sector in which, during the field survey accomplished in 2011, the authors have first found the alien invasive species *Corbicula fluminea*.

The Unionidae communities' dynamics shows the changes which took place in the last decade in respect of human pressure. In the upper reach of this sector, at Șag (S16), the river was investigated three times, in 2000, 2002 and 2011, by a longitudinal transect of about 1000 m, centered in the bridge of the Timișoara - Deta road. Severe changes were obvious since the beginning of the study. In the year 2000 the river was literally paved with Unionidae, in cross-section, from one riverbank to the other, and all the seven species known from Romania were present (facts extremely seldom encountered in our waters), and their abundance was very high, the maximum exceeding 100 individuals/m². Among gastropods *Lithoglyphus naticoides* characteristically inhabited continuously the riverbed, in stripes close to the riverbanks. This sector hosted probably the most diverse and abundant community of naiads in the Romanian Western Plain. In the summer of 2002 the river was crossed by a small dam, built in the meantime, with a narrow opening in the middle part, which changed the whole riverbed structure and water flow features. The Unionidae community spatial dynamics was different than registered before. In order to show the spatial small-scale effect of this dam, we established three sampling stations: the first (1) at about 500 m upstream, the second (2) in the close vicinity of it at about 10-20 m, and the third (3) within of a 400 m line-transect downstream. The data are shown in table 2 and figure 5 (some data were partially published by Sirbu et al., 2006).

Table 2: The Unionidae community structure at Șag, during the field-survey from 2002.

Parameter and station	<i>U. tumidus</i>	<i>U. pictorum</i>	<i>U. crassus</i>	<i>A. anatina</i>	<i>S. woodiana</i>	TOTAL
1. Above the dam						
No. of individuals	4	3	11	0	0	18
RA%	22.22	16.67	61.11	0	0	100
Total weight (G)	108	26.5	88	0	0	222.5
RD%	48.54	11.91	39.55	0	0	100
2. At the dam						
No. of individuals	2	0	3	4	4	13
RA%	15.38	0	23.08	30.77	30.77	100
Total weight (G)	16	0	24.5	35	39.5	115
RD%	13.91	0	21.30	30.43	34.36	100
3. Downstream						
No. of individuals	0	1	49	0	0	50
RA%	0	2	98	0	0	100
Total weight (G)	0	47.5	1710.5	0	0	1758
RD%	0	2.70	97.30	0	0	100

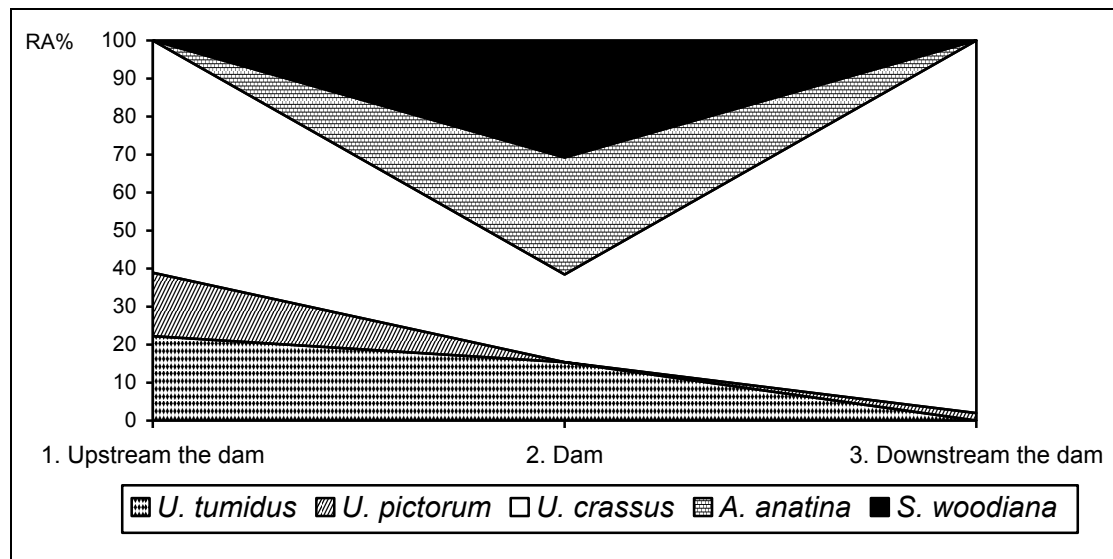


Figure 5: The Unionidae community structure (in terms of relative abundance RA%) and space-dynamics at small-scale in the Timiș River at Șag in the summer of 2002, showing the effect of a newly built dam across the river.

The dam built between the fall of 2000 and the summer of 2002, caused a steep reduction of naiads' abundance as well as diversity (two out of five species have not been found). The slowing of the water flow upstream the dam (station 1), still is prone for all the three *Unio* species; close to the dam the slow speed and muddy sediments, favor the settlement of a lentiphyllous community: the rheophyllous species *U. crassus* shows a low RA% value, being outnumbered by *A. anatina* as well as *S. woodiana*. Downstream the dam, the river flows with high velocity, the favourable sediments are placed in a narrow band along one riverbank, the single microhabitat inhabited by naiads, and the community consists almost only of *U. crassus* (best adapted to these conditions), while only one individual of *U. pictorum* was found within the sampling transect.

This case study has two meanings: showing how a simple human activity in the riverbed causes serious changes in the communities, and how finely tuned the Unionidae may respond, and adequate to this newly formed conditions.

In 2011, the status of the naiads above the dam (also about 500 m upstream), was different. 108 individuals were sampled by simple randomized method, from the specific habitat (0.5 - 2 m from the riverbank). *U. crassus* prevailed both in terms of abundance and weight (Fig. 6 and Fig. 7), while all the other species show values below 10%. Considering the ratios, they seem like those registered in 2002, but the total abundance of the community increased significantly. The naiads were found in densities with maximum values exceeding 100 individuals/m², as it was stated in the year of 2000, before the dam was built. During the last decade, the community has recovered and structured adequately. This is a new proof of the river's capacity of resilience, but also a measure of the Unionidae populations and communities' ecological adaptability.

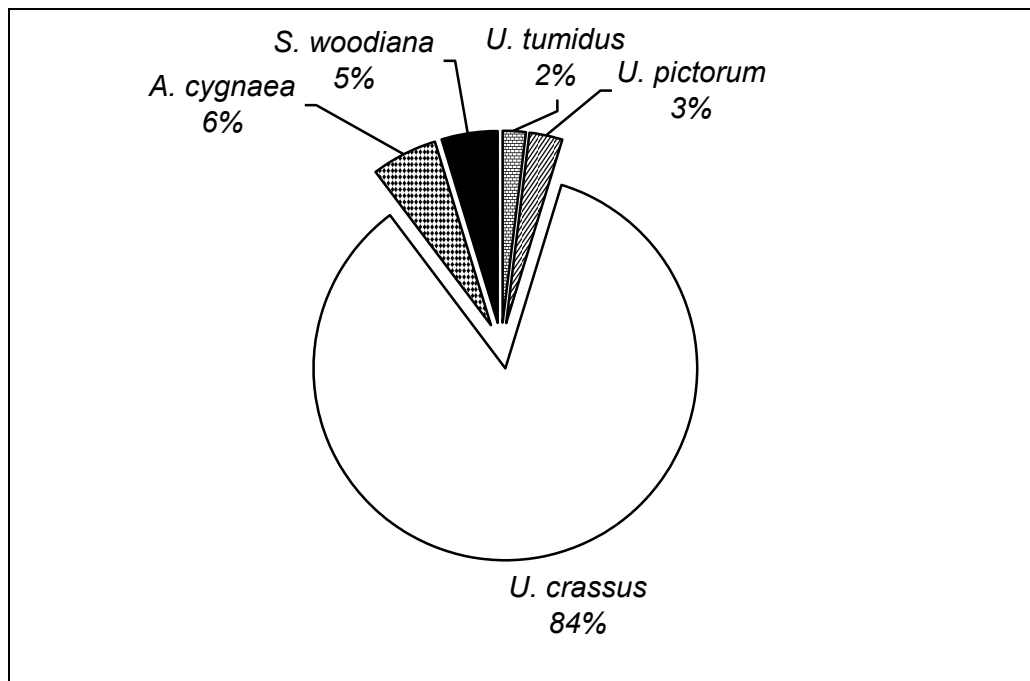


Figure 6: The Unionidae community structure in terms of relative abundance (RA%) in the Timiș River at Șag (S16) in August 2011 - 108 individuals were randomly sampled.

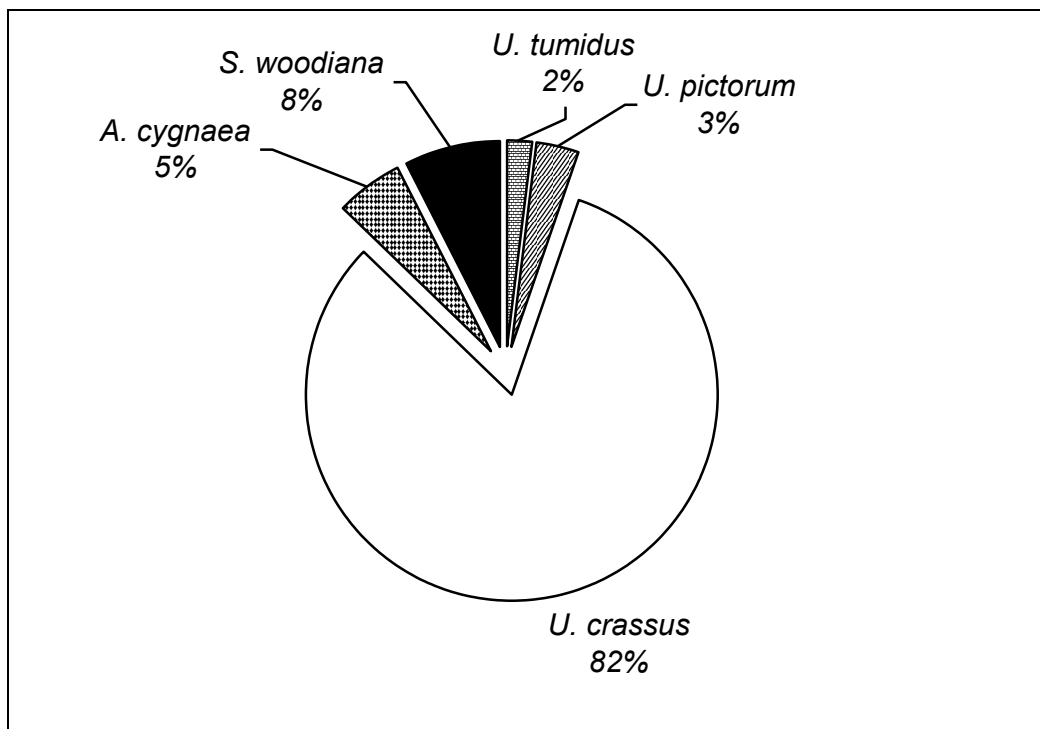


Figure 7: The Unionidae community structure in terms of relative dominance (RD%) in the Timiș River at Șag (S16) in August 2011 - the total weight of the 108 sampled individuals was 2798.5 g.

During the field survey from 2011, downstream Șag Village, at Rudna (S17) and Grăniceri (S18), the last locality on Romanian territory, as well as the final location of this study, the river is once again degraded by ballast excavations, embankments, and hydrotechnical works. At Rudna (S17) a mass-mortality of naiads and a very low diversity of molluscs were noticed. In the last sampling station, at Grăniceri (S18), the river embankment is ongoing, and the water flow is linear between high narrow banks. There is no flood area anymore. Only along one riverbank, less destroyed, a narrow band of sand still shelters scattered individuals of naiads, placed in a single, interrupted row. Along a 200 m transect, a reduced number of Unionidae (34 individuals) were found, sampled, analyzed, and released. The relative abundance structure of this poor community is shown in figure 8. Once again, *U. crassus* prevails in terms of abundance (85% RA), while the other three species show reduced ratios. Most likely these are not confined to this habitat, but drifted from upstream sectors.

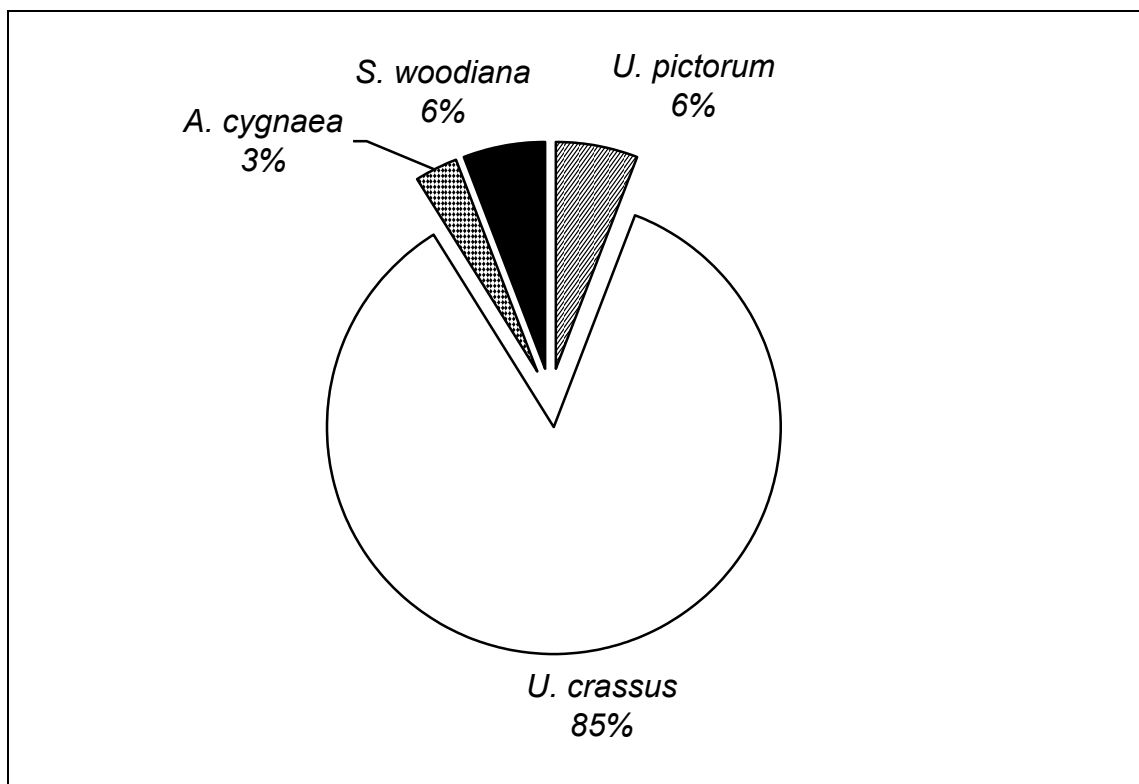


Figure 8: The Unionidae community structure in terms of relative abundance (RA%) in the Timiș River at Grăniceri (S18) during August 2011 - 34 individuals were sampled along a 200 m line transect.

CONCLUSIONS

In the Romanian area of the Timiș River basin, most of its ecological systems are of high quality in their upper sectors (Fig. 9), but prove certain effects of the human impact in their middle and lower sectors.

This river was drastically and unjustifiably degraded, from ecological point of view, during the last decades, and especially in the last years, mainly by mechanical human impact (hydrotechnical plants, embankments, ballast excavations, dams, etc.).

Some sectors are highly damaged (Fig. 10 and Fig. 11), and present a debasement of environmental quality and alteration of the lotic ecosystems' structure and functions.

By contrast to other rivers of Romania, the chemical and biological pollution seem relatively reduced and have a lesser impact.

Despite these facts, the Timiș River still has a remarkable self-cleaning and self-sustaining potential, proved by some sectors with improved ecological state, respectively by the higher parameter values of some freshwater mollusc communities, with certain environmental demands. They have narrow ecological valences, sustaining a series of essential functions of this riverscape (like those of water filtering and cleaning, stabilizing substratum and facilitating the sedimentation, reducing turbidity, being essential resources for other food-levels and links within the tropho-energetic structure, etc.).

Against all odds, this river still shelters high abundances of bivalves and gastropods of ecological and zoological value, but the increasing and ongoing human impact could be a certain menace in the future.

There is still a remarkable and abundant population of *Unio crassus* (Fig. 12), a species included in Annex II of EUHSD (92/43/EEC 1992), also known as the Habitats Directive, which inhabits especially the Hitiș-Șag river sector, but in full decrease of its ecological quantitative parameters between the localities Caransebeș and Coșteiu, as well as in the last lower sector, until the Romanian - Serbian border.

The lower Timiș River sectors shelters also an abundant population of *Pseudanodonta complanata* (Fig. 13), a species that is strictly protected by the Romanian legislation.

According to the evidence of the field surveys, as well as to the aquatic mollusc communities spatial dynamics, the Romanian sector of the Timiș River can be divided in eight different sectors, delimited by ecological and human impact features.



Figure 9: Dredging in the Trei Ape Lake, in the source area of the Timiș River (August, 2011).



Figure 10: Physical damage of the riverbed along most parts of the middle and lower Timiș sectors is the main threat for the riverscapes' structure and function. All the hydrotechnical works and ballast excavations should be planned on ecological and environmental friendly basis.



Figure 11: The Timiș River at the last sampling station at Grăniceri (S18), close to the border with Serbia; the anthropic impact is obvious and ongoing (August, 2011). In the sandy bottom the alien invasive species *Corbicula fluminea* lives in high abundances.



Figure 12: *Unio crassus* sampled from the Timiș River at Albina Village (S15) in August 2011. It is a flag-species included in Annex II of the EUHSD (92/43/EEC 1992), also known as the Habitats Directive.



Figure 13: *Pseudanodonta complanata* sampled from the Timiș River at Albina Village (S15) in August 2011. It is a strictly protected species by the Romanian legislation.

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